Essential Insight Exam Guide

Human Biology

Year 12 WACE
Western Australian Curriculum

2025 Edition

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Essential Insight Exam Guide
Human Biology
Year 12 WACE

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Books available in this series

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Acknowledgements
School Curriculum and Standards Authority. (2019-2023). ATAR Examinations and Marking Keys. The School Curriculum and Standards Authority does not endorse this publication or product.

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Notes	• Science Inquiry Skills is a component of the curriculum that is often embedded within the questions of other topics. Questions which focus primarily on Science Inquiry Skills have been categorised within their own topic as the last chapter of this Exam Guide. • Some question material has not been released by SCSA due to copyright restrictions and are not able to be included in this exam guide. This has been flagged in the relevant questions in the exam guide. Teachers may still be able to locate many of these sources and provide these to students by following the links at the end of the original SCSA exams on the SCSA website.

Unit 3 – Homeostasis and disease

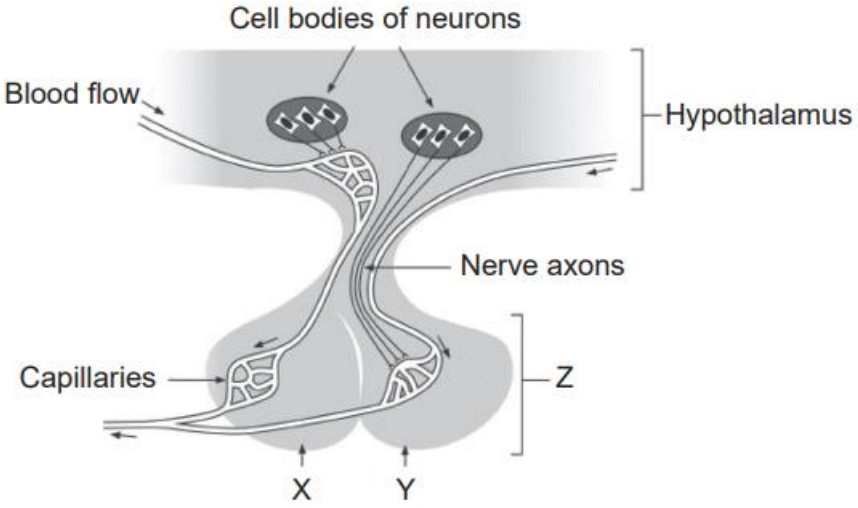
Unit 3 – Endocrine system

Section 1

2023 Section 1 Questions 7-8

Endocrine system

Questions 7 and 8 refer to the diagram shown below.

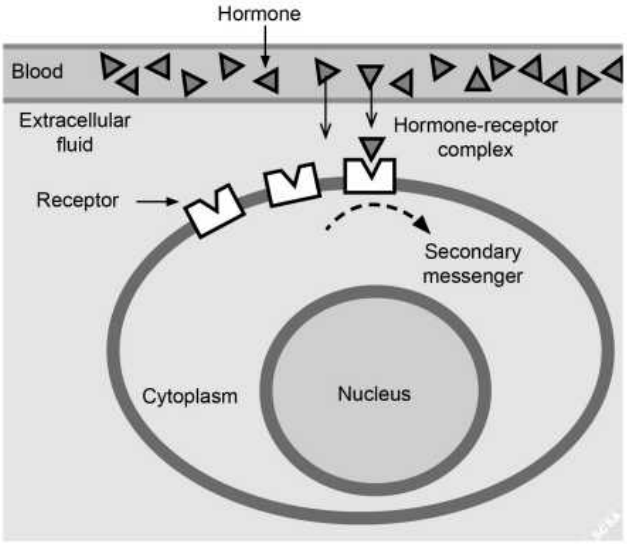


7. Structure Z interacts closely with the hypothalamus to maintain many bodily functions. It consists of two lobes. Which of the following identifies X, Y and Z correctly?

	X	Y	Z
(a)	anterior lobe	posterior lobe	pituitary gland
(b)	anterior lobe	posterior lobe	thyroid gland
(c)	posterior lobe	anterior lobe	pituitary gland
(d)	posterior lobe	anterior lobe	thyroid gland

8. A hormone released from structure Y is

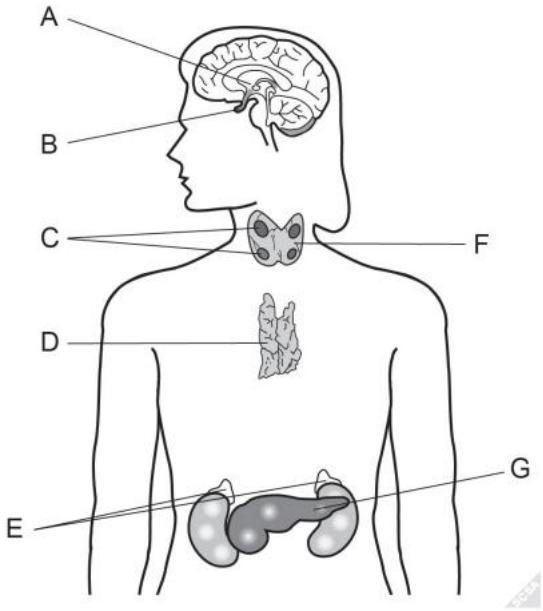
(a) growth hormone.
(b) prolactin.
(c) thyroxine.
(d) oxytocin.

2022 Section 1 Question 6-7 **Endocrine system**	Questions 6 and 7 refer to the diagram shown below, which represents a hormonal action.  6. The hormonal action shown in the diagram is **best** described as (a) water soluble, as the hormone-receptor complex will enter the nucleus and act on the DNA molecule. (b) lipid soluble, as the hormone diffuses across the cell membrane to attach to a receptor inside the cell. (c) lipid soluble, as the secondary messenger will enter the nucleus and act on the DNA molecule. (d) water soluble, as the hormone binds to a receptor on the outside of the cell membrane to form a hormone-receptor complex. 7. Which of the following is a correct comparison between a hormonal mode of transmission (like the one shown in the diagram) and neural transmission? (a) speed of transmission can be faster (b) duration of the message can be long-lasting (c) the message is only short lived in the cell (d) nature of the transmission is electrochemical

2021 Section 1 Question 4-5

Endocrine system

Questions 4 and 5 refer to the diagram shown below.

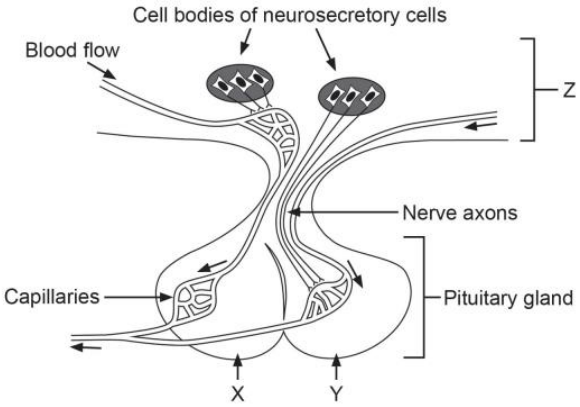


4. Which of the following identifies correctly the endocrine gland, with the hormone it secretes and the target organ?

	Endocrine gland	Hormone secreted	Target organ
(a)	D	Adrenaline	Brain
(b)	E	Cortisol	Stomach
(c)	F	Thyroid	Kidneys
(d)	G	Glucagon	Liver

5. Which of the endocrine glands labelled is/are responsible for controlling metabolic rate?

(a) F only
(b) F and C
(c) B only
(d) B and F

2021 Section 1 Question 26-27 **Endocrine system**	Questions 26 and 27 refer to the diagram below  In which location/s is growth hormone produced? (a) X (b) X and Y (c) Z (d) X and Z Which of the following hormones are released from structure 'Y'? (a) antidiuretic hormone and adrenocorticotropic hormone (b) adrenocorticotropic hormone and oxytocin (c) follicle stimulating hormone and luteinising hormone (d) antidiuretic hormone and oxytocin

2020 Section 1 Question 1 **Endocrine system**	The target organ for the hormone calcitonin is the (a) parathyroid gland. (b) adrenal gland. (c) bones. (d) liver.

2019 Section 1 Question 22 **Endocrine system**	Enlargement of the thyroid gland due to a lack of iodine is called (a) exophthalmia. (b) thyrotoxicosis. (c) goitre. (d) Graves' disease.

Section 2

2020 Section 2 Question 31

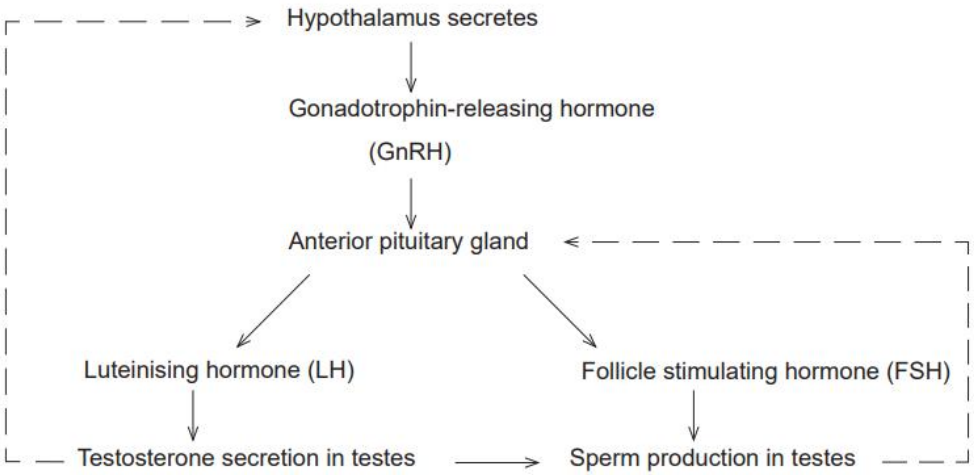
Endocrine system

The nervous system and endocrine system often work together to ensure homeostasis is maintained within the human body.

(a) Hormones differ from nerves in their mode of action. In relation to the mode of transmission and response time, state how a hormonal response is different from a nervous response. (2 marks)

Mode of transmission:

Response time:



The following questions refer to the diagram on page 16 showing the hormonal control of the male testes.

(b) (i) The dotted lines on the diagram indicate negative feedback. Outline what is meant by the term negative feedback. (1 mark)

(ii) Describe the role of the receptor in a feedback loop. (2 marks)

(c) Identify the following components shown in the diagram on page 16. (2 marks)

Control centre:

Effector:

(d) If a tumour began to affect the functioning of the anterior pituitary by inhibiting the production of LH and FSH, explain the impact this would have on the fertility of the affected male. (3 marks)

2019 Section 2 Question 36

Endocrine system

On a hot, dry day, Trisha noticed several physiological changes to her body while exposed to the sun.

(a) Identify two separate effectors and describe the physiological responses that occur in each that would help Trisha maintain her body temperature in the scenario above. (6 marks)

One:

Two:

Trisha noticed that she had similar physiological changes when she was placed in a stressful situation. These changes were brought about by secretions from the adrenal glands.

Shown below is a diagram of an adrenal gland.

Copyright restrictions prohibit the release of this SCSA exam material.

(b) Complete the table below, contrasting the two different parts of the adrenal gland. (10 marks)

	X	Y
Part of the adrenal gland	(1 mark)	(1 mark)
Hormone produced	(1 mark)	Adrenaline and noradrenaline
Effect of the hormone	Helps the body to deal with stress and promotes repair of damaged tissue	(1 mark)
Outline how the release of this hormone is stimulated	(3 marks)	(3 marks)

Section 3

2023 Section 3 Question 38 **Endocrine system**	Changes to the amount of thyroxine being released from the thyroid gland can have major impacts on the functioning of the body. (a) Name each of the disorders that may lead to an over-secretion or under-secretion of thyroxine; describe how the over-secretion or under-secretion impacts on the body; and explain how each disorder can be treated. (12 marks) (b) Explain the role of the liver in the maintenance of blood glucose levels. (8 marks)

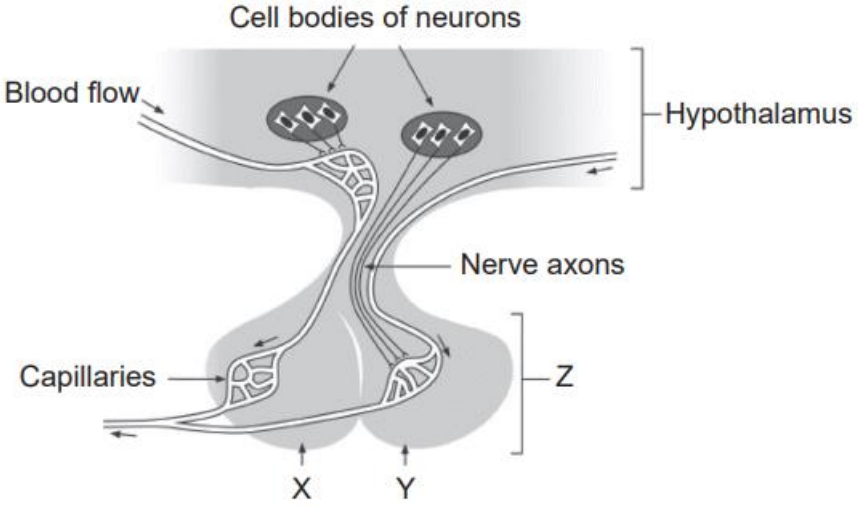
2022 Section 3 Question 38 **Endocrine system**	Two unrelated patients; X and Y, visited the same neurosurgeon. The patients had very similar names, and both had a form of brain damage. The neurosurgeon asked Patient X to complete a point-to-point movement test, where the index finger touches the nose and then touches the outstretched finger of the neurosurgeon. He was also asked to walk across the room while the neurosurgeon observed his stability. Patient X found this very strange, as these tests were not what he normally experienced. He has a benign growth below the hypothalamus, reducing levels of thyroid-stimulating hormone. When Patient X questioned this, the neurosurgeon realised he had mixed up the two patients and mistakenly thought he was seeing Patient Y. (a) Using the information above, identify the part of the brain damaged in both patients (X and Y), describe the role of these parts in normal body functioning and describe the effects damage to these structures would have on both patients. (12 marks) (b) Describe how the hypothalamus and pituitary work together to achieve their main function. (8 marks)

2020 Section 3 Question 40 **Endocrine system**	Production of the human growth hormone (hGH) is controlled by a gene. Lack of this hormone leads to dwarfism in humans. (a) hGH is released from the pituitary gland. State from which lobe of the pituitary this hormone is secreted and explain the relationship between this lobe of the pituitary gland and the hypothalamus. (6 marks) (b) hGH is a water-soluble hormone. Explain how hGH enters and affects the functioning of its target cell. (6 marks) (c) Dwarfism can be treated using synthetically produced hGH. Explain how hGH could be produced using recombinant DNA technology. (8 marks)

2023 Section 1 Questions 7-8

Endocrine system

Questions 7 and 8 refer to the diagram shown below.



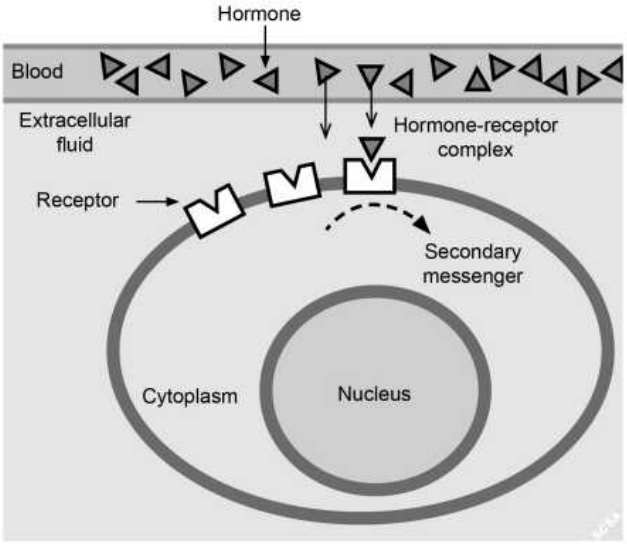
7. Structure Z interacts closely with the hypothalamus to maintain many bodily functions. It consists of two lobes. Which of the following identifies X, Y and Z correctly?

	X	Y	Z
(a)	anterior lobe	posterior lobe	pituitary gland
(b)	anterior lobe	posterior lobe	thyroid gland
(c)	posterior lobe	anterior lobe	pituitary gland
(d)	posterior lobe	anterior lobe	thyroid gland

Answer is a.

8. A hormone released from structure Y is

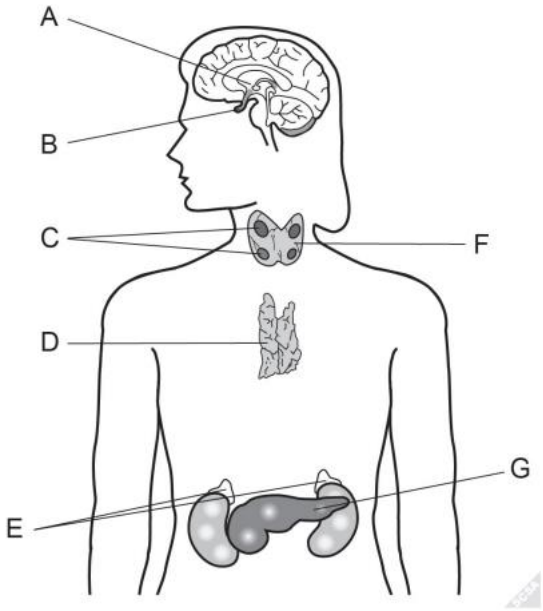
(a) growth hormone.
(b) prolactin.
(c) thyroxine.
(d) oxytocin. – Answer

2022 Section 1 Question 6-7 **Endocrine system**	Questions 6 and 7 refer to the diagram shown below, which represents a hormonal action.  6. The hormonal action shown in the diagram is **best** described as (a) water soluble, as the hormone-receptor complex will enter the nucleus and act on the DNA molecule. (b) lipid soluble, as the hormone diffuses across the cell membrane to attach to a receptor inside the cell. (c) lipid soluble, as the secondary messenger will enter the nucleus and act on the DNA molecule. **(d) water soluble, as the hormone binds to a receptor on the outside of the cell membrane to form a hormone-receptor complex. – Answer** 7. Which of the following is a correct comparison between a hormonal mode of transmission (like the one shown in the diagram) and neural transmission? (a) speed of transmission can be faster **(b) duration of the message can be long-lasting – Answer** (c) the message is only short lived in the cell (d) nature of the transmission is electrochemical

2021 Section 1 Question 4-5

Endocrine system

Questions 4 and 5 refer to the diagram shown below.



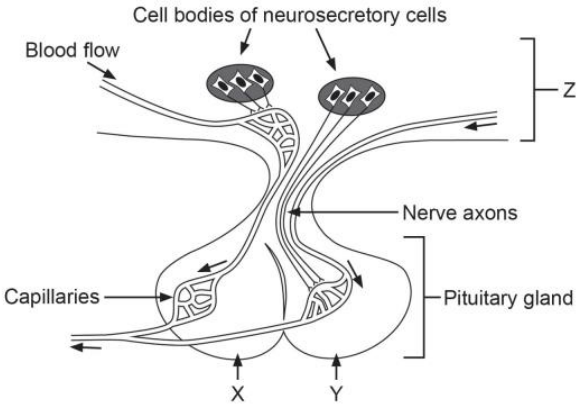
4. Which of the following identifies correctly the endocrine gland, with the hormone it secretes and the target organ?

	Endocrine gland	Hormone secreted	Target organ
(a)	D	Adrenaline	Brain
(b)	E	Cortisol	Stomach
(c)	F	Thyroid	Kidneys
(d)	G	Glucagon	Liver

Answer is D.

5. Which of the endocrine glands labelled is/are responsible for controlling metabolic rate?

(a) F only
(b) F and C
(c) B only
(d) B and F – Answer

2021 Section 1 Question 26-27 **Endocrine system**	Questions 26 and 27 refer to the diagram below  In which location/s is growth hormone produced? **(a) X – Answer** (b) X and Y (c) Z (d) X and Z Which of the following hormones are released from structure 'Y'? (a) antidiuretic hormone and adrenocorticotropic hormone (b) adrenocorticotropic hormone and oxytocin (c) follicle stimulating hormone and luteinising hormone **(d) antidiuretic hormone and oxytocin – Answer**

2020 Section 1 Question 1 **Endocrine system**	The target organ for the hormone calcitonin is the (a) parathyroid gland. (b) adrenal gland. **(c) bones. – Answer** (d) liver.

2019 Section 1 Question 22 **Endocrine system**	Enlargement of the thyroid gland due to a lack of iodine is called (a) exophthalmia. (b) thyrotoxicosis. **(c) goitre. – Answer** (d) Graves' disease.

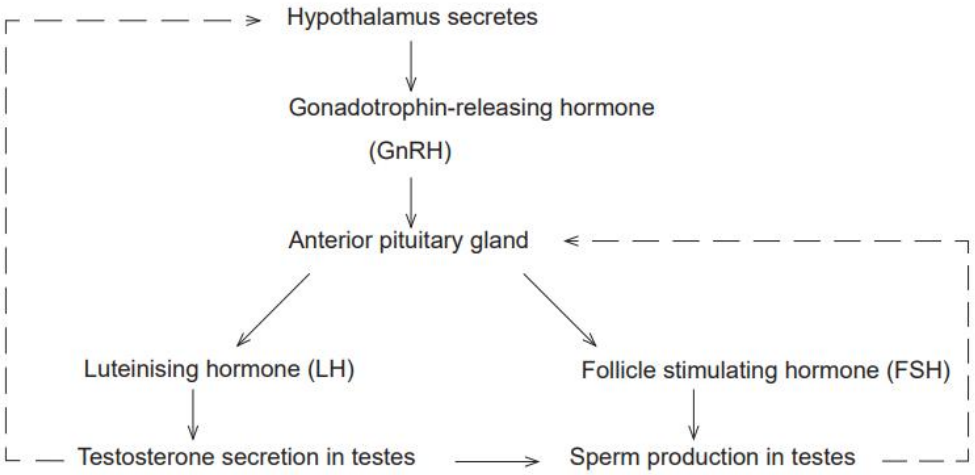
2020 Section 2 Question 31

Endocrine system

The nervous system and endocrine system often work together to ensure homeostasis is maintained within the human body.

(a) Hormones differ from nerves in their mode of action. In relation to the mode of transmission and response time, state how a hormonal response is different from a nervous response. (2 marks)

Description	Marks
Mode of transmission – bloodstream	1
Response time – slower	1
Total	**2**



The following questions refer to the diagram on page 16 showing the hormonal control of the male testes.

(b) (i) The dotted lines on the diagram indicate negative feedback. Outline what is meant by the term negative feedback. (1 mark)

Description	Marks
response reduces stimulus/response works in opposition to stimulus	1
Total	**1**

(ii) Describe the role of the receptor in a feedback loop. (2 marks)

Description	Marks
detects stimulus/change	1
sends signal to coordinating centre/modulator/control centre	1
Total	**2**

(c) Identify the following components shown in the diagram on page 16. (2 marks)

Description	Marks
Control centre – hypothalamus	1
Effector – testes	1
Total	**2**

(d) If a tumour began to affect the functioning of the anterior pituitary by inhibiting the production of LH and FSH, explain the impact this would have on the fertility of the affected male. (3 marks)

Description	Marks
decreased fertility	1
tumour reduces the secretion of testosterone	1
which will reduce the production/maturation of sperm	1
Total	**3**

2019 Section 2 Question 36

Endocrine system

On a hot, dry day, Trisha noticed several physiological changes to her body while exposed to the sun.

(a) Identify two separate effectors and describe the physiological responses that occur in each that would help Trisha maintain her body temperature in the scenario above. (6 marks)

Description	Marks
For each two effectors	
• skin/peripheral arterioles • vasodilation • via ↑ radiation/convection/conduction	1–3
• sweat glands • ↑ sweating • ↑ evaporation	1–3
Total	**6**

Trisha noticed that she had similar physiological changes when she was placed in a stressful situation. These changes were brought about by secretions from the adrenal glands.

Shown below is a diagram of an adrenal gland.

Copyright restrictions prohibit the release of this SCSA exam material.

(b) Complete the table below, contrasting the two different parts of the adrenal gland. (10 marks)

Description			Marks
1 mark per box for first three criteria 3 marks for each process			
	X	**Y**	
part of the adrenal gland	cortex	medulla	1–2
Hormone it produced	cortisol	Adrenaline and noradrenaline	1
Effect of the hormone	Helps the body to deal with stress and promotes repair of damaged tissue	prepares the body for the fight or flight response/or name a specific response (e.g. increase heart rate)	1
Outline how the release of this hormone is stimulated	• anterior pituitary releases • adrenocorticotrophic hormone (ACTH) • travels via blood stream	• CNS/hypothalamus sends • electrical impulses • travels along the ANS/sympathetic pathways	1–6
		Total	**10**
Accept other relevant answers.			

2023 Section 3 Question 38

Endocrine system

Changes to the amount of thyroxine being released from the thyroid gland can have major impacts on the functioning of the body.

(a) Name each of the disorders that may lead to an over-secretion or under-secretion of thyroxine; describe how the over-secretion or under-secretion impacts on the body; and explain how each disorder can be treated. (12 marks)

Description		Marks
Disorder	Disorder	
Hypothyroidism/Hashimoto's disease	Hyperthyroidism/Graves' disease	1–2
	Subtotal	**2**
Impacts	Impacts	
low levels of thyroxine lead to a decrease in metabolic rate causing symptoms such as	high levels of thyroxine lead to overstimulation of body cells which cause things such as	1–2
	Subtotal	**2**
Any two of	Any two of	
• decreased heart rate • decreased BP • cold intolerance • weight gain • goitre/neck swelling • slow brain functioning • fatigue	• increased HR • high BP • weight loss • hyperactivity • protruding eyeballs • increased sweating • increased appetite	1–4
	Subtotal	**4**
Treatment any two of	Treatment any two of	
• increase iodine in diet • synthetic hormone tablets • surgery	• taking drugs to block thyroid's use of iodine • surgery to remove all/part of gland • radioactive iodine	1–4
	Subtotal	**4**
	Total	**12**

(b) Explain the role of the liver in the maintenance of blood glucose levels. (8 marks)

Description	Marks
glucose removed from blood to provide energy for liver functioning	1
glucose also converted to glycogen	1
by the process of glycogenesis	1
controlled by insulin	1
glycogen is stored in the liver	1
when blood sugar levels fall glycogen is converted back to glucose	1
by the process of glycogenolysis	1
controlled by glucagon	1
Total	**8**

2022 Section 3 Question 38

Endocrine system

Two unrelated patients; X and Y, visited the same neurosurgeon. The patients had very similar names, and both had a form of brain damage. The neurosurgeon asked Patient X to complete a point-to-point movement test, where the index finger touches the nose and then touches the outstretched finger of the neurosurgeon. He was also asked to walk across the room while the neurosurgeon observed his stability. Patient X found this very strange, as these tests were not what he normally experienced. He has a benign growth below the hypothalamus, reducing levels of thyroid-stimulating hormone. When Patient X questioned this, the neurosurgeon realised he had mixed up the two patients and mistakenly thought he was seeing Patient Y.

(a) Using the information above, identify the part of the brain damaged in both patients (X and Y), describe the role of these parts in normal body functioning and describe the effects damage to these structures would have on both patients. (12 marks)

Description	Marks
Patient X	
Affected part – Anterior Pituitary	1
Normal role – any two of • produces hormones • releases hormones • maintain homeostasis	1–2
Possible effects of damage – any three of • hypothyroidism/reduced thyroxine • fatigue/reduced energy levels/weakness/lethargy/reduced metabolic rate • loss of appetite • slow heart rate • feeling cold (especially in hands and feet) • increase weight/fluid retention	1–3
Subtotal	**6**
Patient Y	
Affected part – Cerebellum	1
Normal role – any two of • coordination of voluntary motor movement • balance/equilibrium/posture • muscle tone	1–2
Possible effects of damage – any three of • loss of coordination of motor movement • the inability to judge distance and when to stop • the inability to perform rapid alternating movements • movement tremors • staggering, wide based walking • tendency toward falling • weak muscles • slurred speech • abnormal eye movements	1–3
Subtotal	**6**
Total	**12**

(b) Describe how the hypothalamus and pituitary work together to achieve their main function. (8 marks)

Description	Marks
Posterior pituitary	
Hormones are produced (in cell bodies located) in the hypothalamus/not produced by pituitary.	1
Hormones are transported down the axons/neurosecretory cells.	1
Hormones stored in posterior lobe.	1
Released via nervous stimulation.	1
Subtotal	**4**
Anterior pituitary	
Hormones produced in anterior lobe.	1
Inhibiting and releasing factors secreted by hypothalamus determine the release of hormones.	1
Blood vessels (hypothalamic-hypophyseal portal system) connect hypothalamus with the anterior lobe/travels in the blood.	1
Released via chemical/hormonal stimulation.	1
Subtotal	**4**
Total	**8**

2020 Section 3 Question 40

Endocrine system

Production of the human growth hormone (hGH) is controlled by a gene. Lack of this hormone leads to dwarfism in humans.

(a) hGH is released from the pituitary gland. State from which lobe of the pituitary this hormone is secreted and explain the relationship between this lobe of the pituitary gland and the hypothalamus. (6 marks)

Description	Marks
secreted from the anterior lobe	1
communication between the hypothalamus and the anterior pituitary occurs through chemicals/hormones	1–5
through the infundibulum/blood vessels	
hypothalamus stimulates the anterior pituitary to release hormones	
via releasing factors/hormones	
the hormones are released into a capillary network and transported through veins	
also produces inhibiting factors to inhibit activity of the pituitary	
Total	**6**

(b) hGH is a water-soluble hormone. Explain how hGH enters and affects the functioning of its target cell. (6 marks)

Description	Marks
Enters target cell	
dissolve in water (not fats) so cannot pass through cell membrane	1–3
hormone molecule attaches to receptor molecule	
receptor molecule found on surface of target cell	
receptor molecule must match shape of signalling molecule	
Subtotal	**3**
Affects target cell	
binding of hormone to receptor triggers a secondary messenger/response inside the cell	1–3
secondary messenger activates enzymes inside the cytoplasm	
enzymes adjust chemical activity of the cell	
speed of reactions will either increase or decrease	
Subtotal	**3**
Total	**6**

(c) Dwarfism can be treated using synthetically produced hGH. Explain how hGH could be produced using recombinant DNA technology. (8 marks)

Description	Marks
gene for hGH located (on human chromosome)	1–8
gene cut out using endonuclease/treated with restriction enzyme	
cuts DNA at specific sites/produces sticky ends	
plasmid cut with same restriction enzyme	
gene inserted into plasmid using ligase	
acts as a vector/produces a transgenic organism	
recombinant plasmid enters into host bacterial cell	
which propagates/replicates/clone	
bacteria express gene to synthesize human protein/hormone	
produces large scale amounts of hGH	
Total	**8**

Unit 3 – Central and peripheral nervous system

Section 1

2023 Section 1 Question 1

Central and peripheral nervous system

The difference between grey and white matter found within the spinal cord is that

(a) white matter contains dendrites of neurons, while grey matter contains cell bodies of neurons.
(b) grey matter contains unmyelinated neurons, while white matter contains myelinated neurons.
(c) white matter contains cell bodies of neurons, while grey matter contains dendrites of neurons.
(d) grey matter contains myelinated neurons, while white matter contains unmyelinated neurons.

2023 Section 1 Question 10

Central and peripheral nervous system

Chemoreceptors monitor the level of gases in the body and can be found in all areas listed except the

(a) carotid body.
(b) aortic arch.
(c) nose.
(d) brain.

2023 Section 1 Question 22-23

Central and peripheral nervous system

Questions 22 and 23 refer to the diagram shown below.

Copyright restrictions prohibit the release of this SCSA exam material.

22. Which of the following matches the name of the stage of the action to the labels shown on the diagram?

	2	3	4	5
(a)	polarisation	depolarisation	repolarisation	resting state
(b)	depolarisation	hyperpolarisation	repolarisation	polarised
(c)	depolarisation	repolarisation	hyperpolarisation	resting state
(d)	polarisation	hyperpolarisation	depolarisation	polarised

23. The stage at which potassium ions flow out of the neuron is

(a) 1.
(b) 2.
(c) 3.
(d) 4.

2023 Section 1 Question 27

Central and peripheral nervous system

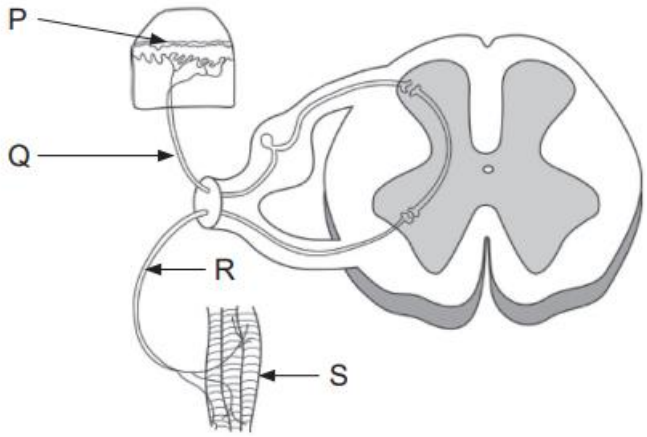
Which division of the nervous system is most likely to have been damaged if a person has a loss of touch sensations and numbness in their hands?

(a) autonomic sympathetic
(b) afferent parasympathetic
(c) efferent autonomic
(d) afferent somatic

2023 Section 1 Question 18-20

Central and peripheral nervous system

Questions 18,19 and 20 refer to the diagram shown below.



18. Which of the labels identifies structures Q, R and S correctly?

	Q	R	S
(a)	sensory neuron	interneuron	effector
(b)	motor neuron	sensory neuron	receptor
(c)	sensory neuron	motor neuron	effector
(d)	interneuron	motor neuron	receptor

19. The key difference between structures Q and R is

(a) R carries impulses towards the central nervous system, while Q carries impulses away from the central nervous system.
(b) Q carries impulses towards the ganglion, while R carries impulses away from the ganglion.
(c) Q has only one nerve fibre, while R has two nerve fibres.
(d) R carries impulses away from the central nervous system, while Q carries impulses towards the central nervous system.

20. If an individual was involved in an accident that cut structure Q, what would be the consequence of this?

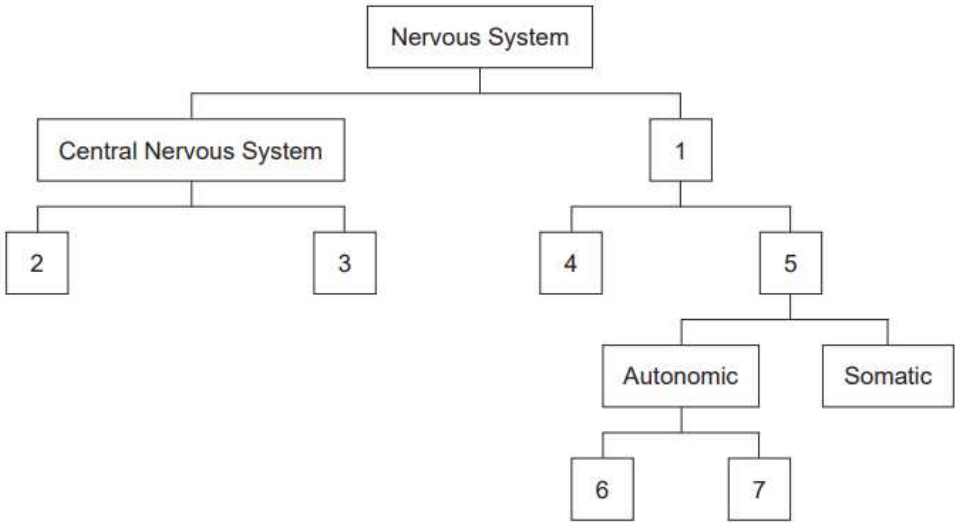
The transmission of impulses from the

(a) effector to the spinal cord would be affected.
(b) receptor to the spinal cord would be affected.
(c) spinal cord to the effector would be affected.
(d) spinal cord to the receptor would be affected.

2022 Section 1 Question 1-2

Central and peripheral nervous system

Questions 1 and 2 refer to the diagram shown below, which represents the divisions of the nervous system.



1. Which of the following identifies the numbered components in the diagram correctly?

	2	3	4	5
(a)	brain	spinal cord	afferent	efferent
(b)	voluntary	involuntary	sensory	motor
(c)	visceral	peripheral	efferent	afferent
(d)	spinal cord	brain	voluntary	involuntary

2. The activation of Component 7 results in the constriction of the pupil of the eye. Which of the following would also occur when Component 7 is activated?

(a) increased sweating
(b) increased release of glucose from the liver
(c) decreased heart rate
(d) decreased secretion of saliva

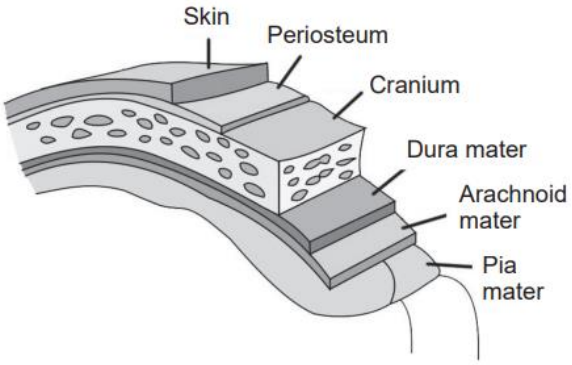
2022 Section 1 Question 3

Central and peripheral nervous system

Blind people are taught to read Braille (raised marks that create patterns on paper). They do this by running their fingertips over the markings. The pathway the impulse travels from the fingers to the brain includes some of the following components:

I. touch receptors
II. connector neuron
III. motor neuron
IV. sensory neuron
V. thalamus to cerebrum
VI. thalamus to cerebellum.

The correct order of the components in the pathway is
(a) IV - II - III - VI
(b) I - IV - II - V
(c) III - II - IV - V
(d) I - II - V - VI

2022 Section 1 Question 23 **Central and peripheral nervous system**	Question 23 refers to the diagram shown below, which represents the layers around the brain.  Referring to the layers around the brain as shown in the diagram, where is cerebrospinal fluid found? (a) between the periosteum and the cranium (b) under the pia mater layer (c) between the cranium and the dura mater (d) within the arachnoid mater layer

2022 Section 1 Question 24 **Central and peripheral nervous system**	Cell replacement therapy for the treatment of Parkinson's disease involves the (a) injection of adult stem cells to replace neurons in the brain that have been damaged by the build-up of plaque. (b) differentiating of stem cells into dopamine-signalling neurons and transplanting them into a patient's brain to replace dying neurons. (c) patient's own neurons being extracted with the DNA inside the cells then altered and the cells reinserted into the patient's body. (d) extraction of non-functioning neurons and replacing them with new cells that have the correct gene and can function normally.

2022 Section 1 Question 26 **Central and peripheral nervous system**	Which of the following is the **key** difference between adrenaline and insulin? Insulin (a) is secreted in response to a chemical stimulus, while adrenaline secretion is controlled by a nerve impulse. (b) controls blood sugar concentrations, while adrenaline helps regulate temperature. (c) is secreted by the pancreas, while adrenaline is secreted by the kidneys. (d) is a water-soluble hormone, while adrenaline is a lipid-soluble one.

2022 Section 1 Question 17 **Central and peripheral nervous system**	The single, long process of a neuron that delivers signals, is termed a/an (a) axon. (b) axon terminal. (c) Schwann cell. (d) dendrite.

2022 Section 1 Question 29 **Central and peripheral nervous system**	Which of the following lists endocrine glands that are **not** controlled directly by the hypothalamus? (a) pituitary, thymus, adrenal medulla (b) thymus, pancreas, adrenal cortex (c) parathyroid, pancreas, adrenal medulla (d) pancreas, thyroid, pituitary

2021 Section 1 Question 1 Central and peripheral nervous system	Which of the following is a response when the parasympathetic nervous system is activated? (a) increased heart rate and breathing rate (b) pupil dilation (c) increased activity of the gastrointestinal tract (d) vasodilation of blood vessels in the skin

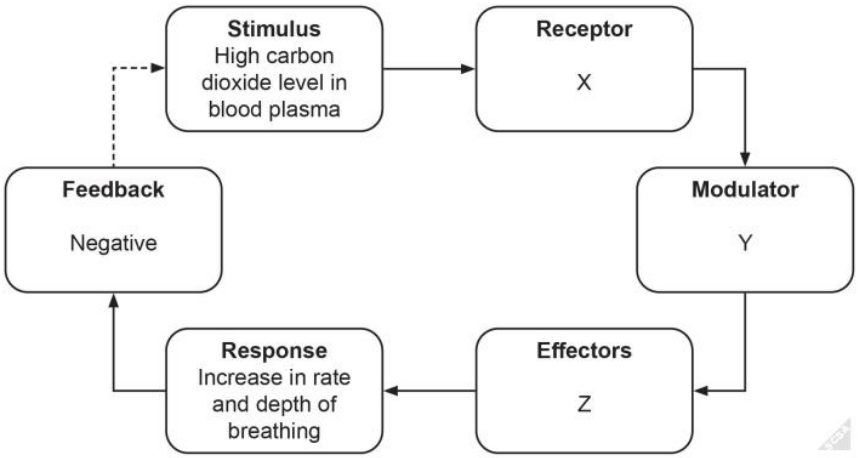
2021 Section 1 Question 3 Central and peripheral nervous system	Homeostatic response mechanisms require the transfer and recognition of information from a sensory receptor and an effector. The transmission of this information (a) may involve both the endocrine and nervous systems. (b) relies only on hormones for a short-term response. (c) is usually a conscious process. (d) is under control of the autonomic system only.

2021 Section 1 Question 9 Central and peripheral nervous system	Which of the following statements about the meninges is correct? They are membranes (a) that surround the axon of a neuron. (b) and fluids found around the brain and spinal cord. (c) that cover and protect the brain. (d) that are not found around the lower spinal cord.

2021 Section 1 Question 14-15

Central and peripheral nervous system

Questions 14 and 15 refer to the diagram shown below.



14. The correct labels for 'X', 'Y' and 'Z' for the diagram shown are

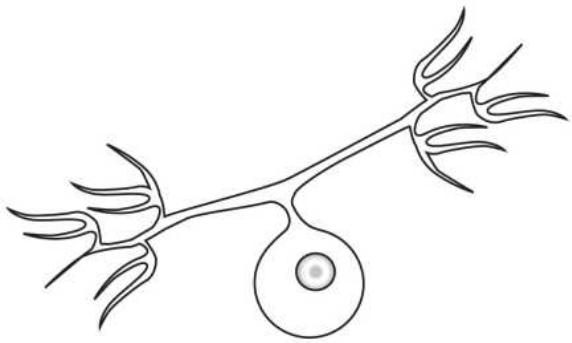
	X	Y	Z
(a)	osmoreceptor	cerebellum	diaphragm and intercostal muscles
(b)	chemoreceptor	medulla oblongata	ribcage and intercostal muscles
(c)	thermoreceptor	hypothalamus	diaphragm and alveoli
(d)	chemoreceptor	medulla oblongata	diaphragm and intercostal muscles

	15. Where are receptors X located? (a) skin and hypothalamus (b) carotid artery and aorta (c) carotid artery and hypothalamus (d) aorta and cerebellum

2021 Section 1 Question 17 **Central and peripheral nervous system**	Which row identifies correctly components of the central and peripheral nervous systems? (a) spinal cord, brain, autonomic, medulla oblongata (b) somatic, autonomic, spinal cord, cerebellum (c) brain, spinal cord, sympathetic, somatic (d) sympathetic, parasympathetic, somatic, brain

2021 Section 1 Question 21 **Central and peripheral nervous system**	The purpose of peripheral vasoconstriction in temperature regulation is to (a) reduce blood oxygen levels when cold thermoreceptors are triggered. (b) increase blood oxygen levels when hot thermoreceptors are triggered. (c) conserve body heat when cold thermoreceptors are triggered. (d) reduce heat loss when hot thermoreceptors are triggered.

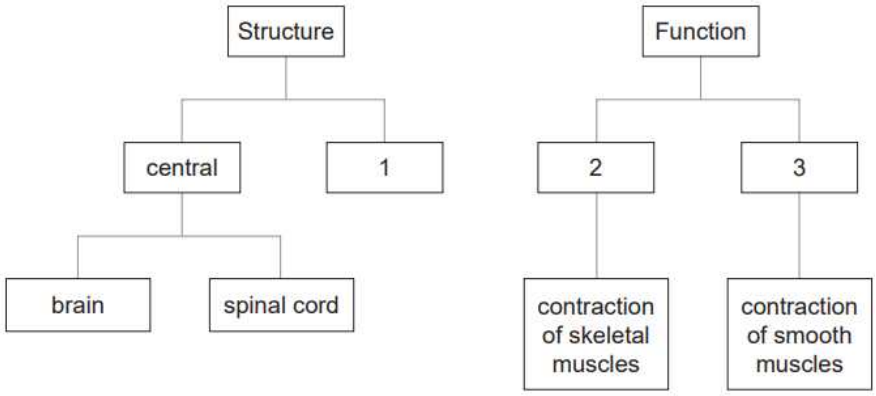
2021 Section 1 Question 25 **Central and peripheral nervous system**	The myelin sheath is (a) fatty tissue that speeds up the neural impulse through the cell body. (b) grey matter that changes up the neural impulse along a dendrite. (c) white matter that reduces the speed of a neural impulse along an axon. (d) fatty tissue that speeds up the neural impulse along sections of the axon.

2020 Section 1 Question 19 **Central and peripheral nervous system**	Question 19 refers to the diagram shown below.  The neuron illustrated would be classified correctly as (a) motor. (b) sensory. (c) connector. (d) multipolar.

2020 Section 1 Question 26

Central and peripheral nervous system

Question 26 refers to the diagram below.



26. The diagram shows two separate ways in which we can classify the nervous system. Which row correctly identifies numbers 1, 2 and 3?

	1	2	3
(a)	peripheral	somatic	autonomic
(b)	somatic	autonomic	peripheral
(c)	autonomic	peripheral	somatic
(d)	peripheral	autonomic	somatic

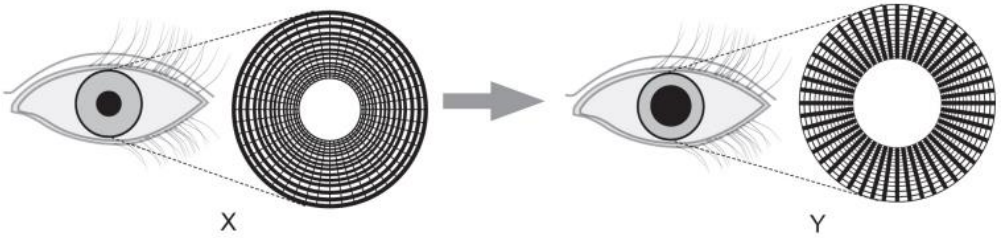
27. Target cells respond to specific hormones as a result of

(a) nucleic acid binding sites in the membrane and cytoplasm.
(b) specific binding sites on enzymes found in the cytoplasm.
(c) carbohydrate receptors in the plasma membrane.
(d) protein receptors in the plasma membrane and cytoplasm.

2019 Section 1 Question 2

Central and peripheral nervous system

Question 2 refers to the diagram shown below.



Which of the following statements describes the diagram correctly?

(a) The pupil is constricted in X. Once stimulated by the parasympathetic nervous system it will become dilated, as shown in Y.
(b) The pupil is constricted in X. Once stimulated by the sympathetic nervous system it will become dilated, as shown in Y.
(c) The pupil is dilated in X. Once stimulated by the parasympathetic nervous system it will become constricted, as shown in Y.
(d) The pupil is dilated in X. Once stimulated by

2019 **Section 1** **Question 3** **Central and peripheral nervous system**	The function of the corpus callosum is to (a) carry impulses between the left and right hemispheres of the brain. (b) connect various areas of the cortex within the same hemisphere of the brain. (c) provide protection, support and a transport network around the brain. (d) connect the cortex to other parts of the brain and to the spinal cord.

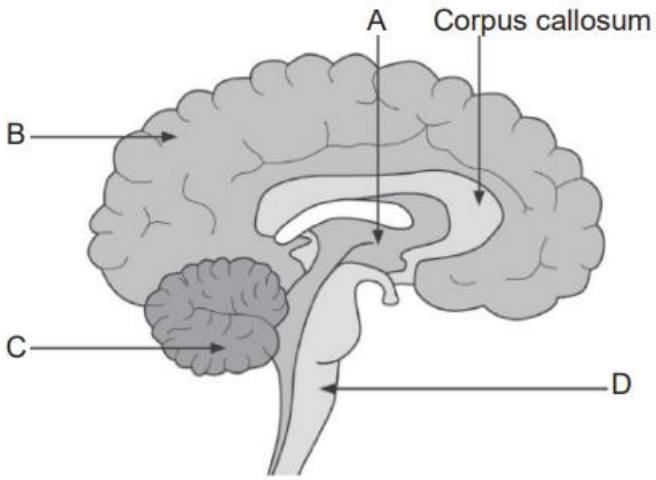
2019 **Section 1** **Question 9** **Central and peripheral nervous system**	Which of the following is **not** a hypothesis as to why hominids became bipedal? Bipedalism (a) freed the hands to carry food and tools. (b) enabled the spinal column to develop a lumbar curve. (c) increased height and allowed better visibility. (d) is a more energy-efficient way of walking.

2019 **Section 1** **Question 21** **Central and peripheral nervous system**	The stimulus for the regulation of water balance by the thirst mechanism is received by the osmoreceptors in the (a) cerebrum. (b) hypothalamus. (c) kidney tubule. (d) medulla oblongata.

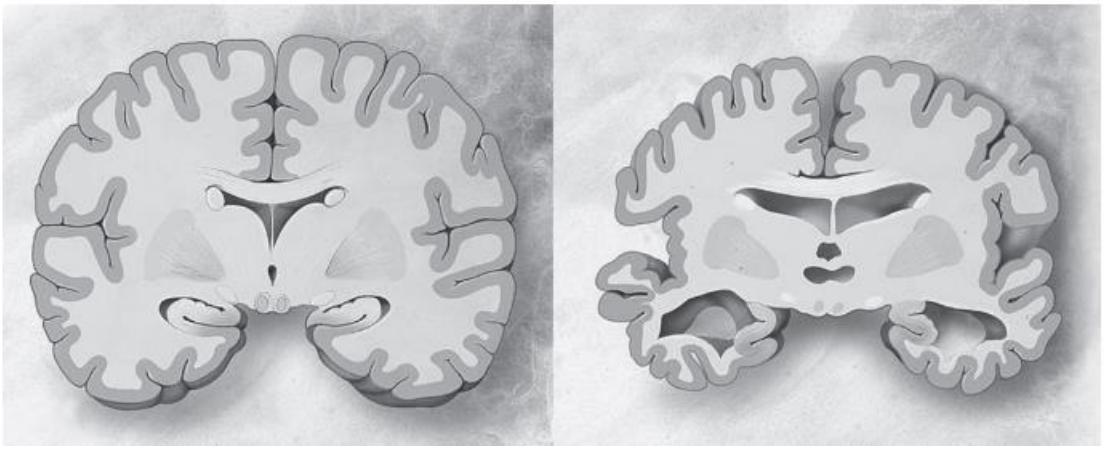
2019 **Section 1** **Question 24** **Central and peripheral nervous system**	Cell replacement therapy involves (a) injecting islet cells into a patient. (b) transplanting stem cells into a patient. (c) removing faulty genes and replacing with healthy ones. (d) inserting a recombinant gene in the cells of a patient.

2019 **Section 1** **Question 27** **Central and peripheral nervous system**	In general, when compared to hormones, nervous impulses have a (a) short duration and a short response time and are involved in long-term adjustments. (b) long duration and a long response time and are involved in short-term adjustments. (c) long duration and a short response time and are involved in short-term adjustments. (d) short duration and a short response time and are involved in short-term adjustments.

Section 2

2023 Section 2 Question 31 **Central and peripheral nervous system**	The following question refers to the diagram of the human brain shown below.  (a) Identify structures A and C. (2 marks) A: _____ C: _____ (b) List **two** homeostatic processes that are controlled by structure D. (2 marks) One: _____ Two: _____

Alzheimer's is a disease of the brain that mostly affects older people. The diagram below shows differences that can be observed when comparing a normal brain to that of an individual suffering from Alzheimer's. One of the main differences that can be observed is the change to the cerebral cortex.



(c) (i) State the change that has occurred to the cerebral cortex of an Alzheimer's sufferer. (1 mark)

(ii) Describe how the change to the cerebral cortex has occurred. (2 marks)

Emerging evidence suggests that Alzheimer's-related brain changes may be produced because of clumping together of proteins and the creation of tangles in-between neurons that disrupt cell functioning and synaptic transmission.

(d) (i) Define the term 'synapse'. (1 mark)

(ii) Annotate the diagram below to show the processes involved in the transmission of a nerve impulse across the synapse. Include labels of the parts and stages in the process. (6 marks)

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	(iii) Explain how cell replacement therapy aims to help Alzheimer's sufferers. (3 marks)

2022 Section 2 Question 31 **Central and peripheral nervous system**	The following question refers to the diagram below, which shows a neuron. ***Copyright restrictions prohibit the release of this SCSA exam material.*** (a) Identify the type of neuron shown in the diagram. (1 mark) (b) List **two** features of the neuron that can be used to distinguish it from other types of neurons found in the human body. (2 marks) One: Two: (c) State the function of the structure labelled as X. (1 mark)

The function of nerves is to transmit electrical impulses.

(d) Contrast the transmission of nerve impulses in myelinated and unmyelinated neurons. (4 marks)

Some local anaesthetics work by interfering with the sodium ion channels in the membrane of a neuron.

(e) (i) Describe the role of sodium channels found within a neuron's cell membrane. (2 marks)

(ii) If a local anaesthetic works by blocking the sodium channels, describe how this would affect the conduction of an action potential. (2 marks)

A study using rats looked at the impact of local anaesthetics on blocking the release of calcium ions at an axon terminal.

(f) Explain how this would lead to pain signals from affected parts of the body not reaching the brain. (6 marks)

2022 Section 2 Question 33 **Central and peripheral nervous system**	Congenital insensitivity to pain is a genetic condition that affects the ability of the body to detect pain stimuli. The condition affects the sodium channels of the pain receptors that transmit messages to the brain and spinal cord. (a) State one specific location in the body where pain receptors are found. (1 mark) Congenital insensitivity to pain is caused by a mutation to the SCN9A gene. (b) Distinguish a gene mutation from a chromosomal mutation. (2 marks)

	The following question refers to the diagram below, which represents different types of mutations. ***Copyright restrictions prohibit the release of this SCSA exam material.*** (c) The mutation to the SCN9A gene is classified as a substitution mutation. Identify which of the three mutations shown above (X, Y or Z) is a substitution mutation and state how the substitution mutation alters the genome. (2 marks) (d) To examine the SCN9A mutation in patients, DNA sequencing needs to be carried out. For the following bacterial enzymes, state the biotechnological technique they are used in and describe their role in that technique. (4 marks) Restriction enzymes: DNA polymerase:

2021 Section 2 Question 31 **Central and peripheral nervous system**	The following question refers to the diagram of the brain shown below. ***Copyright restrictions prohibit the release of this SCSA exam material.*** (a) (i) Identify structure 'Z'. (1 mark) (ii) State one function of structure 'Y'. (1 mark)

(iii) Indicate on the diagram, with a line and label, where the corpus callosum would be located. (1 mark)

(b) (i) Which region, A or B, shows structures that would be found in the outer layer of structure 'X'? (1 mark)

(ii) Justify your decision in part (b)(i). (2 marks)

A man injured his back in a diving accident. Doctors were concerned there was damage to his spine and neural pathways. They touched different areas of his skin with a sharp point and asked him to indicate each time if he felt a sharp point. The sharp point should be felt in two ways, one of which would be pain.

(c) (i) What other sensation would be experienced by the man? (1 mark)

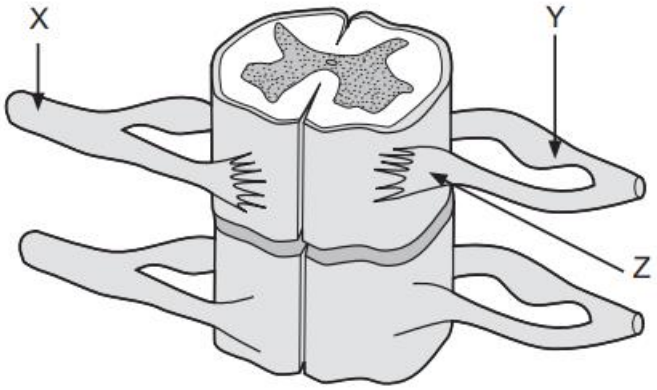
(ii) Describe how this sensation would be detected and registered by the man. (2 marks)

The man felt the sharp point when the point touched his arms, but not when the point touched his legs.

(d) Suggest what this information could tell the doctors about the damage to the man's spinal cord. Explain your answer. (3 marks)

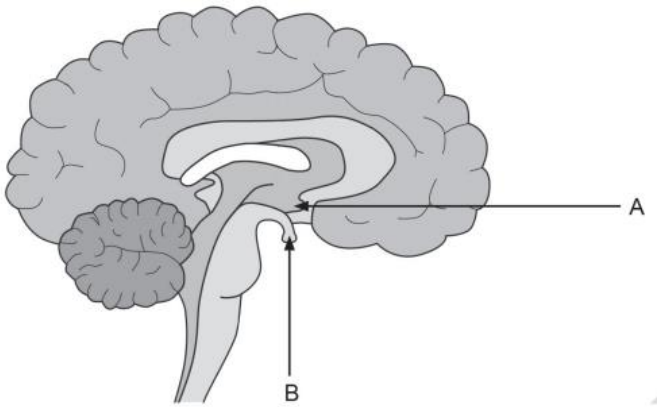
2020 Section 2 Question 34 **Central and peripheral nervous system**	Opponents of the sport of boxing are often concerned with the incidence of traumatic brain injury that occurs among individuals who box on a regular basis. Punches that force the head up and back may cause damage to the cerebellum, as the brain is squashed up against the back of the skull. (a) (i) List **three** structures that would normally assist in protecting the brain against injury. (3 marks) One: _____ Two: _____ Three: _____ (ii) Suggest **two** symptoms a boxer might display if the cerebellum was damaged. (2 marks) One: _____ Two: _____ Muhammad Ali, a former boxer, developed Parkinson's disease. Although not conclusively linked to his boxing career, in his case it was associated with head trauma. (b) (i) Describe the cause of Parkinson's disease. (2 marks) _____ _____ _____ _____ (ii) Describe how cell replacement therapy could be used to treat Parkinson's disease. (2 marks) _____ _____ _____ _____

The following questions refer to the diagram below, which shows a cross section of the spinal cord.



(c) (i) If 'X' is injured, it can lead to paralysis of part/s of the body and loss of sensation, depending on how high up the spinal cord the injury is. Why does this occur? (2 marks)

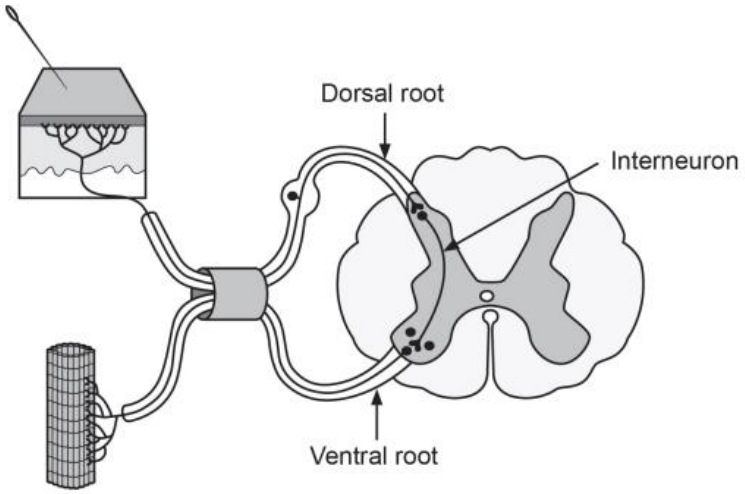
(ii) If Y is damaged, there will be a loss of feeling, but movement can still occur. Injury to Z leads to paralysis, but there will still be a sense of feeling. Explain why this difference occurs. (4 marks)

2019 Section 2 Question 32 **Central and peripheral nervous system**	(a) The following question refers to the diagram of the brain shown below.  (i) Identify structure A. (1 mark) (ii) State one function of structure B. (1 mark) (b) Contrast the role of the cerebellum and the medulla oblongata. (2 marks) Multiple sclerosis (MS) is a disease that destroys Schwann cells in the central nervous system. (c) (i) State the effect of the loss of the Schwann cells on the transmission of nerve impulses and describe why this occurs. (3 marks)

	A person had a touch sensitivity test. This involved them having various areas of their skin touched very gently. In some areas, they were unable to feel the touches. (ii) Explain how this inability to feel the very gentle touches might not be due to MS. (3 marks)

2019 Section 2 Question 35 **Central and peripheral nervous system**	Engineers at Johns Hopkins University have recently developed technology that allows the detection of external stimuli on the fingertips of prosthetic limbs. Called an 'e-dermis', the technology presents a revolutionary development for amputee patients. (a) (i) Name the type of receptors engineers would have to replicate into the e-dermis to allow the detection of a small distortion of the skin when it came into contact with an object. (1 mark) (ii) Engineers are also interested in making the e-dermis capable of detecting temperature. Explain how specific receptors found in human skin can detect external temperatures. (4 marks)

Question 35 (b) refers to the diagram of a spinal reflex arc show below.



(b) (i) Outline the purpose of a spinal reflex arc. (1 mark)

(ii) On the diagram of the reflex arc shown above, shade in the afferent pathway. (1 mark)

For the spinal reflex arc to function, the interneuron shown in the diagram must be triggered at the synapse. This creates an action potential that propagates along the neuron to be passed to the next neuron.

(iii) Explain how an action potential continues along the interneuron. (4 marks)

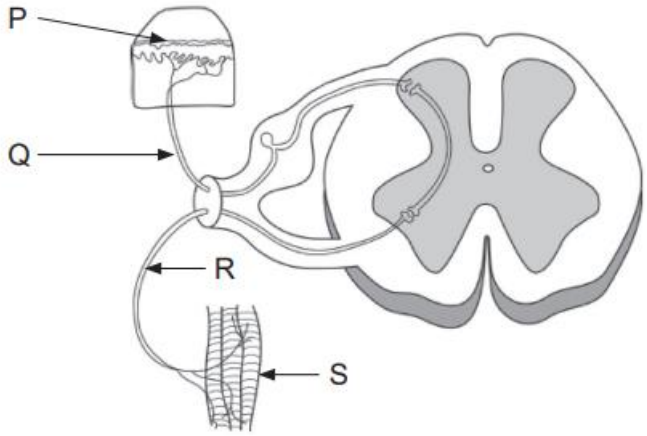
Section 3

2021 Section 3 Question 39 **Central and peripheral nervous system**	Flynn was standing at second base during a game of baseball. The batter hit the ball straight at him. Without thinking, Flynn put his baseball glove up to stop the ball from hitting his face and his face flinched (involuntarily turned) away from the incoming ball. (a) Describe the components of the mechanism that produced the flinching response. (8 marks) (b) Explain how a nerve impulse travels along an axon and between neurons. (12 marks)

Marking Guide – Section 1

2023 Section 1 Question 1 **Central and peripheral nervous system**	The difference between grey and white matter found within the spinal cord is that (a) white matter contains dendrites of neurons, while grey matter contains cell bodies of neurons. **(b) grey matter contains unmyelinated neurons, while white matter contains myelinated neurons. – Answer** (c) white matter contains cell bodies of neurons, while grey matter contains dendrites of neurons. (d) grey matter contains myelinated neurons, while white matter contains unmyelinated neurons.

2023 Section 1 Question 10 **Central and peripheral nervous system**	Chemoreceptors monitor the level of gases in the body and can be found in all areas listed except the (a) carotid body. (b) aortic arch. **(c) nose. – Answer** (d) brain.

2023 Section 1 Question 18-20 **Central and peripheral nervous system**	Questions 18,19 and 20 refer to the diagram shown below.  18. Which of the labels identifies structures Q, R and S correctly? (a) sensory neuron / interneuron / effector (b) motor neuron / sensory neuron / receptor (c) sensory neuron / motor neuron / effector (d) interneuron / motor neuron / receptor **Answer is c.** 19. The key difference between structures Q and R is (a) R carries impulses towards the central nervous system, while Q carries impulses away from the central nervous system. (b) Q carries impulses towards the ganglion, while R carries impulses away from the ganglion. (c) Q has only one nerve fibre, while R has two nerve fibres. **(d) R carries impulses away from the central nervous system, while Q carries impulses towards the central nervous system. – Answer**

	20. If an individual was involved in an accident that cut structure Q, what would be the consequence of this? The transmission of impulses from the (a) effector to the spinal cord would be affected. **(b) receptor to the spinal cord would be affected. – Answer** (c) spinal cord to the effector would be affected. (d) spinal cord to the receptor would be affected.

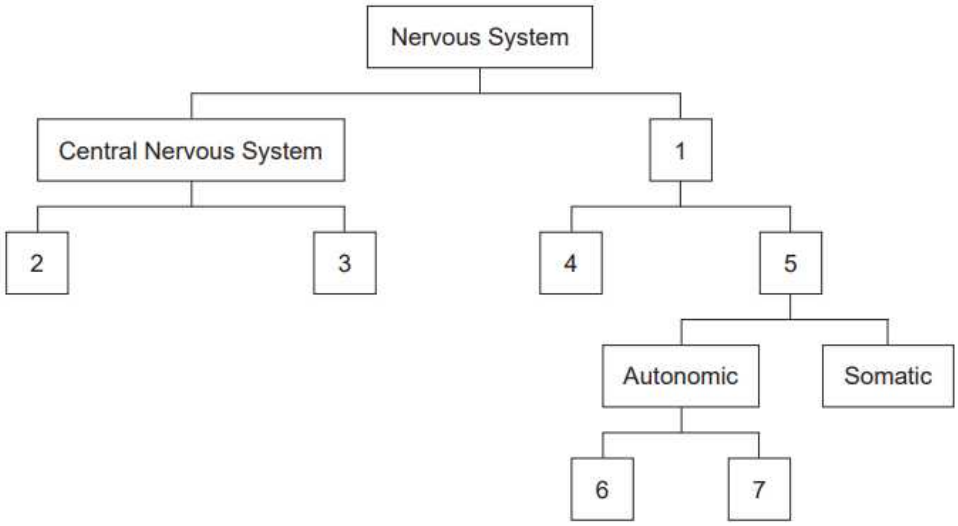
2023 Section 1 Question 22-23 **Central and peripheral nervous system**	Questions 22 and 23 refer to the diagram shown below. ***Copyright restrictions prohibit the release of this SCSA exam material.*** 22. Which of the following matches the name of the stage of the action to the labels shown on the diagram? (a) 2: polarisation; 3: depolarisation; 4: repolarisation; 5: resting state (b) 2: depolarisation; 3: hyperpolarisation; 4: repolarisation; 5: polarised (c) 2: depolarisation; 3: repolarisation; 4: hyperpolarisation; 5: resting state (d) 2: polarisation; 3: hyperpolarisation; 4: depolarisation; 5: polarised **Answer is c.** 23. The stage at which potassium ions flow out of the neuron is (a) 1. (b) 2. **(c) 3. – Answer** (d) 4.

2023 Section 1 Question 27 **Central and peripheral nervous system**	Which division of the nervous system is most likely to have been damaged if a person has a loss of touch sensations and numbness in their hands? (a) autonomic sympathetic (b) afferent parasympathetic (c) efferent autonomic **(d) afferent somatic – Answer**

2022 Section 1 Question 1-2

Central and peripheral nervous system

Questions 1 and 2 refer to the diagram shown below, which represents the divisions of the nervous system.



1. Which of the following identifies the numbered components in the diagram correctly?

	2	3	4	5
(a)	brain	spinal cord	afferent	efferent
(b)	voluntary	involuntary	sensory	motor
(c)	visceral	peripheral	efferent	afferent
(d)	spinal cord	brain	voluntary	involuntary

Answer is A.

2. The activation of Component 7 results in the constriction of the pupil of the eye. Which of the following would also occur when Component 7 is activated?

(a) increased sweating
(b) increased release of glucose from the liver
(c) decreased heart rate **– Answer**
(d) decreased secretion of saliva

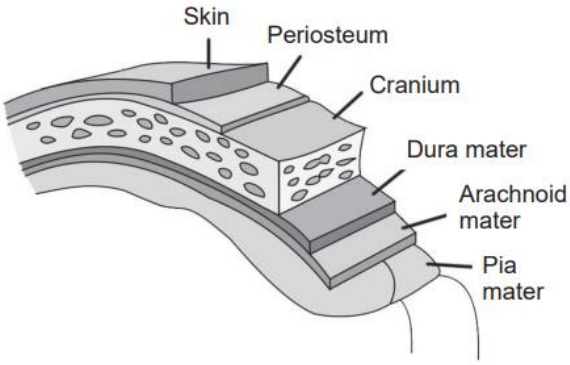
2022 Section 1 Question 3

Central and peripheral nervous system

Blind people are taught to read Braille (raised marks that create patterns on paper). They do this by running their fingertips over the markings. The pathway the impulse travels from the fingers to the brain includes some of the following components:

I. touch receptors
II. connector neuron
III. motor neuron
IV. sensory neuron
V. thalamus to cerebrum
VI. thalamus to cerebellum.

The correct order of the components in the pathway is
(a) IV - II - III - VI
(b) I - IV - II - V – Answer
(c) III - II - IV - V
(d) I - II - V - VI

2022 Section 1 Question 23 **Central and peripheral nervous system**	Question 23 refers to the diagram shown below, which represents the layers around the brain.  Referring to the layers around the brain as shown in the diagram, where is cerebrospinal fluid found? (a) between the periosteum and the cranium (b) under the pia mater layer (c) between the cranium and the dura mater **(d) within the arachnoid mater layer – Answer**

2022 Section 1 Question 24 **Central and peripheral nervous system**	Cell replacement therapy for the treatment of Parkinson's disease involves the (a) injection of adult stem cells to replace neurons in the brain that have been damaged by the build-up of plaque. **(b) differentiating of stem cells into dopamine-signalling neurons and transplanting them into a patient's brain to replace dying neurons. – Answer** (c) patient's own neurons being extracted with the DNA inside the cells then altered and the cells reinserted into the patient's body. (d) extraction of non-functioning neurons and replacing them with new cells that have the correct gene and can function normally.

2022 Section 1 Question 26 **Central and peripheral nervous system**	Which of the following is the **key** difference between adrenaline and insulin? Insulin **(a) is secreted in response to a chemical stimulus, while adrenaline secretion is controlled by a nerve impulse. – Answer** (b) controls blood sugar concentrations, while adrenaline helps regulate temperature. (c) is secreted by the pancreas, while adrenaline is secreted by the kidneys. (d) is a water-soluble hormone, while adrenaline is a lipid-soluble one.

2022 Section 1 Question 17 **Central and peripheral nervous system**	The single, long process of a neuron that delivers signals, is termed a/an **(a) axon. – Answer** (b) axon terminal. (c) Schwann cell. (d) dendrite.

2022 Section 1 Question 29 **Central and peripheral nervous system**	Which of the following lists endocrine glands that are **not** controlled directly by the hypothalamus? (a) pituitary, thymus, adrenal medulla (b) thymus, pancreas, adrenal cortex **(c) parathyroid, pancreas, adrenal medulla – Answer** (d) pancreas, thyroid, pituitary

2021 Section 1 Question 1 Central and peripheral nervous system	Which of the following is a response when the parasympathetic nervous system is activated? (a) increased heart rate and breathing rate (b) pupil dilation **(c) increased activity of the gastrointestinal tract – Answer** (d) vasodilation of blood vessels in the skin

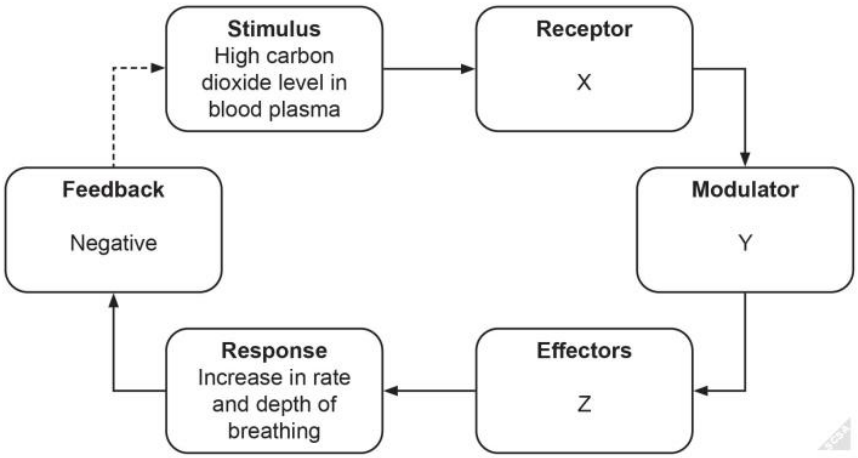
2021 Section 1 Question 3 Central and peripheral nervous system	Homeostatic response mechanisms require the transfer and recognition of information from a sensory receptor and an effector. The transmission of this information **(a) may involve both the endocrine and nervous systems. – Answer** (b) relies only on hormones for a short-term response. (c) is usually a conscious process. (d) is under control of the autonomic system only.

2021 Section 1 Question 9 Central and peripheral nervous system	Which of the following statements about the meninges is correct? They are membranes (a) that surround the axon of a neuron. (b) and fluids found around the brain and spinal cord. **(c) that cover and protect the brain. – Answer** (d) that are not found around the lower spinal cord.

2021 Section 1 Question 14-15

Central and peripheral nervous system

Questions 14 and 15 refer to the diagram shown below.



14. The correct labels for 'X', 'Y' and 'Z' for the diagram shown are

	X	Y	Z
(a)	osmoreceptor	cerebellum	diaphragm and intercostal muscles
(b)	chemoreceptor	medulla oblongata	ribcage and intercostal muscles
(c)	thermoreceptor	hypothalamus	diaphragm and alveoli
(d)	chemoreceptor	medulla oblongata	diaphragm and intercostal muscles

Answer is d.

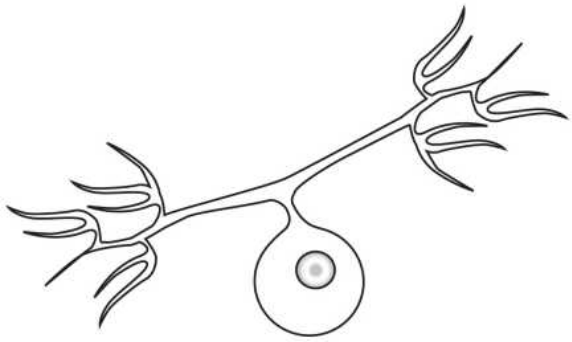
	15. Where are receptors X located? (a) skin and hypothalamus **(b) carotid artery and aorta – Answer** (c) carotid artery and hypothalamus (d) aorta and cerebellum

2021 Section 1 Question 17 **Central and peripheral nervous system**	Which row identifies correctly components of the central and peripheral nervous systems? **Answer is c.**

	Central nervous system		Peripheral nervous system	
(a)	spinal cord	brain	autonomic	medulla oblongata
(b)	somatic	autonomic	spinal cord	cerebellum
(c)	brain	spinal cord	sympathetic	somatic
(d)	sympathetic	parasympathetic	somatic	brain

2021 Section 1 Question 21 **Central and peripheral nervous system**	The purpose of peripheral vasoconstriction in temperature regulation is to (a) reduce blood oxygen levels when cold thermoreceptors are triggered. (b) increase blood oxygen levels when hot thermoreceptors are triggered. **(c) conserve body heat when cold thermoreceptors are triggered. – Answer** (d) reduce heat loss when hot thermoreceptors are triggered.

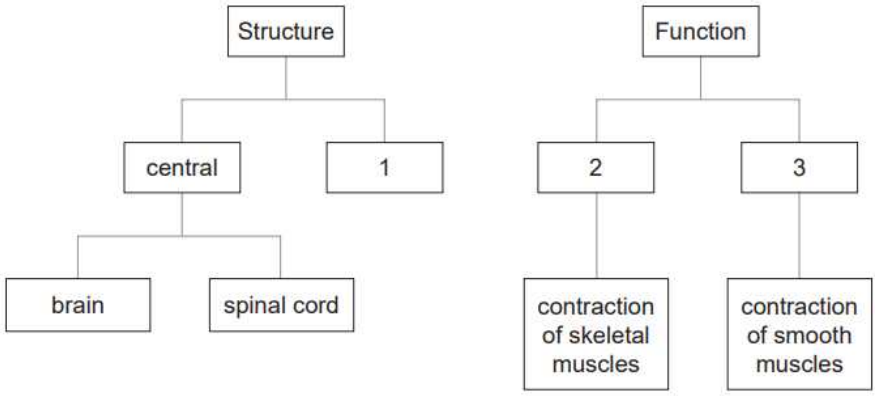
2021 Section 1 Question 25 **Central and peripheral nervous system**	The myelin sheath is (a) fatty tissue that speeds up the neural impulse through the cell body. (b) grey matter that changes up the neural impulse along a dendrite. (c) white matter that reduces the speed of a neural impulse along an axon. **(d) fatty tissue that speeds up the neural impulse along sections of the axon. – Answer**

2020 Section 1 Question 19 **Central and peripheral nervous system**	Question 19 refers to the diagram shown below.  The neuron illustrated would be classified correctly as (a) motor. **(b) sensory. – Answer** (c) connector. (d) multipolar.

2020 Section 1 Question 26

Central and peripheral nervous system

Question 26 refers to the diagram below.



26. The diagram shows two separate ways in which we can classify the nervous system. Which row correctly identifies numbers 1, 2 and 3?

	1	2	3
(a)	peripheral	somatic	autonomic
(b)	somatic	autonomic	peripheral
(c)	autonomic	peripheral	somatic
(d)	peripheral	autonomic	somatic

Answer is a.

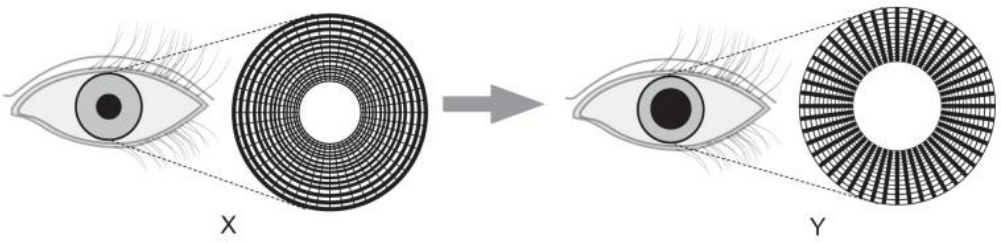
27. Target cells respond to specific hormones as a result of

(a) nucleic acid binding sites in the membrane and cytoplasm.
(b) specific binding sites on enzymes found in the cytoplasm.
(c) carbohydrate receptors in the plasma membrane.
(d) protein receptors in the plasma membrane and cytoplasm. – Answer

2019 Section 1 Question 2

Central and peripheral nervous system

Question 2 refers to the diagram shown below.



Which of the following statements describes the diagram correctly?

(a) The pupil is constricted in X. Once stimulated by the parasympathetic nervous system it will become dilated, as shown in Y.
(b) The pupil is constricted in X. Once stimulated by the sympathetic nervous system it will become dilated, as shown in Y. – Answer
(c) The pupil is dilated in X. Once stimulated by the parasympathetic nervous system it will become constricted, as shown in Y.
(d) The pupil is dilated in X. Once stimulated by

2019 **Section 1** **Question 3** **Central and peripheral nervous system**	The function of the corpus callosum is to **(a) carry impulses between the left and right hemispheres of the brain. – Answer** (b) connect various areas of the cortex within the same hemisphere of the brain. (c) provide protection, support and a transport network around the brain. (d) connect the cortex to other parts of the brain and to the spinal cord.

2019 **Section 1** **Question 9** **Central and peripheral nervous system**	Which of the following is **not** a hypothesis as to why hominids became bipedal? Bipedalism (a) freed the hands to carry food and tools. **(b) enabled the spinal column to develop a lumbar curve. – Answer** (c) increased height and allowed better visibility. (d) is a more energy-efficient way of walking.

2019 **Section 1** **Question 21** **Central and peripheral nervous system**	The stimulus for the regulation of water balance by the thirst mechanism is received by the osmoreceptors in the (a) cerebrum. **(b) hypothalamus. – Answer** (c) kidney tubule. (d) medulla oblongata.

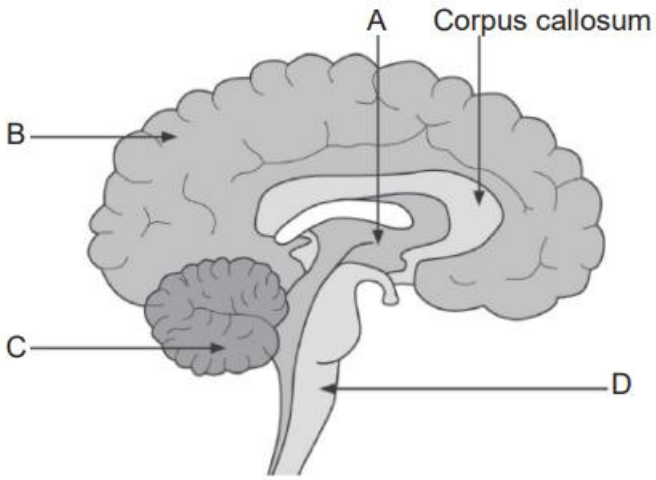
2019 **Section 1** **Question 24** **Central and peripheral nervous system**	Cell replacement therapy involves (a) injecting islet cells into a patient. **(b) transplanting stem cells into a patient. – Answer** (c) removing faulty genes and replacing with healthy ones. (d) inserting a recombinant gene in the cells of a patient.

2019 **Section 1** **Question 27** **Central and peripheral nervous system**	In general, when compared to hormones, nervous impulses have a (a) short duration and a short response time and are involved in long-term adjustments. (b) long duration and a long response time and are involved in short-term adjustments. (c) long duration and a short response time and are involved in short-term adjustments. **(d) short duration and a short response time and are involved in short-term adjustments. – Answer**

2023 Section 2 Question 31

Central and peripheral nervous system

The following question refers to the diagram of the human brain shown below.



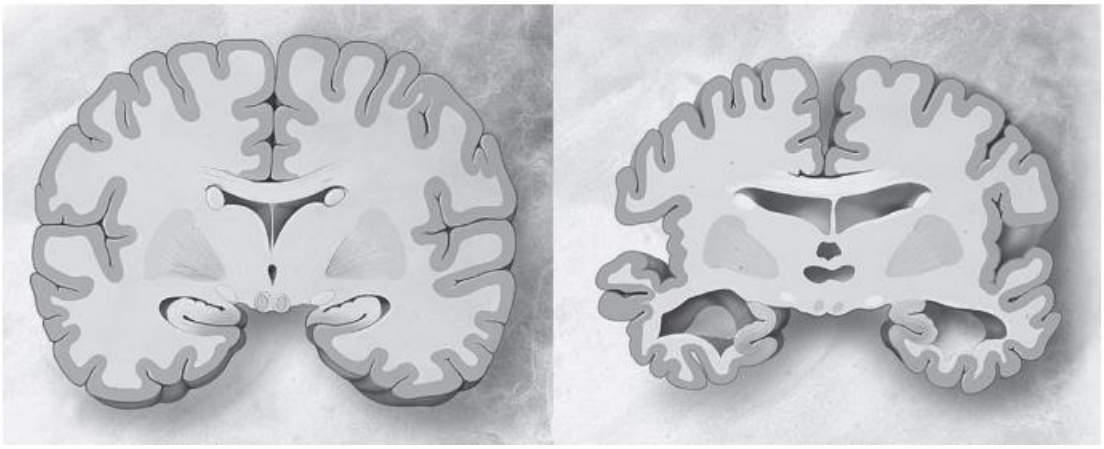
(a) Identify structures A and C. (2 marks)

Description	Marks
A: hypothalamus	1
C: cerebellum	1
Total	**2**

(b) List **two** homeostatic processes that are controlled by structure D. (2 marks)

Description	Marks
Any two of	
• breathing rate • heart rate • blood pressure • blood vessel diameter	1–2
Total	**2**

Alzheimer's is a disease of the brain that mostly affects older people. The diagram below shows differences that can be observed when comparing a normal brain to that of an individual suffering from Alzheimer's. One of the main differences that can be observed is the change to the cerebral cortex.



(c) (i) State the change that has occurred to the cerebral cortex of an Alzheimer's sufferer. (1 mark)

Description	Marks
shrinkage/reduction in size of cerebral cortex/decreasing white matter	1
Total	**1**

(ii) Describe how the change to the cerebral cortex has occurred. (2 marks)

Description	Marks
neurons die/are injured	1
connections between neurons break down	1
Total	**2**

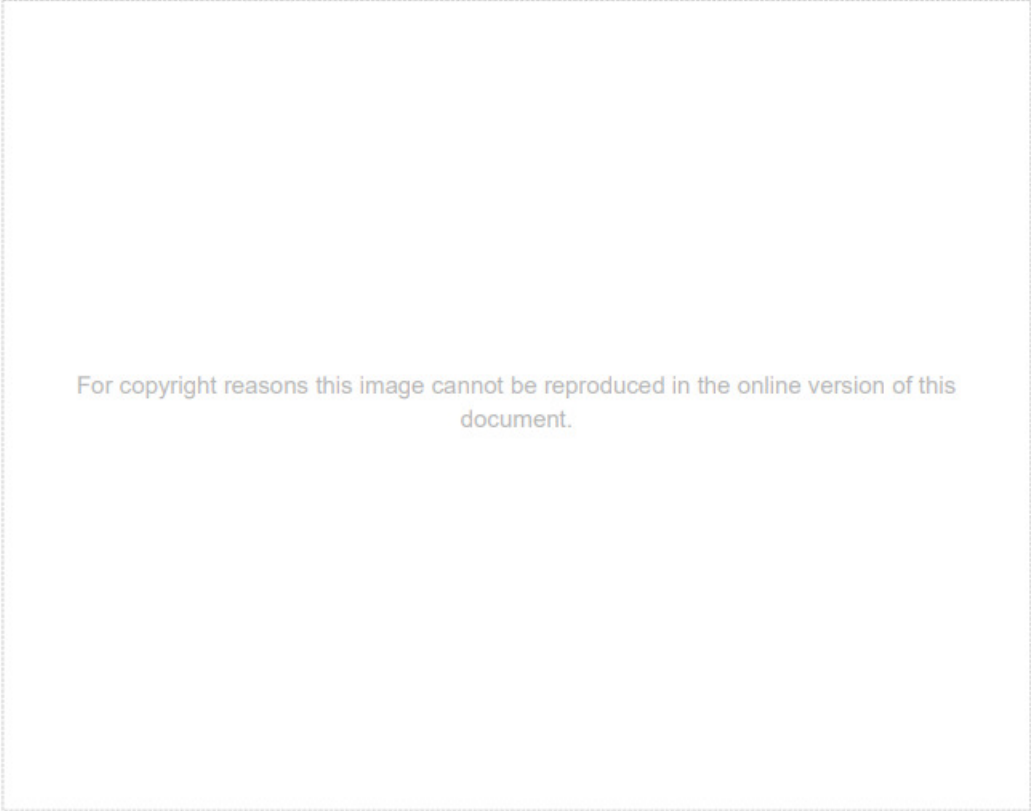
Emerging evidence suggests that Alzheimer's-related brain changes may be produced because of clumping together of proteins and the creation of tangles in-between neurons that disrupt cell functioning and synaptic transmission.

(d) (i) Define the term 'synapse'. (1 mark)

Description	Marks
small gap/junction/space between adjacent neurons	1
Total	**1**

(ii) Annotate the diagram below to show the processes involved in the transmission of a nerve impulse across the synapse. Include labels of the parts and stages in the process. (6 marks)

Description	Marks
label vesicle and neurotransmitter inside	1
label calcium channel and show calcium ions moving in	1
label synaptic cleft and show neurotransmitter moving across	1
label receptor and show neurotransmitter attached	1
indicate action potential arriving at presynaptic neuron and being initiated at postsynaptic neuron	1
indicate the stages (1 = action potential arrives, 2 = diffusion of neurotransmitter and 3 = attach to postsynaptic neuron and trigger next action action) names not needed by an indication of the sequence shown in some way	1
Total	**6**



(iii) Explain how cell replacement therapy aims to help Alzheimer's sufferers. (3 marks)

Description	Marks
replace the damaged cells/neurons with healthy stem cells	1
that can create new healthy brain cells	1
stem cells may reduce protein deposits/may halt progression of the disease	1
Total	**3**

2022 Section 2 Question 31

Central and peripheral nervous system

The following question refers to the diagram below, which shows a neuron.

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(a) Identify the type of neuron shown in the diagram. (1 mark)

Description	Marks
Motor/efferent/multipolar	1
Total	**1**

(b) List **two** features of the neuron that can be used to distinguish it from other types of neurons found in the human body. (2 marks)

Description	Marks
Any two of	
• long singular axon • multipolar • located in ventral root of spinal cord • carries nerve impulses from CNS/towards effectors • cell body located at end of neuron	1–2
Total	**2**

(c) State the function of the structure labelled as X. (1 mark)

Description	Marks
Any one of	
• receives messages/impulses from receptor/other neurons • carry messages/impulses into/towards the cell body	1
Total	**1**

The function of nerves is to transmit electrical impulses.

(d) Contrast the transmission of nerve impulses in myelinated and unmyelinated neurons. (4 marks)

Description	Marks
Myelinated – any two of	
• depolarization occurs in nodes of Ranvier • action potential jumps from node to node/saltatory conduction • impulse moves faster	1–2
Unmyelinated – any two of	
• depolarization occurs along length of axon • action potential must travel full axon length/does not jump • nerve impulse moves slower	1–2
Total	**4**

Some local anaesthetics work by interfering with the sodium ion channels in the membrane of a neuron.

(e) (i) Describe the role of sodium channels found within a neuron's cell membrane. (2 marks)

Description	Marks
allow sodium ions to diffuse (rapidly) into axon	1
this brings about depolarisation/action potentials generated	1
Total	**2**

(ii) If a local anaesthetic works by blocking the sodium channels, describe how this would affect the conduction of an action potential. (2 marks)

Description	Marks
sodium ions can no longer enter the axon	1
there is no action potential/no depolarisation of membrane/no nerve impulse	1
Total	**2**

A study using rats looked at the impact of local anaesthetics on blocking the release of calcium ions at an axon terminal.

(f) Explain how this would lead to pain signals from affected parts of the body not reaching the brain. (6 marks)

Description	Marks
calcium ions cannot diffuse into the synaptic knob	1
prevents (synaptic) vesicles from fusing with presynaptic membrane	1
no neurotransmitter is released	1
no influx of sodium ions into post-synaptic neuron	1
no action potential is generated on next neuron	1
therefore pain signal is not sent along sensory neuron to brain	1
Total	**6**

2022 Section 2 Question 33

Central and peripheral nervous system

Congenital insensitivity to pain is a genetic condition that affects the ability of the body to detect pain stimuli. The condition affects the sodium channels of the pain receptors that transmit messages to the brain and spinal cord.

(a) State one specific location in the body where pain receptors are found. (1 mark)

Description	Marks
skin/cornea/mucosa/muscles/joints/bladder/visceral organs	1
Total	**1**

Congenital insensitivity to pain is caused by a mutation to the SCN9A gene.

(b) Distinguish a gene mutation from a chromosomal mutation. (2 marks)

Description	Marks
gene mutations only affect one gene (loci)	1
chromosomal mutations affects more than one gene/part of a chromosome/whole chromosome	1
Total	**2**

The following question refers to the diagram below, which represents different types of mutations.

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(c) The mutation to the SCN9A gene is classified as a substitution mutation. Identify which of the three mutations shown above (X, Y or Z) is a substitution mutation and state how the substitution mutation alters the genome. (2 marks)

Description	Marks
X	1
Substitution is a type of mutation where one base pair is replaced by a different base pair.	1
Total	**2**

(d) To examine the SCN9A mutation in patients, DNA sequencing needs to be carried out. For the following bacterial enzymes, state the biotechnological technique they are used in and describe their role in that technique. (4 marks)

Description	Marks
Restriction enzymes	
gel electrophoresis	1
cuts DNA into fragments	1
DNA polymerase	
PCR	1
makes repeated copies of the DNA	1
Total	**4**

2021 Section 2 Question 31

Central and peripheral nervous system

The following question refers to the diagram of the brain shown below.

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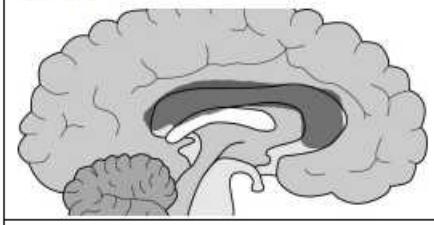
(a) (i) Identify structure 'Z'. (1 mark)

Description	Marks
Hypothalamus	1
Total	**1**

(ii) State one function of structure 'Y'. (1 mark)

Description	Marks
Control breathing rate/heart rate/blood pressure/diameter of blood vessels/expulsion reflex	1
Total	**1**

(iii) Indicate on the diagram, with a line and label, where the corpus callosum would be located. (1 mark)

Description	Marks
Indicates with a line and label in any of the region highlighted below 	1
Total	**1**

(b) (i) Which region, A or B, shows structures that would be found in the outer layer of structure 'X'? (1 mark)

Description	Marks
B	1
Total	**1**

(ii) Justify your decision in part (b)(i). (2 marks)

Description	Marks
Grey matter is made up of unmyelinated nerve fibres/cell bodies	1
The outer region of the cerebrum contains only grey matter	1
Total	**2**

A man injured his back in a diving accident. Doctors were concerned there was damage to his spine and neural pathways. They touched different areas of his skin with a sharp point and asked him to indicate each time if he felt a sharp point. The sharp point should be felt in two ways, one of which would be pain.

(c) (i) What other sensation would be experienced by the man? (1 mark)

Description	Marks
Pressure/touch	1
Total	**1**

(ii) Describe how this sensation would be detected and registered by the man. (2 marks)

Description	Marks
Pressure/mechanoreceptors/touch receptors detect stimuli	1
Send (impulse) along sensory neurons to CNS/brain	1
Total	**2**

The man felt the sharp point when the point touched his arms, but not when the point touched his legs.

(d) Suggest what this information could tell the doctors about the damage to the man's spinal cord. Explain your answer. (3 marks)

Description	Marks
Damage must be between arms and legs/below arms/below waist/lower region of spinal cord	1
Information from nerves in arms still reaches the brain/ascending tracts from the arms are still functioning	1
Information from the legs doesn't reach the brain/ascending tracts from the legs are damaged	1
Total	**3**

2020 Section 2 Question 34

Central and peripheral nervous system

Opponents of the sport of boxing are often concerned with the incidence of traumatic brain injury that occurs among individuals who box on a regular basis. Punches that force the head up and back may cause damage to the cerebellum, as the brain is squashed up against the back of the skull.

(a) (i) List **three** structures that would normally assist in protecting the brain against injury. (3 marks)

Description	Marks
Cranium/skull/bone	1
meninges	1
cerebrospinal fluid/CSF	1
Total	**3**

(ii) Suggest **two** symptoms a boxer might display if the cerebellum was damaged. (2 marks)

Description	Marks
slurred speech	1–2
loss of balance	
lack of coordination/clumsy movements/reduce fine motor control	
involuntary shaking	
Total	**2**

Muhammad Ali, a former boxer, developed Parkinson's disease. Although not conclusively linked to his boxing career, in his case it was associated with head trauma.

(b) (i) Describe the cause of Parkinson's disease. (2 marks)

Description	Marks
damage/degeneration to nerve cells in the brain (substantia nigra/basal ganglia)	1–2
reduced dopamine levels	
dopamine is required for smooth control of muscles and movement	
Total	**2**

(ii) Describe how cell replacement therapy could be used to treat Parkinson's disease. (2 marks)

Description	Marks
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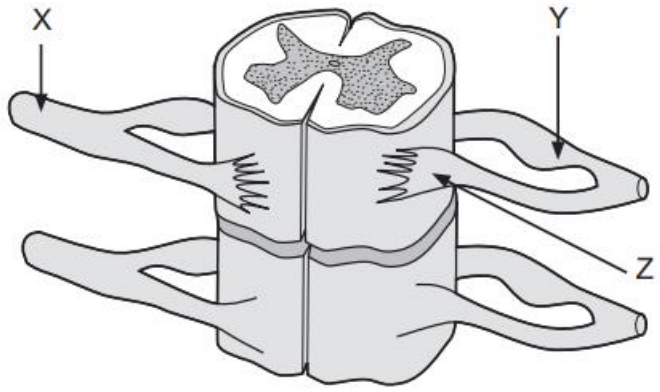
For copyright reasons this text cannot be reproduced in the online version of this document, but may be viewed at the link listed on the acknowledgements page.	1
Total	**2**

The following questions refer to the diagram below, which shows a cross section of the spinal cord.



(c) (i) If 'X' is injured, it can lead to paralysis of part/s of the body and loss of sensation, depending on how high up the spinal cord the injury is. Why does this occur? (2 marks)

Description	Marks
X is a spinal nerve/mixed nerve/it contains both sensory and motor neurons	1
damage effects both neurons/both pathways to and from the brain	1
Total	**2**

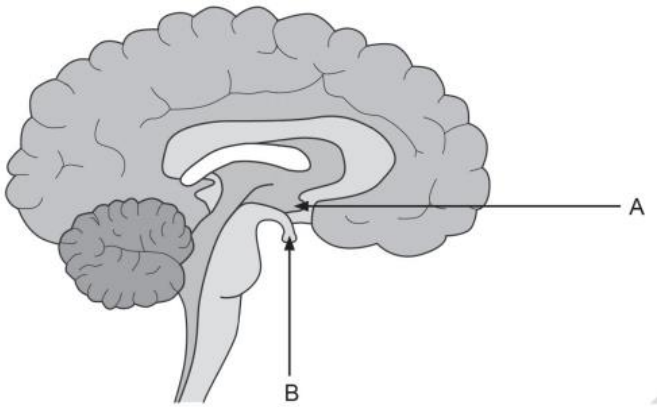
(ii) If Y is damaged, there will be a loss of feeling, but movement can still occur. Injury to Z leads to paralysis, but there will still be a sense of feeling. Explain why this difference occurs. (4 marks)

Description	Marks
if Y is damaged it effects the sensory neuron	1
impulses will not travel into the spinal cord but messages can still be sent out	1
if Z is damaged it effects the motor neuron	1
impulses still travel into the spinal cord but messages cannot be sent out	1
Total	**4**

2019 Section 2 Question 32

Central and peripheral nervous system

(a) The following question refers to the diagram of the brain shown below.



(i) Identify structure A. (1 mark)

Description	Marks
hypothalamus	1
Total	**1**

(ii) State one function of structure B. (1 mark)

Description	Marks
Any **one** of the following:	
• master gland to control thyroid/adrenals/ovaries/testes • secretes hormones produced by the hypothalamus • produces hormones to control kidneys/uterus/mammary glands/growth/immune system/melanin production/pain/mood	1
Total	**1**

(b) Contrast the role of the cerebellum and the medulla oblongata. (2 marks)

Description	Marks
Cerebellum = unconscious control of movement/for posture and balance/fine coordination	1
Medulla oblongata = automatically adjusting body functions/specific examples	1
Total	**2**

Multiple sclerosis (MS) is a disease that destroys Schwann cells in the central nervous system.

(c) (i) State the effect of the loss of the Schwann cells on the transmission of nerve impulses and describe why this occurs. (3 marks)

Description	Marks
Effect of loss of schwann cells	
the impulses will travel slower	1
Subtotal	**1**
Describe why this occurs	
schwann cells make myelin	1
myelin speeds up transmission of impulses/loss of myelin causes impulses to be transmitted to be slower	1
Subtotal	**2**
Total	**3**

A person had a touch sensitivity test. This involved them having various areas of their skin touched very gently. In some areas, they were unable to feel the touches.

(ii) Explain how this inability to feel the very gentle touches might not be due to MS. (3 marks)

Description	Marks
the touches were not reaching a sufficient intensity/not strong enough	1
to pass the threshold intensity/trigger an action potential	1
'all or none' response	1
Total	**3**

2019 Section 2 Question 35

Central and peripheral nervous system

Engineers at Johns Hopkins University have recently developed technology that allows the detection of external stimuli on the fingertips of prosthetic limbs. Called an 'e-dermis', the technology presents a revolutionary development for amputee patients.

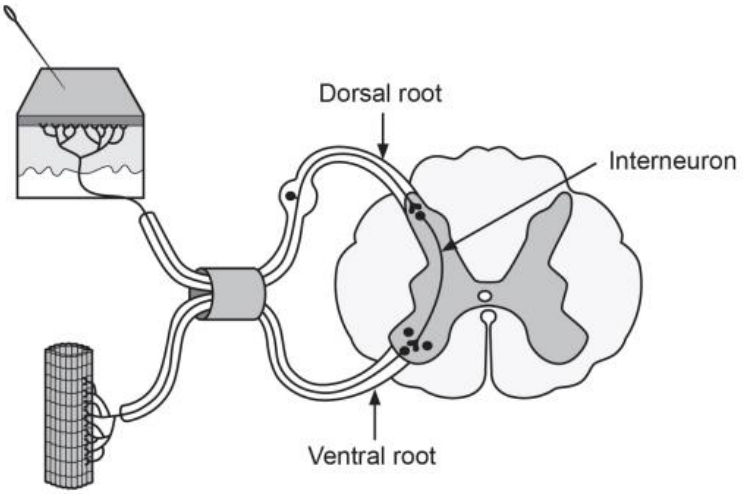
(a) (i) Name the type of receptors engineers would have to replicate into the e-dermis to allow the detection of a small distortion of the skin when it came into contact with an object. (1 mark)

Description	Marks
touch receptors/mechanoreceptors/pressure receptors/Merkel's disks/Meissner's corpuscles/Ruffini's corpuscles	1
Total	**1**

(ii) Engineers are also interested in making the e-dermis capable of detecting temperature. Explain how specific receptors found in human skin can detect external temperatures. (4 marks)

Description	Marks
tissues/blood of the skin changes temperature in response to environment/change in the environmental temperature detected by receptors	1–4
two types of thermoreceptors present/hot and cold receptors present	
low temperatures (below normal body temperature) triggers cold receptors	
high temperatures (above normal body temperature) triggers hot receptors	
Total	**4**

Question 35 (b) refers to the diagram of a spinal reflex arc show below.



(b) (i) Outline the purpose of a spinal reflex arc. (1 mark)

Description	Marks
protect body from harm or damage	1
Total	**1**

(ii) On the diagram of the reflex arc shown above, shade in the afferent pathway. (1 mark)

Description	Marks
shade pathway from receptor to start of grey matter	1
Total	**1**

For the spinal reflex arc to function, the interneuron shown in the diagram must be triggered at the synapse. This creates an action potential that propagates along the neuron to be passed to the next neuron.

(iii) Explain how an action potential continues along the interneuron. (4 marks)

Description	Marks
sodium channels open	1–4
sodium ion cells move into the cell/depolarisation inside the axon	
once the cell reaches the threshold the action potential will fire	
travels along the entire axon/does not jump between myelin	
Total	**4**

2021 Section 3 Question 39

Central and peripheral nervous system

Flynn was standing at second base during a game of baseball. The batter hit the ball straight at him. Without thinking, Flynn put his baseball glove up to stop the ball from hitting his face and his face flinched (involuntarily turned) away from the incoming ball.

(a) Describe the components of the mechanism that produced the flinching response. (8 marks)

Description	Marks
Any **eight** of the following:	
Reflex action (so only involves the spinal cord)	1–8
Impulse travels from receptor to spinal cord	
via a sensory/afferent neuron	
through the dorsal root	
Synapse between a sensory/afferent neuron and an interneuron	
In the grey matter of the spinal cord	
Synapse between interneuron and motor/efferent neuron	
Impulse sent to effector through ventral root	
Motor/efferent neuron stimulates muscle movement	
via a neuromuscular junction/across a motor end plate	
Total	**8**

(b) Explain how a nerve impulse travels along an axon and between neurons. (12 marks)

Description	Marks
Along the axon	
Any **seven** of the following:	
Depolarisation occurs	1–7
Reaches threshold/-55 mV	
Cell membrane becomes permeable to sodium ions/sodium channels open	
Sodium ions diffuse into the cell (across the cell membrane)	
Inside the cell/membrane becomes positive relative to the outside	
Potassium ions diffuse out of the cell (across the membrane)/potassium channels open	
Inside the membrane becomes negative relative to the outside	
A sodium–potassium pump transports sodium ions out of the cell transports potassium ions into the cell	
Returns to a polarised/resting state/neuron repolarised	
Subtotal	**7**
Between neurons	
Any **five** of the following:	
Action potential reaches axon terminal	1–5
Calcium channels open	
Calcium causes vesicles to release neurotransmitter (via exocytosis)	
Neurotransmitter diffuses across synaptic cleft	
Neurotransmitters binds to (neuro)receptors on post synaptic dendrite	
Action potential triggered in post synaptic neuron	
Subtotal	**5**
Total	**12**

Unit 3 – Homeostasis

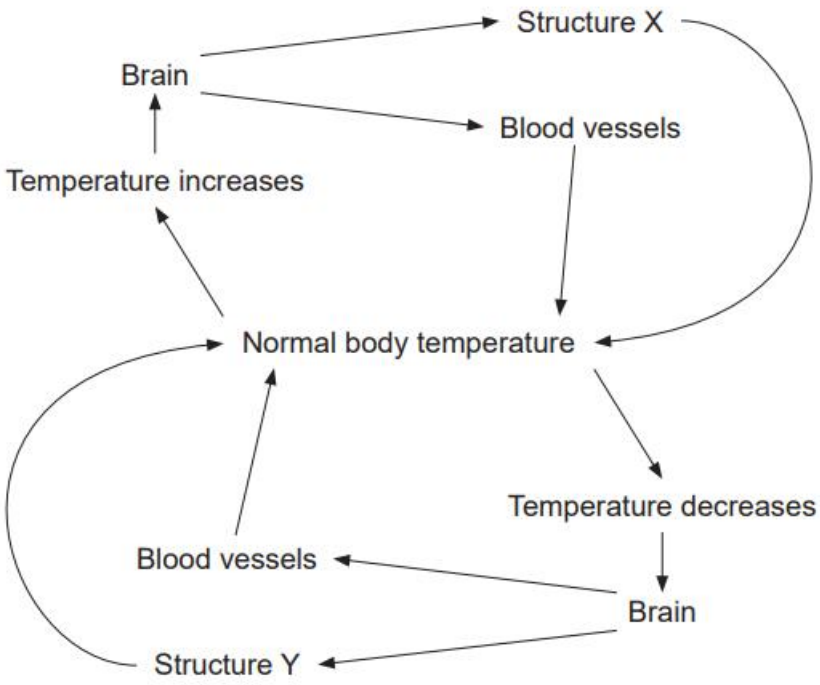
Section 1

2023 Section 1 Question 9 **Homeostasis**	Rate and depth of breathing is regulated via the (a) medulla sending messages to the external intercostal muscles and diaphragm. (b) hypothalamus sending messages to the internal intercostal muscles and diaphragm. (c) medulla sending messages to the internal intercostal muscles and diaphragm. (d) hypothalamus sending messages to the external intercostal muscles and diaphragm.

2023 Section 1 Question 29-30

Homeostasis

Questions 29 and 30 refer to the diagram shown below.



29. Structures X and Y most likely are

	X	Y
(a)	skeletal muscles	skin
(b)	sweat glands	heart
(c)	heart	sweat glands
(d)	sweat glands	skeletal muscles

30. The relationship between the brain and blood vessels shown in the diagram is best explained as the

(a) hypothalamus sending impulses to cause blood vessels of the skin to constrict when the internal body temperature decreases.
(b) medulla sending impulses to cause blood vessels of the skin to dilate when the internal body temperature increases.
(c) hypothalamus sending impulses to cause the blood vessels of the skin to dilate when the internal body temperature decreases.
(d) medulla sending impulses to cause blood vessels of the skin to constrict when the internal body temperature decreases.

2022 **Section 1** **Question 8** **Homeo-stasis**	A study measured the concentration of antidiuretic hormone (ADH) in the blood of 100 healthy elderly volunteers at 4-hourly intervals throughout a 24-hour period. ADH secretion normally increases at night. The expected increase in ADH levels during the night was not seen in 80% of the group. Why would these lower levels of ADH result in the volunteers needing to empty their bladders more than once during the night? Low ADH levels (a) do not allow rapid eye movement (REM) sleep to occur, so the volunteers are awake more often. (b) reduce the ability of the bladder to hold large volumes of urine. (c) stimulate the kidney to filter blood faster and create more urine. (d) decrease the amount of water reabsorbed from kidney tubules.

2020 **Section 1** **Question 4** **Homeo-stasis**	Respiratory acidosis is a disorder whereby the acidity of the blood is high. High acidity of the blood is caused by (a) a decrease in carbon dioxide levels, which leads to a decrease in hydrogen ion concentration. (b) an increase in carbon dioxide levels, which leads to an increase in hydrogen ion concentration. (c) an increase in carbon dioxide levels, which leads to a decrease in hydrogen ion concentration. (d) a decrease in carbon dioxide levels, which leads to an increase in hydrogen ion concentration.

Section 2

2023 Section 2 Question 32

Homeostasis

Nocturia is a medical condition that causes sufferers to wake up frequently during the night to urinate. The condition is more common in older people and has several known causes. One known cause of this condition is the decreased production of antidiuretic hormone (ADH) during the night-time hours. Normally ADH production increases at night-time but in elderly people this normal cycle of production can be altered.

A study was undertaken with 20 elderly volunteer patients to investigate the link between ADH and the condition nocturia. Twelve patients experienced severe symptoms of nocturia, and eight patients did not. They were separated into two groups during a 48-hour monitored hospital visit. During this time, their blood levels of ADH and urine output were recorded. At 11 pm on day 2 of the study, the patients with nocturia were treated with desmopressin (synthetic ADH). The patients who did not suffer from nocturia were also treated at 11 pm but received a placebo. A summary of the results of the study are shown below.

Time of collection	Mean urine output (mL)			
	Day 1		Day 2	
	Group 1	Group 2	Group 1	Group 2
8 am to 8 pm	1188	1247	1230	1190
8 pm to 8 am	594	1035	567	658

(a) Construct an appropriate title for the results table shown above. (2 marks)

(b) Using the data from the table, identify the name scientists would give to each group in the study. Justify your choice. (4 marks)

(c) The summary of the results in the table on page 16 only shows the mean urine output per group. Explain why presenting the data with only the mean and not including the median scores can be misleading. (2 marks)

Normally, the release of ADH is determined by the concentration and volume of blood.

(d) (i) Identify the type and location of the receptors that detect changes in the blood associated with ADH production. (2 marks)

Type:

Location:

(ii) Identify the effector/s targeted by ADH and explain an impact ADH has on the structure/s. (4 marks)

(iii) Describe when and how the thirst reflex plays a role in the homeostasis of blood fluid concentrations. (4 marks)

	(e) ADH is classed as a water-soluble hormone. Outline two differences in the mode of action of a water-soluble hormone and a lipid-soluble hormone. (2 marks) One: Two:

2022 Section 2 Question 35

Homeo-stasis

In December 2021, Perth recorded four consecutive days of temperatures above 40 °C, the most ever for December.

When subjected to extreme heat, the human body needs to employ numerous mechanisms to maintain body temperature within an appropriate range.

(a) (i) Complete the table below by identifying two different effectors, the physiological mechanism that each would employ when operating in the hot conditions and how these mechanisms help to maintain body temperature. (8 marks)

	Effector One	**Effector Two**
Name of the effector	(1 mark)	(1 mark)
Physiological mechanism for hot conditions	(1 mark)	(1 mark)
How the mechanism helps to maintain body temperature	(2 marks)	(2 marks)

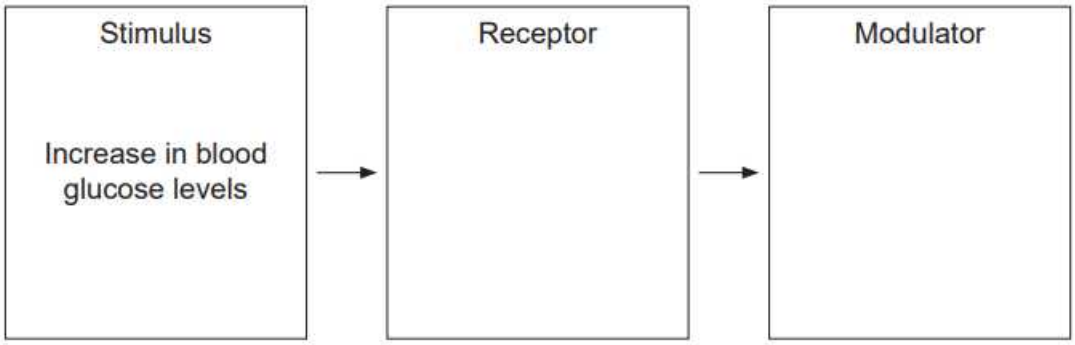
(ii) Identify two behavioural mechanisms that a person could use to maintain body temperature in these hot conditions. (2 marks)

One:

Two:

One popular dieting trend in 2021 was known as the 16:8 intermittent fasting technique. This involves people fasting (not consuming any kilojoules) for 16 hours a day and then eating normally for the remaining eight hours of the day.

(b) (i) Complete the flow diagram below to show how blood glucose would be regulated during the eight hours of normal eating during the diet. (2 marks)



(ii) During the 16-hour fasting stage, which hormone associated with blood glucose regulation would be present in high concentrations? (1 mark)

(iii) Using your understanding of blood glucose regulation, propose how this type of dieting could help achieve weight loss. (3 marks)

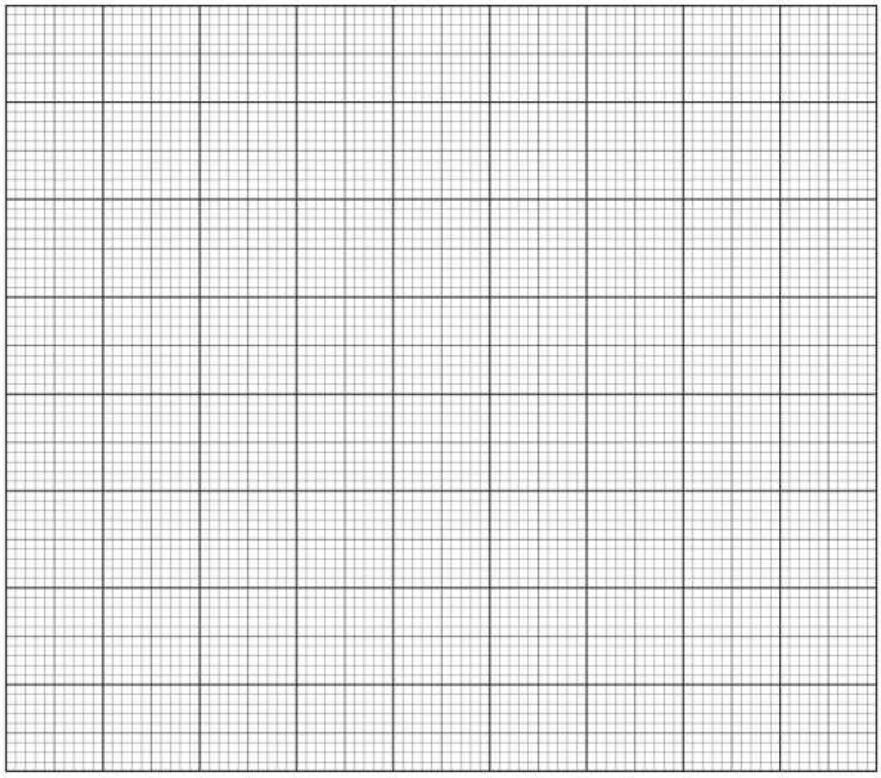
2020 Section 2 Question 33

Homeo-stasis

Central diabetes insipidus (CDI) is a condition that results in polyuria, an excessive production of urine. To diagnose CDI, a water retention test is conducted. The patient is allowed fluids overnight, then they are not allowed any fluids for eight hours. The patient's weight, urine volume and urine concentration are recorded hourly. After a certain amount of time, the patient is given a dose of desmopressin, a synthetic form of antidiuretic hormone (ADH). Their urine volume and concentration are then monitored and recorded for a further two to four hours. Below is a table showing the urine volume and concentration results for a patient suspected of having CDI.

Time (hrs)	Urine volume (mL)	Urine concentration ($mOsmkg^{-1}$)
0	220	-
1	550	150
2	500	170
3	600	160
4	550	160
5	400	160
6	410	220
7	10	310
8	120	350

(a) Graph these results on the grid provided below. (5 marks)



(b) When was the desmopressin administered? Justify your response. (2 marks)

(c) Does this patient have CDI? Justify your response. (2 marks)

(d) Desmopressin acts in the same manner as antidiuretic hormone (ADH).

(i) Identify the gland that secretes ADH. (1 mark)

(ii) Explain the role of ADH in the maintenance of water balance in the body. (6 marks)

2023 **Section 3** **Question 37** **Homeostasis**	Homeostatic processes involve both nerves and hormones in the maintenance of many bodily functions, such as blood glucose levels. (a) Define homeostasis and describe how a negative feedback model contributes to the maintenance of bodily functions. (13 marks) (b) Explain the role the adrenal glands play in maintaining blood glucose levels. (7 marks)

2021 Section 3 Question 38 **Homeo-stasis**	During a trip to the Australian bush, a young man was lost for over six hours. The day on which he was lost was particularly hot, with temperatures peaking at 42 °C. After a day's rest, the young man recovered from his experience with no lasting ill-effects. (a) Describe the physiological mechanisms that would have been operating to maintain his internal body temperature during the six hours he was lost in the bush. (10 marks) (b) Explain how the mechanisms required to maintain homeostasis of the man's internal body temperature would have also triggered the homeostatic processes involved in the maintenance of his body fluid concentration. (10 marks)

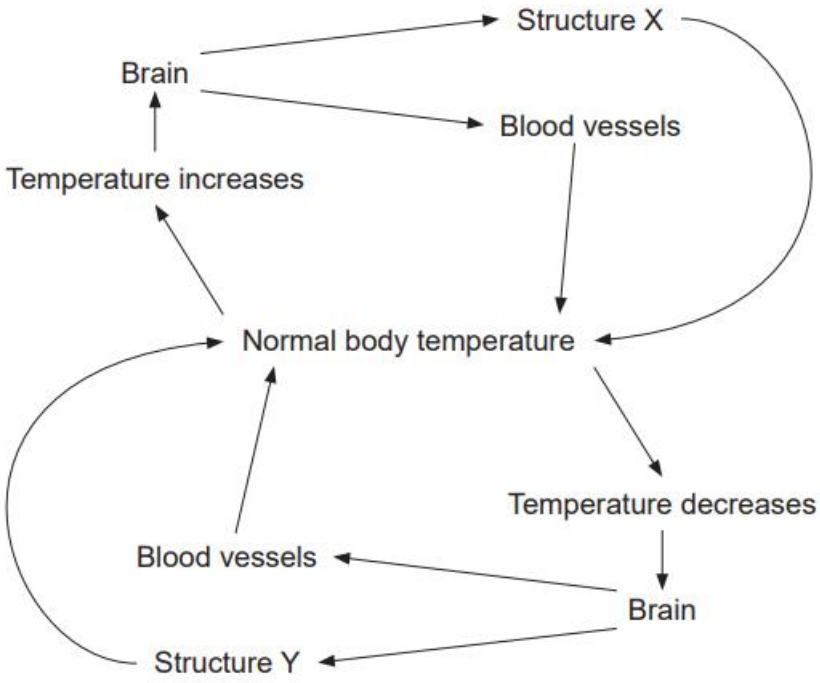
2019 Section 3 Question 41 **Homeo-stasis**	Michael and Bruno are diving at the local swimming pool. Michael has been repeatedly diving and swimming for over an hour. His blood pH has dropped from 7.4 to 7.3. Bruno has decided he wants to try to see how long he can stay underwater during a dive. He induces hyperventilation, where he takes short, rapid breaths. This causes the carbon dioxide concentration of his blood to drop significantly. (a) Describe how the homeostatic mechanism for breathing control would be operating in Michael. Contrast this to Bruno, who had hyperventilated, explaining the reason for the differences. (11 marks) Humans, like other mammals, have a diving reflex that is triggered when our face comes into contact with, or is submerged in, cool water. Thermoreceptors in the nasal cavity trigger autonomic nerves, which stimulate peripheral vasoconstriction. (b) Describe what peripheral vasoconstriction is, how else it can be triggered in the body and why peripheral vasoconstriction would be of benefit to a person when swimming or diving. (9 marks)

2023 Section 1 Question 9 **Homeostasis**	Rate and depth of breathing is regulated via the **(a) medulla sending messages to the external intercostal muscles and diaphragm. – Answer** (b) hypothalamus sending messages to the internal intercostal muscles and diaphragm. (c) medulla sending messages to the internal intercostal muscles and diaphragm. (d) hypothalamus sending messages to the external intercostal muscles and diaphragm.

2023 Section 1 Question 29-30

Homeostasis

Questions 29 and 30 refer to the diagram shown below.



29. Structures X and Y most likely are

	X	Y
(a)	skeletal muscles	skin
(b)	sweat glands	heart
(c)	heart	sweat glands
(d)	sweat glands	skeletal muscles

Answer is d.

30. The relationship between the brain and blood vessels shown in the diagram is best explained as the

(a) hypothalamus sending impulses to cause blood vessels of the skin to constrict when the internal body temperature decreases. – Answer
(b) medulla sending impulses to cause blood vessels of the skin to dilate when the internal body temperature increases.
(c) hypothalamus sending impulses to cause the blood vessels of the skin to dilate when the internal body temperature decreases.
(d) medulla sending impulses to cause blood vessels of the skin to constrict when the internal body temperature decreases.

2022 **Section 1** **Question 8** **Homeo-stasis**	A study measured the concentration of antidiuretic hormone (ADH) in the blood of 100 healthy elderly volunteers at 4-hourly intervals throughout a 24-hour period. ADH secretion normally increases at night. The expected increase in ADH levels during the night was not seen in 80% of the group. Why would these lower levels of ADH result in the volunteers needing to empty their bladders more than once during the night? Low ADH levels (a) do not allow rapid eye movement (REM) sleep to occur, so the volunteers are awake more often. (b) reduce the ability of the bladder to hold large volumes of urine. (c) stimulate the kidney to filter blood faster and create more urine. **(d) decrease the amount of water reabsorbed from kidney tubules. – Answer**

2020 **Section 1** **Question 4** **Homeo-stasis**	Respiratory acidosis is a disorder whereby the acidity of the blood is high. High acidity of the blood is caused by (a) a decrease in carbon dioxide levels, which leads to a decrease in hydrogen ion concentration. **(b) an increase in carbon dioxide levels, which leads to an increase in hydrogen ion concentration. – Answer** (c) an increase in carbon dioxide levels, which leads to a decrease in hydrogen ion concentration. (d) a decrease in carbon dioxide levels, which leads to an increase in hydrogen ion concentration.

2023 Section 2 Question 32

Homeostasis

Nocturia is a medical condition that causes sufferers to wake up frequently during the night to urinate. The condition is more common in older people and has several known causes. One known cause of this condition is the decreased production of antidiuretic hormone (ADH) during the night-time hours. Normally ADH production increases at night-time but in elderly people this normal cycle of production can be altered.

A study was undertaken with 20 elderly volunteer patients to investigate the link between ADH and the condition nocturia. Twelve patients experienced severe symptoms of nocturia, and eight patients did not. They were separated into two groups during a 48-hour monitored hospital visit. During this time, their blood levels of ADH and urine output were recorded. At 11 pm on day 2 of the study, the patients with nocturia were treated with desmopressin (synthetic ADH). The patients who did not suffer from nocturia were also treated at 11 pm but received a placebo. A summary of the results of the study are shown below.

Time of collection	Mean urine output (mL)			
	Day 1		Day 2	
	Group 1	Group 2	Group 1	Group 2
8 am to 8 pm	1188	1247	1230	1190
8 pm to 8 am	594	1035	567	658

(a) Construct an appropriate title for the results table shown above. (2 marks)

Description	Marks
Identifies independent and dependent variable relationship	1
Provides additional detail, such as of time/comparison to control group/using mean scores	1
Total	**2**
Example of title – Mean urine output collected during a 48-hour hospital visit of patients suffering from nocturia compared with unaffected patients.	

(b) Using the data from the table, identify the name scientists would give to each group in the study. Justify your choice. (4 marks)

Description	Marks
Group 2 is the experimental group	1
Group 1 is the control group	1
Any one of (1 x 2 marks)	
• Group 2 showed the high urine production during night-time on day one/showed urine output changes on second day when desmopressin was taken therefore, is the group being tested in the study • Group 1 showed normal urine output during night-time on both days therefore, is the group being used to compare with	1–2
Total	**4**

(c) The summary of the results in the table on page 16 only shows the mean urine output per group. Explain why presenting the data with only the mean and not including the median scores can be misleading. (2 marks)

Description	Marks
the mean does not indicate the spread of the results/cannot show if the results are skewed/can be influenced by outliers	1
when the median is included the distribution of results is clearer/can show if the results are normally distributed	1
Total	**2**

Normally, the release of ADH is determined by the concentration and volume of blood.

(d) (i) Identify the type and location of the receptors that detect changes in the blood associated with ADH production. (2 marks)

Description	Marks
Osmoreceptors	1
Hypothalamus	1
Total	**2**

(ii) Identify the effector/s targeted by ADH and explain an impact ADH has on the structure/s. (4 marks)

Description	Marks
distal convoluted tubule (of nephron/kidney)	1
collecting duct (of nephron/kidney)	1
increases the permeability of the tubule/collecting duct to water	1
increases the reabsorption of water (from the tubule) back into the blood	1
Total	**4**

(iii) Describe when and how the thirst reflex plays a role in the homeostasis of blood fluid concentrations. (4 marks)

Description	Marks
when increased blood osmolarity/decreased blood volume	1
hypothalamus send nerves impulse to cerebrum	1
conscious recognition of thirst prompts individual to intake water	1
water intake decreases blood osmolarity/increases blood volume	1
Total	**4**

(e) ADH is classed as a water-soluble hormone. Outline two differences in the mode of action of a water-soluble hormone and a lipid-soluble hormone. (2 marks)

Description	Marks
Any two of	
• water-soluble bind to receptor proteins on cell membrane while lipid-soluble diffuse through the membrane • water-soluble activate a secondary messenger inside the cytoplasm while lipid-soluble activate an intracellular receptor inside the cytoplasm • water-soluble cause transient changes in protein activity or gene expression while lipid-soluble always alter gene expression • water-soluble is fast onset while lipid-soluble is slower/longer lasting changes	1–2
Total	**2**

2022 Section 2 Question 35

Homeo-stasis

In December 2021, Perth recorded four consecutive days of temperatures above 40 °C, the most ever for December.

When subjected to extreme heat, the human body needs to employ numerous mechanisms to maintain body temperature within an appropriate range.

(a) (i) Complete the table below by identifying two different effectors, the physiological mechanism that each would employ when operating in the hot conditions and how these mechanisms help to maintain body temperature. (8 marks)

	Description		Marks
	Effector One	**Effector Two**	
Name of the effector	Skin Arterioles (1)	Sweat glands (1)	1–2
Physiological mechanism for hot conditions	Vasodilation (1)	(Increased) sweating (1)	1–2
How the mechanism helps to maintain body temperature	Vasodilation by bringing blood close to the surface (1). Heat can then be removed through radiation/conduction/ convection (1).	Sweating increases water/moisture on the skin (1). Heat drawn from body to evaporate water on skin (1).	1–4
		Total	**8**

(ii) Identify two behavioural mechanisms that a person could use to maintain body temperature in these hot conditions. (2 marks)

Description	Marks
Any two of	
• remove clothing • stay still/reduce activity • spread body out • avoid heat sources/stay in cool place • go for a swim/cold shower	1–2
Total	**2**

One popular dieting trend in 2021 was known as the 16:8 intermittent fasting technique. This involves people fasting (not consuming any kilojoules) for 16 hours a day and then eating normally for the remaining eight hours of the day.

(b) (i) Complete the flow diagram below to show how blood glucose would be regulated during the eight hours of normal eating during the diet. (2 marks)

Description	Marks
Receptor – Chemoreceptors/Beta cells (of pancreas)	1
Modulator – Beta cells (of pancreas)	1
Total	**2**

(ii) During the 16-hour fasting stage, which hormone associated with blood glucose regulation would be present in high concentrations? (1 mark)

Description	Marks
glucagon	1
Total	**1**

(iii) Using your understanding of blood glucose regulation, propose how this type of dieting could help achieve weight loss. (3 marks)

Description	Marks
more time is spent with high levels of glucagon (than insulin)	1
Any two of	
• means more time spent converting glycogen/fats/amino acids to glucose • less time spent storing glucose/converting to fat • less time eating means overall less kilojoules can be consumed	1–2
Total	**3**

2020 Section 2 Question 33

Homeo-stasis

Central diabetes insipidus (CDI) is a condition that results in polyuria, an excessive production of urine. To diagnose CDI, a water retention test is conducted. The patient is allowed fluids overnight, then they are not allowed any fluids for eight hours. The patient's weight, urine volume and urine concentration are recorded hourly. After a certain amount of time, the patient is given a dose of desmopressin, a synthetic form of antidiuretic hormone (ADH). Their urine volume and concentration are then monitored and recorded for a further two to four hours. Below is a table showing the urine volume and concentration results for a patient suspected of having CDI.

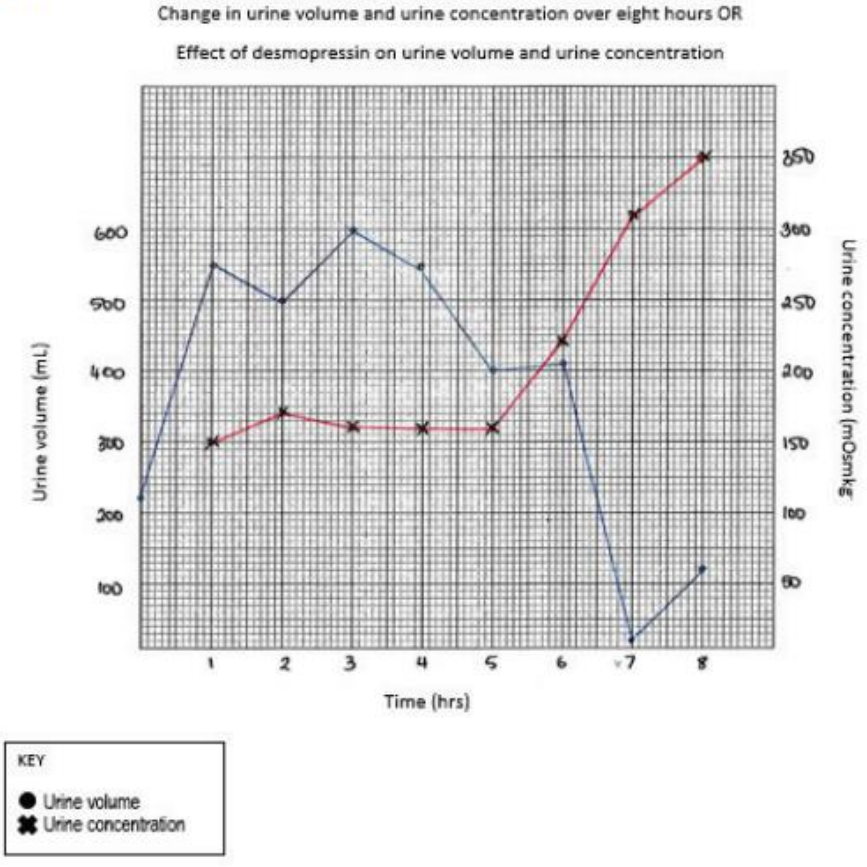
Time (hrs)	Urine volume (mL)	Urine concentration ($mOsmkg^{-1}$)
0	220	-
1	550	150
2	500	170
3	600	160
4	550	160
5	400	160
6	410	220
7	10	310
8	120	350

(a) Graph these results on the grid provided below. (5 marks)

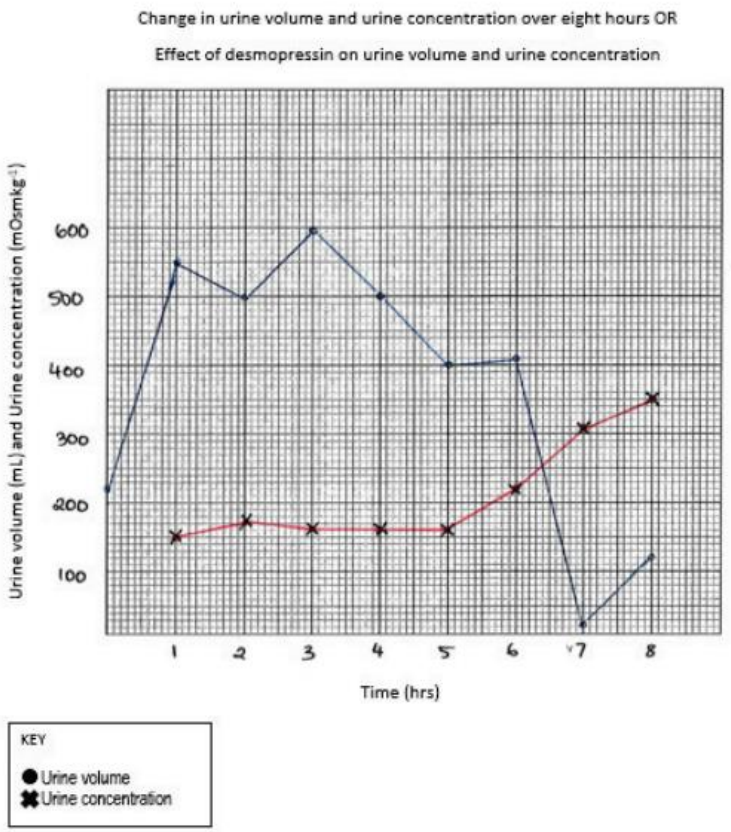
Description	Marks
correctly constructs axes using appropriate scale (urine volume and urine osmolality on Y axes, Time on X axis)	1
correctly plots points and joins points to form a line (ruler)	1
labelling of axes with correct name and unit	1
identifies lines using key/labels	1
title appropriate with both independent and dependent variables included 'Effect of Desmopressin on Urine Volume and Urine Concentration' or 'Urine Volume and Urine Concentration changes over eight hours'	1
Total	**5**

Answers could include:

Example one



Example two



(b) When was the desmopressin administered? Justify your response. (2 marks)

Description	Marks
at six hours	1
desmopressin will reduce urine volume (like ADH does, this occurs when urine volume is reduced from 410 mL to 10 mL)	1
urine concentration increases (decreasing water volume in urine)	
Total	**2**

(c) Does this patient have CDI? Justify your response. (2 marks)

Description	Marks
yes	1
high urine production despite having had no fluids to drink	1
drop of urine volume to 10 after desmopressin administered indicating no ADH in blood to reduce urine volume previously	
Total	**2**

(d) Desmopressin acts in the same manner as antidiuretic hormone (ADH).

(i) Identify the gland that secretes ADH. (1 mark)

Description	Marks
posterior pituitary gland	1
Total	**1**

(ii) Explain the role of ADH in the maintenance of water balance in the body. (6 marks)

Description	Marks
water concentration of blood plasma decreases/osmotic pressure of the blood increases	1
osmoreceptors (in hypothalamus) detect decrease in water concentration/increase in osmotic pressure	1
hypothalamus stimulates posterior pituitary gland	1
to release ADH	1
permeability of the distal convoluted tubule and collecting tubule (of the nephron) to water is increased	1
Increased amount of water is reabsorbed into the blood/water concentration of blood plasma increases/osmotic pressure of the blood decreases	1
Total	**6**

2023 Section 3 Question 37

Homeostasis

Homeostatic processes involve both nerves and hormones in the maintenance of many bodily functions, such as blood glucose levels.

(a) Define homeostasis and describe how a negative feedback model contributes to the maintenance of bodily functions. (13 marks)

Description	Marks
Homeostasis	
is the ability of an organism to maintain a constant internal environment/steady state	1
despite changes in either internal or external conditions	1
to maintain optimal functioning of cells/cell processes/metabolic processes	1
Subtotal	**3**
Negative feedback	
activated when internal or external conditions change from optimal conditions	1
is when the response counteracts the change/response reduces stimulus	1
returns body/body cells to normal	1
Subtotal	**3**
Maintenance of bodily functions	
a stimulus is a change in the internal/external environment	1
the receptor detects a change (outside of the tolerance limits)	1
produces a nervous or hormonal signal	1
the control centre/modulator receives the signal/processes signal	1
sends a message to the effector	1
the effector/muscle/gland carries out the response	1
the response counteracts the initial stimulus/reduces stimulus/has the opposite effect to the initial stimulus	1
Subtotal	**7**
Total	**13**

(b) Explain the role the adrenal glands play in maintaining blood glucose levels. (7 marks)

Description	Marks
Any seven of	
• adrenal cortex secretes cortisol/glucocorticoids • stimulates the conversion of glycogen into glucose/glycogenolysis in liver • increases the rate that amino acids are removed from muscle cells (and taken to liver) • amino acids converted into glucose/gluconeogenesis by liver • increase movement of fatty acids from adipose tissue to muscle cells for use • adrenal medulla produces adrenaline/noradrenaline • stimulates production of lactic acid from glycogen in muscle cells • lactic acid converted to glucose in liver	1–7
Total	**7**

2021 Section 3 Question 38

Homeo-stasis

During a trip to the Australian bush, a young man was lost for over six hours. The day on which he was lost was particularly hot, with temperatures peaking at 42 °C. After a day's rest, the young man recovered from his experience with no lasting ill-effects.

(a) Describe the physiological mechanisms that would have been operating to maintain his internal body temperature during the six hours he was lost in the bush. (10 marks)

Description	Marks
Any **ten** of the following:	
Internal body temperature increase	1–10
Thermoreceptors detect increased temperature	
Central thermoreceptors located in hypothalamus/peripheral thermoreceptors located in the skin	
Hypothalamus activates cooling mechanisms/acts as modulator	
Peripheral blood vessels/skin arterioles	
Vasodilation occurs	
Heat loss by radiation/conduction	
Heat loss by evaporation	
Sweat glands activated	
(Increases) sweating occurs	
Decrease metabolic rate	
Occurs because of decrease thyroxine	
To decrease heat production	
Total	**10**

(b) Explain how the mechanisms required to maintain homeostasis of the man's internal body temperature would have also triggered the homeostatic processes involved in the maintenance of his body fluid concentration. (10 marks)

Description	Marks
Increase sweating results in greater water loss from body	1
Water must be conserved/replaced	1
Any **eight** of the following:	
Water concentration of blood plasma decreases/osmotic pressure of the blood increases	1–8
Osmoreceptors detect decrease in water concentration/increase in osmotic pressure	
Osmoreceptors in hypothalamus	
Hypothalamus stimulates posterior pituitary gland	
Increased ADH released	
Permeability of the distal convoluted tubule/collecting tubule (of the nephron) to water is increased	
Increased amount of water is reabsorbed into the blood/water concentration of blood plasma increases/osmotic pressure of the blood decreases	
Thirst reflex also triggered	
Nerve impulse to cerebrum/cerebral cortex/conscious desire to drink/ skeletal muscle effectors carry out response	
Total	**10**

2019 Section 3 Question 41

Homeo-stasis

Michael and Bruno are diving at the local swimming pool. Michael has been repeatedly diving and swimming for over an hour. His blood pH has dropped from 7.4 to 7.3. Bruno has decided he wants to try to see how long he can stay underwater during a dive. He induces hyperventilation, where he takes short, rapid breaths. This causes the carbon dioxide concentration of his blood to drop significantly.

(a) Describe how the homeostatic mechanism for breathing control would be operating in Michael. Contrast this to Bruno, who had hyperventilated, explaining the reason for the differences. (11 marks)

Description	Marks
Michael's breathing control	
chemoreceptors (in aorta, carotid artery and medulla oblongata) detect in decrease in pH	1–7
send message to respiratory control centre in the medulla	
message sent along phrenic and intercostal nerves	
intercostal muscles and diaphragm stimulated	
effectors increase rate of contraction	
increases depth and rate of breathing	
reduces carbon dioxide concentration/increases pH	
Subtotal	**7**
Contrast this to Bruno who had hyperventilated	
breathing depth and rate would have decreased	1–4
$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$ /decreased carbon dioxide in his blood causes increase pH	
same pathway but triggered oppositely	
breathing rate slows to return pH back to normal	
Subtotal	**4**
Total	**11**

Humans, like other mammals, have a diving reflex that is triggered when our face comes into contact with, or is submerged in, cool water. Thermoreceptors in the nasal cavity trigger autonomic nerves, which stimulate peripheral vasoconstriction.

(b) Describe what peripheral vasoconstriction is, how else it can be triggered in the body and why peripheral vasoconstriction would be of benefit to a person when swimming or diving. (9 marks)

Description	Marks
Describes peripheral vasoconstriction	
is the reduction in diameter of arterioles	1–3
involves arterioles found in the limbs	
directs more blood flow towards vital internal organs	
Subtotal	**3**
Describes how else it is triggered	
triggered during temperature regulation	1–4
decreased temperature detected by thermoreceptors	
triggers hypothalamus	
message sent via nerves/by noradrenaline	
Subtotal	**4**
Benefit to a person swimming or diving	
helps to conserve blood oxygen for the brain	1–2
helps to conserve body heat/reduce heat loss	
Subtotal	**2**
Total	**9**

Unit 3 – Response to infection

Section 1

2023 Section 1 Question 4

Response to infection

Question 4 refers to the diagram shown below.

Copyright restrictions prohibit the release of this SCSA exam material.

Which of the following structures produce lysozyme to help kill invading pathogens?

(a) A and B only
(b) A, B, C and D
(c) A and D only
(d) A, B and C only

2023 Section 1 Question 5

Response to infection

The Zika virus is a pathogen readily spread from mosquito bites and sexual intercourse with an infected person. Match correctly the type of transmission each mode represents.

	Mosquito bites	Sexual intercourse
(a)	indirect contact	transfer of body fluids
(b)	disease-specific vector	transfer of body fluids
(c)	disease-specific vector	indirect contact
(d)	transfer of body fluids	direct contact

2023 Section 1 Questions 11-12

Response to infection

Questions 11 and 12 refer to the graphic below.

Copyright restrictions prohibit the release of this SCSA exam material.

11. This correlation of malaria and occurrence of sickle-cell in Africa is best explained by the inference that

(a) the disease malaria provides a survival advantage to people with sickle-cell anaemia.
(b) sickle-cell shaped haemoglobin provides a survival advantage in regions where malaria is prevalent.
(c) sickle-cell shaped haemoglobin has evolved because of the high incidence of malaria present in the region.
(d) the disease sickle-cell anaemia is less lethal to human populations in regions with a high occurrence of malaria.

12. In the area highlighted on the map for sickle-cell allele, people carrying the allele would be expected to have either sickle-cell trait or sickle-cell anaemia. The difference between these is that

(a) people affected with sickle-cell trait rarely have symptoms, while people with sickle-cell anaemia do.
(b) sickle-cell trait sufferers cannot pass the condition onto their children, while sickle-cell anaemia sufferers can.
(c) people with sickle-cell anaemia have a genotype containing at least one allele for sickle-cell, while people with sickle-cell trait have two alleles.
(d) sickle-cell trait is fatal to people in areas without the presence of malaria, while sickle-cell anaemia is fatal regardless of the presence of malaria.

2023 **Section 1** **Question** **13** **Response** **to infection**	A blood sample from an area of the body exhibiting inflammation would be (a) high in complement proteins, high in histamine, low in heparin and low in tissue fluid. (b) low in complement proteins, low in histamine, low in heparin and high in tissue fluid. (c) low in complement proteins, high in histamine, high in heparin and low in tissue fluid. (d) high in complement proteins, high in histamine, high in heparin and high in tissue fluid.

2023 **Section 1** **Question** **24** **Response** **to infection**	The statements below relate to cells found in the immune system called lymphocytes. I. matured in bone marrow II. produces antibodies III. matured in thymus gland IV. release cytokines V. produce memory cells Which statements relate specifically to T lymphocytes? (a) III, IV and V (b) I, II and IV (c) II, III and V (d) I, IV and V

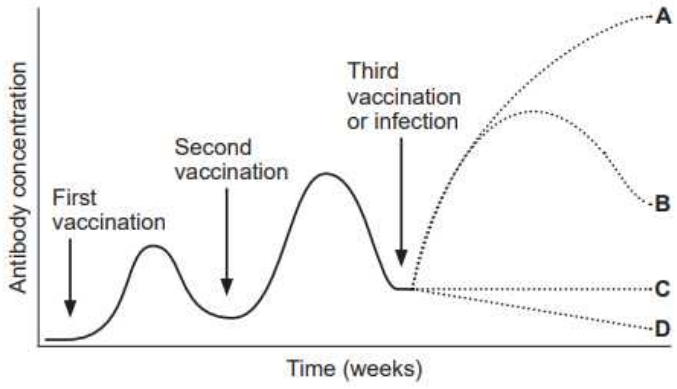
2022 **Section 1** **Question** **11** **Response** **to infection**	Which of the following is the **best** description of gene therapy? (a) mutating the sequence of a particular gene to produce variation (b) replacing a healthy gene with a defective gene (c) transferring a gene from one species into the genome of another species (d) replacing a defective gene with a functional one

2022 **Section 1** **Question** **15** **Response** **to infection**	Which of the following statements concerning the regulation of blood gases is true? The respiratory centre in the (a) hypothalamus detects the increase in blood pH and sends impulses to the respiratory muscles via efferent nerves. (b) medulla oblongata detects the decrease in blood pH and sends impulses to the respiratory muscles via efferent nerves. (c) medulla oblongata detects the increase in blood pH and sends impulses to the respiratory muscles via afferent nerves. (d) hypothalamus detects the decrease in blood pH and sends impulses to the respiratory muscles via afferent nerves.

2022 Section 1 Question 18-19

Response to infection

Questions 18 and 19 refer to the diagram shown below, which represents changes in antibody concentrations over many weeks.



18. Which of the dotted lines shown above **best** indicates the level of antibodies after a third vaccination or infection?

(a) A
(b) B
(c) C
(d) D

19. The **best** explanation for the change in the level of antibodies found after the second vaccination is that

(a) killer T cells were activated quickly to seek out the antigen.
(b) the antigen reactivated plasma cells to produce antibodies rapidly.
(c) memory cells rapidly stimulated production of antibodies.
(d) B lymphocytes were already primed and ready to produce antibodies.

2022 Section 1 Question 22

Response to infection

Fever plays an important role in humans' defence against disease. This role is **best** described as

(a) specific immunity, which destroys invading pathogens directly.
(b) non-specific immunity, which helps to speed up the immune response.
(c) specific immunity, which activates the killer T cells and helper T cells.
(d) non-specific immunity, which helps to neutralise pathogens at the entry site.

2022 Section 1 Question 30

Response to infection

Which of the following is a correct comparison between bacterial and viral pathogens?

	Bacterial	Viral
(a)	infected patients can be treated with vaccines	infected patients can be treated with antivirals
(b)	are very small and can only be seen through an electron microscope	are small but some can be seen without a microscope
(c)	infection is caused by bacterial cells multiplying or toxins within the body of the host	infection is caused by invading a host cell and creating multiple copies of itself
(d)	all bacteria found in nature are harmful to humans	some viruses are helpful to humans and not disease causing

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2021 Section 1 Question 7

Response to infection

An example of natural active immunity is a

(a) breastfed baby who does not catch a cold that they are exposed to.
(b) hospital worker who is vaccinated against the flu.
(c) person bitten by a snake who is given anti-venom antibodies.
(d) child who contracts chicken pox and does not get the disease again.

2020 Section 1 Question 8 Response to infection	Type 2 diabetes is a condition whereby a person can (a) produce glucagon but their cells do not respond to it. (b) produce insulin but their cells do not respond to it. (c) no longer produce insulin. (d) no longer produce glucagon.

2020 Section 1 Question 20 Response to infection	Antibiotics are ineffective against viruses because viruses (a) keep changing their external protein coat. (b) are able to disguise themselves in the host cell membrane. (c) are not living cells and thus do not metabolise. (d) can change antibiotics into useful food substances.

2020 Section 1 Question 24 Response to infection	A key component of cell-mediated immunity is the body's production of (a) antigens. (b) antibodies. (c) memory B cells. (d) killer T cells.

2019 Section 1 Question 6 Response to infection	Australian scientist Howard Florey used controlled experiments to demonstrate the effectiveness of penicillin in treating bacterial infections. Eight mice, all of similar weight and age, were each injected with 100 million streptococci, a type of bacterium. After the injection, four mice were given no further treatment and the other four were given penicillin injections. Which of the following pair of responses identifies correctly the control of the experiment (A) and a controlled variable (B)? **A** / **B** (a) two groups of four mice / each mouse receiving the same penicillin injections (b) all mice of similar weight and age / each mouse receiving 100 million streptococci (c) mice not receiving penicillin / each mouse receiving 100 million streptococci (d) all mice were injected with streptococci / each mouse receiving the same penicillin injections

2019 Section 1 Question 7 Response to infection	Scientists are investigating if single gene disorders, such as diabetes mellitus and cystic fibrosis, can be treated by gene therapy. Gene therapy involves (a) using a person's stem cells to grow replacement organs. (b) inserting stem cells into a synthetic scaffold. (c) adding extra alleles to embryos during IVF. (d) using a vector to transfer alleles into cells.

2019 Section 1 Question 13 Response to infection	Which of the following contains substances that act as external defence mechanisms against pathogens? (a) cebum, lysozyme, sweat, cerumen (b) cebum, lymphocytes, sweat, lysozyme (c) antibodies, lysozyme, lymphocytes, T-cells (d) lysozyme, lymphocytes, sweat, cilia

2019 **Section 1** **Question** **18** **Response** **to infection**	Which of the following best describes an airborne mode of transmission of a pathogen? (a) exchange of blood and other body fluids by a used syringe (b) contact with contaminated vomit while cleaning it up (c) transmission from mother to baby via breastfeeding (d) sharing an elevator with an infected person who is sneezing

2019 **Section 1** **Question** **23** **Response** **to infection**	Antibiotic drugs differ in their specificity to pathogens and as such, are often classified as (a) bactericidal and bacteriostatic antibiotics. (b) multiple drug-resistant and total drug-resistant antibiotics. (c) broad-spectrum and narrow-spectrum antibiotics. (d) antiviral and antifungal antibiotics.

2019 **Section 1** **Question** **25** **Response** **to infection**	Which of the answers completes the following sentence below? In diabetes mellitus the _____ found in the are _____ destroyed. (a) beta cells, pancreas (b) b cells, pancreas (c) beta cells, liver (d) alpha cells, liver

2019 **Section 1** **Question** **26** **Response** **to infection**	In humans, an example of active immunity is the (a) presence of ‘natural flora’ bacteria in different parts of the body. (b) presence of antibacterial agents in body secretions. (c) action of memory cells when a person is exposed to a second infection. (d) action of phagocytes to kill some pathogenic bacteria on the skin.

Section 2

2023 **Section 2** **Question 36** **Response to infection**	The following question refers to the diagram shown below which depicts the three processes involved in the body's third line of defence against disease that enhance another process labelled Y. ***Copyright restrictions prohibit the release of this SCSA exam material.*** (a) Identify the processes that can be seen at X and Y. (2 marks) X: _____ Y: _____ (b) Describe how the first three processes in the diagram enhance the process at Y. (2 marks) _____ _____ _____ _____ (c) Explain why one antibody is unable to protect the human body effectively. (3 marks) _____ _____ _____ _____ _____ _____

Vomiting and diarrhoea are symptoms of both Rotavirus and Salmonella infections. The pathogen responsible for causing each infection is different.

(d) (i) Complete the table below outlining two structural differences between them. (4 marks)

	Rotavirus (virus)	Salmonella (bacteria)
One		
Two		

(ii) Identify which pathogen in part (d)(i) could be treated effectively with antibiotics and outline **two** ways in which antibiotics are effective against this pathogen. (3 marks)

Pathogen:

One:

Two:

There are numerous infections that can be prevented with a vaccination.

(e) Australia provides a free vaccination schedule for children, yet some families choose to not vaccinate their children. Suggest **two** reasons why this may be the case. (2 marks)

One:

Two:

	(f) Explain how vaccines produce immunity to a pathogen. (6 marks)

2022 Section 2 Question 34

Response to infection

Researchers were interested in trialling a new antibiotic for golden staph (*Staphylococcus aureus*), a common bacterium that is resistant to many commonly used antibiotics. The current treatment is an intravenous course of the antibiotic Vancomycin. A new antibiotic, Trishillin, has the advantage that it can be taken orally.

The researchers set up 1200 Petri dishes with nutrient agar and inoculated these with a resistant strain of golden staph. Five hundred of these were treated with various concentrations of Trishillin, the other 500 dishes were treated with various concentrations of Vancomycin.

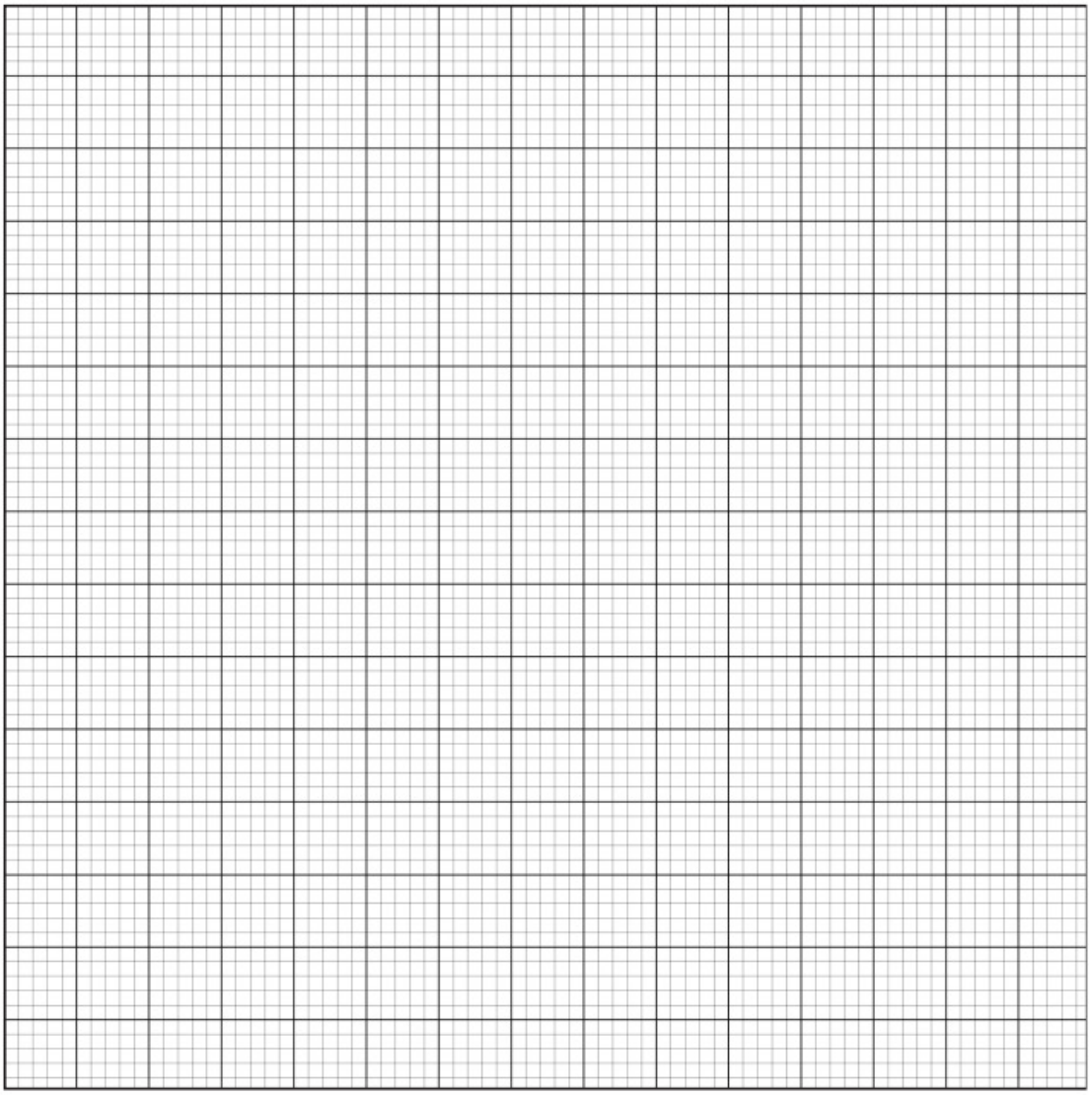
All dishes were cultured under identical conditions and the number of bacterial colonies was counted after 48 hours. The data are shown below.

Antibiotic	Dosage (mg kg^{-1})	Number of colonies detected
Trishillin	0	28
	15	16
	30	7
	45	1
	60	0
	75	0
Vancomycin	0	30
	5	25
	10	19
	20	2
	25	0
	30	0

(a) State a hypothesis for this investigation. (2 marks)

(b) Determine whether the investigation had a control. Justify your response. (3 marks)

(c) On the grid below, graph the number of colonies for each antibiotic dosage. (5 marks)



(d) Using your graph, estimate the number of colonies you would expect if a 15 mg kg^{-1} dosage of Vancomycin had been tested. (1 mark)

(e) Explain why the researchers cultured the Petri dishes under identical conditions except for the variation in antibiotics. (2 marks)

(f) Explain why the researchers used 100 Petri dishes for each antibiotic concentration rather than 10. (2 marks)

(g) Antibiotics are divided into two types on the basis of their mode of action. These are known as bactericidal and bacteriostatic. Explain how each type of antibiotic acts on bacterial cells. (4 marks)

Bactericidal:

Bacteriostatic:

Researchers are also interested in the possibility of producing a synthetic vaccine to treat golden staph.

(h) (i) Identify a biotechnological technique that could be used to create a synthetic vaccine. (1 mark)

(ii) Explain the role of a transgenic organism, or genetically-modified organism, in the process identified in part (h)(i). (2 marks)

2021 Section 2 Question 35 **Response to infection**	Two parts of the human body are highlighted in the diagram below. Both parts play a role in providing external defence mechanisms to the entry of pathogens into the body. ***Copyright restrictions prohibit the release of this SCSA exam material.*** (a) For each part, outline one mechanism that functions to prevent the entry of a pathogen into the internal environment. (2 marks) X: _____ _____ Y: _____ _____ Lyme disease is caused by a bacterium known as Borrelia burgdorferi. Typical symptoms of the illness include fever, headache, fatigue, joint pain and a skin rash. (b) The bacterium that causes Lyme disease is known to be transmitted to humans through the bite of infected blacklegged ticks. (i) Identify the type of disease transmission that Lyme disease displays. (1 mark) _____ (ii) Lyme disease is not believed to be transmitted from person to person but, if it was, describe how a mode of direct person to person transmission could occur. (2 marks) _____ _____ _____ (c) Many of the symptoms associated with Lyme disease are caused by inflammation triggered in response to the bacterium. (i) What is the role of inflammation in the prevention of disease? (2 marks) _____ _____ _____ _____

(ii) Explain the process of inflammation that causes an area to become red, swollen and hot. (4 marks)

(d) Lyme disease is treated by antibiotics. However, due to the nature of the disease it could also be potentially treated with a vaccine. Complete the table below, outlining the differences in how an antibiotic and a vaccine provide protection against infection. (8 marks)

	Antibiotics	**Vaccines**
Time when the treatment should be administered	(1 mark)	(1 mark)
How the treatment fights the pathogen	(2 marks)	(2 marks)
Length of duration of defence against the pathogen	(1 mark)	(1 mark)

	The decision to participate in immunisation programs can be influenced by the social, economic and cultural context in which it is considered. (e) Provide **one** social/cultural and one economic argument to justify the decision to participate in immunisation programs. (2 marks) Social/cultural: Economic:

2021 Section 2 Question 36 **Response to infection**	The following question refers to the diagram shown below. ***Copyright restrictions prohibit the release of this SCSA exam material.*** (a) Identify chemical 'X'. (1 mark) (b) Describe how chemicals 'X' and 'Y' differ in the way in which they reach their target cell/s. (2 marks) (c) (i) Identify which pathway has the quicker response time. (1 mark) (ii) Describe one characteristic of the pathway you chose in part (c)(i) that is significant in making the difference in response time. (2 marks) The concentration of glucose in human blood is kept within a narrow normal range. All body cells need a continuous supply of glucose. To prevent the concentration of glucose in the blood falling below the normal range, the pancreas releases a hormone. (d) (i) State the name of this hormone. (1 mark) (ii) Describe how this hormone causes an increase in blood glucose concentration. (3 marks)

Type 1 diabetes is an autoimmune disease in which the immune system mistakenly attacks insulin-producing cells found in the pancreas. Researchers in the Type 1 diabetes field have aimed to develop a treatment that preserves and restores function to these cells.

(e) Explain how Type 1 diabetes can affect the control of blood sugar levels. (4 marks)

(f) Synthetic insulin can be used to treat Type 1 diabetes. Describe the steps involved in producing the functioning bacterial cell that can be used to make synthetic insulin. (5 marks)

2020 Section 2 Question 32 **Response to infection**	Botulism is a communicable disease caused by a toxin produced by the bacterium known as *Clostridium botulinum*. Symptoms of the disease can include muscle weakness, blurred vision, trouble in speaking, vomiting and diarrhoea. (a) Botulism is classified as a bacterium. List three structural characteristics of a bacterium. (3 marks) One: Two: Three: (b) Botulism can be transmitted in many ways. For each of the mechanisms listed below outline how it can spread the pathogen. (3 marks) Droplet transmission: Direct contact with infected bodily fluid: Contamination of food or water: The symptoms associated with botulism are caused by the bacterial toxin blocking the release of acetylcholine from nerve endings. (c) (i) Acetylcholine is a neurotransmitter. State its role in nervous transmission. (1 mark)

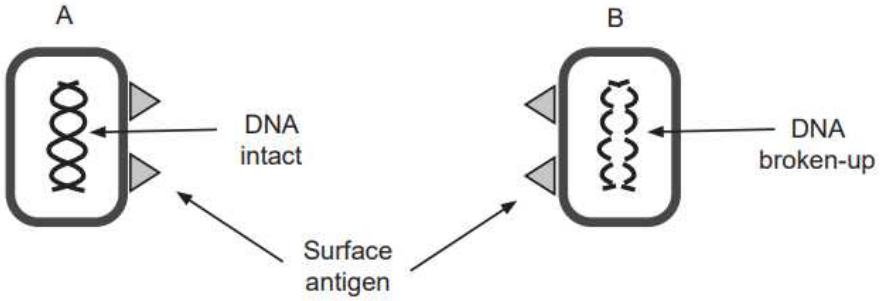
(ii) Explain how transmission across a synapse normally occurs. (5 marks)

2020 Section 2 Question 37

Response to infection

The measles vaccine is normally given to children at 12 months and 18 months of age and is found in a combined vaccine that protects against measles, mumps and rubella (MMR vaccine). The measles vaccine is created using live attenuated microorganisms.

The figure below shows a disease-causing microorganism (A) and an attenuated version of the same microorganism (B).



(a) (i) What type of immunity would the measles vaccine provide? (1 mark)

(ii) Suggest why a vaccine containing B would provide immunity to microorganism A. (4 marks)

Most children have antibodies to measles in their blood stream at birth. The concentration of these antibodies decreases quite quickly after birth. Between the ages of 6–12 months the concentration is low enough to make these children the most susceptible to measles.

(b) (i) State the term given to the type of immunity described above. (1 mark)

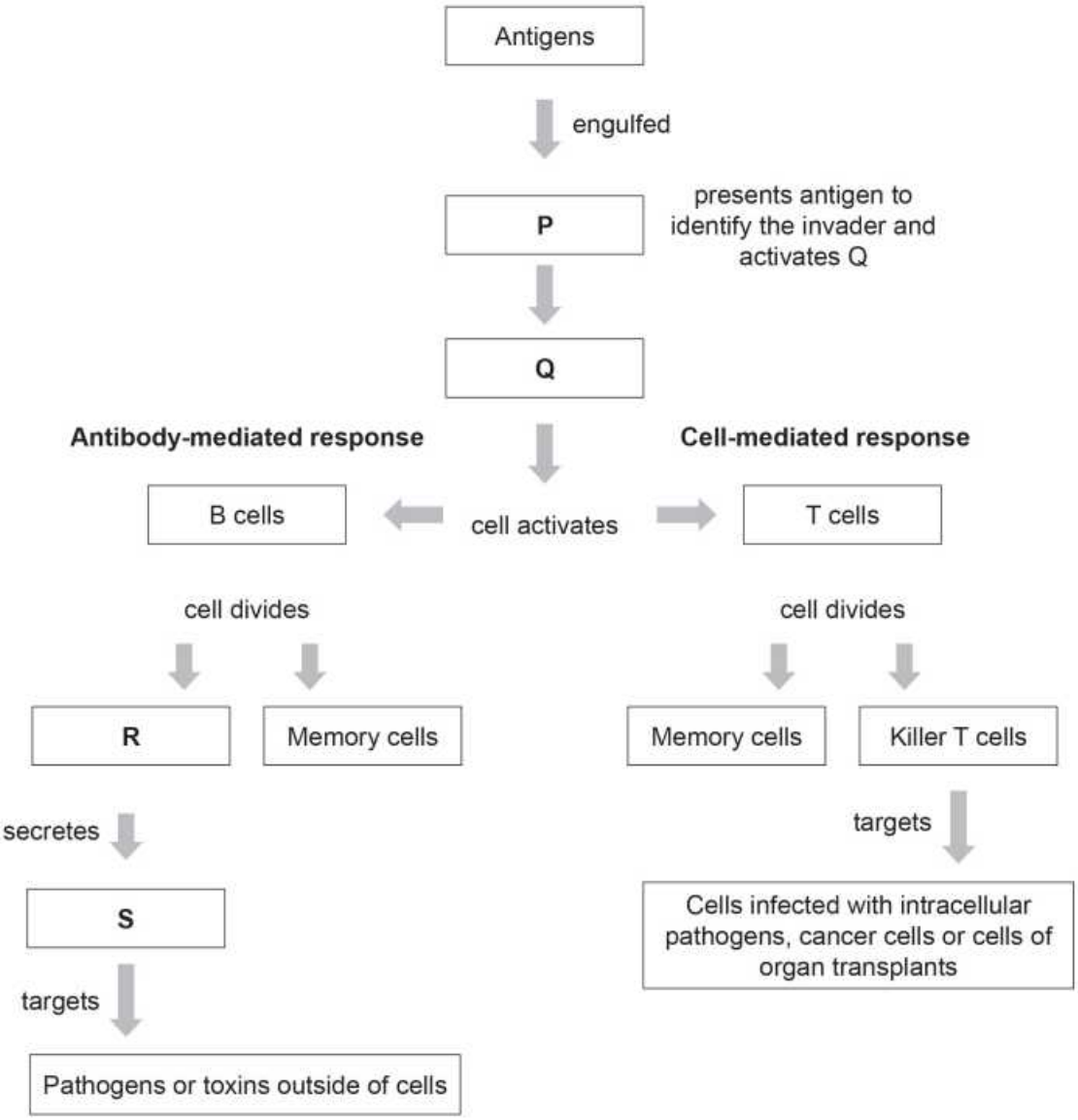
(ii) Describe how antibodies to measles are present in babies at birth. (2 marks)

(c) If a child under the age of 12 months contracted measles, would it be necessary for them to still be immunised with the MMR vaccine? Provide a reason for your answer. (4 marks)

2019 Section 2 Question 38

Response to infection

Below is a flow chart showing the key components in an immune response of a healthy individual.



(a) Identify **P, Q, R** and **S** from the flow chart. (4 marks)

P: _____

Q: _____

R: _____

S: _____

(b) Complete the table below by naming a disease that each type of vaccine is most effective against. (2 marks)

Type of vaccine	A disease that the vaccine is most effective against
Living attenuated micro-organisms	
Recombinant, sub-unit or conjugate vaccines	

Australian immunologist Ian Frazer developed Gardasil, a vaccine against human papilloma virus, a sexually-transmitted virus that is also the most common cause of cervical cancer. Health authorities recommend the vaccine for children aged between nine and 14 years.

(c) Outline **three** concerns regarding the use of this vaccine. Your answer must include at least one social/cultural concern and at least **one** economic concern. (3 marks)

One:

Two:

Three:

Section 3

2022 Section 3 Question 38 **Response to infection**	Mumps is a disease caused by a RNA virus. Patients with mumps experience a variety of symptoms, which could include painful and swollen glands in the neck. Mumps is transmitted via droplets. (a) Identify and describe four external defence mechanisms found in the human body that could help prevent the entry of the mumps pathogen. (8 marks) (b) Immunisation against mumps can be achieved with vaccination. Distinguish between the terms 'immunisation' and 'vaccination'. Explain how vaccines provide immunity to pathogens and outline four different types of vaccines available. (12 marks)

2020 Section 3 Question 39 **Response to infection**	A man arrived home feeling unwell. His partner took him to the doctor when he started suffering a fever, sweats and chills. The patient was given an antibiotic to take every day for the following 10 days. The doctor stressed the importance of completing the course of antibiotics even when he started to feel better. (a) Describe the physiological mechanisms that cause fever. (8 marks) (b) Explain how different antibiotics can be used to treat infections. (8 marks) (c) Explain why the doctor stressed that the full course of antibiotics needed to be taken. (4 marks)

Marking Guide – Section 1

2023 Section 1 Question 4

Response to infection

Question 4 refers to the diagram shown below.

Copyright restrictions prohibit the release of this SCSA exam material.

Which of the following structures produce lysozyme to help kill invading pathogens?

(a) A and B only
(b) A, B, C and D
(c) A and D only
(d) A, B and C only – Answer

2023 Section 1 Question 5

Response to infection

The Zika virus is a pathogen readily spread from mosquito bites and sexual intercourse with an infected person. Match correctly the type of transmission each mode represents.

	Mosquito bites	Sexual intercourse
(a)	indirect contact	transfer of body fluids
(b)	disease-specific vector	transfer of body fluids
(c)	disease-specific vector	indirect contact
(d)	transfer of body fluids	direct contact

Answer is d.

2023 Section 1 Questions 11-12

Response to infection

Questions 11 and 12 refer to the graphic below.

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11. This correlation of malaria and occurrence of sickle-cell in Africa is best explained by the inference that

(a) the disease malaria provides a survival advantage to people with sickle-cell anaemia.
(b) sickle-cell shaped haemoglobin provides a survival advantage in regions where malaria is prevalent. – Answer
(c) sickle-cell shaped haemoglobin has evolved because of the high incidence of malaria present in the region.
(d) the disease sickle-cell anaemia is less lethal to human populations in regions with a high occurrence of malaria.

12. In the area highlighted on the map for sickle-cell allele, people carrying the allele would be expected to have either sickle-cell trait or sickle-cell anaemia. The difference between these is that

(a) people affected with sickle-cell trait rarely have symptoms, while people with sickle-cell anaemia do. – Answer
(b) sickle-cell trait sufferers cannot pass the condition onto their children, while sickle-cell anaemia sufferers can.
(c) people with sickle-cell anaemia have a genotype containing at least one allele for sickle-cell, while people with sickle-cell trait have two alleles.
(d) sickle-cell trait is fatal to people in areas without the presence of malaria, while sickle-cell anaemia is fatal regardless of the presence of malaria.

2023 Section 1 Question 13

Response to infection

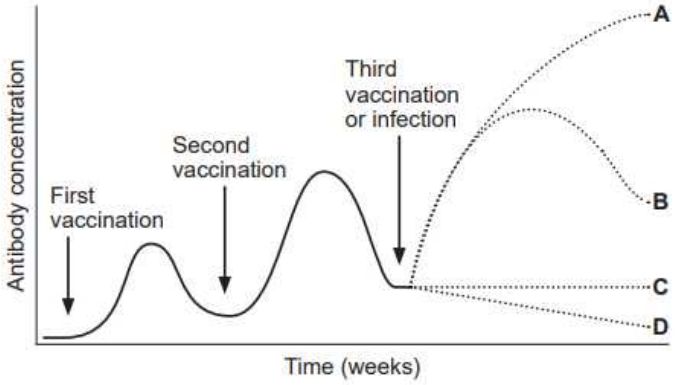
A blood sample from an area of the body exhibiting inflammation would be

(a) high in complement proteins, high in histamine, low in heparin and low in tissue fluid.
(b) low in complement proteins, low in histamine, low in heparin and high in tissue fluid.
(c) low in complement proteins, high in histamine, high in heparin and low in tissue fluid.
(d) high in complement proteins, high in histamine, high in heparin and high in tissue fluid. – Answer

2023 Section 1 Question 24 **Response to infection**	The statements below relate to cells found in the immune system called lymphocytes. I. matured in bone marrow II. produces antibodies III. matured in thymus gland IV. release cytokines V. produce memory cells Which statements relate specifically to T lymphocytes? **(a) III, IV and V – Answer** (b) I, II and IV (c) II, III and V (d) I, IV and V

2022 Section 1 Question 11 **Response to infection**	Which of the following is the **best** description of gene therapy? (a) mutating the sequence of a particular gene to produce variation (b) replacing a healthy gene with a defective gene (c) transferring a gene from one species into the genome of another species **(d) replacing a defective gene with a functional one – Answer**

2022 Section 1 Question 15 **Response to infection**	Which of the following statements concerning the regulation of blood gases is true? The respiratory centre in the (a) hypothalamus detects the increase in blood pH and sends impulses to the respiratory muscles via efferent nerves. **(b) medulla oblongata detects the decrease in blood pH and sends impulses to the respiratory muscles via efferent nerves. – Answer** (c) medulla oblongata detects the increase in blood pH and sends impulses to the respiratory muscles via afferent nerves. (d) hypothalamus detects the decrease in blood pH and sends impulses to the respiratory muscles via afferent nerves.

2022 Section 1 Question 18-19 **Response to infection**	Questions 18 and 19 refer to the diagram shown below, which represents changes in antibody concentrations over many weeks.  18. Which of the dotted lines shown above **best** indicates the level of antibodies after a third vaccination or infection? (a) A **(b) B – Answer** (c) C (d) D

	19. The **best** explanation for the change in the level of antibodies found after the second vaccination is that (a) killer T cells were activated quickly to seek out the antigen. (b) the antigen reactivated plasma cells to produce antibodies rapidly. **(c) memory cells rapidly stimulated production of antibodies. – Answer** (d) B lymphocytes were already primed and ready to produce antibodies.

2022 Section 1 Question 22 Response to infection	Fever plays an important role in humans' defence against disease. This role is **best** described as (a) specific immunity, which destroys invading pathogens directly. **(b) non-specific immunity, which helps to speed up the immune response. – Answer** (c) specific immunity, which activates the killer T cells and helper T cells. (d) non-specific immunity, which helps to neutralise pathogens at the entry site.

2022 Section 1 Question 30 Response to infection	Which of the following is a correct comparison between bacterial and viral pathogens? **Answer is c.**

	Bacterial	Viral
(a)	infected patients can be treated with vaccines	infected patients can be treated with antivirals
(b)	are very small and can only be seen through an electron microscope	are small but some can be seen without a microscope
(c)	infection is caused by bacterial cells multiplying or toxins within the body of the host	infection is caused by invading a host cell and creating multiple copies of itself
(d)	all bacteria found in nature are harmful to humans	some viruses are helpful to humans and not disease causing

2021 Section 1 Question 7 Response to infection	An example of natural active immunity is a (a) breastfed baby who does not catch a cold that they are exposed to. (b) hospital worker who is vaccinated against the flu. (c) person bitten by a snake who is given anti-venom antibodies. **(d) child who contracts chicken pox and does not get the disease again. – Answer**

2020 Section 1 Question 8 Response to infection	Type 2 diabetes is a condition whereby a person can (a) produce glucagon but their cells do not respond to it. **(b) produce insulin but their cells do not respond to it. – Answer** (c) no longer produce insulin. (d) no longer produce glucagon.

2020 Section 1 Question 20 Response to infection	Antibiotics are ineffective against viruses because viruses (a) keep changing their external protein coat. (b) are able to disguise themselves in the host cell membrane. **(c) are not living cells and thus do not metabolise. – Answer** (d) can change antibiotics into useful food substances.

2020 Section 1 Question 24 Response to infection	A key component of cell-mediated immunity is the body's production of (a) antigens. (b) antibodies. (c) memory B cells. **(d) killer T cells. – Answer**

2019 Section 1 Question 6

Response to infection

Australian scientist Howard Florey used controlled experiments to demonstrate the effectiveness of penicillin in treating bacterial infections. Eight mice, all of similar weight and age, were each injected with 100 million streptococci, a type of bacterium. After the injection, four mice were given no further treatment and the other four were given penicillin injections.

Which of the following pair of responses identifies correctly the control of the experiment (A) and a controlled variable (B)?

	A	B
(a)	two groups of four mice	each mouse receiving the same penicillin injections
(b)	all mice of similar weight and age	each mouse receiving 100 million streptococci
(c)	mice not receiving penicillin	each mouse receiving 100 million streptococci
(d)	all mice were injected with streptococci	each mouse receiving the same penicillin injections

Answer is c.

2019 Section 1 Question 7

Response to infection

Scientists are investigating if single gene disorders, such as diabetes mellitus and cystic fibrosis, can be treated by gene therapy.

Gene therapy involves

(a) using a person's stem cells to grow replacement organs.
(b) inserting stem cells into a synthetic scaffold.
(c) adding extra alleles to embryos during IVF.
(d) using a vector to transfer alleles into cells. – Answer

2019 Section 1 Question 13

Response to infection

Which of the following contains substances that act as external defence mechanisms against pathogens?

(a) cebum, lysozyme, sweat, cerumen – Answer
(b) cebum, lymphocytes, sweat, lysozyme
(c) antibodies, lysozyme, lymphocytes, T-cells
(d) lysozyme, lymphocytes, sweat, cilia

2019 Section 1 Question 18

Response to infection

Which of the following best describes an airborne mode of transmission of a pathogen?

(a) exchange of blood and other body fluids by a used syringe
(b) contact with contaminated vomit while cleaning it up
(c) transmission from mother to baby via breastfeeding
(d) sharing an elevator with an infected person who is sneezing – Answer

2019 Section 1 Question 23

Response to infection

Antibiotic drugs differ in their specificity to pathogens and as such, are often classified as

(a) bactericidal and bacteriostatic antibiotics.
(b) multiple drug-resistant and total drug-resistant antibiotics.
(c) broad-spectrum and narrow-spectrum antibiotics. – Answer
(d) antiviral and antifungal antibiotics.

2019 Section 1 Question 25

Response to infection

Which of the answers completes the following sentence below?

In diabetes mellitus the _____ found in the are _____ destroyed.

(a) beta cells, pancreas – Answer
(b) b cells, pancreas
(c) beta cells, liver
(d) alpha cells, liver

2019 Section 1 Question 26 Response to infection	In humans, an example of active immunity is the (a) presence of 'natural flora' bacteria in different parts of the body. (b) presence of antibacterial agents in body secretions. **(c) action of memory cells when a person is exposed to a second infection. – Answer** (d) action of phagocytes to kill some pathogenic bacteria on the skin.

2023 Section 2 Question 36

Response to infection

The following question refers to the diagram shown below which depicts the three processes involved in the body's third line of defence against disease that enhance another process labelled Y.

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(a) Identify the processes that can be seen at X and Y. (2 marks)

Description	Marks
X – agglutination	1
Y – phagocytosis	1
Total	**2**

(b) Describe how the first three processes in the diagram enhance the process at Y. (2 marks)

Description	Marks
enlarge antigens/bind antigen/capture antigens	1
easier to be engulfed/phagocytosed/located	1
Total	**2**

(c) Explain why one antibody is unable to protect the human body effectively. (3 marks)

Description	Marks
antigens are structurally different	1
antibodies must be specific	1
to be able to produce the antigen-antibody complex/to bind to the active site	1
Total	**3**

Vomiting and diarrhoea are symptoms of both Rotavirus and Salmonella infections. The pathogen responsible for causing each infection is different.

(d) (i) Complete the table below outlining two structural differences between them. (4 marks)

Description		Marks
Any two for each		
Rotavirus (virus)	**Salmonella (bacteria)**	1–4
• protein coat • DNA or RNA • not a living cell	• cell wall/slime layer • DNA • Prokaryotic	
	Total	**4**

(ii) Identify which pathogen in part (d)(i) could be treated effectively with antibiotics and outline **two** ways in which antibiotics are effective against this pathogen. (3 marks)

Description	Marks
Salmonella	1
Any two of	
• preventing the cell wall production • preventing protein synthesis • disrupting enzyme functioning • preventing replication	1–2
Total	**3**

There are numerous infections that can be prevented with a vaccination.

(e) Australia provides a free vaccination schedule for children, yet some families choose to not vaccinate their children. Suggest **two** reasons why this may be the case. (2 marks)

Description	Marks
Any two of	
• children are allergic to components/adverse reactions to vaccines • concerned about preservatives they contain/animal products/human tissues • misinformation (e.g., can cause autism) • religious/cultural beliefs	1–2
Total	**2**

(f) Explain how vaccines produce immunity to a pathogen. (6 marks)

Description	Marks
Any six of	
• contain antigens • B cells are activated produce plasma cells and memory cells • plasma cells produce antibodies • memory cells remain (spread through the lymph) • if they encounter the antigen again • they produce more antibodies quickly • individuals usually do not show symptoms	1–6
Total	**6**

2022 Section 2 Question 34

Response to infection

Researchers were interested in trialling a new antibiotic for golden staph (*Staphylococcus aureus*), a common bacterium that is resistant to many commonly used antibiotics. The current treatment is an intravenous course of the antibiotic Vancomycin. A new antibiotic, Trishillin, has the advantage that it can be taken orally.

The researchers set up 1200 Petri dishes with nutrient agar and inoculated these with a resistant strain of golden staph. Five hundred of these were treated with various concentrations of Trishillin, the other 500 dishes were treated with various concentrations of Vancomycin.

All dishes were cultured under identical conditions and the number of bacterial colonies was counted after 48 hours. The data are shown below.

Antibiotic	Dosage (mg kg^{-1})	Number of colonies detected
Trishillin	0	28
	15	16
	30	7
	45	1
	60	0
	75	0
Vancomycin	0	30
	5	25
	10	19
	20	2
	25	0
	30	0

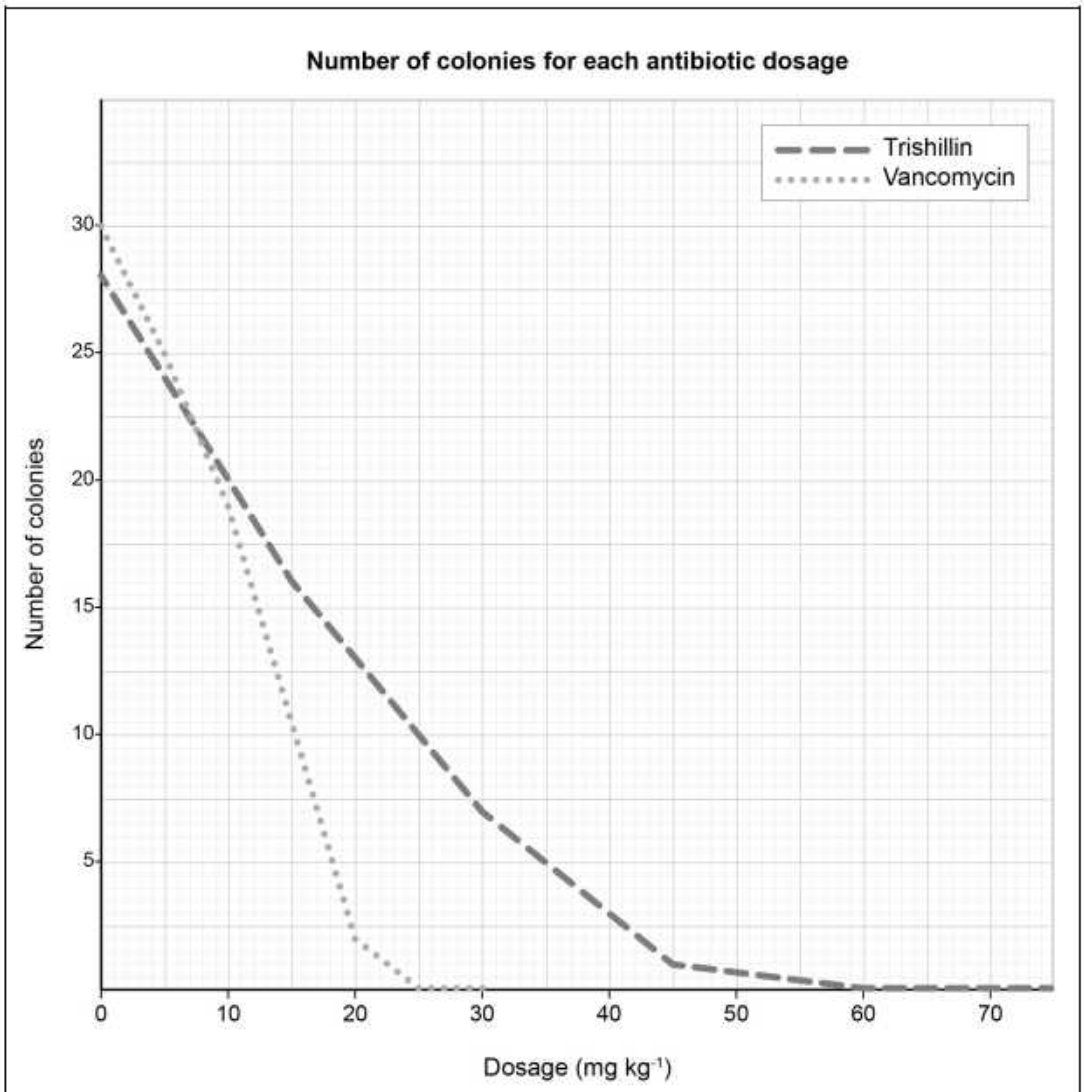
(a) State a hypothesis for this investigation. (2 marks)

Description	Marks
Hypothesis in an appropriate format (e.g. must not be a question, must not have an "and", be precisely written, testable statement).	1
Hypothesis contrasts increasing the type of antibiotic/dosage with the number of bacterial colonies.	1
Total	**2**
Answer could include: Trishillin antibiotic will reduce the numbers of golden staph bacteria colonies more than Vancomycin antibiotic.	

(b) Determine whether the investigation had a control. Justify your response. (3 marks)

Description	Marks
Yes	1
Any one of (1 mark for identifying the control and 1 mark for justification)	
• vancomycin/original/used treatment • gives data/to compare the action of Trishillin/new antibiotic	1–2
• zero dose (for each treatment) • gives data to compare the action with no dose and the treatment	
Total	**3**

(c) On the grid below, graph the number of colonies for each antibiotic dosage. (5 marks)



Description	Marks
Title appropriate with both independent and dependent variables included (independent = type of dosage; dependent = number of colonies).	1
Correctly constructs axes using appropriate scale.	1
Correctly plots points and joins points to form a line.	1
Identifies lines using key/labels.	1
Labelling of axes with correct name and unit (dosage on X axis, number of colonies on Y axis).	1
Total	**5**

(d) Using your graph, estimate the number of colonies you would expect if a 15 mg kg^{-1} dosage of Vancomycin had been tested. (1 mark)

Description	Marks
10 (+ - 2)	1
Total	**1**

(e) Explain why the researchers cultured the Petri dishes under identical conditions except for the variation in antibiotics. (2 marks)

Description	Marks
controlled variables	1
no other factors could influence the dependent variable/increase validity	1
Total	**2**

(f) Explain why the researchers used 100 Petri dishes for each antibiotic concentration rather than 10. (2 marks)

Description	Marks
increases sample size/acts as replication/acts as repetition	1
reduces effects of biological variation/experimental error/increase reliability	1
Total	**2**

(g) Antibiotics are divided into two types on the basis of their mode of action. These are known as bactericidal and bacteriostatic. Explain how each type of antibiotic acts on bacterial cells. (4 marks)

Description	Marks
Bactericidal	
change the structure of the cell wall/membrane/disrupt action of essential enzymes/disrupt metabolic pathways	1
destroy the pathogen	1
Bacteriostatic	
prevent reproduction/inhibit growth	1
disrupting protein synthesis	1
Total	**2**

Researchers are also interested in the possibility of producing a synthetic vaccine to treat golden staph.

(h) (i) Identify a biotechnological technique that could be used to create a synthetic vaccine. (1 mark)

Description	Marks
recombinant DNA	1
Total	**1**

(ii) Explain the role of a transgenic organism, or genetically-modified organism, in the process identified in part (h)(i). (2 marks)

Description	Marks
Any two of	
• plasmids with the inserted gene of interest • to produce the desired protein/vaccine • in large quantities/quickly/cheaply	1–2
Total	**2**

2021 Section 2 Question 35

Response to infection

Two parts of the human body are highlighted in the diagram below. Both parts play a role in providing external defence mechanisms to the entry of pathogens into the body.

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(a) For each part, outline one mechanism that functions to prevent the entry of a pathogen into the internal environment. (2 marks)

Description	Marks
X: Eye	
Any **one** of the following:	
Lysozyme/chemical in tears to kill bacteria	1
Eyelashes catch debris/cleanse by tears	
Blinking action washes away debris	
Y: Urethra	
Any **one** of the following:	
Regular flushing of urine to wash away pathogens/maintain sterile environment	1
Acidic urine inhibits/prevents bacterial growth	
Total	**2**

Lyme disease is caused by a bacterium known as Borrelia burgdorferi. Typical symptoms of the illness include fever, headache, fatigue, joint pain and a skin rash.

(b) The bacterium that causes Lyme disease is known to be transmitted to humans through the bite of infected blacklegged ticks.

(i) Identify the type of disease transmission that Lyme disease displays. (1 mark)

Description	Marks
Vector	1
Total	**1**

(ii) Lyme disease is not believed to be transmitted from person to person but, if it was, describe how a mode of direct person to person transmission could occur. (2 marks)

Description	Marks
• infected blood/bodily fluids/faecal matter from one person • enters the blood stream of another through open cut or mucous membranes, **or**	1–2
• when droplets containing microorganisms are sneezed/ coughed/breathed into air by one person • and inhaled by another person	
Total	**2**

(c) Many of the symptoms associated with Lyme disease are caused by inflammation triggered in response to the bacterium.

(i) What is the role of inflammation in the prevention of disease? (2 marks)

Description	Marks
Localised non-specific response to infection	1
To increase speed of healing/reduce the spread of pathogen	1
Total	**2**

(ii) Explain the process of inflammation that causes an area to become red, swollen and hot. (4 marks)

Description	Marks
When tissue damage occurs mast cells are triggered	1
Histamine is released	1
Vasodilation/increased blood flow/increased permeability of capillaries	1
Macrophages/leucocytes/phagocytes are attracted to the area	1
Total	**4**

(d) Lyme disease is treated by antibiotics. However, due to the nature of the disease it could also be potentially treated with a vaccine. Complete the table below, outlining the differences in how an antibiotic and a vaccine provide protection against infection. (8 marks)

Description			Marks
	Antibiotics	Vaccines	1–8
Time when the treatment should be administered	When infected with a pathogen (1)	Before exposure to pathogen (1)	
How the treatment fights the pathogen	Inhibit bacterial growth/directly destroy the bacterium (1) by interfering with protein synthesis of the bacteria to prevent reduction/kill bacteria by destroying cell walls or cell membranes of bacteria/block metabolic pathways of bacteria/inhibit enzyme activity (1)	Triggers own immune response/ produces antibodies to fight pathogen (1) Memory cells produced (1)	
Length of duration of defence against the pathogen	Short-lived/only while taking the antibiotic (1)	Long-lived/years/ permanently (1)	
		Total	**8**

The decision to participate in immunisation programs can be influenced by the social, economic and cultural context in which it is considered.

(e) Provide **one** social/cultural and one economic argument to justify the decision to participate in immunisation programs. (2 marks)

Description	Marks
Social/cultural	
Any **one** of the following:	
Helping to create herd immunity/social responsibility to protect everyone from communicable disease	1
Following the health advice of government/health professionals	
Negative side effects considered very rare	
Historically always done in families/cultural groups	
Economic	
Any **one** of the following:	
Reduced health care cost for treating the sick	1
No loss of family tax benefits/immunisation bonus paid to participants	
Businesses can fully function when disease spread is limited	
Total	**2**

2021 Section 2 Question 36

Response to infection

The following question refers to the diagram shown below.

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(a) Identify chemical 'X'. (1 mark)

Description	Marks
Neurotransmitter	1
Total	**1**

(b) Describe how chemicals 'X' and 'Y' differ in the way in which they reach their target cell/s. (2 marks)

Description	Marks
Chemical X/neurotransmitter diffuses across the synapse	1
Chemical Y travels through the bloodstream	1
Total	**2**

(c) (i) Identify which pathway has the quicker response time. (1 mark)

Description	Marks
Pathway 1/nervous	1
Total	**1**

(ii) Describe one characteristic of the pathway you chose in part (c)(i) that is significant in making the difference in response time. (2 marks)

Description	Marks
Nervous signal is an electrochemical/electrical impulse	1
The nervous signal travels faster than blood (carrying hormones in the bloodstream)	1
Total	**2**

The concentration of glucose in human blood is kept within a narrow normal range. All body cells need a continuous supply of glucose. To prevent the concentration of glucose in the blood falling below the normal range, the pancreas releases a hormone.

(d) (i) State the name of this hormone. (1 mark)

Description	Marks
Glucagon	1
Total	**1**

(ii) Describe how this hormone causes an increase in blood glucose concentration. (3 marks)

Description	Marks
Glucagon (acts on liver) to convert glycogen to glucose/ glycogenolysis	1
Amino acids converted to glucose/gluconeogenesis	1
Fatty acids are converted to glucose/lipolysis	1
Total	**3**

Type 1 diabetes is an autoimmune disease in which the immune system mistakenly attacks insulin-producing cells found in the pancreas. Researchers in the Type 1 diabetes field have aimed to develop a treatment that preserves and restores function to these cells.

(e) Explain how Type 1 diabetes can affect the control of blood sugar levels. (4 marks)

Description	Marks
Any **four** of the following:	
Pancreas (beta cells) produces little/no insulin	1–4
Glucose not taken into cells	
Glucose also not able to be stored as glycogen/fat	
Blood glucose levels remain high	
Glucagon secretion is not inhibited	
Total	**4**

(f) Synthetic insulin can be used to treat Type 1 diabetes. Describe the steps involved in producing the functioning bacterial cell that can be used to make synthetic insulin. (5 marks)

Description	Marks
Cut out required gene using restriction enzyme	1
Bacterial plasmid/DNA removed from bacterial cell	1
Bacterial plasmid/DNA cut with the same restriction enzyme	1
Gene (for human insulin) inserted into bacterial plasmid/DNA	1
Recombinant plasmid is inserted into a bacterial cell	1
Total	**5**

2020 Section 2 Question 32

Response to infection

Botulism is a communicable disease caused by a toxin produced by the bacterium known as *Clostridium botulinum*. Symptoms of the disease can include muscle weakness, blurred vision, trouble in speaking, vomiting and diarrhoea.

(a) Botulism is classified as a bacterium. List three structural characteristics of a bacterium. (3 marks)

Description	Marks
cell wall	1–3
microscopic/single-celled organism	
prokaryote/have no nucleus	
no membrane bound organelles	
plasmid/rings of DNA	
can be rod, spiral, spherical shape	
(many) flagellum present/slime layer	
Total	**3**

(b) Botulism can be transmitted in many ways. For each of the mechanisms listed below outline how it can spread the pathogen. (3 marks)

Description	Marks
Droplet transmission – when droplets containing microorganisms are sneezed/coughed into air and inhaled by another person	1
Direct contact with infected bodily fluid – Infected blood/bodily fluids/ faecal matter enters the blood stream (through an open cut or the mucous membranes of a bodily opening)	1
Contamination of food or water – Microorganisms present in unclean food or water supplies consumed/enter through digestive tract.	1
Total	**3**

The symptoms associated with botulism are caused by the bacterial toxin blocking the release of acetylcholine from nerve endings.

(c) (i) Acetylcholine is a neurotransmitter. State its role in nervous transmission. (1 mark)

Description	Marks
enables an impulse (message) to cross the neuromuscular junction/synapse	1
Total	**1**

(ii) Explain how transmission across a synapse normally occurs. (5 marks)

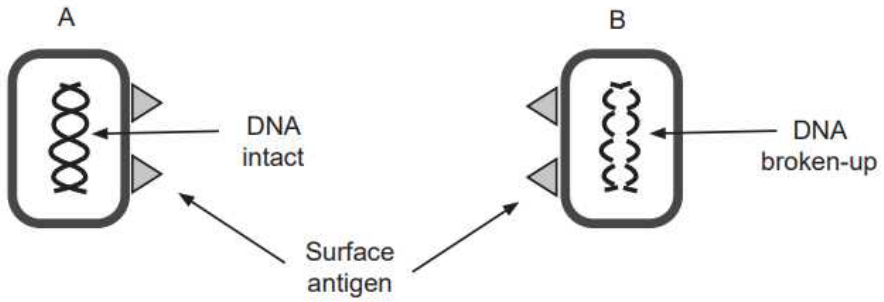
Description	Marks
action potential arrives at pre-synaptic knob/axon endings	1
calcium ions flow into pre-synaptic knob/exocytosis of vesicles containing neurotransmitter	1
neurotransmitter diffuses across gap/synapse	1
neurotransmitter binds to receptors on post-synaptic membrane/ dendrite of next neuron	1
ion channels on the post synaptic membrane open/causes an influx of sodium ions/triggering depolarisation/triggering action potential	1
Total	**5**

2020 Section 2 Question 37

Response to infection

The measles vaccine is normally given to children at 12 months and 18 months of age and is found in a combined vaccine that protects against measles, mumps and rubella (MMR vaccine). The measles vaccine is created using live attenuated microorganisms.

The figure below shows a disease-causing microorganism (A) and an attenuated version of the same microorganism (B).



(a) (i) What type of immunity would the measles vaccine provide? (1 mark)

Description	Marks
artificial active/active artificial	1
Total	**1**

(ii) Suggest why a vaccine containing B would provide immunity to microorganism A. (4 marks)

Description	Marks
immune system responds to antigen (even in damaged/weakened state)/same surface antigen present	1
B cells produce antibodies	1
also produce memory cells	1
allowing a rapid/stronger response to antigen if virus invades in the future	1
Total	**4**

Most children have antibodies to measles in their blood stream at birth. The concentration of these antibodies decreases quite quickly after birth. Between the ages of 6–12 months the concentration is low enough to make these children the most susceptible to measles.

(b) (i) State the term given to the type of immunity described above. (1 mark)

Description	Marks
natural passive/passive natural	1
Total	**1**

(ii) Describe how antibodies to measles are present in babies at birth. (2 marks)

Description	Marks
antibodies that mother has produced in response to measles vaccine/or prior exposure to the disease	1
can be passed across the placenta	1
Total	**2**

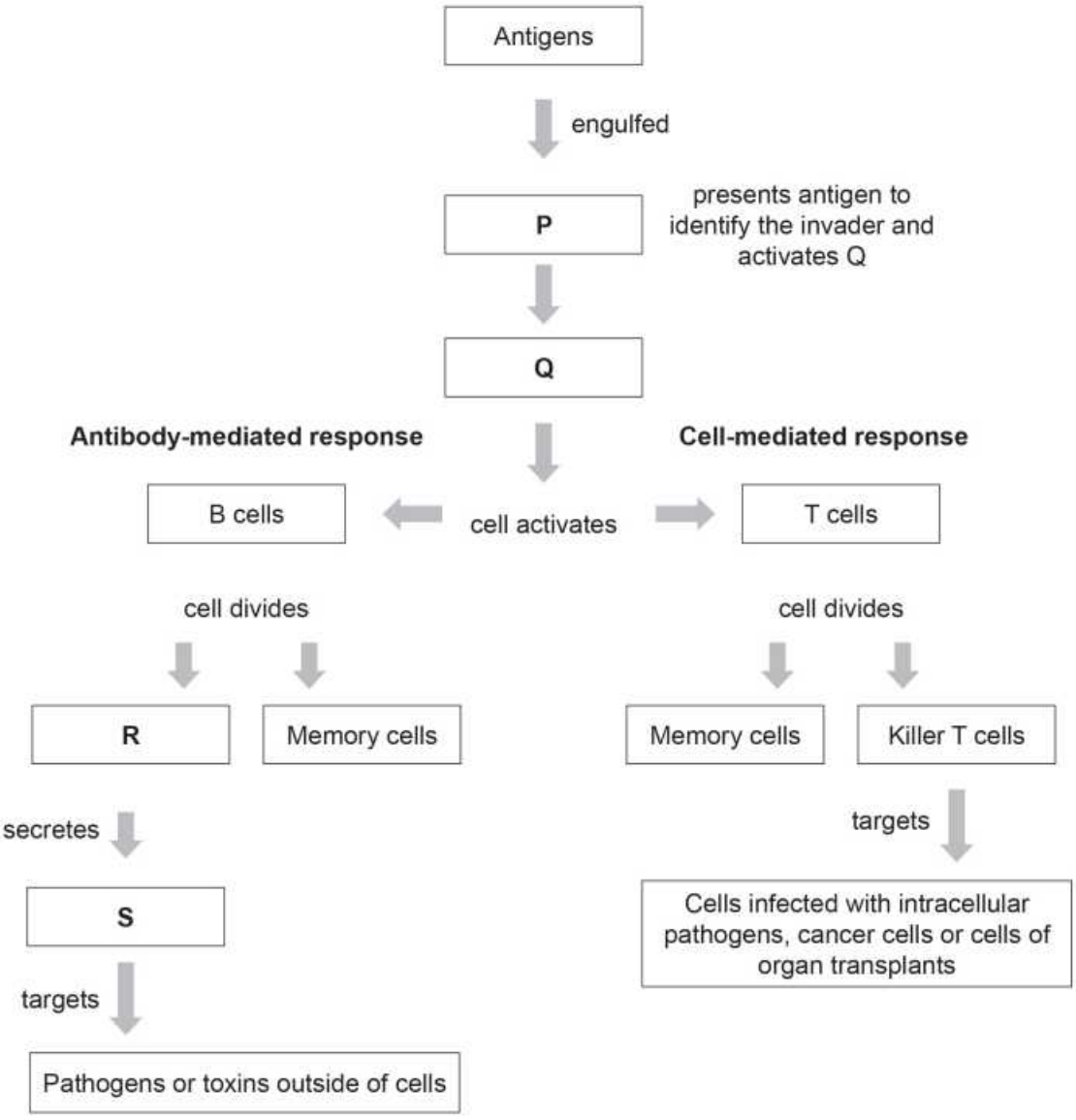
(c) If a child under the age of 12 months contracted measles, would it be necessary for them to still be immunised with the MMR vaccine? Provide a reason for your answer. (4 marks)

Description	Marks
yes	1
they would only have memory cells against measles	1
each pathogen has a different antigen/there would be no memory cells formed in the body for mumps or rubella	1
vaccine would also help to increase the immunity of the child further to measles	1
Total	**4**

2019 Section 2 Question 38

Response to infection

Below is a flow chart showing the key components in an immune response of a healthy individual.



(a) Identify **P, Q, R** and **S** from the flow chart. (4 marks)

Description	Marks
P: macrophage/APC/B cells	1
Q: helper T cells or T helper cells (T cells not accepted)	1
R: plasma cells	1
S: antibodies	1
Total	**4**

(b) Complete the table below by naming a disease that each type of vaccine is most effective against. (2 marks)

Description	Marks
Tuberculosis/measles/rubella/rabies/poliomyelitis/yellow fever/influenza	1
Human papilloma virus/meningococcal disease/hepatitis B/polio/Hib disease (influenza B)	1
Total	**2**
Accept any other relevant answers.	

Australian immunologist Ian Frazer developed Gardasil, a vaccine against human papilloma virus, a sexually-transmitted virus that is also the most common cause of cervical cancer. Health authorities recommend the vaccine for children aged between nine and 14 years.

(c) Outline **three** concerns regarding the use of this vaccine. Your answer must include at least one social/cultural concern and at least **one** economic concern. (3 marks)

Description	Marks
Any **three** responses – At least one answer must be social/cultural	
Social/cultural	1–3
encourage vaccinated teenagers to be sexually active/presumption of early onset sexual relations for recommending the vaccine	
the right of parent to vaccinate children too young to understand vaccination/right of making informed choices/right to autonomous choice	
possible existence of negative side effects	
possible unnecessary for people who abstain from sex	
Economic	
cost of vaccines may not be affordable to all	
interests of commercial enterprise that manufacture the vaccine can affect its use	
Total	**3**
Accept other relevant answers.	

2022 Section 3 Question 38

Response to infection

Mumps is a disease caused by a RNA virus. Patients with mumps experience a variety of symptoms, which could include painful and swollen glands in the neck. Mumps is transmitted via droplets.

(a) Identify and describe four external defence mechanisms found in the human body that could help prevent the entry of the mumps pathogen. (8 marks)

Description	Marks
Any four of (1 mark for identifying and 1 mark for describing)	
• skin • impervious barrier to block pathogen entry	1–8
• good/friendly/beneficial bacteria on skin/in respiratory or digestive system • destroy the pathogen/inhibits growth of pathogen	
• mucus/cilia in respiratory tract • trap pathogen and push out of body	
• lysozyme enzyme in tears/saliva/mucous • destroy the pathogen	
• stomach acid • destroy the pathogen/inhibits growth of pathogen	
• tears from the eye • flush pathogen from eye	
• eyelashes/blinking action of the eye • block entry of pathogen	
Total	**8**
Note: Answers can include skin, respiratory and digestive system, eyes but not the ear, urine flushing or vaginal secretions.	

(b) Immunisation against mumps can be achieved with vaccination. Distinguish between the terms 'immunisation' and 'vaccination'. Explain how vaccines provide immunity to pathogens and outline four different types of vaccines available. (12 marks)

Description	Marks
Distinction between immunisation and vaccination	
Immunisation involves preparing the immune system to respond to pathogens/becoming immune to a pathogen.	1
Vaccination in the artificial introduction of pathogens or their antigens so that the body can make antibodies to that pathogen/cause an immune response.	1
Subtotal	**2**
How vaccines work – any six of	
• vaccines contain weakened or inactive parts of a particular pathogen (antigen) • body manufactures its own antibodies (to combat the antigen) • also manufactures memory cells • memory cells remain in the body for a long period of time • when exposed/infected with pathogen are triggered memory cells • produces a faster/larger immune response • patients should now not experience illness/experience less severe illness	1–6
Subtotal	**6**
Types of vaccines – any four of	
• live attenuated vaccines contain pathogens of reduced virulence/ reduced ability to produce disease symptoms • inactivated (killed) vaccines contain an inactivated or dead pathogen • toxoid vaccines contain the inactive disease causing toxin of a pathogen • subunit vaccines are when only part of a pathogen (isolated protein) is administered • conjugate vaccines contain pieces of bacterial coat including the carrier protein combined together • recombinant vaccines are genetically engineered vaccines where a virus protein is inserted into another virus	1–4
Subtotal	**4**
Total	**12**

2020 Section 3 Question 39

Response to infection

A man arrived home feeling unwell. His partner took him to the doctor when he started suffering a fever, sweats and chills. The patient was given an antibiotic to take every day for the following 10 days. The doctor stressed the importance of completing the course of antibiotics even when he started to feel better.

(a) Describe the physiological mechanisms that cause fever. (8 marks)

Description	Marks
hypothalamus increases thermostat setting of body (person feels cold)	1–8
pyrogens released	
Produced by white cells or pathogens	
muscles begin to shiver	
blood vessels constrict	
both processes help to drive up body temperature	
macrophage engulfed pathogen	
macrophage stimulated to release interleukins/cytokines	
interleukins/cytokines enhance the pyrogens	
Total	**8**

(b) Explain how different antibiotics can be used to treat infections. (8 marks)

Description	Marks
antibiotics target disease causing bacteria	1–8
can be broad spectrum/affect a wide range of bacteria	
or can narrow spectrum/effective only against specific types of bacteria	
(bacteriostatic) antibiotics inhibit growth of bacteria	
by interfering with protein synthesis	
(bactericidal) antibiotics destroy bacterial pathogens	
by targeting cell walls, cell membranes or	
metabolic pathways/action of enzymes found inside bacteria	
Total	**8**

(c) Explain why the doctor stressed that the full course of antibiotics needed to be taken. (4 marks)

Description	Marks
antibiotics gradually reduce the numbers of bacteria	1–4
will still be a small population of bacteria that remain	
if antibiotics are then stopped the bacteria that persist will increase in number/surviving bacteria reproduce	
reinfection occurs/become sick again	
eeduce likelihood of resistance developing	
Total	**4**

Unit 4 – Human variation and evolution

Unit 4 – Mutations

Section 1

2020 Section 1 Question 3 **Mutations**	The term 'selectively-advantageous mutation' means the mutation (a) provides a survival advantage in a particular environment. (b) will always be passed to the offspring. (c) is always changing to adapt to new environments. (d) provides a benefit to heterozygote individuals in populations.

2019 Section 1 Question 11 **Mutations**	Mitochondrial DNA is useful in evolutionary studies because of its (a) high mutation rate. (b) role in respiration. (c) location in the mitochondria. (d) reduced number of gene loci.

Section 2

2021 Section 2 Question 32 **Mutations**	In 2009, the University of California discovered a mutated gene that has been shown to produce naturally short sleepers. The gene was found in a family who all normally went to bed around 11 pm and woke up naturally around 5 am. The mutated gene, known as DEC2, is believed to affect the circadian rhythm and results in people who don't need as much sleep as the average person. (a) DEC2 is a gene mutation. How do gene and chromosomal mutations differ? (2 marks) (b) In the study, the mutation was found in several family members. What does this tell you about where the original mutation occurred? Justify your response. (2 marks) (c) Mutations can be caused in several ways. For each of the three ways stated below, describe how they may produce new mutations. (6 marks) Mutagens: DNA replication: Cell division:

(d) If researchers wanted to further investigate the link between the DEC2 gene and sleep, they would need to set up an experimental study.

(i) Propose a possible hypothesis for the study. (1 mark)

(ii) In the study, what would the control group consist of, and what purpose would it have? (2 marks)

(e) A mutation, such as the DEC2 gene, could be favourable to the human population. Explain how a favourable gene like this could lead to changes in allele frequencies of a gene pool. (4 marks)

2019 Section 2 Question 33 **Mutations**	'The Radium Girls' of the 1920s were women who worked in United States factories applying glow paint to the dark dials of watch faces. The women used paint containing radium to create the numerals on the watch faces. The women were told to use their lips and tongue to pinch the paint brush tip in order to create a fine painting point. As a result, the women were accidently consuming radium. The women suffered many devastating negative effects, including bone disease and various cancers. (a) Radium is known to cause mutations in the DNA. Therefore, radium can be classified as what type of substance? (1 mark) (b) Studies of the types of mutations that radium causes have shown that it can result in a change to DNA, known as aneuploidy. Examples of aneuploidy included trisomy-21 and Turner's syndrome. In these cases, there is either an extra number or a reduced number of chromosomes found in daughter cells when compared to normal cells. (i) When would the error occur to cause aneuploidy, including genetic disorders such as trisomy-21 and Turner's syndrome? (1 mark) (ii) Is aneuploidy an example of a gene or chromosomal mutation? Justify your answer. (2 marks) (iii) Is aneuploidy an example of a somatic or germline mutation? Justify your answer. (2 marks) (c) Explain how mutations can lead to changes in the allele frequencies of gene pools. (3 marks)

Section 3

2023 Section 3 Question 39 **Mutations**	A mutation is a permanent change in the DNA code. Lactase persistence is the ability to digest lactose (the sugar found in milk) in adults. This ability is attributed to a mutation that became present in various gene pools between 2000 and 20 000 years ago. Only about 35% of the world's adults possess the mutation today and can effectively digest lactose. (a) Identify and describe the type of mutation that would be responsible for lactase persistence, considering that it has been maintained within the gene pool. Compare this type of mutation to mutations that are not passed to future generations. (5 marks) (b) Point mutations can alter the DNA code in a number of ways, one of these being a frameshift mutation. Explain what a frameshift mutation is and describe two other ways point mutations can alter the DNA code. (6 marks) (c) In farming populations, the allele frequency for lactase persistence can be as high as 96% whereas in non-farming populations the frequency is only 20%. Explain how natural selection could be responsible for this difference in allele frequency. (9 marks)

2021 Section 3 Question 40 **Mutations**	Excavations of the sediments at an Aboriginal rock shelter in Juukan Gorge found flaked stone artefacts and a 4000 year-old belt made of plaited hair. A survey of the sediments provided a pollen record charting thousands of years of environmental changes. (a) Name and describe **two** techniques that could be used to date the stone artefacts and **one** technique that could be used to date the hair belt. (12 marks) (b) The mitochondrial DNA (mtDNA) in the plaited hair belt was associated with the DNA of today's traditional owners. Describe what mitochondrial DNA is and explain how it can be used to demonstrate a genetic relationship. (8 marks)

Marking Guide – Section 1

2020 **Section 1** **Question 3** **Mutations**	The term 'selectively-advantageous mutation' means the mutation **(a) provides a survival advantage in a particular environment. – Answer** (b) will always be passed to the offspring. (c) is always changing to adapt to new environments. (d) provides a benefit to heterozygote individuals in populations.

2019 **Section 1** **Question 11** **Mutations**	Mitochondrial DNA is useful in evolutionary studies because of its **(a) high mutation rate. – Answer** (b) role in respiration. (c) location in the mitochondria. (d) reduced number of gene loci.

2021 Section 2 Question 32

Mutations

In 2009, the University of California discovered a mutated gene that has been shown to produce naturally short sleepers. The gene was found in a family who all normally went to bed around 11 pm and woke up naturally around 5 am. The mutated gene, known as DEC2, is believed to affect the circadian rhythm and results in people who don't need as much sleep as the average person.

(a) DEC2 is a gene mutation. How do gene and chromosomal mutations differ? (2 marks)

Description	Marks
Gene mutations only affect one gene (loci)/small section of DNA	1
Chromosomal mutations affect more than one gene/part of a chromosome/whole chromosome	1
Total	**2**

(b) In the study, the mutation was found in several family members. What does this tell you about where the original mutation occurred? Justify your response. (2 marks)

Description	Marks
It occurred in the cells that produce the gamete (germline)/germline cell	1
Only mutations produced in these cells can be inherited/passed on	1
Total	**2**

(c) Mutations can be caused in several ways. For each of the three ways stated below, describe how they may produce new mutations. (6 marks)

Description	Marks
Mutagens	
Substances that are known to increase the (rate of) changes to DNA	1
Includes ionising radiation/mustard gas/some antibiotics/formaldehyde	1
DNA replication	
Errors during the process that alter DNA code	1
Can be deleting/duplicating/insertions/frameshifts of DNA	1
Cell division	
Errors during the process that alter the genes or chromosomes in daughter cells formed	1
Can be non-disjunction/translocation/inversions of DNA	1
Total	**6**

(d) If researchers wanted to further investigate the link between the DEC2 gene and sleep, they would need to set up an experimental study.

(i) Propose a possible hypothesis for the study. (1 mark)

Description	Marks
A statement that contrasts the presence/absence of the DEC2 gene and amount of sleep required e.g. individuals with the DEC2 gene will sleep less hours a night	1
Total	**1**

(ii) In the study, what would the control group consist of, and what purpose would it have? (2 marks)

Description	Marks
Individuals without the DEC2 gene	1
Act as a comparison to the experimental group	1
Total	**2**

(e) A mutation, such as the DEC2 gene, could be favourable to the human population. Explain how a favourable gene like this could lead to changes in allele frequencies of a gene pool. (4 marks)

Description	Marks
Mutations introduce new alleles into the population/mutations create variation	1
Alleles may produce traits favourable to survival	1
Favourable alleles are passed to offspring	1
Favourable traits will increase in number within the gene pool/natural selection will produce changes to gene pool	1
Total	**4**

2019 Section 2 Question 33

Mutations

'The Radium Girls' of the 1920s were women who worked in United States factories applying glow paint to the dark dials of watch faces. The women used paint containing radium to create the numerals on the watch faces. The women were told to use their lips and tongue to pinch the paint brush tip in order to create a fine painting point. As a result, the women were accidently consuming radium. The women suffered many devastating negative effects, including bone disease and various cancers.

(a) Radium is known to cause mutations in the DNA. Therefore, radium can be classified as what type of substance? (1 mark)

Description	Marks
mutagen	1
Total	**1**

(b) Studies of the types of mutations that radium causes have shown that it can result in a change to DNA, known as aneuploidy. Examples of aneuploidy included trisomy-21 and Turner's syndrome. In these cases, there is either an extra number or a reduced number of chromosomes found in daughter cells when compared to normal cells.

(i) When would the error occur to cause aneuploidy, including genetic disorders such as trisomy-21 and Turner's syndrome? (1 mark)

Description	Marks
during cell division/meiosis/when homologous chromosomes separate	1
Total	**1**

(ii) Is aneuploidy an example of a gene or chromosomal mutation? Justify your answer. (2 marks)

Description	Marks
chromosomal	1
it effects the whole chromosome/does not affect only a gene	1
Total	**2**

(iii) Is aneuploidy an example of a somatic or germline mutation? Justify your answer. (2 marks)

Description	Marks
germline	1
it would be inherited/passed to offspring/occurs in gametes	1
Total	**2**

(c) Explain how mutations can lead to changes in the allele frequencies of gene pools. (3 marks)

Description	Marks
mutations introduce new alleles into the population	1
alleles may produce traits favourable to survival	1
favourable traits will increase in number within the gene pool	1
Total	**3**

2023 Section 3 Question 39

Mutations

A mutation is a permanent change in the DNA code. Lactase persistence is the ability to digest lactose (the sugar found in milk) in adults. This ability is attributed to a mutation that became present in various gene pools between 2000 and 20 000 years ago. Only about 35% of the world's adults possess the mutation today and can effectively digest lactose.

(a) Identify and describe the type of mutation that would be responsible for lactase persistence, considering that it has been maintained within the gene pool. Compare this type of mutation to mutations that are not passed to future generations. (5 marks)

Description	Marks
germ-line mutation	1
not somatic	1
found in the gametes not body cells	1
involved with production of the zygote/formation of offspring	1
not removed from the gene pool when the individual dies	1
Total	**5**

(b) Point mutations can alter the DNA code in a number of ways, one of these being a frameshift mutation. Explain what a frameshift mutation is and describe two other ways point mutations can alter the DNA code. (6 marks)

Description	Marks
Frameshift	
occurs when nucleotides are added or removed from a section of code	1
results in new codons/codes for different amino acids	1
Subtotal	**2**
Other types any two of (2 x 2 marks)	
• the codon still codes for the same amino acid caused by insertion of a new nucleotide/deleting a nucleotide/silent mutation • the code is changed to a different amino acid caused by substitution of one nucleotide being replaced by a new nucleotide/missense mutation • a new stop codon is formed/no amino acid is coded for caused by substitution of one nucleotide being replaced by a new nucleotide/nonsense mutation	1–4
Subtotal	**4**
Total	**6**

(c) In farming populations, the allele frequency for lactase persistence can be as high as 96% whereas in non-farming populations the frequency is only 20%. Explain how natural selection could be responsible for this difference in allele frequency. (9 marks)

Description	Marks
lactase persistence mutation became present	1
causing variation in the gene pool	1
in populations that used milk as an energy source	1
those that had the lactase persistence mutation had a better chance of survival	1
more individuals with the lactase persistence allele reach adulthood/survive to reproduce	1
more offspring born with the mutation present	1
allele frequency of the mutation increases over time	1
in populations without a milk diet there would be no difference in survival rate/selection advantage	1
allele frequency of mutation remains unchanged	1
Total	**9**

2021 Section 3 Question 40

Mutations

Excavations of the sediments at an Aboriginal rock shelter in Juukan Gorge found flaked stone artefacts and a 4000 year-old belt made of plaited hair. A survey of the sediments provided a pollen record charting thousands of years of environmental changes.

(a) Name and describe **two** techniques that could be used to date the stone artefacts and **one** technique that could be used to date the hair belt. (12 marks)

Description	Marks
Indicates an understanding there are relative and absolute dating methods	1
Subtotal	**1**
Stone Artefacts	
Name and describe **two** of the following techniques (3 marks each)	
• stratigraphy • study the rock strata/layers • match similar strata to other strata already dated/artefacts in the same strata are the same age. • principle of superposition • assume lower rock layers are older • deeper artefacts are older. • index fossils • fossils widely found but only present for a limited time on Earth • match index fossils from various locations with known dates.	1–6
Subtotal	**6**
Hair belt	
Radiocarbon/carbon-14/C14 dating	1
Based on the decay of carbon-14/C14 to nitrogen	1
Amount of carbon-14/C14 fixed at death	1
Carbon-14/C14 half-life 5730 years	1
The ratio of carbon-14/C14 to carbon-12/C12 determines the age (years)	1
Subtotal	**5**
Total	**12**

(b) The mitochondrial DNA (mtDNA) in the plaited hair belt was associated with the DNA of today's traditional owners. Describe what mitochondrial DNA is and explain how it can be used to demonstrate a genetic relationship. (8 marks)

Description	Marks
Definition	
Genetic material found within mitochondria	1
mtDNA is found in small circular molecules/plasmids	1
mtDNA is inherited only from the mother/via the mitochondria in the mother's ova	1
Subtotal	**3**
Use	
Mutations occur more readily in mtDNA (than in nuclear DNA)/higher rate	1
Similarities in MtDNA between traditional owner and hair sample can be used to identify relatedness	1
Number of mutations in mDNA of traditional owner and hair sample assessed	1
The less the diversity in their mtDNA	1
The more closely related they are	1
Subtotal	**5**
Total	**8**

Unit 4 – Gene pools

Section 1

2023 Section 1 Question 16 Gene pools	Many genetic diseases are caused by a defect in just a single allele. The ability to replace a defective allele with a normal or non-defective allele is known as (a) gene therapy. (b) cloning. (c) cell replacement therapy. (d) stem cell therapy.

2022 Section 1 Question 14 Gene pools	If a geneticist is studying the amino acid sequence of haemoglobin, they are **most** likely looking for the possibility of (a) sickle cell anaemia or thalassemia. (b) Tay-Sachs disease or thalassemia. (c) thalassemia or malaria. (d) malaria or sickle cell anaemia.

2022 Section 1 Question 20 Gene pools	Natural selection is often referred to as 'survival of the fittest'. Which of the following is the **best** definition for 'fittest' as used in this statement? (a) the ability of an organism to survive and reproduce (b) adaptations that produce favourable traits (c) selective breeding to promote favourable traits (d) heritable traits that will be passed on to offspring

2021 Section 1 Question 13 Gene pools	Which of the following are all selection pressures which could reduce genetic variation in a population? (a) disease, increased competition and climate change (b) increased food availability, disease and climate change (c) increased competition, reduced environmental pollutants and disease (d) reduced land availability, increased food availability and climate change

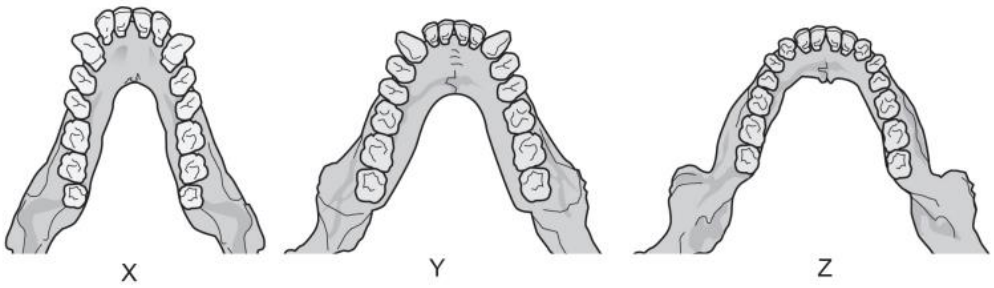
2021 Section 1 Question 22 Gene pools	Which of the following statements does **not** support the theory of natural selection? (a) Organisms reproduce at a rate greater than can be supported by the environment. (b) Genotypic variation is exhibited in the phenotypes of individuals. (c) Selective agents act on the alleles in a gene pool. (d) Similar individuals mate and produce offspring with favourable traits.

2021 Section 1 Question 28 Gene pools	Alpha and Beta Thalassemia have similarities and differences in their inheritance patterns. Which of the following is correct? (a) Both are autosomal dominant conditions controlled on multiple gene loci. (b) Alpha Thalassemia is fatal for homozygote individuals while Beta Thalassemia is not. (c) Both are autosomal recessive conditions that result in affected individuals having four defective globin genes. (d) Beta Thalassemia is fatal for heterozygote individuals while Alpha Thalassemia is not.

2020 Section 1 Question 10-11

Gene pools

Questions 10 and 11 refer to the diagram shown below.



10. Which of the following is true?

Jaw

(a) Y is the least parabolic and most likely belongs to an Australopithecine.
(b) Z is the most parabolic and most likely belongs to a modern human.
(c) X is the most parabolic and most likely belongs to an ape.
(d) Z is the least parabolic and most likely belongs to a modern human.

11. A scientist found a lower jaw specimen that looked almost exactly like jaw X. Together with this jawbone, the scientist found other bones, including part of the pelvis. What characteristic would you expect the pelvis to have?

(a) short from top to bottom and narrow
(b) broad and long from top to bottom
(c) long from top to bottom and narrow
(d) short from top to bottom and broad

2019 Section 1 Question 10

Gene pools

Which of the following pair of responses identifies correctly the difference between sickle cell anaemia and sickle cell trait?

	Sickle cell anaemia	Sickle cell trait
(a)	provides resistance to malaria	provides no resistance to malaria
(b)	people are carriers of the genetic disease	people are not carriers of the genetic disease
(c)	involves two affected alleles for the condition	involves only one affected allele for the condition
(d)	people have malformed haemoglobin	people have crescent-shaped haemoglobin

2019 Section 1 Question 14

Gene pools

Gene flow occurs when

(a) species migrate to new areas.
(b) genes are exchanged during fertilisation.
(c) individuals migrate to new areas.
(d) mating occurs between related individuals.

2019 Section 1 Question 20

Gene pools

The 'Toba catastrophe theory' suggests that the human population was almost completely wiped out around 75 000 years ago. It is believed that a super-volcano near Lake Toba in Indonesia erupted, creating a global volcanic winter that lasted 10 years. This event killed most humans, leaving as few as 40 breeding pairs of adults. According to the theory, this small population went on to repopulate the entire human species.

If true, this repopulation would be **best** described as an example of

(a) natural selection.
(b) random genetic drift.
(c) gene flow.
(d) selective breeding.

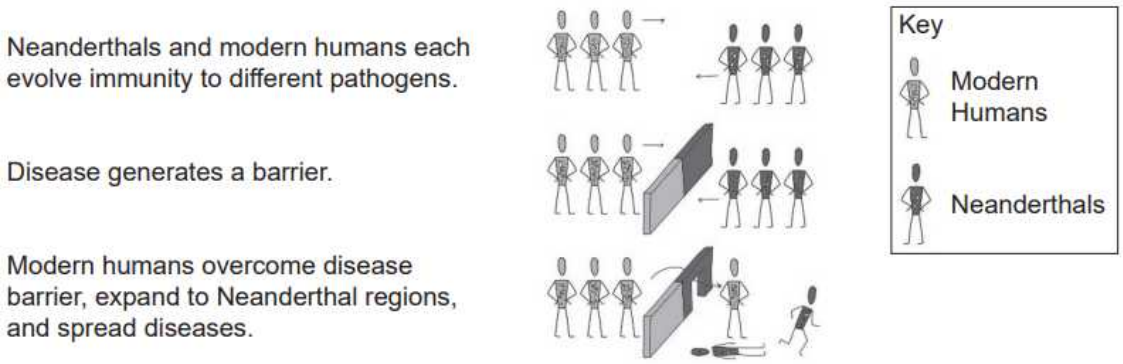
2019 **Section 1** **Question** **28** **Gene pools**	While excavating a cave, scientists discovered the skeletal remains of a hominid with the following anatomical features. A skull with a flat forehead and a sagittal crest, massive jaws, small incisors and canines, large pre-molars and molars, and a heavy body frame about 160 cm tall. This hominid was most likely a/an (a) *Australopithecus afarensis.* (b) *Australopithecus africanus.* (c) *Paranthropus robustus.* (d) *Homo habilis.*

Section 2

2023 Section 2 Question 35 **Gene pools**	There are many different theories used to account for why Homo neanderthalensis died out around 40 000 years ago, leaving only modern Homo sapiens as the living hominin species on Earth today. One of the theories often used to explain why Homo neanderthalensis died out is attributed to small population size. Evidence suggests that Homo neanderthalensis had a relatively small total population and many small, isolated populations that were not in contact with other groups. (a) Identify **two** effects a small population has on a gene pool that can reduce the chance of species survival. (2 marks) One: Two: (b) If Homo neanderthalensis populations were isolated, then barriers to gene flow must have existed. Name and outline one type of barrier to gene flow. (2 marks)

Another theory used to explain the extinction of *Homo neanderthalensis* is associated with disease. Scientific models have demonstrated that *Homo neanderthalensis* and modern Homo sapiens carried diseases unique to one another. This created an invisible disease barrier that deterred the mixing of the species into the other's territory. There must have been a narrow contact zone on the edges of the territories, where minimal contact did occur. This situation lasted over tens of thousands of years with modern *Homo sapiens* slowly building immunity to the Homo neanderthalensis diseases. However, *Homo neanderthalensis* seems to have not been able do the same. The result is that modern *Homo sapiens* could break through the disease barrier, invading the territory and eventually replacing *Homo neanderthalensis*.

The image below represents the theory.



(c) Explain how the theory outlined implies that natural selection occurred in the process of Homo sapiens replacing Homo neanderthalensis. (3 marks)

The following question refers to the tool diagrams shown below.

Copyright restrictions prohibit the release of this SCSA exam material.

(d) Determine which of the tools shown above is the best example of one that belonged to Homo neanderthalensis. Name the tool culture associated with this type and species. (2 marks)

(e) Outline **two** trends that are evident in the manufacturing techniques of tools from early hominins to modern **Homo sapiens** and state what each of these trends indicate about changes in lifestyle. (4 marks)

One:

Two:

2022 Section 2 Question 36

Gene pools

The occurrence of atavism provides a possible piece of evidence for evolution. Atavism involves the reappearance of an ancestral genetic trait that has been lost over many generations of evolutionary change. One example in humans is a 'caudal appendage', where babies are born with a posterior tail made of cartilage and additional vertebrae.

The caudal appendage is an exterior extension of the coccyx. The coccyx itself is often considered an example of a vestigial organ.

(a) (i) Identify one other vestigial organ of the human body. (1 mark)

(ii) Explain how vestigial organs provide evidence for evolution. (3 marks)

Human colour blindness is considered another possible example of atavism in modern humans. It is believed that the colour blindness trait may have originated in early humans as a survival advantage. It is possible that the inability to distinguish some colours can improve the ability to view different textures and shades, providing a visual advantage in some habitats.

(b) If colour blindness did provide a survival advantage, using the theory of natural selection, explain how colour blindness would have been maintained in early human populations. (5 marks)

Consider the following hypothetical situation: An isolated island had a population of 300 people, 10 of which were colour blind. After 150 years, the island had a population of 400 people, none of whom were colour blind.

(c) (i) If colour blindness did provide a survival advantage to this population, identify the name of the process that would provide the **best** explanation for the change in the population over time. (1 mark)

(ii) Justify your response to part (c)(i). (3 marks)

2021 Section 2 Question 34 **Gene pools**	Approximately 1 in 25 people from the Ashkenazi Jewish community in Australia will be a genetic carrier for Tay-Sachs as well as other genetic conditions, such as cystic fibrosis. There are several theories as to why the frequency of these genetic conditions is high in the Ashkenazi Jewish population. (a) State what is Tay-Sachs. (1 mark) (b) Explain how the high incidence of Tay-Sachs within the Ashkenazi Jewish community in Australia is an example of the founder effect. (4 marks) A genetic carrier screening program for Tay-Sachs disease was carried out at a high school that has a significant number of Jewish students. One process the specimens were passed through during screening was polymerase chain reaction (PCR). (c) Outline what occurs in each stage of the PCR process. (3 marks) Denaturing: Annealing: Extension:

	During the Second World War, tuberculosis (TB) ran unchecked in Eastern European Jewish settlements. Often, healthy relatives of children with Tay-Sachs disease did not contract TB, even when exposed repeatedly. (d) Using the theory of natural selection, explain why Tay-Sachs disease still exists in the Ashkenazi Jewish populations today. (4 marks)

2020 Section 2 Question 36 **Gene pools**	Thalassemia is a genetically inherited disorder that affects the haemoglobin of blood. Two types of thalassemia are alpha (α) and beta (β). One of the treatments of both types of thalassemia involves drugs that are administered to help remove excess iron from the blood. A research team wanted to investigate the effectiveness of the different modes of delivery of these drugs. The team set up an investigation to compare the drugs in injectable form with the orally ingested form. The team conducted their investigation on a sample of 53 beta (β) thalassemia sufferers. The participants were divided into four groups. The participants in each group had daily treatments lasting one month. The groups were: Group A – 14 participants who received the injectable drug Group B – 13 participants who received an inactive injectable drug Group C – 13 participants who received the orally ingested drug Group D – 13 participants who received an inactive oral drug. (a) Propose an hypothesis for the study described above. (1 mark) (b) Why were both groups B and D required for this study? (3 marks)

(c) Identify a variable that was controlled in the study. (1 mark)

(d) Describe the data the researchers would need to collect and when they should collect the data. (3 marks)

(e) Outline the cause of alpha (α) and beta (β) thalassemia and identify what makes each type of thalassemia different. (3 marks)

(f) Alpha (α) and beta (β) thalassemia display the same inheritance pattern but can have differing effects on the gene pool of a population. Justify this statement. (5 marks)

2019 Section 2 Question 39 **Gene pools**	A genetic condition which is often associated with the Founder Effect is Tay Sach's disease. The disease occurs in much higher incidence among Ashkenazi Jews and members of the Cajun community of Louisiana. (a) Explain how the Founder Effect could account for the occurrence of Tay Sach's disease in these populations. (4 marks) Although Tay Sach's disease is fatal, the allele has been maintained in gene pools. This is believed to be because it provides a heterozygote advantage. (b) (i) What is meant by the term 'heterozygote advantage'? (2 marks) (ii) Identify the heterozygote advantage that Tay Sach's is believed to provide. (1 mark)

Section 3

2020 Section 3 Question 41 **Gene pools**	Many scientists propose that one day humans could colonise and live on Mars. This idea presents numerous challenges to human survival. One such challenge focuses on genetics and evolutionary processes. (a) If in the future a group of 50 humans was selected to colonise Mars, over time this group could be at risk of becoming an example of the Founder Effect and, potentially, speciation. Justify this statement by explaining how the evolutionary mechanisms of both the Founder Effect and speciation could apply to this scenario. (13 marks) (b) If this hypothetical group of 50 humans was to colonise Mars, it would be advisable to obtain DNA sequences of the individuals as part of the selection process. Define the term 'DNA sequencing' and name and explain the method by which a DNA sequence is obtained today. (7 marks)

2019 Section 3 Question 42 **Gene pools**	The Sentinelese are an indigenous people who inhabit North Sentinel Island in the Bay of Bengal in India. They refuse to have contact with any other groups of humans and are one of the world's last uncontacted peoples. Their skin colour is described as 'dark, shining black'. (a) Explain how the process of natural selection can lead to a particular phenotype becoming prevalent in a population. (10 marks) The Sentinelese people come into regular contact with pathogens in their forest environment. If a pathogen manages to breach the external defence mechanisms, the body will respond with the non-specific inflammation response. (b) Define what is meant by 'non-specific' immune response, list the signs of inflammation and describe the process of inflammation. (10 marks)

Marking Guide – Section 1

2023 Section 1 Question 16 **Gene pools**	Many genetic diseases are caused by a defect in just a single allele. The ability to replace a defective allele with a normal or non-defective allele is known as **(a) gene therapy. – Answer** (b) cloning. (c) cell replacement therapy. (d) stem cell therapy.

2022 Section 1 Question 14 **Gene pools**	If a geneticist is studying the amino acid sequence of haemoglobin, they are **most** likely looking for the possibility of **(a) sickle cell anaemia or thalassemia. – Answer** (b) Tay-Sachs disease or thalassemia. (c) thalassemia or malaria. (d) malaria or sickle cell anaemia.

2022 Section 1 Question 20 **Gene pools**	Natural selection is often referred to as 'survival of the fittest'. Which of the following is the **best** definition for 'fittest' as used in this statement? **(a) the ability of an organism to survive and reproduce – Answer** (b) adaptations that produce favourable traits (c) selective breeding to promote favourable traits (d) heritable traits that will be passed on to offspring

2021 Section 1 Question 13 **Gene pools**	Which of the following are all selection pressures which could reduce genetic variation in a population? **(a) disease, increased competition and climate change – Answer** (b) increased food availability, disease and climate change (c) increased competition, reduced environmental pollutants and disease (d) reduced land availability, increased food availability and climate change

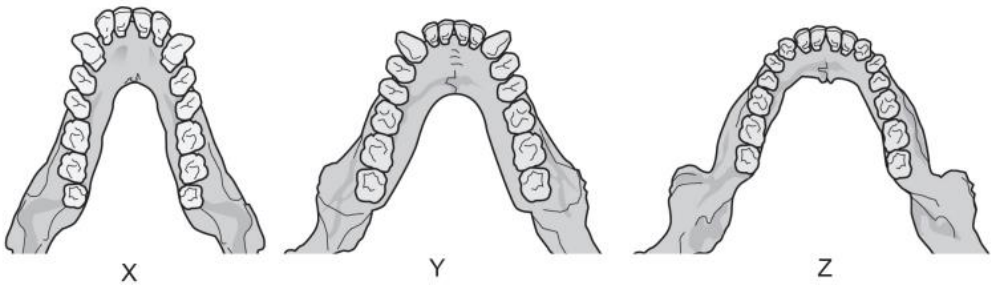
2021 Section 1 Question 22 **Gene pools**	Which of the following statements does **not** support the theory of natural selection? (a) Organisms reproduce at a rate greater than can be supported by the environment. (b) Genotypic variation is exhibited in the phenotypes of individuals. (c) Selective agents act on the alleles in a gene pool. **(d) Similar individuals mate and produce offspring with favourable traits. – Answer**

2021 Section 1 Question 28 **Gene pools**	Alpha and Beta Thalassemia have similarities and differences in their inheritance patterns. Which of the following is correct? (a) Both are autosomal dominant conditions controlled on multiple gene loci. **(b) Alpha Thalassemia is fatal for homozygote individuals while Beta Thalassemia is not. – Answer** (c) Both are autosomal recessive conditions that result in affected individuals having four defective globin genes. (d) Beta Thalassemia is fatal for heterozygote individuals while Alpha Thalassemia is not.

2020 Section 1 Question 10-11

Gene pools

Questions 10 and 11 refer to the diagram shown below.



10. Which of the following is true?

Jaw

(a) Y is the least parabolic and most likely belongs to an Australopithecine.
(b) Z is the most parabolic and most likely belongs to a modern human. – Answer
(c) X is the most parabolic and most likely belongs to an ape.
(d) Z is the least parabolic and most likely belongs to a modern human.

11. A scientist found a lower jaw specimen that looked almost exactly like jaw X. Together with this jawbone, the scientist found other bones, including part of the pelvis. What characteristic would you expect the pelvis to have?

(a) short from top to bottom and narrow
(b) broad and long from top to bottom
(c) long from top to bottom and narrow – Answer
(d) short from top to bottom and broad

2019 Section 1 Question 10

Gene pools

Which of the following pair of responses identifies correctly the difference between sickle cell anaemia and sickle cell trait?

	Sickle cell anaemia	Sickle cell trait
(a)	provides resistance to malaria	provides no resistance to malaria
(b)	people are carriers of the genetic disease	people are not carriers of the genetic disease
(c)	involves two affected alleles for the condition	involves only one affected allele for the condition
(d)	people have malformed haemoglobin	people have crescent-shaped haemoglobin

Answer is c.

2019 Section 1 Question 14

Gene pools

Gene flow occurs when

(a) species migrate to new areas.
(b) genes are exchanged during fertilisation.
(c) individuals migrate to new areas. – Answer
(d) mating occurs between related individuals.

2019 **Section 1** **Question** **20** **Gene pools**	The 'Toba catastrophe theory' suggests that the human population was almost completely wiped out around 75 000 years ago. It is believed that a super-volcano near Lake Toba in Indonesia erupted, creating a global volcanic winter that lasted 10 years. This event killed most humans, leaving as few as 40 breeding pairs of adults. According to the theory, this small population went on to repopulate the entire human species. If true, this repopulation would be **best** described as an example of (a) natural selection. **(b) random genetic drift. – Answer** (c) gene flow. (d) selective breeding.

2019 **Section 1** **Question** **28** **Gene pools**	While excavating a cave, scientists discovered the skeletal remains of a hominid with the following anatomical features. A skull with a flat forehead and a sagittal crest, massive jaws, small incisors and canines, large pre-molars and molars, and a heavy body frame about 160 cm tall. This hominid was most likely a/an (a) *Australopithecus afarensis.* (b) *Australopithecus africanus.* **(c) *Paranthropus robustus.* – Answer** (d) *Homo habilis.*

2023 Section 2 Question 35

Gene pools

There are many different theories used to account for why Homo neanderthalensis died out around 40 000 years ago, leaving only modern Homo sapiens as the living hominin species on Earth today. One of the theories often used to explain why Homo neanderthalensis died out is attributed to small population size. Evidence suggests that Homo neanderthalensis had a relatively small total population and many small, isolated populations that were not in contact with other groups.

(a) Identify **two** effects a small population has on a gene pool that can reduce the chance of species survival. (2 marks)

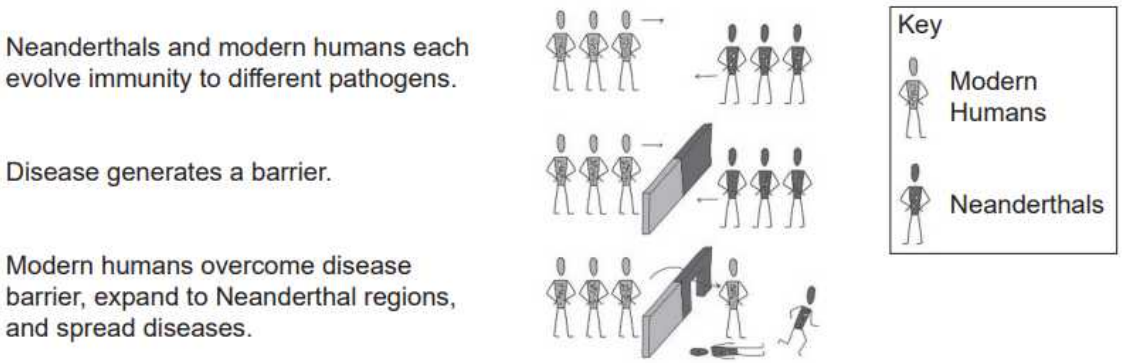
Description	Marks
Any two of	
• reduce genetic diversity/less variation • increase chance of random genetic drift events • reduce instance of new mutations • increase likelihood of inbreeding (leading to gene pool homogeneity)	1–2
Total	**2**

(b) If Homo neanderthalensis populations were isolated, then barriers to gene flow must have existed. Name and outline one type of barrier to gene flow. (2 marks)

Description	Marks
Any one of (1 x 2 marks)	
• geographical/physical/oceans/mountain ranges/ice sheets/deserts interbreeding restricted by physical barriers that cannot be crossed • cultural/social/religion/language/education/social position/economic status choosing not to interbreed because of differences in beliefs and attitudes	1–2
Total	**2**

Another theory used to explain the extinction of *Homo neanderthalensis* is associated with disease. Scientific models have demonstrated that *Homo neanderthalensis* and modern Homo sapiens carried diseases unique to one another. This created an invisible disease barrier that deterred the mixing of the species into the other's territory. There must have been a narrow contact zone on the edges of the territories, where minimal contact did occur. This situation lasted over tens of thousands of years with modern *Homo sapiens* slowly building immunity to the Homo neanderthalensis diseases. However, *Homo neanderthalensis* seems to have not been able do the same. The result is that modern *Homo sapiens* could break through the disease barrier, invading the territory and eventually replacing *Homo neanderthalensis*.

The image below represents the theory.



(c) Explain how the theory outlined implies that natural selection occurred in the process of Homo sapiens replacing Homo neanderthalensis. (3 marks)

Description	Marks
when *Homo sapiens* invaded *Homo neanderthalensis* territory there must have been a struggle for survival/competition for resources/not enough resources for both	1
Homo sapiens were better adapted to the environment/most 'fit' species/had immunity to diseases of both populations	1
the strongest (*Homo sapiens*) were able to survive to reproduce/the weakest (*Homo neanderthalensis*) did not survive to reproduce	1
Total	**3**

The following question refers to the tool diagrams shown below.

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(d) Determine which of the tools shown above is the best example of one that belonged to Homo neanderthalensis. Name the tool culture associated with this type and species. (2 marks)

Description	Marks
Y	1
Mousterian	1
Total	**2**

(e) Outline **two** trends that are evident in the manufacturing techniques of tools from early hominins to modern **Homo sapiens** and state what each of these trends indicate about changes in lifestyle. (4 marks)

Description	Marks
Any two of (2 x 2 marks)	
• greater amount of materials used/use of stone only to bone, antler, ivory, wood used resources more effectively/used more variety of resources/understood how to use their environment better • greater number of blows/increased workmanship/time into tool production completed more complex jobs/did finer work/had time to create • tools became more specialised/tools used to make tools hominids had more specialised roles within communities	1–4
Total	**4**

2022 Section 2 Question 36

Gene pools

The occurrence of atavism provides a possible piece of evidence for evolution. Atavism involves the reappearance of an ancestral genetic trait that has been lost over many generations of evolutionary change. One example in humans is a 'caudal appendage', where babies are born with a posterior tail made of cartilage and additional vertebrae.

The caudal appendage is an exterior extension of the coccyx. The coccyx itself is often considered an example of a vestigial organ.

(a) (i) Identify one other vestigial organ of the human body. (1 mark)

Description	Marks
appendix/male nipples/muscles to move ears/nictitating membrane/pointed canines/wisdom teeth/hair on body	1
Total	**1**
Accept other relevant answers.	

(ii) Explain how vestigial organs provide evidence for evolution. (3 marks)

Description	Marks
structures that have a benefit/normal function in some species	1
present but not functional in other species	1
indicates shared common ancestry/at one point both species shared an ancestor who had the structure	1
Total	**3**

Human colour blindness is considered another possible example of atavism in modern humans. It is believed that the colour blindness trait may have originated in early humans as a survival advantage. It is possible that the inability to distinguish some colours can improve the ability to view different textures and shades, providing a visual advantage in some habitats.

(b) If colour blindness did provide a survival advantage, using the theory of natural selection, explain how colour blindness would have been maintained in early human populations. (5 marks)

Description	Marks
some individuals possess the colour blindness trait/allele for colour blindness present in population/variation in the population	1
competition exists in population/struggle to survive/limited resources present	1
those with colour blindness are more suited to the environment/have better vision so able to see predators better	1
more likely to survive to reproduce/more likely to pass alleles onto offspring	1
allele maintained/increased in gene pool	1
Total	**5**

Consider the following hypothetical situation: An isolated island had a population of 300 people, 10 of which were colour blind. After 150 years, the island had a population of 400 people, none of whom were colour blind.

(c) (i) If colour blindness did provide a survival advantage to this population, identify the name of the process that would provide the **best** explanation for the change in the population over time. (1 mark)

Description	Marks
(Random) genetic drift	1
Total	**1**

(ii) Justify your response to part (c)(i). (3 marks)

Description	Marks
Any three of	
• due to small size more likely to occur • no gene flow evident with other populations • must be a chance event • because if it does have a survive advantage it would be selected for/it would be maintained or increase in the population	1–3
Total	**3**

2021 Section 2 Question 34

Gene pools

Approximately 1 in 25 people from the Ashkenazi Jewish community in Australia will be a genetic carrier for Tay-Sachs as well as other genetic conditions, such as cystic fibrosis. There are several theories as to why the frequency of these genetic conditions is high in the Ashkenazi Jewish population.

(a) State what is Tay-Sachs. (1 mark)

Description	Marks
Any **one** of the following:	
Degenerative neurological disease	1
Caused by deficiency of the HexA enzyme	
Disorder of lipid metabolism	
Autosomal recessive disease	
Total	**1**

(b) Explain how the high incidence of Tay-Sachs within the Ashkenazi Jewish community in Australia is an example of the founder effect. (4 marks)

Description	Marks
Small original population/migration of small group to Australia	1
With some (or one) individuals carrying the allele for Tay-Sachs disease	1
Restricted breeding with gene pool/cultural isolation	1
Frequency of allele increases over time	1
Total	**4**

A genetic carrier screening program for Tay-Sachs disease was carried out at a high school that has a significant number of Jewish students. One process the specimens were passed through during screening was polymerase chain reaction (PCR).

(c) Outline what occurs in each stage of the PCR process. (3 marks)

Description	Marks
Denaturing	
Separates complimentary base pairs/DNA strands separate/heating separates the DNA	1
Annealing	
Adding a primer (small single strand of DNA) to bind to complementary base sequences	1
Extension	
(DNA polymerase) makes a copy of DNA strands through repeated series/ elongation/replication	1
Total	**3**

During the Second World War, tuberculosis (TB) ran unchecked in Eastern European Jewish settlements. Often, healthy relatives of children with Tay-Sachs disease did not contract TB, even when exposed repeatedly.

(d) Using the theory of natural selection, explain why Tay-Sachs disease still exists in the Ashkenazi Jewish populations today. (4 marks)

Description	Marks
Variation is present in individuals/individual are heterozygous for Tay-Sachs	1
Isolation of gene pool/barriers to gene flow	1
Individuals that are heterozygous are more likely to survive/not contract TB and produce offspring	1
Suitable genes are passed onto offspring/individuals that do not possess suitable genes die off	1
Total	**4**

2020 Section 2 Question 36

Gene pools

Thalassemia is a genetically inherited disorder that affects the haemoglobin of blood. Two types of thalassemia are alpha (α) and beta (β). One of the treatments of both types of thalassemia involves drugs that are administered to help remove excess iron from the blood. A research team wanted to investigate the effectiveness of the different modes of delivery of these drugs.

The team set up an investigation to compare the drugs in injectable form with the orally ingested form. The team conducted their investigation on a sample of 53 beta (β) thalassemia sufferers. The participants were divided into four groups. The participants in each group had daily treatments lasting one month. The groups were:

Group A – 14 participants who received the injectable drug
Group B – 13 participants who received an inactive injectable drug
Group C – 13 participants who received the orally ingested drug
Group D – 13 participants who received an inactive oral drug.

(a) Propose an hypothesis for the study described above. (1 mark)

Description	Marks
testable, predictive statement E.g. injectable drugs will be more effective in treating thalassemia symptoms than orally ingested drugs	1
Total	**1**

(b) Why were both groups B and D required for this study? (3 marks)

Description	Marks
control groups of the study to compare results with	1
they both administer the placebo treatment (to minimise any psychological effects)	1
needs both as there is two different modes of delivery that need to be equally controlled	1
Total	**3**

(c) Identify a variable that was controlled in the study. (1 mark)

Description	Marks
treatment schedule/daily treatments for a month **or**, all participants have same type of thalassemia	1
Total	**1**

(d) Describe the data the researchers would need to collect and when they should collect the data. (3 marks)

Description	Marks
test for the levels of iron found in the blood	1
testing should be done before treatment	1
testing should be done at the end of the one-month treatment	1
Total	**3**

(e) Outline the cause of alpha (α) and beta (β) thalassemia and identify what makes each type of thalassemia different. (3 marks)

Description	Marks
mutation of the gene responsible for red blood cells/haemoglobin production	1
alpha (α) – effects genes on chromosome 16/reduces the formation of alpha polypeptide chains/the alpha globin of red blood cells	1
beta (β) – effects genes on chromosome 11/reduces the formation of beta polypeptide chains/the beta globin of red blood cells	1
Total	**3**

(f) Alpha (α) and beta (β) thalassemia display the same inheritance pattern but can have differing effects on the gene pool of a population. Justify this statement. (5 marks)

Description	Marks
both are recessive traits	1
heterozygotes are mildly affected with the disease/heterozygous carrier parents pass the traits on to their children	1
homozygous condition in alpha thalassemia is fatal	1
homozygous condition in beta thalassemia is severe but not fatal	1
no homozygote alpha sufferers present in a population but there will be beta sufferers	1
Total	**5**

2019 Section 2 Question 39

Gene pools

A genetic condition which is often associated with the Founder Effect is Tay Sach's disease. The disease occurs in much higher incidence among Ashkenazi Jews and members of the Cajun community of Louisiana.

(a) Explain how the Founder Effect could account for the occurrence of Tay Sach's disease in these populations. (4 marks)

Description	Marks
small original population	1
with some (or one) individual carrying the allele for Tay Sach's disease	1
restricted breeding with gene pool/isolated	1
frequency of allele increases over time	1
Total	**4**

Although Tay Sach's disease is fatal, the allele has been maintained in gene pools. This is believed to be because it provides a heterozygote advantage.

(b) (i) What is meant by the term 'heterozygote advantage'? (2 marks)

Description	Marks
individuals who carry the allele/only have one allele for the trait	1
have a selected advantage to survival	1
Total	**2**

(ii) Identify the heterozygote advantage that Tay Sach's is believed to provide. (1 mark)

Description	Marks
resistance to Tuberculosis	1
Total	**1**

2020 Section 3 Question 41

Gene pools

Many scientists propose that one day humans could colonise and live on Mars. This idea presents numerous challenges to human survival. One such challenge focuses on genetics and evolutionary processes.

(a) If in the future a group of 50 humans was selected to colonise Mars, over time this group could be at risk of becoming an example of the Founder Effect and, potentially, speciation. Justify this statement by explaining how the evolutionary mechanisms of both the Founder Effect and speciation could apply to this scenario. (13 marks)

Description	Marks
Founder effect	
50 people represents a small original population	1–4
geographic barrier to gene flow present	
random genetic drift more likely to occur/gene pool may not be reflective of original population	
allele frequencies change over time	
Subtotal	**4**
Speciation	
genetic variation exists in the 50 people	1–9
new environmental conditions on Mars	
there could be a struggle for survival/limited resources	
isolated gene pool/restricted breeding	
an allele in the gene pool could be selected for/survival advantage present	
frequency of alleles change over time from original	
over many generations changes become greater	
changes can become so great that the new group can no longer reproduce with the original population	
new/distinct species has been formed	
Subtotal	**9**
Total	**13**

(b) If this hypothetical group of 50 humans was to colonise Mars, it would be advisable to obtain DNA sequences of the individuals as part of the selection process. Define the term 'DNA sequencing' and name and explain the method by which a DNA sequence is obtained today. (7 marks)

Description	Marks
Define and name	
process of determining the order of nucleotides in the DNA	1
gel electrophoresis/sanger sequencing	1
Subtotal	**2**
Process – One to five of the following:	
DNA sample undergoes PCR	1–5
DNA polymerase added to primer	
Fluorescents dideoxynucleotides (ddNTPs = ddATP + ddCTP + ddTTP + ddGTP) added to four reaction mixtures	
DNA terminated at different lengths	
Four mixtures run separate lines	
DNA pieces are placed at one end of a bed of gel into wells	
an electric current is passed through the gel/a voltage is applied across the gel	
DNA is negatively charged so moves through the gel to the positive electrode	
DNA pieces move through the gel at different speeds/smaller DNA pieces move faster than large ones	
bands form which represent different segments/sizes of DNA	
Subtotal	**5**
Total	**7**

2019 Section 3 Question 42

Gene pools

The Sentinelese are an indigenous people who inhabit North Sentinel Island in the Bay of Bengal in India. They refuse to have contact with any other groups of humans and are one of the world's last uncontacted peoples. Their skin colour is described as 'dark, shining black'.

(a) Explain how the process of natural selection can lead to a particular phenotype becoming prevalent in a population. (10 marks)

Description	Marks
Variation	
variation present in individuals/many phenotypes present	1
wide variety of genes/large gene pool present	
Subtotal	**1**
Struggle	
overproduction of offspring	1–3
limited resources available	
selection pressure present	
competition for resources/struggle to survive	
Subtotal	**3**
Selection	
genes passed to offspring	1–6
a particular phenotype is more suitable for the environment	
individuals that do not possess the phenotype (genes) die-off	
individuals that do possess the phenotype (genes) survive/survival of the fittest	
over time more individuals have more suitable characteristics	
after many generations the particular phenotype is more prevalent	
can produce speciation	
Subtotal	**6**
Total	**10**

The Sentinelese people come into regular contact with pathogens in their forest environment. If a pathogen manages to breach the external defence mechanisms, the body will respond with the non-specific inflammation response.

(b) Define what is meant by 'non-specific' immune response, list the signs of inflammation and describe the process of inflammation. (10 marks)

Description	Marks
Define – 'non-specific' immune response	
the same response occurs (for all pathogen)/generalised response	1–2
in response to all tissue infections/injuries	
Subtotal	**2**
Signs of inflammation	
redness	1–3
heat	
swelling	
pain	
loss of function	
Subtotal	**3**
Process of inflammation	
mast cells release histamine/histamine triggered	1
Vasodilation/ ↑ blood flow/ ↑ permeability of capillaries	1
causing heat, redness and swelling	1
histamine attracts phagocytes to the area	1
phagocytes consume pathogens (and debris)	1
Subtotal	**5**
Total	**10**

Unit 4 – Evidence for evolution

Section 1

2023 Section 1 Question 2 Evidence for evolution	DNA sequencing provides evidence for evolution by demonstrating (a) the degree of similarity of a genome between different species. (b) the shared ancestry of species through similarities in anatomical structure. (c) precisely how and when species evolved from one another. (d) whether species shared the same base pairs in their DNA molecule.

2023 Section 1 Question 6 Evidence for evolution	In a polymerase chain reaction, the process by which new nucleotides are added is known as (a) priming. (b) denaturation. (c) extension. (d) annealing.

2023 Section 1 Question 14 Evidence for evolution	The polymerase chain reaction process begins by targeting the specific sequence of DNA that is required for amplification. Which of the following is required to indicate the correct starting point for adding nucleotides? (a) DNA polymerase (b) RNA polymerase (c) DNA primers (d) DNA ligase

2023 Section 1 Question 17 Evidence for evolution	How can radioisotopes be used to date volcanic rocks? The (a) depth of index fossils found below the surface can be measured. (b) amounts of potassium-40 and argon can be measured. (c) amounts of carbon-14 and nitrogen can be measured. (d) depth of rocks below the surface can be measured.

2023 Section 1 Question 25-26

Evidence for evolution

Questions 25 and 26 refer to the diagram shown below.

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25. The study of rock layers, like those shown in the diagram above, to help date fossils is known as

(a) correlation.
(b) stratigraphy.
(c) deposition.
(d) superposition.

26. Which of the following correctly identifies the youngest and oldest rock layers that can be seen in the diagram above?

	Youngest	Oldest
(a)	G	I
(b)	C	G
(c)	I	G
(d)	G	D

2023 Section 1 Question 28

Evidence for evolution

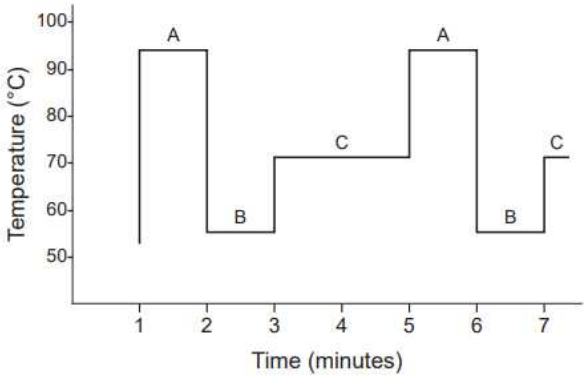
The role of gel electrophoresis in generating a DNA sequence can best be described as a process that

(a) amplifies the DNA sample to ensure enough material is available for sequencing.
(b) divides the DNA into singular nucleotide segments so that a sequence can be visible in the gel.
(c) separates the different lengths of DNA so one can determine the sequence of nucleotides.
(d) magnifies the DNA so one can observe the DNA sequence in the gel.

2022 Section 1 Question 4

Evidence for evolution

Question 4 refers to the diagram shown below, which represents the temperature changes during the polymerase chain reaction (PCR) process.



Which of the following identifies the three stages in PCR correctly?

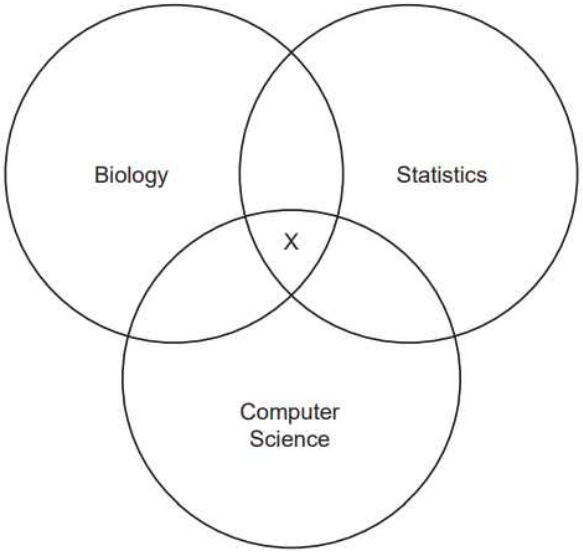
	A	B	C
(a)	denaturing	annealing	extension
(b)	annealing	denaturing	elongation
(c)	denaturing	hybridisation	annealing
(d)	extension	denaturing	annealing

2022 Section 1 Question 5 **Evidence for evolution**	A fossil can be defined as a (a) preserved trace of an object that can support evolutionary relationships. (b) bone that has been preserved and can be dated to show evolutionary relationships. (c) buried artefact made by humans that supports human evolutionary relationships. (d) preserved trace of a previously living organism that supports evolutionary relationships.

2022 Section 1 Question 9 **Evidence for evolution**	Which of the following lists includes only relative dating methods? (a) index fossils, radiocarbon dating, correlation of rock strata (b) stratigraphy, correlation of rock strata, index fossils (c) radiocarbon dating, stratigraphy, principle of superposition (d) principle of superposition, stratigraphy, potassium argon dating

2022 Section 1 Question 16 **Evidence for evolution**	According to the phylogenetic tree, the closest evolutionary relationship between *Homo sapiens* and a non *Homo* species is the (a) Eastern Gorilla. (b) Eastern Chimpanzee. (c) *Homo habilis*. (d) Bonobo.

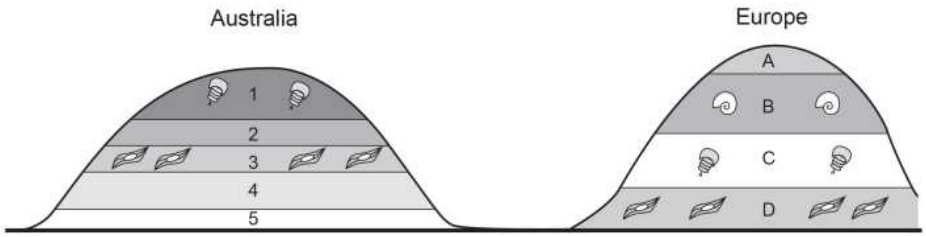
2022 Section 1 Question 25 **Evidence for evolution**	A scientist used the potassium-argon dating method to determine the age of a sample. This type of dating involves comparing the amount of (a) Argon-40 and Potassium-40 to the remaining Calcium-40. (b) Potassium-41 remaining in the sample to the amount of Argon-41. (c) Argon-40 in the sample to the remaining amount of Potassium-40. (d) Argon-40 and Calcium-40 to the remaining Potassium-41.

2022 Section 1 Question 27 **Evidence for evolution**	Question 27 refers to the diagram shown below, which represents an area of study related to Human Biology.  The area of study shown as X is **best** described as (a) comparative genomics. (b) biotechnology. (c) comparative biochemistry. (d) bioinformatics.

2021 Section 1 Question 6 **Evidence for evolution**	Comparative genomics refers to research in which (a) the complete DNA sequence of an organism is compared to one of another species. (b) computerised data on the molecular structure of the genome of a species is analysed. (c) chromosomes are extracted and gene sequences of a species are mapped. (d) proteins, RNA and DNA of one species are compared to that of another species.

2021 Section 1 Question 18 **Evidence for evolution**	Shown below is a list of steps involved in gel electrophoresis and some incorrect statements that could be associated with the process. I. DNA moves from positive to negative electrode. II. An electric current is passed through the gel. III. DNA pieces are placed at one end of the gel. IV. DNA moves from negative to positive electrode. V. Smaller pieces of DNA move faster through the gel. VI. DNA bands form. VII. Larger pieces of DNA move faster through the gel. Which of the following orders the steps of gel electrophoresis correctly? (a) III – II – IV – V – VI (b) II – III – I – V – VI (c) II – III – IV – VII – VI (d) III – II – I – VII – VI

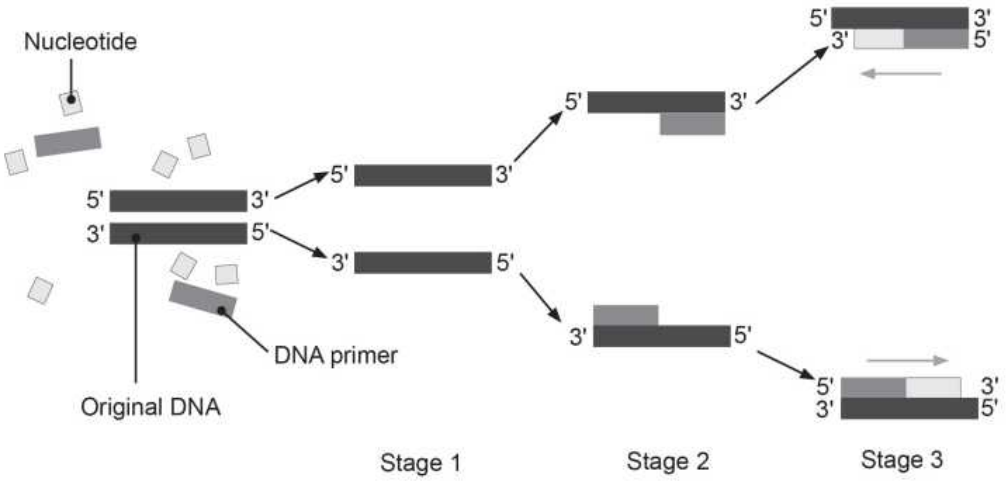
2021 Section 1 Question 20 **Evidence for evolution**	A limitation of potassium-argon dating is that it (a) does not provide an absolute date, only a relative one. (b) can only date organic material younger than 70 000 years. (c) does not provide a good statistical measure of the age of an artefact. (d) can only date rocks older than 100 000 years.

2020 Section 1 Question 2 **Evidence for evolution**	Question 2 refers to the following diagram.  The two layers which are of similar age are (a) Australia 2, Europe A. (b) Australia 1, Europe C. (c) Australia 4, Europe A. (d) Australia 3, Europe B.

2020 Section 1 Question 5-6

Evidence for evolution

Questions 5 and 6 refer to the diagram shown below.



5. The correct names for the three stages shown in the diagram are

	Stage 1	Stage 2	Stage 3
(a)	denaturing	replication	annealing
(b)	elongation	hybridisation	extension
(c)	replication	annealing	extension
(d)	denaturing	annealing	elongation

6. Which of the following describes correctly the temperature changes between Stage 1 and Stage 2 needed for the process to occur?

Initial reaction occurs at

(a) 65 °C and is heated to 96 °C.
(b) 72 °C and is cooled to 40 °C.
(c) 96 °C and is cooled to 60 °C.
(d) 55 °C and is heated to 72 °C.

2020 Section 1 Question 15

Evidence for evolution

Which one of the following statements explains correctly why fossils younger than 100 000 years cannot be dated with the potassium argon method?

(a) Rocks younger than 100 000 years have too much argon-40 for accurate dating to be undertaken.
(b) The half-life of potassium-40 is long and there is not enough argon-40 to measure until 100 000 years.
(c) The normal proportion of potassium-40 to argon-40 in the rock specimens is not known before 100 000 years ago.
(d) Before 100 000 years there is no argon-40 found in the rock specimens for dating.

2020 Section 1 Question 18

Evidence for evolution

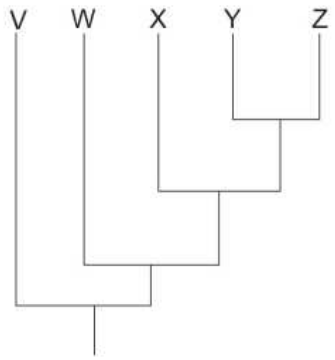
Which of the following would involve studying vestigial organs and homologous structures to determine evolutionary relationships?

(a) comparative studies of embryology
(b) comparative genomics
(c) comparative anatomy
(d) comparative studies of DNA

2020 Section 1 Question 25 **Evidence for evolution**	Which field of research would be **best** described as involving the comparison of genetic sequences of two species to establish the degree of evolutionary relatedness? (a) bioinformatics (b) comparative biochemistry (c) comparative genomics (d) palaeontology

2020 Section 1 Question 28 **Evidence for evolution**	The following is a list of statements associated with fossils and fossil formation. I. Specimens need to be protected from decay by micro-organisms. II. Fossils may be destroyed by human activity and earth movements. III. Archaeologists may be looking in the wrong place. IV. Specimens need to be buried rapidly. V. Fossils need to be left undisturbed for a long time. Which of the statements are correct reasons for it being difficult to locate fossils? (a) I, II and III (b) II and III (c) II, III and IV (d) IV and V

2019 Section 1 Question 4 **Evidence for evolution**	In gel electrophoresis, DNA moves (a) toward the positive electrode. (b) toward the negative electrode. (c) further when the fragments are larger. (d) faster when the gel is denser.

2019 Section 1 Question 15 **Evidence for evolution**	Question 15 refers to the diagram shown below.  In this phylogenetic tree, which two species possess the **greatest** difference? (a) V and W (b) Y and Z (c) W and Z (d) X and Y

Section 2

2023 Section 2 Question 33

Evidence for evolution

The following question refers to the image shown below of a trilobite, a group of arthropods that existed on Earth 300 million years ago, before becoming extinct around 250 million years ago.

(a) The trilobite is considered an index fossil. Complete the table below, to identify two features a fossil must have to be considered an index fossil and state why each feature is necessary to meet index fossil requirements. (4 marks)

Feature	Why feature is necessary to meet index fossil requirements

(b) Describe two factors that improve the chances that an organism will become a fossil. (4 marks)

One:

Two:

(c) In a stratum that contained trilobite fossils, a modern human skull was also located. Outline two ways in which this could have occurred. (2 marks)

One:

Two:

(d) Suggest how a scientist would determine an absolute date for an anatomically-modern human. (4 marks)

2022 Section 2 Question 32 **Evidence for evolution**	The following question refers to the diagram shown below, which represents various skull and teeth profiles. ***Copyright restrictions prohibit the release of this SCSA exam material.*** The diagram depicts four skull specimens with graphics of the relative brain sizes and teeth profiles that belong to each of the skulls. Note: the teeth profiles do not necessarily match the skulls and brain sizes shown above them. (a) Identify the names of the two types of mammalian teeth that are shown in the teeth profile part of the diagram. (2 marks) One: Two (b) State the letter of the tooth profile that matches correctly the skull as shown in the diagram. (2 marks) Skull 2: Skull 4: (c) Using the diagram on page 16, identify three hominid evolutionary trends shown in the jaws and teeth. (3 marks) One: Two: Three:

(d) Explain how an index fossil can be used to date another fossil. (3 marks)

(e) 'Homo sapiens could, in a future setting, be an excellent example of an index fossil. All other known hominin species would be poor index fossils.' Justify this statement. (3 marks)

Gaps in the fossil record could potentially mean that our current conclusions about evolutionary pathways are flawed.

(f) (i) One reason why gaps in the fossil record exist is that conditions for fossil formation are very specific. Complete the table below, describing each specific condition needed for fossil formation. (4 marks)

Condition	Description of condition for fossil formation
Soil type	
Specimen to be fossilised	
Micro-organisms	
Exposure to atmosphere	

(ii) Apart from the conditions listed in part (f)(i), describe two other reasons why gaps in the fossil record exist. (4 marks)

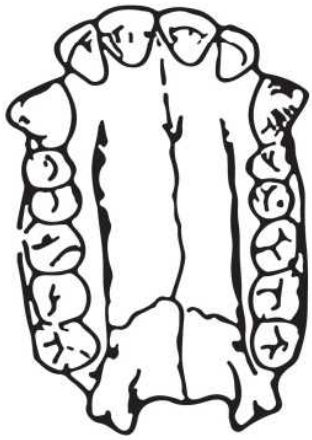
One:

Two:

2021 Section 2 Question 33

Evidence for evolution

The following question refers to the jaw diagram shown below.



(a) Is the jaw pictured from a great ape or a human? Justify your answer by identifying **one** feature that supports your conclusion. (2 marks)

(b) The evolution from great ape to human has involved several changes to the cranium. For the following cranial features, contrast great ape and human craniums. (3 marks)

Brow ridges:

Facial profile:

Foramen magnum:

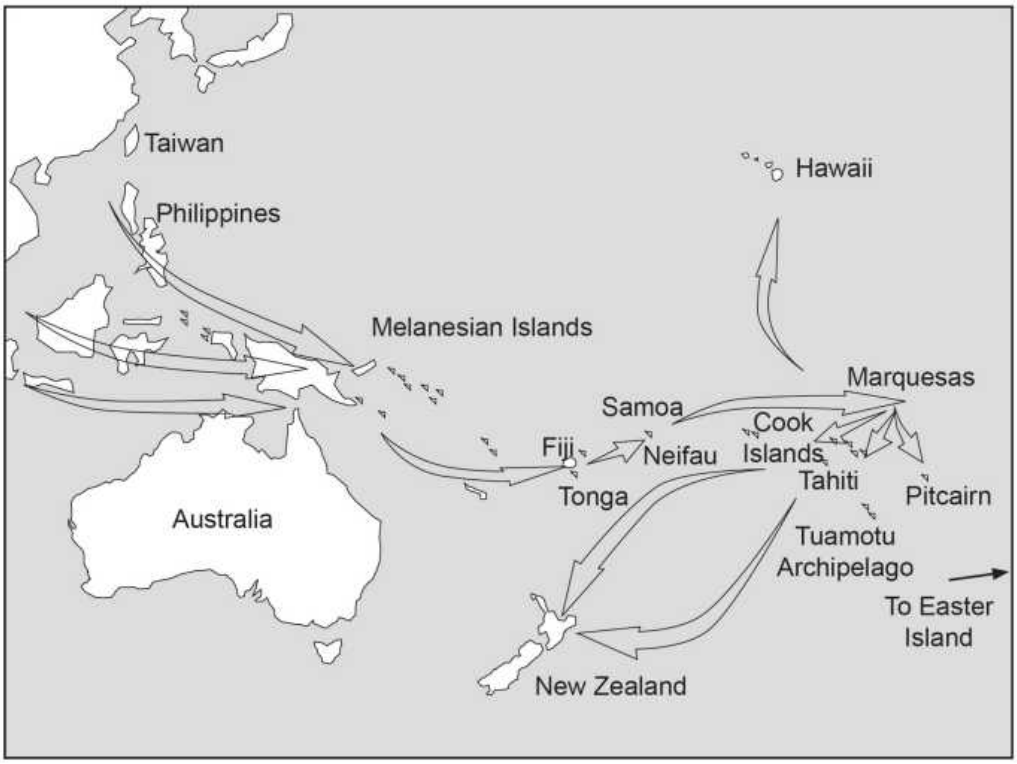
(c) With hominins becoming bipedal there were several changes to their hands and feet. Describe what these changes were and how they contributed to bipedalism and mobility of their digits. (6 marks)

Evolutionary changes to the feet	(2 marks)
Contribution to bipedalism	(1 mark)
Evolutionary changes to the hands	(2 marks)
Contribution to the mobility of digits	(1 mark)

2020 Section 2 Question 35

Evidence for evolution

The image below depicts a possible settlement pattern for the previously uninhabited Polynesian islands.



(a) In relation to the following, describe the effect on the gene pools each time a small group of people settle onto a new Polynesian island.

(i) Gene flow: (2 marks)

(ii) Impact of selection pressures on alleles: (3 marks)

Recent genetic studies have indicated that modern-day Polynesians are descendants of people who lived on the island of Taiwan, off the coast of China, approximately 5000 years ago. In one study, the DNA from the skeletons of four ancient Polynesian women, dated between 2300 to 3100 years ago, was analysed. An absolute date for the skeletons was calculated using radiocarbon dating.

(b) (i) Identify two reasons why radiocarbon dating was an appropriate method for determining the age of the Polynesian skeletons. (2 marks)

One:

Two:

(ii) Describe how radiocarbon dating works to determine the age of a fossil. (3 marks)

(c) A fossil of a human skeleton was found in Australia. Can the Polynesian fossil be used to provide a relative date for the Australian skeleton? Provide a reason for your answer. (2 marks)

2019 Section 2 Question 37 **Evidence for evolution**	Embryos generated by in vitro fertilisation (IVF) are screened for suitability for implantation. This involves isolating a few cells from the early embryos, amplifying the DNA regions of interest from those cells and performing DNA sequencing. (a) (i) Identify the biotechnology application used to amplify the DNA regions of interest. (1 mark) (ii) List the **three** stages involved in this biotechnology application. (3 marks) One: Two: Three: (b) What is DNA sequencing? (1 mark) (c) State **two** ways in which the genomic information obtained by DNA sequencing of the embryo cells could be useful. (2 marks) One: Two: Personal genomic tests are now accessible by Australians from online medical companies. (d) Propose three ethical considerations when accessing personal genome information. (3 marks) One: Two: Three:

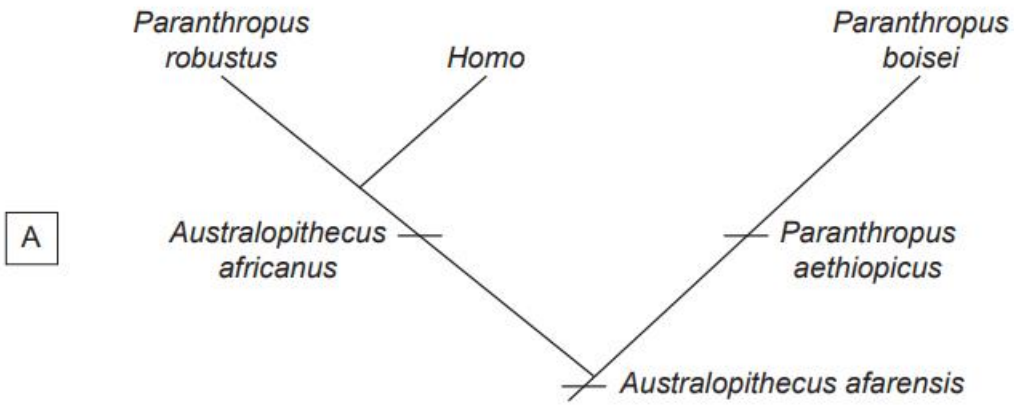
2019 Section 2 Question 40 **Evidence for evolution**	At the Madjedbebe rock shelter in Kakadu (Northern Territory), archaeologists recently extracted several Aboriginal artefacts. These included hatchets, tools for seed grinding and ochre crayons used to make pigment. Through a range of techniques, the artefacts were dated at about 65 000 years old. The diagram below shows a cross-section of the rock strata at the excavation site. ***Copyright restrictions prohibit the release of this SCSA exam material.*** Artefacts at Madjedbebe were found in the oldest rock strata layer. (a) According to the diagram above, state which rock strata layer 1, 2 or 3 would the artefacts have been found by archaeologists. (1 mark) (b) Name the relative dating method used to identify the oldest and youngest layers from rock strata and explain how this dating method is applied. (3 marks) Archaeologists did not only use relative dating. (c) Identify the evidence that supports this statement and outline why they used more than one dating method. (2 marks)

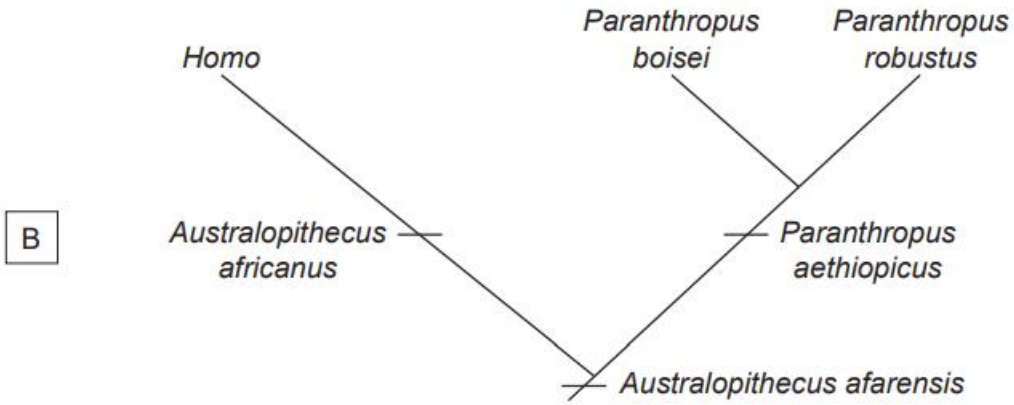
Section 3

2023 Section 3 Question 40

Evidence for evolution

Phylogenetic trees are essential tools used in understanding evolutionary pathways. Below are two possible phylogenetic trees for hominin evolution.





(a) Recall the evidence that phylogenetic trees illustrate. (4 marks)

(b) Compare the information about hominin evolution that can be deduced from what is depicted in the two phylogenetic trees. (10 marks)

(c) Explain how the inclusion of the terms 'Homo', 'Australopithecus' or 'Paranthropus' in a species provides information about hominin evolution and identify the skull feature that distinguishes a Paranthropus specimen from the others. (6 marks)

Marking Guide – Section 1

2023 Section 1 Question 2 **Evidence for evolution**	DNA sequencing provides evidence for evolution by demonstrating **(a) the degree of similarity of a genome between different species. – Answer** (b) the shared ancestry of species through similarities in anatomical structure. (c) precisely how and when species evolved from one another. (d) whether species shared the same base pairs in their DNA molecule.

2023 Section 1 Question 6 **Evidence for evolution**	In a polymerase chain reaction, the process by which new nucleotides are added is known as (a) priming. (b) denaturation. **(c) extension. – Answer** (d) annealing.

2023 Section 1 Question 14 **Evidence for evolution**	The polymerase chain reaction process begins by targeting the specific sequence of DNA that is required for amplification. Which of the following is required to indicate the correct starting point for adding nucleotides? (a) DNA polymerase (b) RNA polymerase **(c) DNA primers – Answer** (d) DNA ligase

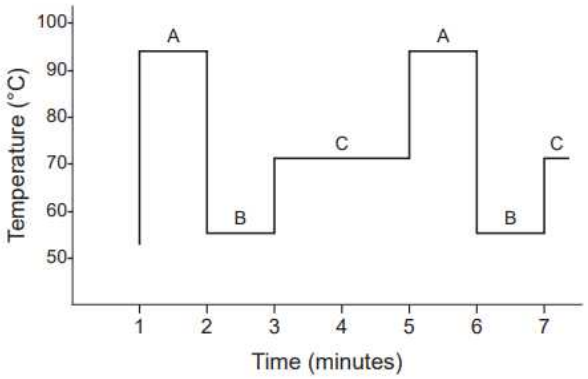
2023 Section 1 Question 17 **Evidence for evolution**	How can radioisotopes be used to date volcanic rocks? The (a) depth of index fossils found below the surface can be measured. **(b) amounts of potassium-40 and argon can be measured. – Answer** (c) amounts of carbon-14 and nitrogen can be measured. (d) depth of rocks below the surface can be measured.

2023 Section 1 Question 25-26 **Evidence for evolution**	Questions 25 and 26 refer to the diagram shown below. ***Copyright restrictions prohibit the release of this SCSA exam material.*** 25. The study of rock layers, like those shown in the diagram above, to help date fossils is known as (a) correlation. **(b) stratigraphy. – Answer** (c) deposition. (d) superposition. 26. Which of the following correctly identifies the youngest and oldest rock layers that can be seen in the diagram above?

	Youngest	Oldest
(a)	G	I
(b)	C	G
(c)	I	G
(d)	G	D

Answer is c.

2023 Section 1 Question 28 **Evidence for evolution**	The role of gel electrophoresis in generating a DNA sequence can best be described as a process that (a) amplifies the DNA sample to ensure enough material is available for sequencing. (b) divides the DNA into singular nucleotide segments so that a sequence can be visible in the gel. **(c) separates the different lengths of DNA so one can determine the sequence of nucleotides. – Answer** (d) magnifies the DNA so one can observe the DNA sequence in the gel.

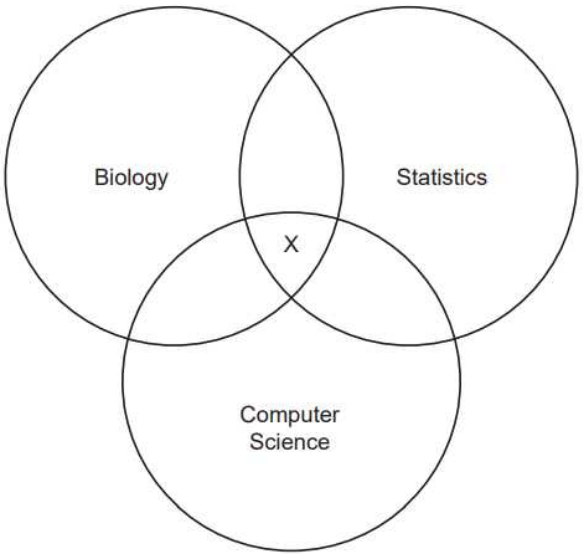
2022 Section 1 Question 4 **Evidence for evolution**	Question 4 refers to the diagram shown below, which represents the temperature changes during the polymerase chain reaction (PCR) process.  Which of the following identifies the three stages in PCR correctly? (a) denaturing / annealing / extension (b) annealing / denaturing / elongation (c) denaturing / hybridisation / annealing (d) extension / denaturing / annealing **Answer is a.**

2022 Section 1 Question 5 **Evidence for evolution**	A fossil can be defined as a (a) preserved trace of an object that can support evolutionary relationships. (b) bone that has been preserved and can be dated to show evolutionary relationships. (c) buried artefact made by humans that supports human evolutionary relationships. **(d) preserved trace of a previously living organism that supports evolutionary relationships. – Answer**

2022 Section 1 Question 9 **Evidence for evolution**	Which of the following lists includes only relative dating methods? (a) index fossils, radiocarbon dating, correlation of rock strata **(b) stratigraphy, correlation of rock strata, index fossils – Answer** (c) radiocarbon dating, stratigraphy, principle of superposition (d) principle of superposition, stratigraphy, potassium argon dating

2022 Section 1 Question 16 **Evidence for evolution**	According to the phylogenetic tree, the closest evolutionary relationship between *Homo sapiens* and a non *Homo* species is the (a) Eastern Gorilla. (b) Eastern Chimpanzee. (c) *Homo habilis*. **(d) Bonobo. – Answer**

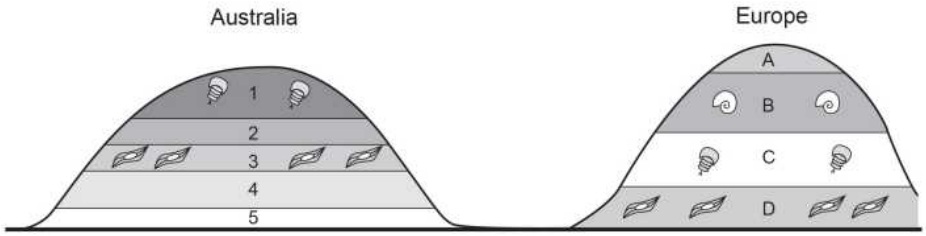
2022 Section 1 Question 25 **Evidence for evolution**	A scientist used the potassium-argon dating method to determine the age of a sample. This type of dating involves comparing the amount of (a) Argon-40 and Potassium-40 to the remaining Calcium-40. (b) Potassium-41 remaining in the sample to the amount of Argon-41. **(c) Argon-40 in the sample to the remaining amount of Potassium-40. – Answer** (d) Argon-40 and Calcium-40 to the remaining Potassium-41.

2022 Section 1 Question 27 **Evidence for evolution**	Question 27 refers to the diagram shown below, which represents an area of study related to Human Biology.  The area of study shown as X is **best** described as (a) comparative genomics. (b) biotechnology. (c) comparative biochemistry. **(d) bioinformatics. – Answer**

2021 Section 1 Question 6 **Evidence for evolution**	Comparative genomics refers to research in which **(a) the complete DNA sequence of an organism is compared to one of another species. – Answer** (b) computerised data on the molecular structure of the genome of a species is analysed. (c) chromosomes are extracted and gene sequences of a species are mapped. (d) proteins, RNA and DNA of one species are compared to that of another species.

2021 **Section 1** **Question 18** **Evidence for evolution**	Shown below is a list of steps involved in gel electrophoresis and some incorrect statements that could be associated with the process. I. DNA moves from positive to negative electrode. II. An electric current is passed through the gel. III. DNA pieces are placed at one end of the gel. IV. DNA moves from negative to positive electrode. V. Smaller pieces of DNA move faster through the gel. VI. DNA bands form. VII. Larger pieces of DNA move faster through the gel. Which of the following orders the steps of gel electrophoresis correctly? **(a) III – II – IV – V – VI – Answer** (b) II – III – I – V – VI (c) II – III – IV – VII – VI (d) III – II – I – VII – VI

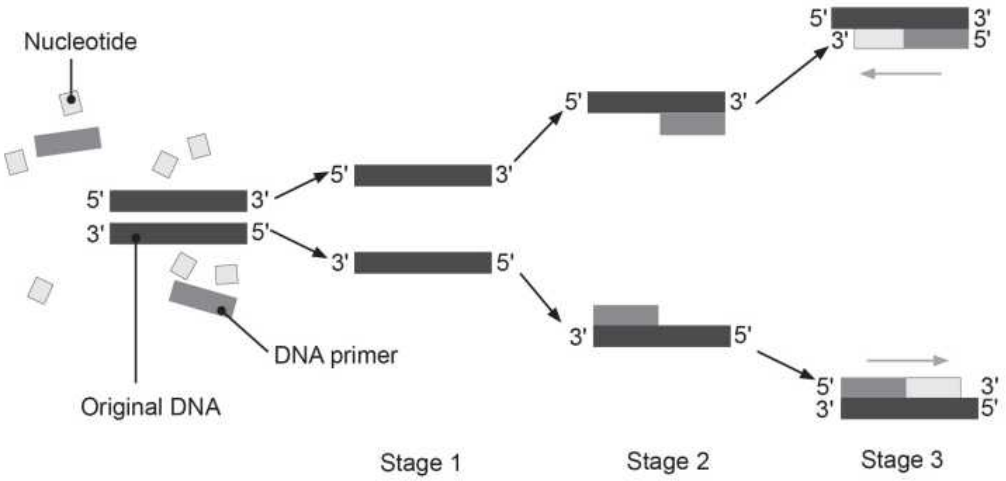
2021 **Section 1** **Question 20** **Evidence for evolution**	A limitation of potassium-argon dating is that it (a) does not provide an absolute date, only a relative one. (b) can only date organic material younger than 70 000 years. (c) does not provide a good statistical measure of the age of an artefact. **(d) can only date rocks older than 100 000 years. – Answer**

2020 **Section 1** **Question 2** **Evidence for evolution**	Question 2 refers to the following diagram.  The two layers which are of similar age are (a) Australia 2, Europe A. **(b) Australia 1, Europe C. – Answer** (c) Australia 4, Europe A. (d) Australia 3, Europe B.

2020 Section 1 Question 5-6

Evidence for evolution

Questions 5 and 6 refer to the diagram shown below.



5. The correct names for the three stages shown in the diagram are

	Stage 1	Stage 2	Stage 3
(a)	denaturing	replication	annealing
(b)	elongation	hybridisation	extension
(c)	replication	annealing	extension
(d)	denaturing	annealing	elongation

Answer is d.

6. Which of the following describes correctly the temperature changes between Stage 1 and Stage 2 needed for the process to occur?

Initial reaction occurs at

(a) 65 °C and is heated to 96 °C.
(b) 72 °C and is cooled to 40 °C.
(c) 96 °C and is cooled to 60 °C. – Answer
(d) 55 °C and is heated to 72 °C.

2020 Section 1 Question 15

Evidence for evolution

Which one of the following statements explains correctly why fossils younger than 100 000 years cannot be dated with the potassium argon method?

(a) Rocks younger than 100 000 years have too much argon-40 for accurate dating to be undertaken.
(b) The half-life of potassium-40 is long and there is not enough argon-40 to measure until 100 000 years. – Answer
(c) The normal proportion of potassium-40 to argon-40 in the rock specimens is not known before 100 000 years ago.
(d) Before 100 000 years there is no argon-40 found in the rock specimens for dating.

2020 Section 1 Question 18

Evidence for evolution

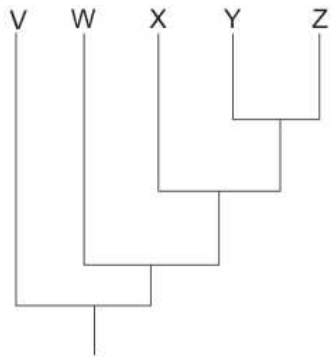
Which of the following would involve studying vestigial organs and homologous structures to determine evolutionary relationships?

(a) comparative studies of embryology
(b) comparative genomics
(c) comparative anatomy – Answer
(d) comparative studies of DNA

2020 **Section 1** **Question 25** **Evidence for evolution**	Which field of research would be **best** described as involving the comparison of genetic sequences of two species to establish the degree of evolutionary relatedness? (a) bioinformatics (b) comparative biochemistry **(c) comparative genomics – Answer** (d) palaeontology

2020 **Section 1** **Question 28** **Evidence for evolution**	The following is a list of statements associated with fossils and fossil formation. I. Specimens need to be protected from decay by micro-organisms. II. Fossils may be destroyed by human activity and earth movements. III. Archaeologists may be looking in the wrong place. IV. Specimens need to be buried rapidly. V. Fossils need to be left undisturbed for a long time. Which of the statements are correct reasons for it being difficult to locate fossils? (a) I, II and III **(b) II and III – Answer** (c) II, III and IV (d) IV and V

2019 **Section 1** **Question 4** **Evidence for evolution**	In gel electrophoresis, DNA moves **(a) toward the positive electrode. – Answer** (b) toward the negative electrode. (c) further when the fragments are larger. (d) faster when the gel is denser.

2019 **Section 1** **Question 15** **Evidence for evolution**	Question 15 refers to the diagram shown below.  In this phylogenetic tree, which two species possess the **greatest** difference? (a) V and W (b) Y and Z **(c) W and Z – Answer** (d) X and Y

2023 Section 2 Question 33

Evidence for evolution

The following question refers to the image shown below of a trilobite, a group of arthropods that existed on Earth 300 million years ago, before becoming extinct around 250 million years ago.

(a) The trilobite is considered an index fossil. Complete the table below, to identify two features a fossil must have to be considered an index fossil and state why each feature is necessary to meet index fossil requirements. (4 marks)

Description		Marks
Any two features with matching reason: (2 x 2 marks)		
Feature	**Why feature is necessary to meet index fossil requirements**	1–4
must be widespread	to allow dating worldwide/a range of locations	
in large numbers	numerous enough to be easily found	
recognisable	helps to be found easily/distinguishable	
lived for limited/known time	to identify the time period of their existence	
	Total	**4**

(b) Describe two factors that improve the chances that an organism will become a fossil. (4 marks)

Description	Marks
Any two of (2 x 2 marks)	
• made of hard exoskeleton or bone less chance of being decomposed/eaten • needs to be covered by sediment quickly/rapid burial to remove oxygen/no decomposers/less chance of scavengers destroying it • low energy area/left undisturbed less chance of being destroyed by motion/erosion/moving water/wind	1–4
Total	**4**

(c) In a stratum that contained trilobite fossils, a modern human skull was also located. Outline two ways in which this could have occurred. (2 marks)

Description	Marks
Any two of	
• folding/faulting/earth movements that bring lower strata to a higher position • erosion collapsing of higher strata to lower strata • animals burying bones into lower strata • human burial of bones into lower strata	1–2
Total	**2**

(d) Suggest how a scientist would determine an absolute date for an anatomically-modern human. (4 marks)

Description	Marks
using C-14/carbon dating	1
ratio of C-12 to C-14 is measured	1
half-life of C-14 is 5730 years	1
actual age is calculated	1
Total	**4**

2022 Section 2 Question 32

Evidence for evolution

The following question refers to the diagram shown below, which represents various skull and teeth profiles.

Copyright restrictions prohibit the release of this SCSA exam material.

The diagram depicts four skull specimens with graphics of the relative brain sizes and teeth profiles that belong to each of the skulls. Note: the teeth profiles do not necessarily match the skulls and brain sizes shown above them.

(a) Identify the names of the two types of mammalian teeth that are shown in the teeth profile part of the diagram. (2 marks)

Description	Marks
canines	1
premolars/molar	1
Total	**2**

(b) State the letter of the tooth profile that matches correctly the skull as shown in the diagram. (2 marks)

Description	Marks
skull 2 – P	1
skull 4 – O	1
Total	**2**

(c) Using the diagram on page 16, identify three hominid evolutionary trends shown in the jaws and teeth. (3 marks)

Description	Marks
Any three of	
• reduced size of canines/molars/teeth • loss of diastema • teeth become more evenly sized to one another • flatter face/reduced prognathism/smaller jaw	1–3
Total	**3**

(d) Explain how an index fossil can be used to date another fossil. (3 marks)

Description	Marks
index fossils have a known date/age range	1
due to widespread but limited time span they exist	1
if found with other fossils, age can be correlated	1
Total	**3**

(e) 'Homo sapiens could, in a future setting, be an excellent example of an index fossil. All other known hominin species would be poor index fossils.' Justify this statement. (3 marks)

Description	Marks
index fossils have a known date/age range	1
due to widespread but limited time span they exist	1
if found with other fossils, age can be correlated	1
Total	**3**

Gaps in the fossil record could potentially mean that our current conclusions about evolutionary pathways are flawed.

(f) (i) One reason why gaps in the fossil record exist is that conditions for fossil formation are very specific. Complete the table below, describing each specific condition needed for fossil formation. (4 marks)

Description	Marks
Soil type – Alkaline with low oxygen levels	1
Specimen to be fossilised – Contains hard (solid) parts/bone/teeth	1
Micro-organisms – Not present/protected from decay	1
Exposure to atmosphere – Covered quickly at death/protected by sediment	1
Total	**4**

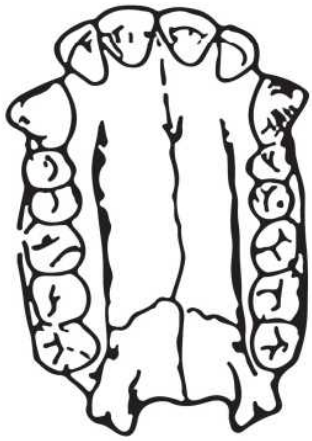
(ii) Apart from the conditions listed in part (f)(i), describe two other reasons why gaps in the fossil record exist. (4 marks)

Description	Marks
Any two of (1 mark for the condition and 1 mark for describing it)	
• fossils can be buried too deep • making them too hard to find	1–4
• fossil can be destroyed • through human activity/geological processes/weathering and erosion	
• fossils need to be left undisturbed for a long time/not attacked by scavengers/disturbed by geological process • to allow time for the fossilisation process to take place	
• fossil may not be discovered • people not looking in right locations/not being recognised	
Total	**4**

2021 Section 2 Question 33

Evidence for evolution

The following question refers to the jaw diagram shown below.



(a) Is the jaw pictured from a great ape or a human? Justify your answer by identifying **one** feature that supports your conclusion. (2 marks)

Description	Marks
Great ape	1
Any **one** of the following:	
It is 'U' shaped as opposed to parabolic	1
Range of teeth sizes as opposed to teeth of similar size	
Large teeth as opposed to small teeth	
Large molars as opposed to molars of similar size to other teeth	
Prominent canines as opposed to canines same size as other teeth	
The jaw has gaps (diastema) between some of the teeth	
Total	**2**

(b) The evolution from great ape to human has involved several changes to the cranium. For the following cranial features, contrast great ape and human craniums. (3 marks)

Description	Marks
Brow ridges	
Great ape – prominent brow ridge; Humans – reduced/absent brow ridge	1
Facial profile	
Great ape – prognathic/sloping face; Humans – flatter/vertical face	1
Foramen magnum	
Great ape – foramen magnum to rear of base of skull; Humans – foramen magnum more central/underneath skull	1
Total	**3**

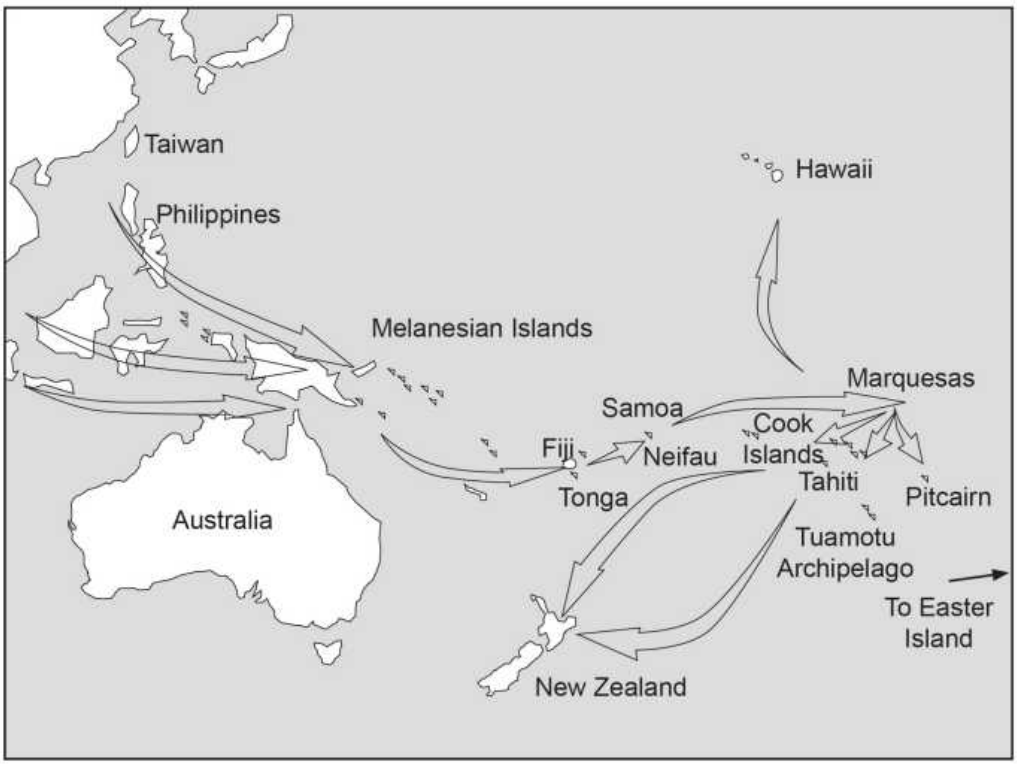
(c) With hominins becoming bipedal there were several changes to their hands and feet. Describe what these changes were and how they contributed to bipedalism and mobility of their digits. (6 marks)

Description	Marks
Evolutionary changes to the feet Any **two** of the following:	
Longitudinal and transverse arches	1–2
Big toe aligned with other toes/non-prehensile big toe/parallel toes	
Robust calcaneus	
How the changes to the feet contributed to bipedalism	
Any **one** of the following:	
Allowed feet to carry more load	1
Allows for striding gait	
Acts as a shock absorber	
Better balance when upright	
Evolutionary changes to the hands	
Any **two** of the following:	
Thumb relatively longer to fingers	1–2
Opposability of thumb	
Short broad palm	
Relocation of muscles for fingers to forearm	
How the changes to the hands contributed to mobility of digits Any **one** of the following:	
Allowed for the precision grip	1
Allowed hands to be more manoeuvrable/manipulate objects	
Total	**6**

2020 Section 2 Question 35

Evidence for evolution

The image below depicts a possible settlement pattern for the previously uninhabited Polynesian islands.



(a) In relation to the following, describe the effect on the gene pools each time a small group of people settle onto a new Polynesian island.

(i) Gene flow: (2 marks)

Description	Marks
gene flow is reduced due to geographical barriers (ocean)/isolation/inhibiting interbreeding between populations	1
traits (alleles) that are not frequent in the original population can become more frequent	1
Total	**2**

(ii) Impact of selection pressures on alleles: (3 marks)

Description	Marks
different environmental pressures result in different alleles being selected for	1–3
over time (generations) allele frequencies in the gene pools will change	
populations become less like each other depending on which alleles are selected for	
Total	**3**

Recent genetic studies have indicated that modern-day Polynesians are descendants of people who lived on the island of Taiwan, off the coast of China, approximately 5000 years ago. In one study, the DNA from the skeletons of four ancient Polynesian women, dated between 2300 to 3100 years ago, was analysed. An absolute date for the skeletons was calculated using radiocarbon dating.

(b) (i) Identify two reasons why radiocarbon dating was an appropriate method for determining the age of the Polynesian skeletons. (2 marks)

Description	Marks
because it can date fossils up to the age of 60 000–70 000 years old/the skeletons found were at the correct age range for dating technique	1
skeleton is organic material	1
Total	**2**

(ii) Describe how radiocarbon dating works to determine the age of a fossil. (3 marks)

Description	Marks
based on the decay of carbon-14 to nitrogen	1
the ratio of carbon-14 to carbon-12 determines the age	1
carbon-14 has a half-life of 5730 years	1
Total	**3**

(c) A fossil of a human skeleton was found in Australia. Can the Polynesian fossil be used to provide a relative date for the Australian skeleton? Provide a reason for your answer. (2 marks)

Description	Marks
no	1
the fossils are from different locations so cannot be correlated	1
or	
Yes	1
if index fossils are present that allow correlation	1
Total	**2**

2019 Section 2 Question 37

Evidence for evolution

Embryos generated by in vitro fertilisation (IVF) are screened for suitability for implantation. This involves isolating a few cells from the early embryos, amplifying the DNA regions of interest from those cells and performing DNA sequencing.

(a) (i) Identify the biotechnology application used to amplify the DNA regions of interest. (1 mark)

Description	Marks
PCR/Polymerase chain reaction	1
Total	**1**

(ii) List the **three** stages involved in this biotechnology application. (3 marks)

Description	Marks
denaturation	1
annealing	1
extension/elongation	1
Total	**3**

(b) What is DNA sequencing? (1 mark)

Description	Marks
a process to determine the order of the nucleotides in a gene of interest/sample of DNA	1
Total	**1**

(c) State **two** ways in which the genomic information obtained by DNA sequencing of the embryo cells could be useful. (2 marks)

Description	Marks
Any **two** of the following:	
establish long-term prognosis/identify disease-causing mutations/whether a person will develop an inherited disease.	1–2
family planning	
paternity/maternity testing	
Total	**2**

Personal genomic tests are now accessible by Australians from online medical companies.

(d) Propose three ethical considerations when accessing personal genome information. (3 marks)

Description	Marks
Any **three** of the following:	
Autonomy – personal responsibility • right to access personal genomic information • right to be informed about the meaning and support based upon the personal genomic information	1–3
Confidentiality – information is sensitive and controlled • access to personal genomic information is sensitive • access to sensitive personal genomic information is controlled/limited	
Privacy – limited access to information • right to limited access to personal genomic information • right for the individual and the personal genomic information to remain private • right that others may know personal genomic information (access by other companies and family)	
Equity – fair treatment based on information • right to equal and fair treatment based on personal genomic information	
Total	**3**
Answers may include: • individuals should be able to draw on unbiased information/advice • individuals need to be able to consider possible options available from genetic information • individuals should consider government support provided to help make decisions • individuals need to consider possible information that may be revealed (unknown genetic relationships) • potential distress/harm caused by revealing unknown genetic information • ownership of genetic information by the person or company • possible uses of genetic information by health providers/insurance companies (information falling into the wrong hands) • possible financial cost of testing/cost of dealing with uncovered issues	
Any other relevant answer	

2019 Section 2 Question 40

Evidence for evolution

At the Madjedbebe rock shelter in Kakadu (Northern Territory), archaeologists recently extracted several Aboriginal artefacts. These included hatchets, tools for seed grinding and ochre crayons used to make pigment. Through a range of techniques, the artefacts were dated at about 65 000 years old.

The diagram below shows a cross-section of the rock strata at the excavation site.

Copyright restrictions prohibit the release of this SCSA exam material.

Artefacts at Madjedbebe were found in the oldest rock strata layer.

(a) According to the diagram above, state which rock strata layer 1, 2 or 3 would the artefacts have been found by archaeologists. (1 mark)

Description	Marks
3	1
Total	**1**

(b) Name the relative dating method used to identify the oldest and youngest layers from rock strata and explain how this dating method is applied. (3 marks)

Description	Marks
principle of superposition	1
rock layers are deposited over time	1
further down a layer the older a layer is/newer layers laid on top	1
Total	**3**

Archaeologists did not only use relative dating.

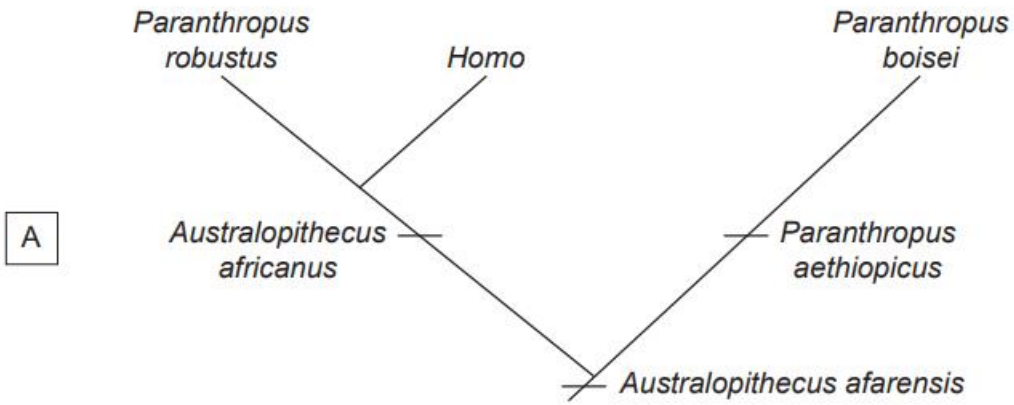
(c) Identify the evidence that supports this statement and outline why they used more than one dating method. (2 marks)

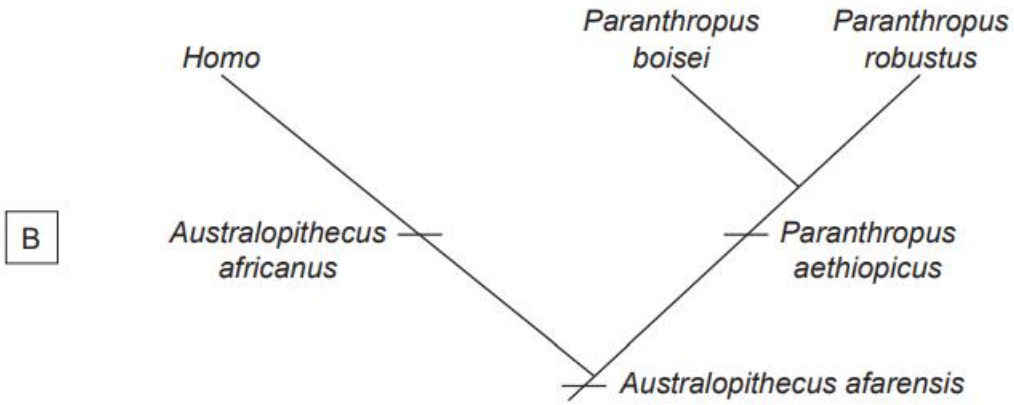
Description	Marks
they had an actual date for the artefacts	1
relative dating does not provide dates/need absolute dating technique to give an age	1
improves reliability/validity	
error in relative dating/eg. Earth movements can alter strata levels	
Total	**2**

2023 Section 3 Question 40

Evidence for evolution

Phylogenetic trees are essential tools used in understanding evolutionary pathways. Below are two possible phylogenetic trees for hominin evolution.





(a) Recall the evidence that phylogenetic trees illustrate. (4 marks)

Description	Marks
Any four of	
• represent evolutionary relationships between organisms • reflect how recently species evolved from common ancestors • more recent common ancestors indicate more closely related species • less recent common ancestors indicate less closely related species • hypotheses of the relationships/not facts/possible relationships/ possible pathways	1–4
Total	**4**

(b) Compare the information about hominin evolution that can be deduced from what is depicted in the two phylogenetic trees. (10 marks)

Description	Marks
Similarities – any four of	
• both show *A. afarensis* as the common ancestor to all other species in the tree • both show *P. boisei* as not a direct relative to *Homo*/more distantly related to *Homo* than others • both show *P. aethiopicus* as older than *P. boisei* and *P. robustus* • both show *A. africanus* as older than *P. boisei* and *P. robustus* • both show *A. africanus* as a direct ancestor to *Homo* species	1–4
Subtotal	**4**
Differences – any six of	
• A shows that *Homo* and *P. robustus* shared a (recent) common ancestor while B doesn't • B shows that *P. bosei* and *P. robustus* shared a (recent) common ancestor while A doesn't • A shows that *Homo* and *P. robustus* are closely related while B doesn't • B shows that *P. bosei* and *P. robustus* are closely related while A doesn't • A shows that *Homo* are more closely related to *P. robustus* while more distantly related to *P. boisei* species while B doesn't • B shows that *Homo* and both *P. bosei* and *P. robustus* are the most distantly related while A doesn't • A shows that *A. africanus* is a direct ancestor to *P. robustus* while B doesn't • B shows that *P. aethiopicus* is a direct ancestor to *P. robustus* while A doesn't	1–6
Subtotal	**6**
Total	**10**

(c) Explain how the inclusion of the terms 'Homo', 'Australopithecus' or 'Paranthropus' in a species provides information about hominin evolution and identify the skull feature that distinguishes a Paranthropus specimen from the others. (6 marks)

Description	Marks
all Paranthropus specimens have a sagittal crest	1
Any five of	
• the name is the genus name • those with the same genus name are more closely related than others • Paranthropus is given to hominids considered more ape like/more distantly related to Homo • Paranthropus specimens are not considered direct descendants to Homo • Australopithecus are specimens more closely related to Homo • Homo refers to all specimens with larger brains/proficient bipedalism/well-developed precision grip/tool making organisms	1–5
Total	**6**

Unit 4 – Hominid evolutionary trends

Section 1

2023 Section 1 Question 3

Hominid evolutionary trends

Listed below is a series of characteristics found within the primate group.

I. reduction in olfactory centre of brain
II. non-opposable big toe
III. bipedal gait
IV. flat face
V. pentadactyl limb

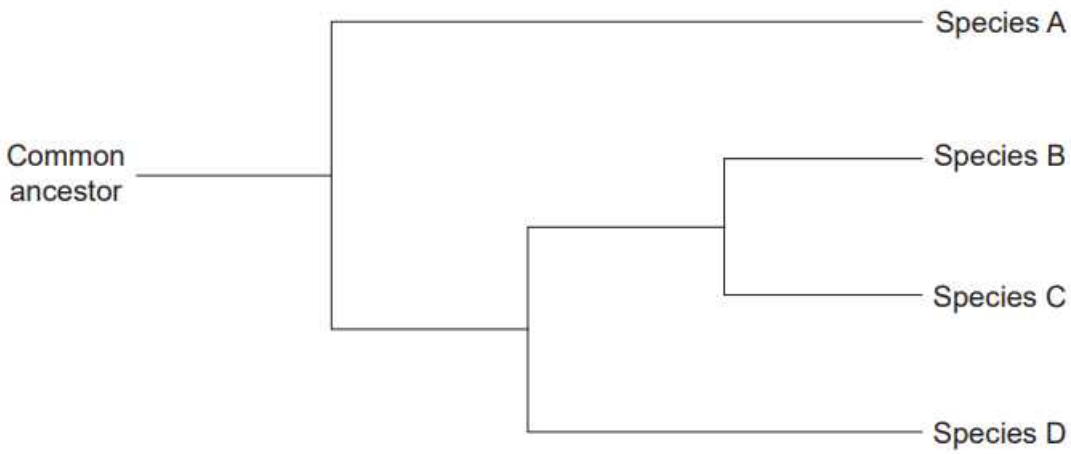
Which combination of characteristics makes a hominin different from all other primates?

(a) I and III only
(b) II and III only
(c) III, IV and V
(d) I, III and IV

2023 Section 1 Question 15

Hominid evolutionary trends

Question 15 refers to the diagram shown below.



Which of the following statements best describes the similarity in DNA sequences between the shown species?

(a) Species D and Species B have more similar DNA sequences than Species D and Species C.
(b) The DNA sequence is the most similar between Species A and Species D.
(c) The DNA sequence is the least similar between Species B and Species C.
(d) Species B and Species C share the most similarities in DNA sequence.

2022 Section 1 Question 21

Hominid evolutionary trends

Which of the following distinguishes correctly between the Paranthropus and Australopithecus genera?

	Paranthropus	***Australopithecus***
(a)	long, wide pelvis	short, narrow pelvis
(b)	long, prognathic snout	flat face with no prognathism
(c)	larger cranium with evidence of a sagittal crest	smaller cranium with no evidence of a sagittal crest
(d)	S shaped spinal column with large lumbar vertebrae	C shaped spinal column with large cervical vertebrae

2022 Section 1 Question 28

Hominid evolutionary trends

An interbreeding population of hominids became geographically separated by a mountain range, forming two isolated groups, Y and Z. The two groups were subjected to different environmental selection pressures for many generations. After 1000 years, individuals from each group met up and formed a new group.

Which of the following observations would indicate that Y was a different species to Z?

(a) they failed to produce fertile children
(b) their physical appearance was markedly different
(c) the DNA sequence in their haemoglobin gene was different
(d) Group Z had a survival advantage over Group Y

2021 Section 1 Question 8

Hominid evolutionary trends

A student was examining a collection of hominin fossil skulls that were missing their labels. The student was asked to identify the skulls based on the skull features they could observe. Below is a summary the student made of the observed characteristics of the skulls.

Skull X – a less prognathic jaw than skull Y, but a prominent brow ridge present

Skull Y – smallest cranial capacity of all three skulls, no sagittal crest and a relatively small and narrow facial profile

Skull Z – largest cranial capacity of all three skulls, lacks a forehead and occipital bun present

According to the information, hominins X, Y and Z are most likely

	X	Y	Z
(a)	*Homo neanderthalensis*	*Homo habilis*	*Homo erectus*
(b)	*Homo habilis*	*Homo neanderthalensis*	*Homo erectus*
(c)	*Homo habilis*	*Homo erectus*	*Homo neanderthalensis*
(d)	*Homo erectus*	*Homo habilis*	*Homo neanderthalensis*

2021 Section 1 Question 12

Hominid evolutionary trends

Cytochrome C is a ubiquitous protein, meaning it is present in all types of cells. The amino acid sequence for Cytochrome C is identical for chimpanzees and humans. Compared to humans, the amino acid sequence in Rhesus monkeys shows one difference.

This information suggests that

(a) humans and chimpanzees had a common ancestor.
(b) humans and chimpanzees evolved at the same time.
(c) humans evolved from Rhesus monkeys, and chimpanzees evolved from another primate group.
(d) chimpanzees evolved from Rhesus monkeys, and humans evolved from chimpanzees.

2021 Section 1 Question 24

Hominid evolutionary trends

Which of the following contains adaptations that contribute to bipedalism?

(a) S-shaped curve, increased size of lumbar vertebrae, centralisation of the foramen magnum
(b) C-shaped curve, increased size of lumbar vertebrae, centralisation of the foramen magnum
(c) S-shaped curve, increased size of lumbar vertebrae, long, narrow pelvis
(d) C-shaped curve, increased size of thoracic vertebrae, centralisation of the foramen magnum

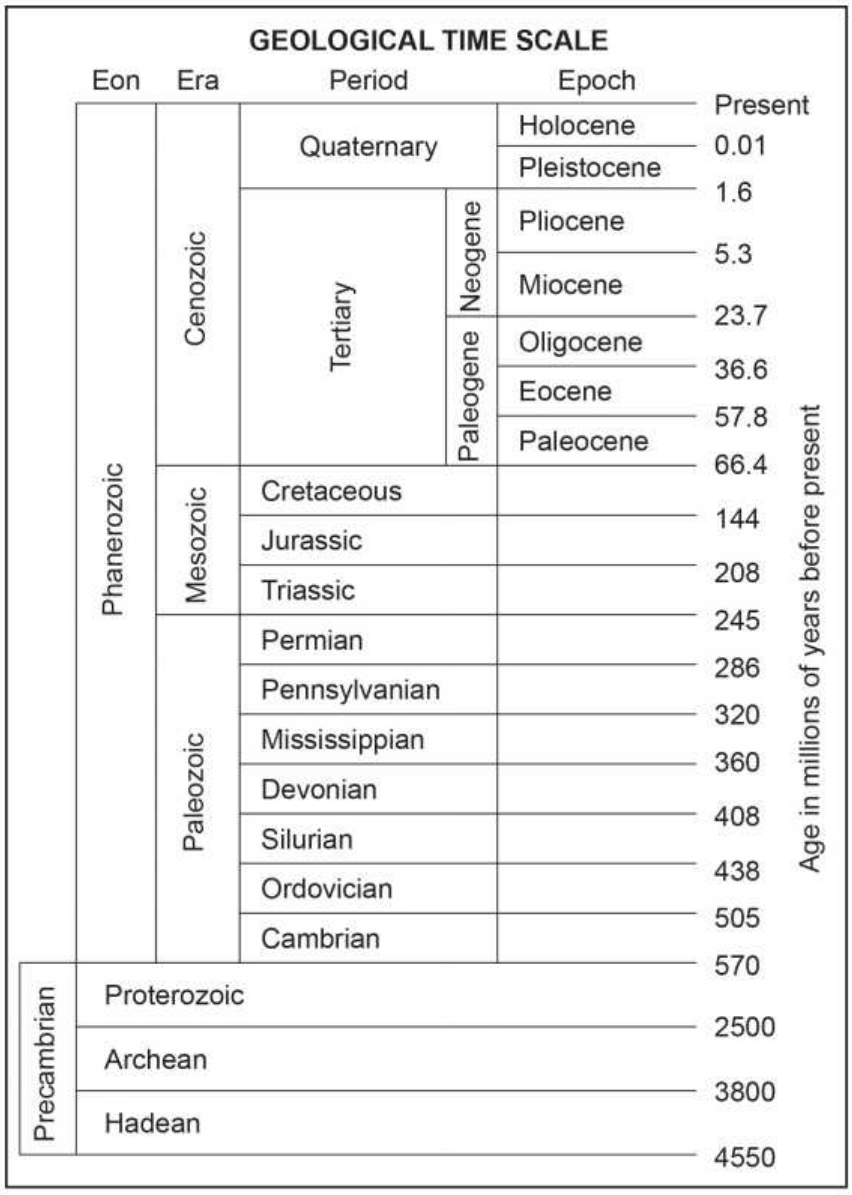
2021 Section 1 Question 29

Hominid evolutionary trends

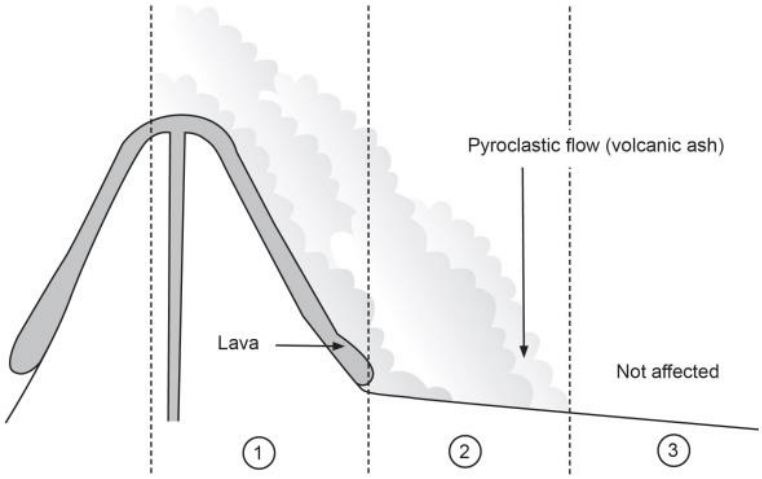
Human-made objects associated with the remains of Homo species are **best** described as

(a) tools.
(b) artefacts.
(c) artifices.
(d) fossils.

2020 Section 1 Question 7 **Hominid evolutionary trends**	Which of the following correctly lists features associated with the evolutionary trend in primates and hominins relating to locomotion? (a) broader pelvis, increased number of arches in the feet, shorter arm length and opposability of the thumb (b) narrower pelvis, opposability of the thumb, longer arm length and increased number of curves in the spine (c) decreased number of curves in the spine, decreased number of arches in the feet, shorter arm length and narrower pelvis (d) non-opposable big toe, increased number of curves in the spine, increased number of arches in the feet and broader pelvis

2020 Section 1 Question 30 **Hominid evolutionary trends**	Question 30 refers to the information shown below.  Primates are believed to have first evolved around 60 million years ago. Ancestral humans are believed to have first evolved around 6 million years ago. According to the geological time scale, primates and ancestral humans first appear in (a) the same era but different epochs. (b) different eras but the same time periods. (c) the same era, period and epoch. (d) different eras, periods and epochs.

2019 **Section 1** **Question 1** **Hominid evolutionary trends**	A fossil hominid skull has a cranial capacity of 1485 cubic centimetres, large brow ridges and a sloping forehead. The skull is probably from a/an (a) *Australopithecus afarensis.* (b) *Homo habilis.* (c) *Homo erectus.* (d) *Homo neanderthalensis.*

2019 **Section 1** **Question 5** **Hominid evolutionary trends**	Question 5 refers to the diagram of a volcanic eruption shown below.  In which region/s would you expect to find the greatest number of preserved fossil specimens? (a) 1 only (b) 2 only (c) similar amount in 1 and 2 (d) similar amount in 2 and 3

2019 **Section 1** **Question 16** **Hominid evolutionary trends**	There are four steps involved in fossilisation and fossil discovery. I. erosion and exposure of the organism to the surface II. death and decay of the soft parts of the organism III. permineralisation, where mineral deposits form internal casts of the organism IV. deposition of sand and silt layers to cover the organism The correct order of these events is (a) I, II, IV and III. (b) II, III, IV and I. (c) III, II, I and IV. (d) II, IV, III and I.

2023 Section 2 Question 34

Hominid evolutionary trends

Changes to the cranial capacity of skulls are a distinguishing feature for hominin species. The data shown in the table below have been determined by measuring the volume inside the cranium of several fossil specimens.

Average brain size in hominin species	
Hominin species	**Brain size (cm^3)**
Hominin A	420
Hominin B *(Australopithecus africanus)*	450
Hominin C	600
Hominin D *(Homo erectus)*	1000
Hominin E	1350
Hominin F	1450

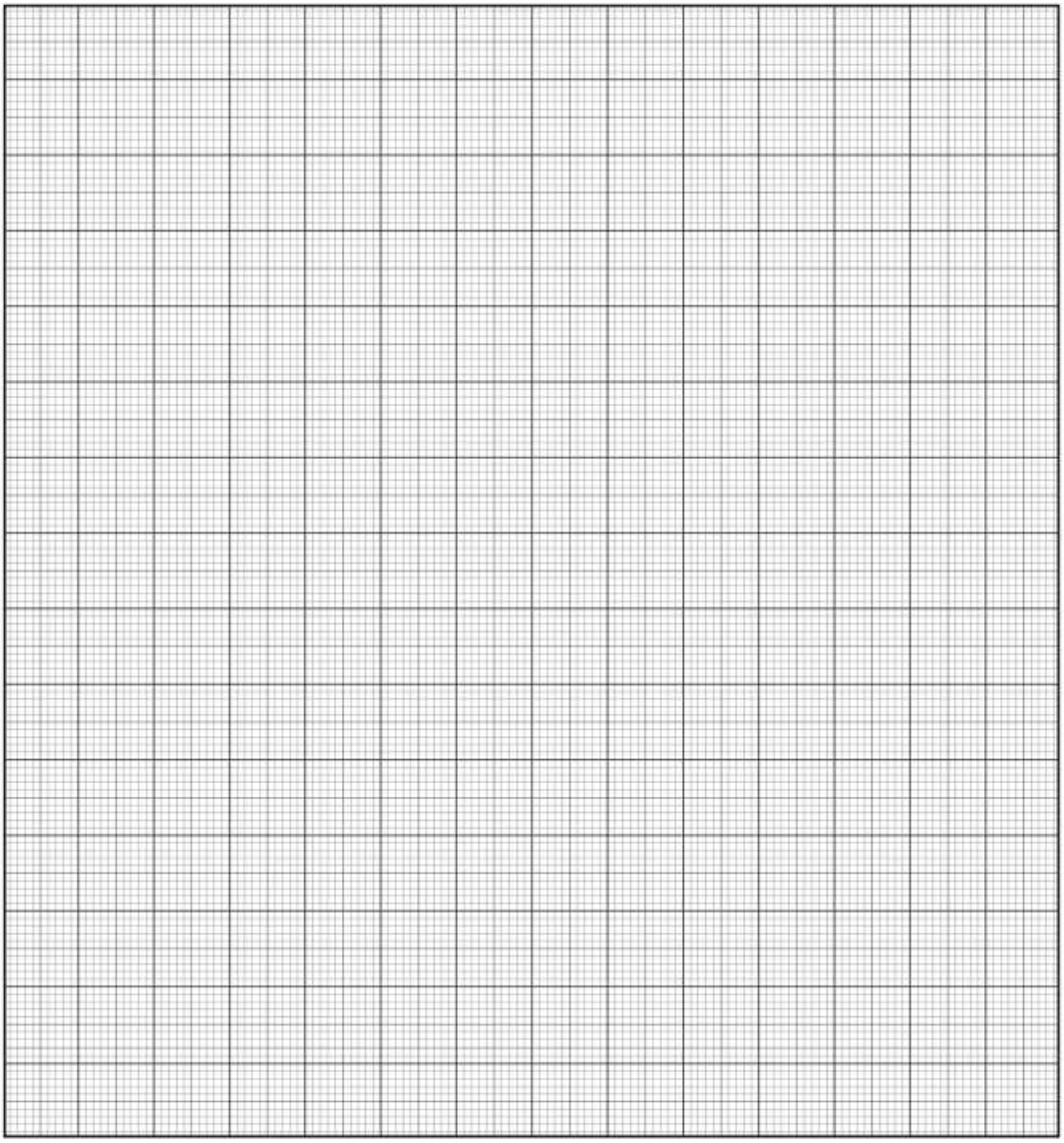
(a) State which of the cranial capacities from the table above would belong to, (2 marks)

Australopithecus afarensis:

Homo habilis:

(b) Determine whether Hominin E is evolutionarily older or younger than Hominin F. Justify your response. (3 marks)

(c) Graph the data from the table on page 22 *(above)* on the grid below. (5 marks)



(d) Comment on the evolutionary significance for the increase in brain size shown by the data. (3 marks)

Over 7 million years ago, human ancestors climbed trees and walked on four legs when on the ground. By 1.8 million years ago, our human ancestors had developed long legs and a fully-bipedal gait.

(e) Complete the table below, comparing skeletal structures as they would have been 7 million years ago to those that had developed by 1.8 million years ago. (6 marks)

Skeletal structure	7 million years ago	1.8 million years ago
Pelvis		
Knees		
Toes		

(f) Outline **two** ways in which being bipedal helped with hominin survival. (2 marks)

One: _____

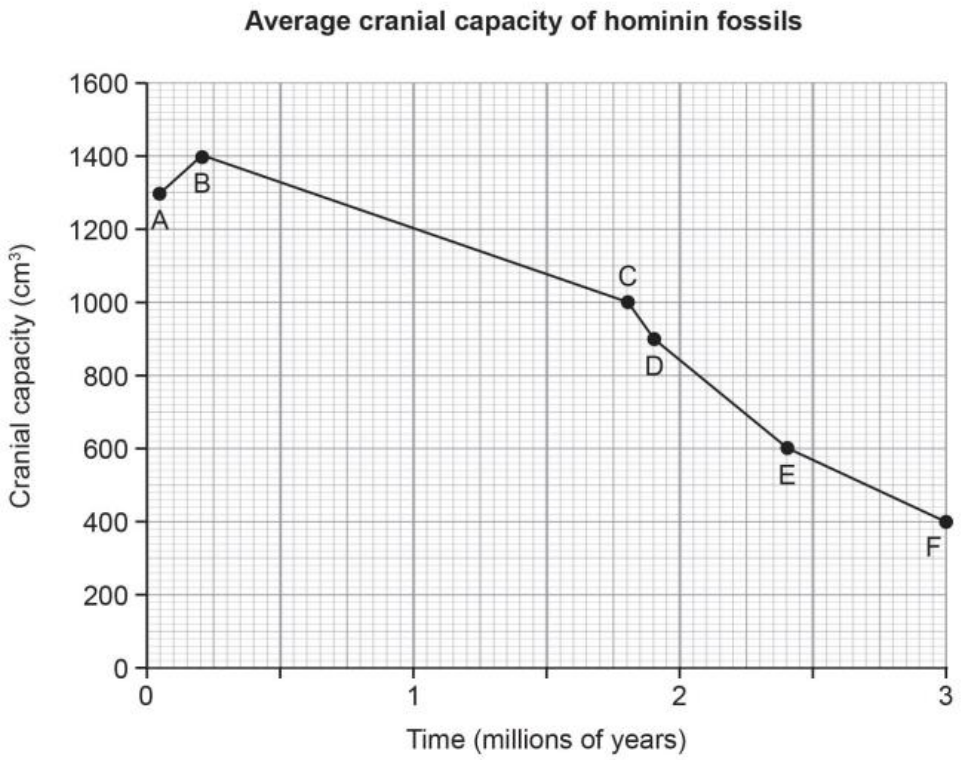
_____

Two: _____

_____

2021 Section 2 Question 37 **Hominid evolutionary trends**	(a) Read the following paragraph and fill in the missing information. (3 marks) The first hominins were the australopithecines. They had a gracile body; the two known species are called *Australopithecus* _____ and *Australopithecus* _____ . A robust hominin called _____ *robustus* existed around the same time. (b) It is thought that the earliest use of tools would have been by australopithecines using sticks and stones picked up from the local environment, whereas Homo habilis is the first hominin known to have produced tools. (i) What is the name given to the tools made by Homo habilis? (1 mark) (ii) Describe how the tools identified in part (b)(i) were made. (2 marks) (c) Dated fossils of Homo habilis and Homo erectus indicate that they were both present on Earth at the same time. List two anatomical differences between the two species. (2 marks) One: Two:

(d) The graph below shows the average cranial capacity for several hominin fossils graphed against the fossils' age.



(i) Calculate the difference in cranial capacity between fossils B and E. (1 mark)

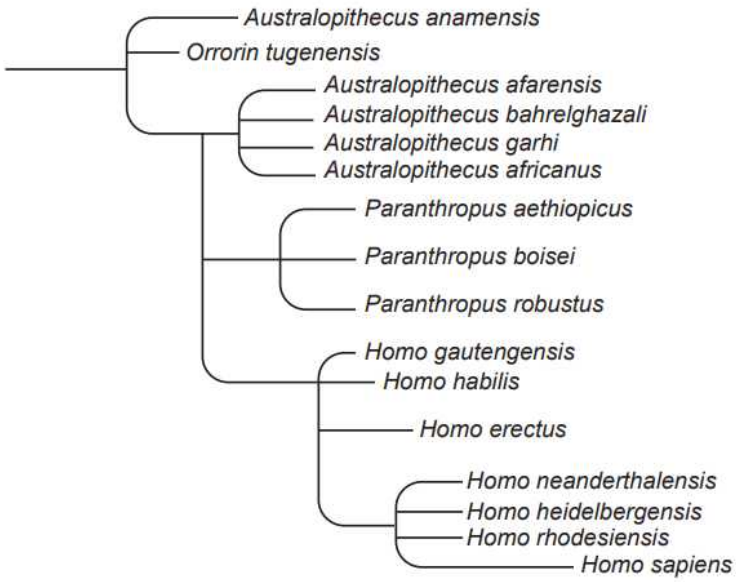
(ii) What percentage of fossil D's cranial capacity would be taken up by that of fossil F? Show your working. (3 marks)

(iii) State what hominin species fossil B is most likely from, and propose why, although older, it has a greater cranial capacity than fossil A. (2 marks)

2020 Section 2 Question 38

Hominid evolutionary trends

The following questions refer to the phylogenetic tree shown below.



Complete the following, using the data provided in the phylogenetic tree.

(a) (i) Identify the organism that most recently shared a common ancestor with *Australopithecus anamensis*. (1 mark)

(ii) Select which of the following hominins is most distantly related to modern humans: *Australopithecus afarensis* or *Paranthropus boisei*. (1 mark)

(b) Explain how evidence from DNA sequencing can be used to construct a phylogenetic tree. (3 marks)

Homo heidelbergensis had a cranial capacity around 1280 cc. This is much closer to the size of modern humans than Homo neanderthalensis. Many researchers believe Homo heidelbergensis is in fact the common ancestor to both modern humans and Homo neanderthalensis.

(c) In the space below, redraw the phylogenetic tree on page 30 showing *Homo heidelbergensis* as the common ancestor to modern humans and *Homo neanderthalensis* and *Homo rhodesiensis* as more distantly related to the other three Homo species on the same branch. (3 marks)

(Note: You do **not** need to draw the whole tree. Only draw the section of the tree associated with the species stated above.)

(d) State **two** features of a typical Homo neanderthalensis skull that distinguish it from modern humans. (2 marks)

One: _____

Two: _____

Tools created by some of the hominins mentioned in the phylogenetic tree on page 30 are shown below. Note: these tools are not drawn to scale.

Copyright restrictions prohibit the release of this SCSA exam material.

(e) (i) Rearrange the tools I to IV in order from oldest to youngest. (1 mark)

_____

(ii) The tools display a trend in tool manufacture. State this trend and what it implies about the changes to hominin lifestyle. (2 marks)

(iii) Identify which tool was **most** likely to be made first by Homo erectus. (1 mark)

(iv) How would hominins have manufactured tool III? (3 marks)

2019 Section 2 Question 31

Hominid evolutionary trends

The diagram below is a representation of tools from the Oldowan tool culture.

Copyright restrictions prohibit the release of this SCSA exam material.

(a) (i) Name the hominid species said to have made and used these tools. (1 mark)

(ii) Identify **two** ways in which hominids would have used these tools in their daily lives. (2 marks)

One:

Two:

Shown below are examples of tools made by other hominid species. Note: diagrams are not drawn to scale.

Copyright restrictions prohibit the release of this SCSA exam material.

(b) Using the information in the diagrams above, complete the table below. (4 marks)

Description	Select one or more of the alternatives from the diagrams labelled X, Y and/or Z
This tool culture came immediately after the Oldowan culture	
The most recent tools	
These tools are commonly referred to as hand axes	
These tools were often hafted	

(c) State **two** trends that are evident in the manufacturing techniques of tools from early hominids to modern humans and outline what these trends indicate about changes in hominid lifestyle. (4 marks)

One:

Two:

Section 3

2022 Section 3 Question 39

Hominid evolutionary trends

Fossil remains of the Homo naledi were found in a cave system in South Africa in 2013. They showed that this species had a combination of both primitive and modern features. The fossil evidence also showed that there was a distinct separation of upper body features adapted for living in trees (arboreal life) and lower body features adapted for bipedalism.

A reconstruction of the fossil remains into a complete skeleton and a scan of the footprint from this hominin are shown below.

Image of a computer reconstruction of *Homo naledi* skeleton

Homo naledi footprint (not shown to scale)

(a) Describe how the features of Homo naledi shown above support the idea that this hominin was both bipedal and arboreal. (12 marks)

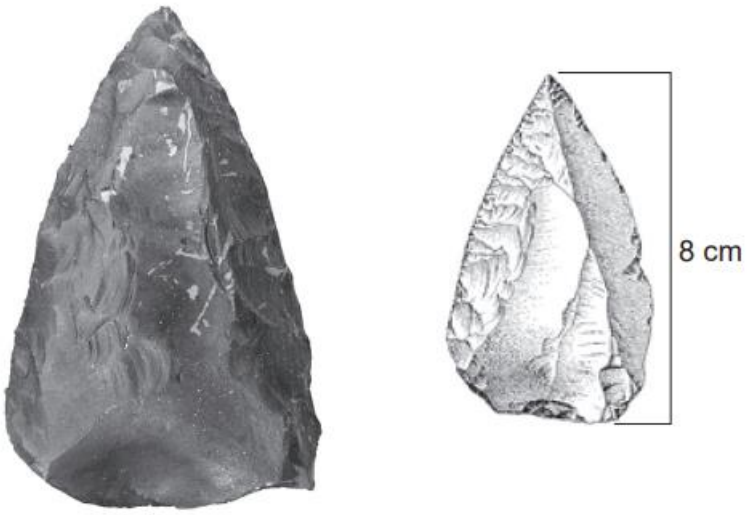
(b) Explain the relationship between bipedalism, increasing cranial capacity and tool use seen in the hominin group. (8 marks)

2022
Section 3
Question 40

Hominid evolutionary trends

A paleontologist came across a tool artefact during a dig at a location in Europe. During the dig, detailed notes, drawings and photographs were recorded for detailed analysis later.

A photograph and sketch of this tool are shown below.



(a) Identify the tool culture and the name of the hominin that produced the tool. Describe how the tool would have been manufactured. (6 marks)

(b) Parts of a fossilised skull and jaw were extracted from the site in the rock stratum directly below the artefact. Identify and describe the techniques that could be used to give this fossil both a relative and an absolute date. (9 marks)

(c) Outline **five** features the paleontologist would be looking for in the skull if they assumed the fossil belonged to the hominin that manufactured the tool shown in the photograph. (5 marks)

2021 Section 3 Question 41 **Hominid evolutionary trends**	It is estimated that millions of hominins pre-dating the modern Homo sapiens have populated the Earth and yet only 6000 individuals are represented in the hominin fossil record. (a) Explain why there are so few fossils in the fossil record. (10 marks) (b) Explain, using examples, how the comparative studies of anatomy can be used for the construction of phylogenetic trees. (10 marks)

2020 Section 3 Question 42 **Hominid evolutionary trends**	Species of the genus Homo do not possess the powerful jaw muscles commonly found in the genera *Australopithecus* and *Paranthropus*. According to the fossil record, this decrease in the size of jaw muscles coincided with changes in brain size. Scientists have discovered that both the reduction in the size of the jaw muscles and the change in brain size occurred due to mutations. (a) Describe the various types of mutations, identify the causes and describe how they can occur. (15 marks) (b) Explain how the example of the evolution of the unique hominin jaw illustrates the importance of mutations to evolution. (5 marks)

2019 Section 3 Question 43 **Hominid evolutionary trends**	In 2012, a team of Australian and Chinese scientists discovered the bones of a new human species in the Red Deer Cave located in a province of China. Archaeologists retrieved over 30 fossilised bones, including three partial skulls, two lower jaws, isolated teeth, rib and limb bones. The fossils of this human species, now known as the Red Deer Cave people, were tested and dated at about 11 500 years old. (a) State the dating technique used to date the Red Deer Cave fossils and explain why this was the most appropriate technique. (4 marks) (b) Describe how bioinformatics and comparative genomics can be used to determine the interrelatedness between the Red Deer Cave people and other hominids. (6 marks) (c) For each of the following **five** characteristics of the fossilised bones, outline what evidence would show how closely related the Red Deer Cave People are to modern humans and state how each of these features benefit modern humans. • cerebral cortex size • prognathism • dentition • pelvis • feet (10 marks)

Marking Guide – Section 1

2023 Section 1 Question 3

Hominid evolutionary trends

Listed below is a series of characteristics found within the primate group.

I. reduction in olfactory centre of brain
II. non-opposable big toe
III. bipedal gait
IV. flat face
V. pentadactyl limb

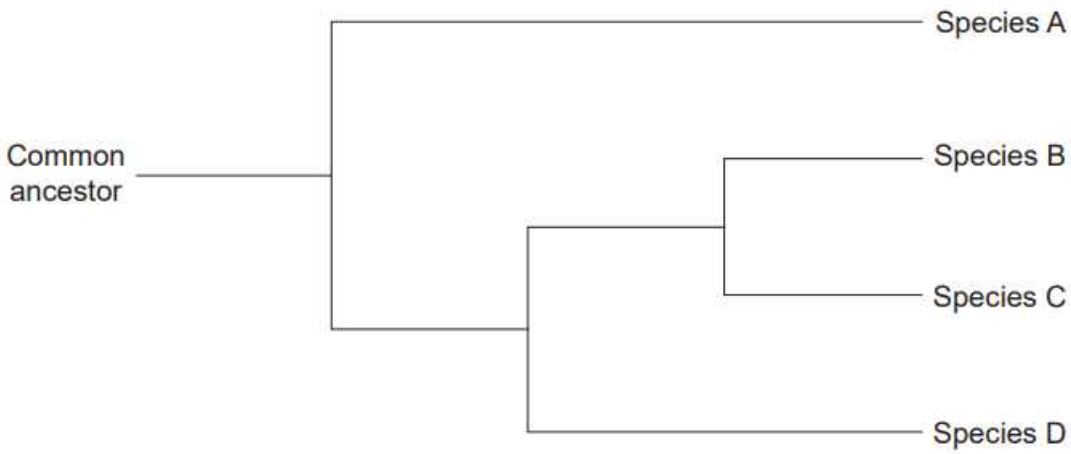
Which combination of characteristics makes a hominin different from all other primates?

(a) I and III only
(b) II and III only – Answer
(c) III, IV and V
(d) I, III and IV

2023 Section 1 Question 15

Hominid evolutionary trends

Question 15 refers to the diagram shown below.



Which of the following statements best describes the similarity in DNA sequences between the shown species?

(a) Species D and Species B have more similar DNA sequences than Species D and Species C.
(b) The DNA sequence is the most similar between Species A and Species D.
(c) The DNA sequence is the least similar between Species B and Species C.
(d) Species B and Species C share the most similarities in DNA sequence. – Answer

2022 Section 1 Question 21

Hominid evolutionary trends

Which of the following distinguishes correctly between the Paranthropus and Australopithecus genera?

	Paranthropus	***Australopithecus***
(a)	long, wide pelvis	short, narrow pelvis
(b)	long, prognathic snout	flat face with no prognathism
(c)	larger cranium with evidence of a sagittal crest	smaller cranium with no evidence of a sagittal crest
(d)	S shaped spinal column with large lumbar vertebrae	C shaped spinal column with large cervical vertebrae

Answer is C.

2022 Section 1 Question 28

Hominid evolutionary trends

An interbreeding population of hominids became geographically separated by a mountain range, forming two isolated groups, Y and Z. The two groups were subjected to different environmental selection pressures for many generations. After 1000 years, individuals from each group met up and formed a new group.

Which of the following observations would indicate that Y was a different species to Z?

(a) they failed to produce fertile children – Answer
(b) their physical appearance was markedly different
(c) the DNA sequence in their haemoglobin gene was different
(d) Group Z had a survival advantage over Group Y

2021 Section 1 Question 8

Hominid evolutionary trends

A student was examining a collection of hominin fossil skulls that were missing their labels. The student was asked to identify the skulls based on the skull features they could observe. Below is a summary the student made of the observed characteristics of the skulls.

Skull X – a less prognathic jaw than skull Y, but a prominent brow ridge present

Skull Y – smallest cranial capacity of all three skulls, no sagittal crest and a relatively small and narrow facial profile

Skull Z – largest cranial capacity of all three skulls, lacks a forehead and occipital bun present

According to the information, hominins X, Y and Z are most likely

	X	Y	Z
(a)	*Homo neanderthalensis*	*Homo habilis*	*Homo erectus*
(b)	*Homo habilis*	*Homo neanderthalensis*	*Homo erectus*
(c)	*Homo habilis*	*Homo erectus*	*Homo neanderthalensis*
(d)	*Homo erectus*	*Homo habilis*	*Homo neanderthalensis*

Answer is d.

2021 Section 1 Question 12

Hominid evolutionary trends

Cytochrome C is a ubiquitous protein, meaning it is present in all types of cells. The amino acid sequence for Cytochrome C is identical for chimpanzees and humans. Compared to humans, the amino acid sequence in Rhesus monkeys shows one difference.

This information suggests that

(a) humans and chimpanzees had a common ancestor. – Answer
(b) humans and chimpanzees evolved at the same time.
(c) humans evolved from Rhesus monkeys, and chimpanzees evolved from another primate group.
(d) chimpanzees evolved from Rhesus monkeys, and humans evolved from chimpanzees.

2021 Section 1 Question 24

Hominid evolutionary trends

Which of the following contains adaptations that contribute to bipedalism?

(a) S-shaped curve, increased size of lumbar vertebrae, centralisation of the foramen magnum – Answer
(b) C-shaped curve, increased size of lumbar vertebrae, centralisation of the foramen magnum
(c) S-shaped curve, increased size of lumbar vertebrae, long, narrow pelvis
(d) C-shaped curve, increased size of thoracic vertebrae, centralisation of the foramen magnum

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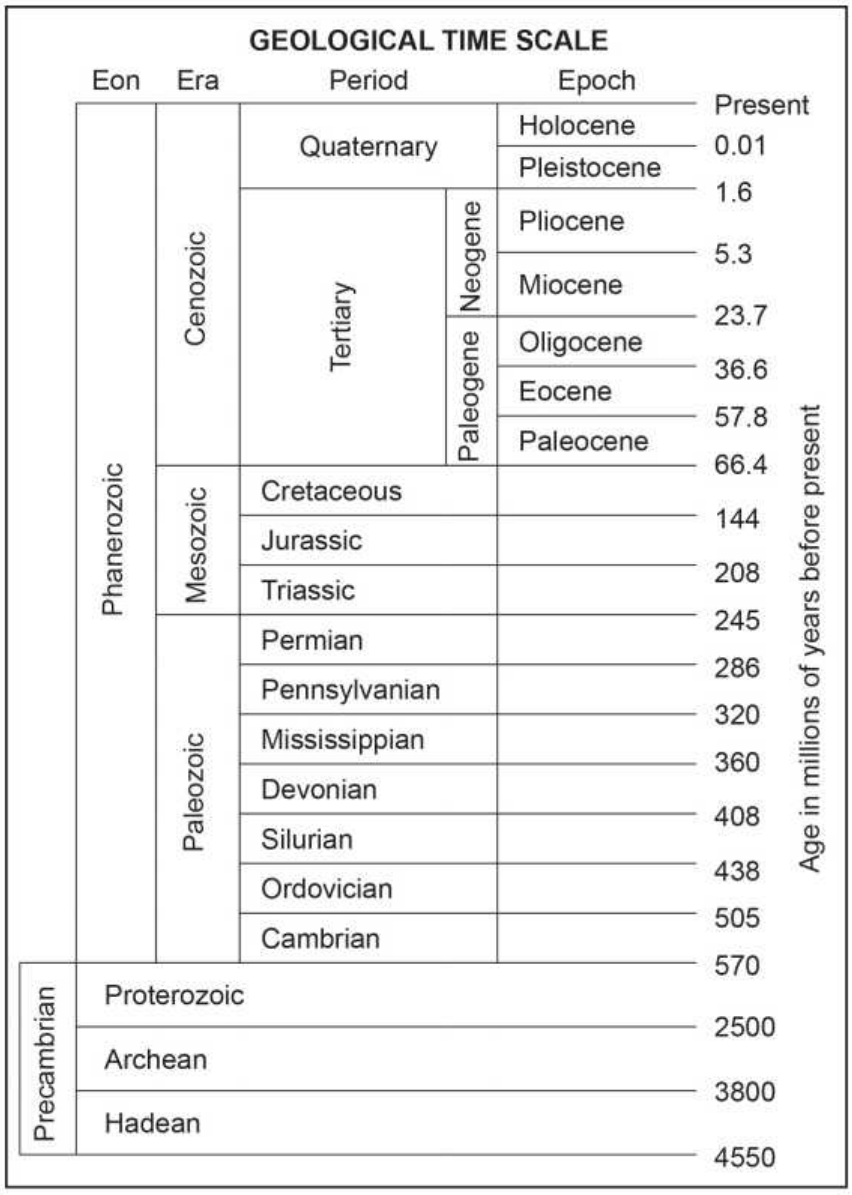
2021 Section 1 Question 29

Hominid evolutionary trends

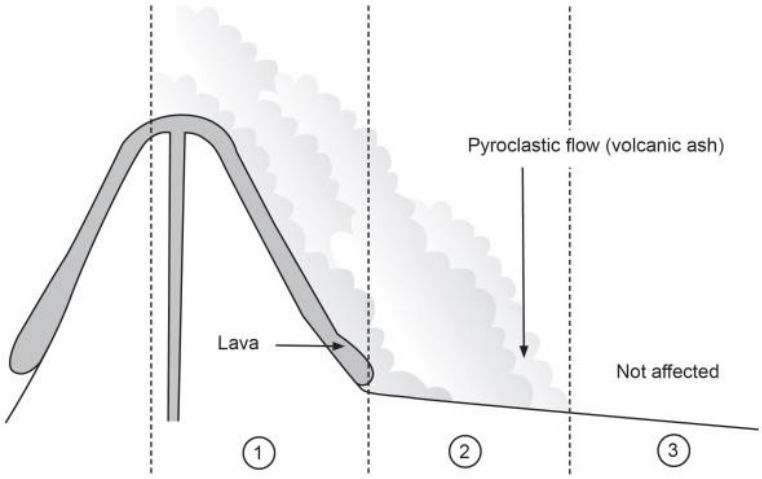
Human-made objects associated with the remains of Homo species are **best** described as

(a) tools.
(b) artefacts. – Answer
(c) artifices.
(d) fossils.

2020 Section 1 Question 7 **Hominid evolutionary trends**	Which of the following correctly lists features associated with the evolutionary trend in primates and hominins relating to locomotion? (a) broader pelvis, increased number of arches in the feet, shorter arm length and opposability of the thumb (b) narrower pelvis, opposability of the thumb, longer arm length and increased number of curves in the spine (c) decreased number of curves in the spine, decreased number of arches in the feet, shorter arm length and narrower pelvis **(d) non-opposable big toe, increased number of curves in the spine, increased number of arches in the feet and broader pelvis – Answer**

2020 Section 1 Question 30 **Hominid evolutionary trends**	Question 30 refers to the information shown below.  Primates are believed to have first evolved around 60 million years ago. Ancestral humans are believed to have first evolved around 6 million years ago. According to the geological time scale, primates and ancestral humans first appear in **(a) the same era but different epochs. – Answer** (b) different eras but the same time periods. (c) the same era, period and epoch. (d) different eras, periods and epochs.

2019 **Section 1** **Question 1** **Hominid evolutionary trends**	A fossil hominid skull has a cranial capacity of 1485 cubic centimetres, large brow ridges and a sloping forehead. The skull is probably from a/an (a) *Australopithecus afarensis.* (b) *Homo habilis.* (c) *Homo erectus.* **(d) *Homo neanderthalensis.* – Answer**

2019 **Section 1** **Question 5** **Hominid evolutionary trends**	Question 5 refers to the diagram of a volcanic eruption shown below.  In which region/s would you expect to find the greatest number of preserved fossil specimens? (a) 1 only **(b) 2 only – Answer** (c) similar amount in 1 and 2 (d) similar amount in 2 and 3

2019 **Section 1** **Question 16** **Hominid evolutionary trends**	There are four steps involved in fossilisation and fossil discovery. I. erosion and exposure of the organism to the surface II. death and decay of the soft parts of the organism III. permineralisation, where mineral deposits form internal casts of the organism IV. deposition of sand and silt layers to cover the organism The correct order of these events is (a) I, II, IV and III. (b) II, III, IV and I. (c) III, II, I and IV. **(d) II, IV, III and I. – Answer**

2023 Section 2 Question 34

Hominid evolutionary trends

Changes to the cranial capacity of skulls are a distinguishing feature for hominin species. The data shown in the table below have been determined by measuring the volume inside the cranium of several fossil specimens.

Average brain size in hominin species	
Hominin species	**Brain size (cm^3)**
Hominin A	420
Hominin B *(Australopithecus africanus)*	450
Hominin C	600
Hominin D *(Homo erectus)*	1000
Hominin E	1350
Hominin F	1450

(a) State which of the cranial capacities from the table above would belong to, (2 marks)

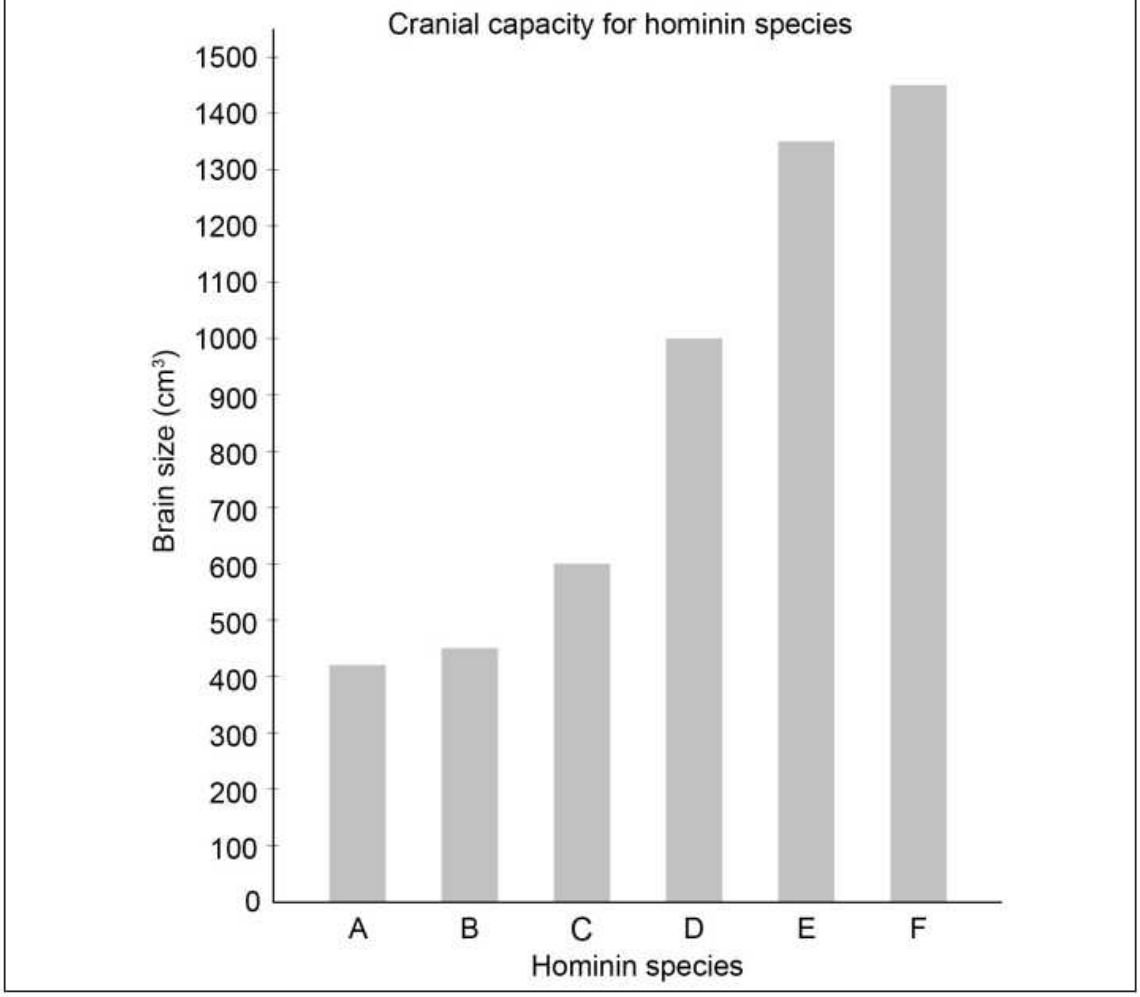
Description	Marks
Australopithecus afarensis – A	1
Homo habilis – C	1
Total	**2**

(b) Determine whether Hominin E is evolutionarily older or younger than Hominin F. Justify your response. (3 marks)

Description	Marks
younger	1
although Hominin F has a larger brain size it is not because they are more evolved, but because they had a larger more robust and longer cranium/they had bigger brain cases, not necessarily a more complex brain	1
Hominin E is *Homo sapiens* while Hominin F is *Homo neanderthalensis*	1
Total	**3**

(c) Graph the data from the table on page 22 *(above)* on the grid below. (5 marks)

Description	Marks
Correctly constructs axes using appropriate scale	1
Correctly plots data in bar/column graph form	1
Labelling of axes with correct name and unit	1
Appropriate title	1
Uses a ruler and uses most of the grid	1
Total	**5**



(d) Comment on the evolutionary significance for the increase in brain size shown by the data. (3 marks)

Description	Marks
Any three of	
• larger brain can store more complex information • increasing brain size increased social interaction • allowed for adaptability in unfamiliar environments • allowed for the manufacture of tools	1–3
Total	**3**

Over 7 million years ago, human ancestors climbed trees and walked on four legs when on the ground. By 1.8 million years ago, our human ancestors had developed long legs and a fully-bipedal gait.

(e) Complete the table below, comparing skeletal structures as they would have been 7 million years ago to those that had developed by 1.8 million years ago. (6 marks)

Description			Marks
Skeletal structure	**7 million years ago**	**1.8 million years ago**	
Pelvis	Tall/long and narrow	short and wide/bowl shaped	1–2
Knees	have two similar sized condyles/knee joint unable to lock	medial and lateral condyles large/knee joint locks	1–2
Toes	bones long and curved/big toe opposable	bones short and straight/big toe aligned with other toes/big toes not opposable	1–2
		Total	**6**

(f) Outline **two** ways in which being bipedal helped with hominin survival. (2 marks)

Description	Marks
Any two of	
• freed hands to carry infants/tools/food • freed hands to pick vegetation/fruits from tree branches • can cover large distances over open ground efficiently • easier to see predators/see above vegetation/see long distances	1–2
Total	**2**

2021 Section 2 Question 37

Hominid evolutionary trends

(a) Read the following paragraph and fill in the missing information. (3 marks)

Description	Marks
afarensis	1
africanus	1
Paranthropus	1
Note – must have correct use of lower and upper case	
Note – *afarensis* and *africanus* can be written in any order	
Total	**3**

(b) It is thought that the earliest use of tools would have been by australopithecines using sticks and stones picked up from the local environment, whereas Homo habilis is the first hominin known to have produced tools.

(i) What is the name given to the tools made by Homo habilis? (1 mark)

Description	Marks
Oldowan/pebble tools	1
Total	**1**

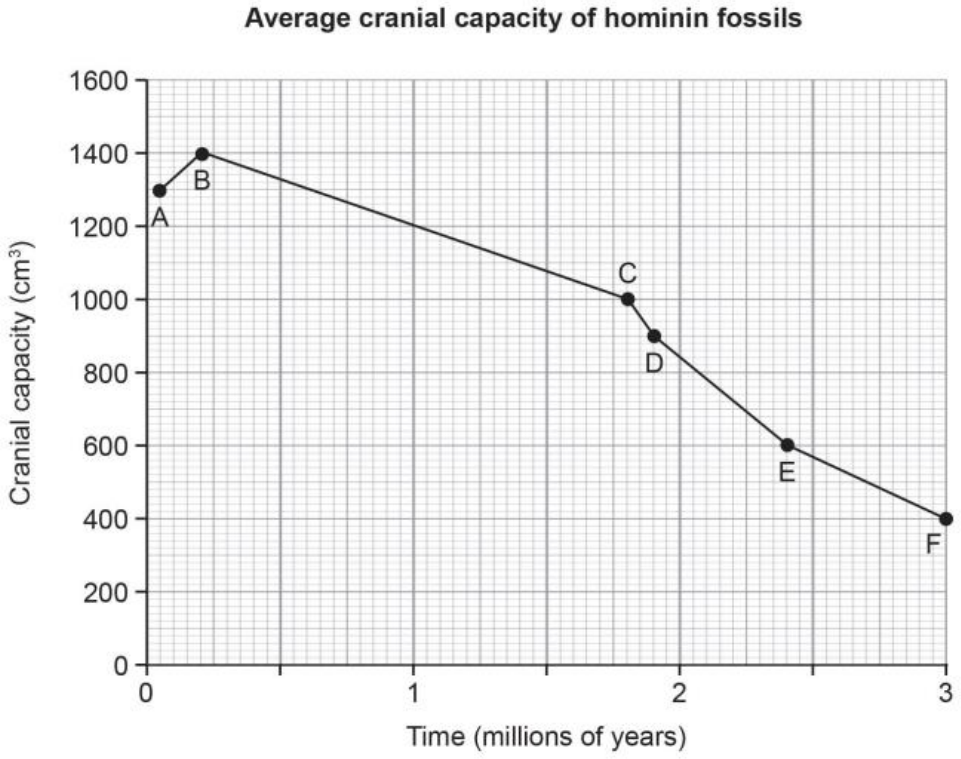
(ii) Describe how the tools identified in part (b)(i) were made. (2 marks)

Description	Marks
Stones/pebbles/rocks	1
with one or two pieces chipped off by striking/flaking rocks together/striking one stone with another	1
Total	**2**

(c) Dated fossils of Homo habilis and Homo erectus indicate that they were both present on Earth at the same time. List two anatomical differences between the two species. (2 marks)

Description	Marks
Any **two** of the following:	
H erectus had a larger brain/*H erectus* (1000 cm^3) cranial capacity compared to (600 cm^3) for *H habilis*	1–2
H erectus had a taller/larger body	
H erectus had a relatively flatter face with less prominent cheekbones and large brow-ridges	
H erectus had a more sloping forehead	
H erectus had a flatter face	
H erectus dental arcade was shorter and more rounded	
H erectus had a shorter more rounded jaw	
H erectus had smaller teeth/molars/modern style teeth	
H erectus had more human-like proportions e.g. longer legs/shorter arms	
Total	**2**

(d) The graph below shows the average cranial capacity for several hominin fossils graphed against the fossils' age.



(i) Calculate the difference in cranial capacity between fossils B and E. (1 mark)

Description	Marks
Answer including correct unit – 800 cm^3	1
Total	**1**

(ii) What percentage of fossil D's cranial capacity would be taken up by that of fossil F? Show your working. (3 marks)

Description	Marks
Read data from graph e.g. F – 400 cm^3 and D – 900 cm^3	1
Calculation e.g. (400 x 100)/900	1
Answer – 44/44.4 %	1
Total	**3**
Note: Do not penalise for consequential errors	

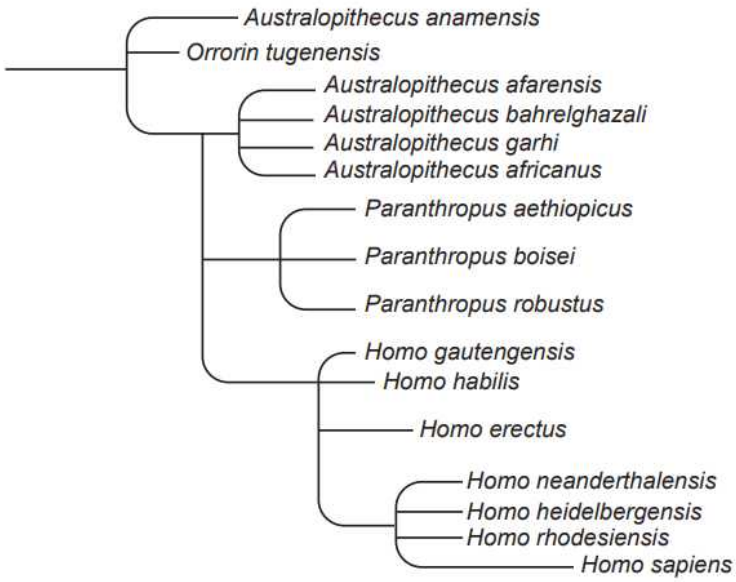
(iii) State what hominin species fossil B is most likely from, and propose why, although older, it has a greater cranial capacity than fossil A. (2 marks)

Description	Marks
Fossil B – *Homo neanderthalensis/Homo neandethal*	1
Any **one** of the following for one mark:	
• larger brain needed for control of larger leg/arm muscles • larger brain volume needed to control larger body • larger brain associated with larger visual cortex needed for better vison • larger brain a result of a longer growing period	1
Total	**2**

2020 Section 2 Question 38

Hominid evolutionary trends

The following questions refer to the phylogenetic tree shown below.



Complete the following, using the data provided in the phylogenetic tree.

(a) (i) Identify the organism that most recently shared a common ancestor with *Australopithecus anamensis*. (1 mark)

Description	Marks
Orrorin tugenesis	1
Total	**1**

(ii) Select which of the following hominins is most distantly related to modern humans: *Australopithecus afarensis* or *Paranthropus boisei*. (1 mark)

Description	Marks
Australopithecus afarensis	1
Total	**1**

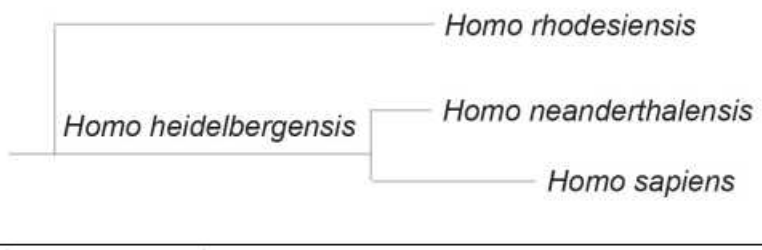
(b) Explain how evidence from DNA sequencing can be used to construct a phylogenetic tree. (3 marks)

Description	Marks
the sequence of nucleotides of the DNA of organisms is compared	1
the more similar the sequence the more closely related organisms are/less time since common ancestor/less time since divergence	1
organisms appear closer together on the phylogenetic tree	1
Total	**3**

Homo heidelbergensis had a cranial capacity around 1280 cc. This is much closer to the size of modern humans than Homo neanderthalensis. Many researchers believe Homo heidelbergensis is in fact the common ancestor to both modern humans and Homo neanderthalensis.

(c) In the space below, redraw the phylogenetic tree on page 30 showing *Homo heidelbergensis* as the common ancestor to modern humans and *Homo neanderthalensis* and *Homo rhodesiensis* as more distantly related to the other three Homo species on the same branch. (3 marks)

(Note: You do **not** need to draw the whole tree. Only draw the section of the tree associated with the species stated above.)

Description	Marks
	1–3
Answer – must have • *Homo rhodesiensis* on different branch above other two • *Homo heidelbergensis* on common ancestor branch • *Homo neanderthalensis* and *Homo sapiens* both from same common ancestor	
Total	**3**

(d) State **two** features of a typical Homo neanderthalensis skull that distinguish it from modern humans. (2 marks)

Description	Marks
Any **two** of:	
large cranial capacity around 1400 cc	1–2
lack of chin	
occipital bun	
lack of forehead	
elongated skull	
depression (the suprainiac fossa) at back of skull	
flared zygomatic arch	
Larger brow ridges	
Total	**2**

Tools created by some of the hominins mentioned in the phylogenetic tree on page 30 are shown below. Note: these tools are not drawn to scale.

Copyright restrictions prohibit the release of this SCSA exam material.

(e) (i) Rearrange the tools I to IV in order from oldest to youngest. (1 mark)

Description	Marks
IV – I – II – III	1
Total	**1**

(ii) The tools display a trend in tool manufacture. State this trend and what it implies about the changes to hominin lifestyle. (2 marks)

Description	Marks
greater workmanship/greater number of blows made in construction/greater design complexity	1
hominids completed more specialised tasks/did finer work/had more time to create	1
Total	**2**

(iii) Identify which tool was **most** likely to be made first by Homo erectus. (1 mark)

Description	Marks
I	1
Total	**1**

(iv) How would hominins have manufactured tool III? (3 marks)

Description	Marks
Levallois method/large flake removed from stone core	1
flakes reworked edges/edges sharpened	1
pressure flaking	1
Total	**3**

2019 Section 2 Question 31

Hominid evolutionary trends

The diagram below is a representation of tools from the Oldowan tool culture.

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(a) (i) Name the hominid species said to have made and used these tools. (1 mark)

Description	Marks
Homo habilis	1
Total	**1**

(ii) Identify **two** ways in which hominids would have used these tools in their daily lives. (2 marks)

Description	Marks
Any **two** of the following:	
'chop' up meat/butchering/skinning	1–2
dig up edible roots and plants	
crush/grind tough plant materials	
break open animal bones	
Total	**2**

Shown below are examples of tools made by other hominid species. Note: diagrams are not drawn to scale.

Copyright restrictions prohibit the release of this SCSA exam material.

(b) Using the information in the diagrams above, complete the table below. (4 marks)

Description		Marks
this tool culture came immediately after the Oldowan culture	Y	1
the most recent tools	X	1
these tools are commonly referred to as hand axes	Y	1
these tools were often hafted	X and Z	1
	Total	**4**

(c) State **two** trends that are evident in the manufacturing techniques of tools from early hominids to modern humans and outline what these trends indicate about changes in hominid lifestyle. (4 marks)

Description	Marks
One mark for trend and one mark for lifestyle maximum of 4 marks	
Trend – greater variety of materials used/use of stone only to bone, anther, ivory, wood Change of lifestyle – hominids used resources more effectively/used more variety of resources/understood how to use their environment better	1–2
Trend – greater number of blows/increased workmanship/time into tool production/greater complexity Change of lifestyle – hominids completed more complex jobs/did finer work/had time to create	1–2
Trend – tools became more specialised/tools used to make tools/hafted tools Change of lifestyle – hominids had more specialised roles within communities	1–2
Total	**4**

2022 **Section 3** **Question 39** **Hominid evolutionary trends**	Fossil remains of the Homo naledi were found in a cave system in South Africa in 2013. They showed that this species had a combination of both primitive and modern features. The fossil evidence also showed that there was a distinct separation of upper body features adapted for living in trees (arboreal life) and lower body features adapted for bipedalism. A reconstruction of the fossil remains into a complete skeleton and a scan of the footprint from this hominin are shown below. Image of a computer reconstruction of *Homo naledi* skeleton *Homo naledi* footprint (not shown to scale) (a) Describe how the features of Homo naledi shown above support the idea that this hominin was both bipedal and arboreal. (12 marks)

Description	Marks
Arboreal	
Evidence from images – any four of • short clavicle • high shoulder blades • longer arms/smaller arm to leg ratio • long, curved fingers • long thumbs/prehensile	1–4
Arms/shoulder adapted for swinging in the trees/circular arms movements/flexibility of arms to rotate through trees.	1
Hands adapted to grip branches/hang from branches. Note: not adapted for brachiation.	1
Subtotal	**6**
Bipedal – any three of	
• long legs • allows for striding gait	1–6
• medial/lateral condyles of knee joint (femur) are large • allows for stability/weight-bearing during walking	
• wide pelvis/carrying angle present • allows for balance/stability	
• robust heel/calcaneus/transverse and longitudinal arches of the feet/non-opposable big toe/aligned big toes • allows for stability/weight-bearing/propulsion	
Subtotal	**6**
Total	**12**

(b) Explain the relationship between bipedalism, increasing cranial capacity and tool use seen in the hominin group. (8 marks)

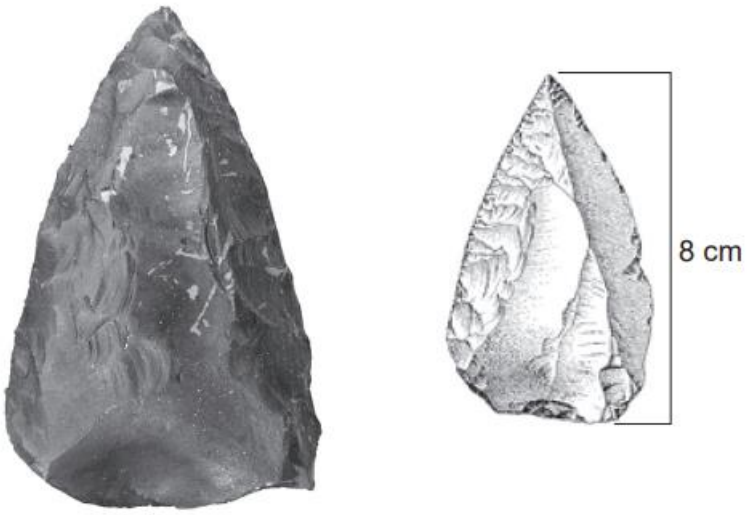
Description	Marks
Any eight of	
• bipedalism freed hands to carry infants, tools and food • manufacture of tools requires mental dexterity/problem-solving abilities • tools became more complex in their size, manufacture and use • using efficient tools meant better ability to hunt for food (meat) • increase in protein provide energy required to support a larger brain • a larger brain may have contributed to more cooperation and communication • bipedalism may have led to overall behavioural changes in hominids • behavioural changes may have impacted on cranial development/increase in frontal lobe size • speech and language evolved due to increase in cranial capacity	1–8
Total	**8**

2022
Section 3
Question 40

Hominid evolutionary trends

A paleontologist came across a tool artefact during a dig at a location in Europe. During the dig, detailed notes, drawings and photographs were recorded for detailed analysis later.

A photograph and sketch of this tool are shown below.



(a) Identify the tool culture and the name of the hominin that produced the tool. Describe how the tool would have been manufactured. (6 marks)

Description	Marks
Tool culture	
Mousterian	1
Homo neanderthalensis	1
Subtotal	**2**
Manufacture	
made of stone	1
starts with a large core/block of stone	1
large oval flakes struck from worked cores/percussion method/Levallois technique	1
edges trimmed by flaking off pieces around the outline of the flake	1
Subtotal	**4**
Total	**6**

(b) Parts of a fossilised skull and jaw were extracted from the site in the rock stratum directly below the artefact. Identify and describe the techniques that could be used to give this fossil both a relative and an absolute date. (9 marks)

Description	Marks
Relative	
Stratigraphy	1
study of rock layers on site or from photographs	1
principle of superposition/layers at top older than layers at the bottom	1
if fossil found lower than stone tool/artefact then it is older	1
Subtotal	**4**
Absolute	
• Carbon-14 dating • radiation produced from sample would be measured • a ratio of carbon-12 to carbon-14 would be estimated • using that half-life of carbon-14 is 5730 years • actual age would be calculated or • Potassium-argon dating • radiation produced from sample would be measured • potassium-40 to argon-40/argon-40 and calcium-40 in the rock • 1.25 – 1.3 billion years • actual age would be calculated	1–5
Subtotal	**5**
Total	**9**

(c) Outline **five** features the paleontologist would be looking for in the skull if they assumed the fossil belonged to the hominin that manufactured the tool shown in the photograph. (5 marks)

Description	Marks
Any five of	
• cranial capacity around 1400 cc • long and low brain case • receding/sloping forehead • heavy brow ridges • occipital bun present • depression (the suprainiac fossa) at back of skull • no chin • swept back cheek bones/flared zygomatic arch • more prognathic jaw than modern man	1–5
Total	**5**

2021 Section 3 Question 41

Hominid evolutionary trends

It is estimated that millions of hominins pre-dating the modern Homo sapiens have populated the Earth and yet only 6000 individuals are represented in the hominin fossil record.

(a) Explain why there are so few fossils in the fossil record. (10 marks)

Description	Marks
Any **ten** of the following:	
Generally only hard/solid parts e.g. bones/teeth are fossilised	1–10
Organisms need to 'die' in area suitable to fossilisation	
The sediments/soils needs to be of the right conditions/alkaline/low oxygen levels	
Organisms need to be protected from decay from microorganisms	
The body/remains need to be undisturbed by scavengers	
The body/remains need to be quickly covered by sediments/rapid burial	
The soil/sediments need to be undisturbed by geological processes	
Many fossils are buried too deep to be found/not exposed to the surface	
Many fossils are destroyed by geological processes/human activity	
Many fossils are not recognised as being so/people don't recognise them	
Many fossils once exposed are eroded/weathered	
Total	**10**

(b) Explain, using examples, how the comparative studies of anatomy can be used for the construction of phylogenetic trees. (10 marks)

Description	Marks
Any **two** of the following examples:	
Comparative embryology	
Compare anatomical structure during embryo development/stages of embryo development from different species	1
Organisms share similar anatomical structures during early development	1
Indicates shared common ancestry/at one point they all shared an ancestor who had the basic structure	1
More similar the structures are for longer in the embryonic stage = more closely placed together on phylogenetic trees	1
Example – gill silts and tail found in vertebrate embryos	1
Subtotal	**5**
or Homologous structures	
Compare anatomical structure from different species	1
Structures show a high degree of structural similarity but perform different functions	1
Indicates shared common ancestry/at one point they all shared an ancestor who had the basic structure	1
More similar the structures are = more closely placed together on phylogenetic trees	1
Example – bone structure in the vertebrate limbs	1
Subtotal	**5**
or Vestigial organs	
Homologous structures that have a benefit/normal function in some species	1
Present but not functional in other species	1
Indicates shared common ancestry/at one point they all shared an ancestor who had the structure	1
More shared features = more closely placed together on phylogenetic trees	1
Example – appendix/nictitating membrane/muscles to move ears/ body hair/wisdom teeth in humans	1
Subtotal	**5**
Total	**10**

2020 Section 3 Question 42

Hominid evolutionary trends

Species of the genus Homo do not possess the powerful jaw muscles commonly found in the genera *Australopithecus* and *Paranthropus*. According to the fossil record, this decrease in the size of jaw muscles coincided with changes in brain size. Scientists have discovered that both the reduction in the size of the jaw muscles and the change in brain size occurred due to mutations.

(a) Describe the various types of mutations, identify the causes and describe how they can occur. (15 marks)

Description	Marks
Define	
a mutation is a change in a gene or a chromosome (leading to new characteristics in an organism or their offspring)	1
Types of mutations	
can be gene mutation or chromosomal mutations	1–3
Gene – changes in a single gene (which occurs during DNA replication)	
Chromosomal – all or part of a chromosome is affected	
can be somatic or germline	1–3
Somatic – mutations that occur in the body cells (reproductive cells are not affected) therefore mutation is not passed on to offspring	
Germline – mutations that occur in the reproductive cells/gametes therefore can be passed on to offspring	
Causes	
Mutagens	
caused by mutagens/mutagenic agents	1
substances that are known to increase the rate at which mutations occur	1
e.g. ionising radiation (e.g. X-rays), mustard gas, formaldehyde, some antibiotics	
DNA replication	
caused by errors in DNA replication	1
deletion – part of a chromosome is lost	1–2
Duplication – section of chromosome is repeated/occurs twice	
Insertions – DNA can be duplicated/extra DNA added	
Frameshifts – incomplete DNA code/unreadable DNA code	
Cell division	
cause by errors in cell division/meiosis	1
Inversion – broken part of chromosome joins back but in the wrong way	1–2
Translocation – part of chromosome breaks off and re-joins to the wrong chromosome	
Non-disjunction – during meiosis, a chromosome pair does not separate so one daughter cell has an extra chromosome and one daughter cell has one less (aneuploidy)	
Total	**15**

(b) Explain how the example of the evolution of the unique hominin jaw illustrates the importance of mutations to evolution. (5 marks)

Description	Marks
mutations introduce new alleles into population	1–5
hominin jaw mutations must have been favourable/an advantage to survival	
organisms are better suited to bipedal locomotion/balance of head in bipedal locomotion/better for stereoscopic vision/helped to enable increases in cranial capacity	
favourable alleles passed onto offspring	
mutation maintained in population/future generations	
Total	**5**

2019 Section 3 Question 43

Hominid evolutionary trends

In 2012, a team of Australian and Chinese scientists discovered the bones of a new human species in the Red Deer Cave located in a province of China. Archaeologists retrieved over 30 fossilised bones, including three partial skulls, two lower jaws, isolated teeth, rib and limb bones. The fossils of this human species, now known as the Red Deer Cave people, were tested and dated at about 11 500 years old.

(a) State the dating technique used to date the Red Deer Cave fossils and explain why this was the most appropriate technique. (4 marks)

	Marks
radiocarbon dating/Carbon 14 dating	1
bones are carbon based/organic	1
ratio of C14 – C12 can be measured	1
can date up to 60 000 years (consistent with given time frame of 11 500 years)	1
Total	**4**

(b) Describe how bioinformatics and comparative genomics can be used to determine the interrelatedness between the Red Deer Cave people and other hominids. (6 marks)

Description	Marks
Describes bioinformatics and use in context	
The greater the degree of similarities in specific genes (and nucleotides), the closer the evolutionary relationship between the two species.	1
Combines computer science, statistics, mathematics and engineering to analyse biological data.	1–2
Techniques such as image and signal processing used to extract results from large amount of raw data.	
Raw data obtained from biochemical testings.	
Testing highlights the amount of similarity between the species.	
Subtotal	**3**
Describes comparative genomics and use in context	
The greater the degree of alignment (similarity) of the genome (genomic sequence), the closer the evolutionary relationship between the two species.	1
Genomic features may include DNA sequence, genes, gene order, regulatory sequences and other genomic structural landmarks or biomarkers.	1–2
Uses the principle that common features of two organisms will often be encoded within that DNA that is conserved evolutionarily between them.	
Approach start by checking for alignment of genome sequence and look for DNA sequences that share a common ancestry.	
Testing infers the evolutionary relationship between two species.	
Subtotal	**3**
Total	**6**

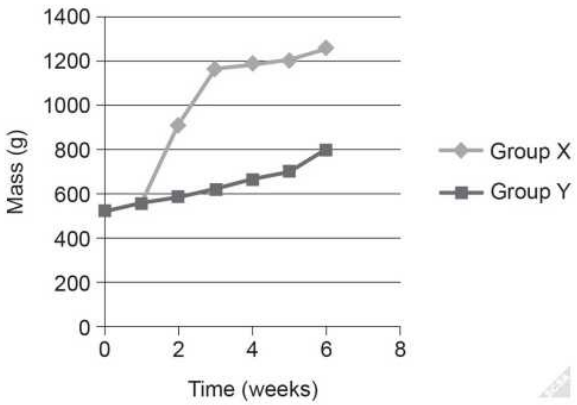
(c) For each of the following **five** characteristics of the fossilised bones, outline what evidence would show how closely related the Red Deer Cave People are to modern humans and state how each of these features benefit modern humans.

- cerebral cortex size
- prognathism
- dentition
- pelvis
- feet (10 marks)

Description	Marks
Cerebral cortex – Skull (one mark feature, one mark benefit)	
Feature • increase of cortex size compared to body, closer to modern humans **or** • increased cranial capacity shows greater relatedness to H sapiens/modern humans	1
Benefit increase in cranial capacity means increase proportion of brain which is the site of higher functions (vision, memory and reasoning and manipulative ability and special skills such as tool making)	1
Subtotal	**2**
Prognathism – Skull	
Feature • large prognathism shows closer relationship to early hominids/flatter face shows closer relationship to modern humans	1
Benefit reduced prognathism enables the skull to balance on top of spine/facilitate upright stance for bipedalism	1
Subtotal	**2**
Dentition – Jaw and Teeth	
Feature • smaller, more even teeth show closer relationship to modern human **or** • less prominent canines show closer relationship to modern human **or** • parabolic jaw shows closer relationship to modern human/U-shaped jaw show closer relationship to early hominids	1
Benefit smaller jaw aids in balance of skull for bipedalism	1
Subtotal	**2**
Pelvis	
Feature • carrying angle present shows closer relationship to modern human/no carrying angle present shows closer relationship to early hominids **or** • pelvis flatter and broader/a long narrow pelvis shows a relationship to early hominids	1
Benefit greater stability for bipedal locomotion	1
Subtotal	**2**

Unit 3 and 4 – Science Inquiry Skills

Section 1

2021 Section 1 Question 10 **Science Inquiry Skills**	Questions 10 and 11 refer to the information shown below An experiment was conducted to investigate the effect of a calcium-based diet supplement on growth rates in guinea pigs. Fifty young guinea pigs were divided into two equal groups. Guinea pigs in Group X were fed a diet containing the supplement; those in Group Y received the same food, but without the supplement. Each week the guinea pigs were weighed and their mass recorded. The average mass of the guinea pigs in each group over the six-week trial period is shown in the graph below. **Effect of a calcium-based diet supplement on growth rates in guinea pigs**  10. The independent variable for this experiment would be (a) amount of calcium consumed. (b) time (weeks). (c) the supplement. (d) Group X. 11. Which of the following would **not** improve the reliability of this experiment? (a) increasing the sample size (b) duplicating the experiment (c) randomly selecting the guinea pigs (d) replicating the experiment multiple times

2021 Section 1 Question 30 **Science Inquiry Skills**	One of the ethical considerations that must be adhered to during animal research relates to when and how animals can be used. Which of the following is **not** part of an ethical reason to test on animals? (a) The research has the potential to significantly benefit humans. (b) The financial cost of testing on animals is less than humans. (c) A minimum number of animals will be used during the study. (d) The use of animals is essential and cannot be substituted for.

2020 Section 1 Question 9

Science Inquiry Skills

Eloise wanted to investigate the effect of temperature changes on the basal metabolic rate of rats. According to the *Australian code of practice for care and use of animals for scientific purposes, eighth edition 2013*, she must follow the principles of the 3Rs for the ethical and humane care of the animals. Which of the following is **not** one of the 3Rs?

(a) Replacement – that wherever possible one should use alternative approaches that do not use animals.
(b) Reduction – one should use the smallest number of animals possible to achieve the aims and statistical design requirements.
(c) Refinement – one should modify methodology to minimise harm to the animals.
(d) Repetition – one should repeat the investigative approach to ensure consistent results.

2020 Section 1 Question 16

Science Inquiry Skills

The data below refer to heights of individuals in a Year 12 Human Biology class.

Height (cm)	Number of people
140–149	2
150–159	6
160–169	10
170–179	8
180–189	3
190–199	1

The **best** graph to represent this data would be

(a) column.
(b) line.
(c) scatterplot.
(d) histogram.

2020 Section 1 Question 21

Science Inquiry Skills

A pharmacist has been given the option of providing four generic versions of a drug prescribed by a doctor. Which of the following treatment courses would have the **lowest** cost?

(a) Drug A costs $25.00 for 28 tablets. The standard dose is one tablet twice a day for seven days.
(b) Drug B costs $30.00 for 100 tablets. The standard dose is one tablet four times a day for 14 days.
(c) Drug C costs $25.00 for 28 tablets. The standard dose is one tablet twice a day for five days.
(d) Drug D costs $20.00 for 14 tablets. The standard dose is one tablet per day for five days.

2019 Section 1 Question 17

Science Inquiry Skills

Scientific inquiry is based on the understanding that well-designed experiments will reveal information to help support an hypothesis. This process involves keeping certain variables constant while adjusting one variable to determine the effect on another variable. The variable that is adjusted by the experimenter is called the

(a) measured variable.
(b) controlled variable.
(c) dependent variable.
(d) independent variable.

Section 2

2019 Section 2 Question 34

Science Inquiry Skills

A group of scientists was investigating the effect of a new form of insulin. Two subjects, both with Type 1 diabetes (diabetes mellitus), were asked to drink one litre of glucose solution. Subject A was given an injection of the standard insulin. Subject B was given an injection of the new insulin. Following the injection their blood glucose levels (BGL) were measured every 10 minutes for one hour. The scientists' computer malfunctioned just before the investigation started. As a result, they hand-wrote the measurements on a piece of paper. Their results are reproduced below.

Just before the consumption of the glucose solution Subject A's BGL was 90 mg/100 mL and subject B's was 92 mg/100 mL.

For the 1st reading Subject A was 110 mg/100 mL and Subject B was 104 mg/100 mL.

At 20 minutes Subject A's BGL was 122 mg/100 mL and Subject B had a reading of 125 mg/100 mL.

Half-way through the investigation Subject B's BGL was 135 mg/100 mL and Subject A had peaked at 126 mg/100 mL.

At 40 minutes Subject A = 105 mg/100 mL and Subject B = 115 mg/100 mL.

Subject B = 100 mg/100 mL and Subject A is 96 mg/100 mL at 50 minutes.

After one hour, Subject A was at the same BGL level as that they had started and Subject B was still 5 mg/100 mL above the level at which they started.

(a) Construct a scientific table to display these data. (6 marks)

(b) In terms of experimental design, the investigation was flawed due to its small sample size. Outline the benefit to investigations of having a suitable sample size. (1 mark)

(c) (i) Were the numerical data collected by the investigators discrete or continuous? (1 mark)

(ii) What type of graph would they have used to display their data? (1 mark)

(d) Calculate the percentage change in BGL for Subject A from the start of the investigation to their peak BGL. Show your workings. (3 marks)

(e) In both subjects, the insulin caused a decrease in their BGL. Describe **three** cellular processes that normally occur in response to insulin. (6 marks)

One:

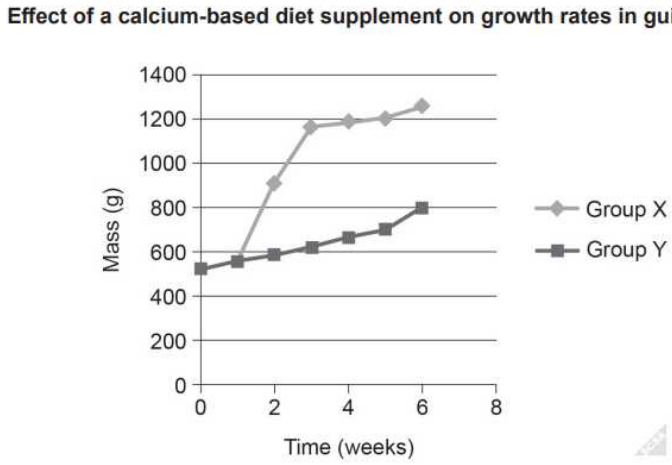
Two:

Three:

Section 3

There have been no questions on this topic for this section in the exams of recent years.

Marking Guide – Section 1

2021 Section 1 Question 10 **Science Inquiry Skills**	Questions 10 and 11 refer to the information shown below An experiment was conducted to investigate the effect of a calcium-based diet supplement on growth rates in guinea pigs. Fifty young guinea pigs were divided into two equal groups. Guinea pigs in Group X were fed a diet containing the supplement; those in Group Y received the same food, but without the supplement. Each week the guinea pigs were weighed and their mass recorded. The average mass of the guinea pigs in each group over the six-week trial period is shown in the graph below.  10. The independent variable for this experiment would be (a) amount of calcium consumed. (b) time (weeks). **(c) the supplement. – Answer** (d) Group X. 11. Which of the following would **not** improve the reliability of this experiment? (a) increasing the sample size (b) duplicating the experiment **(c) randomly selecting the guinea pigs – Answer** (d) replicating the experiment multiple times

2021 Section 1 Question 30 **Science Inquiry Skills**	One of the ethical considerations that must be adhered to during animal research relates to when and how animals can be used. Which of the following is **not** part of an ethical reason to test on animals? (a) The research has the potential to significantly benefit humans. **(b) The financial cost of testing on animals is less than humans. – Answer** (c) A minimum number of animals will be used during the study. (d) The use of animals is essential and cannot be substituted for.

2020 Section 1 Question 9 **Science Inquiry Skills**	Eloise wanted to investigate the effect of temperature changes on the basal metabolic rate of rats. According to the *Australian code of practice for care and use of animals for scientific purposes, eighth edition 2013*, she must follow the principles of the 3Rs for the ethical and humane care of the animals. Which of the following is **not** one of the 3Rs? (a) Replacement – that wherever possible one should use alternative approaches that do not use animals. (b) Reduction – one should use the smallest number of animals possible to achieve the aims and statistical design requirements. (c) Refinement – one should modify methodology to minimise harm to the animals. **(d) Repetition – one should repeat the investigative approach to ensure consistent results. – Answer**

2020 Section 1 Question 16 **Science Inquiry Skills**	The data below refer to heights of individuals in a Year 12 Human Biology class. | Height (cm)	Number of people | |---|---| | 140–149 | 2 | | 150–159 | 6 | | 160–169 | 10 | | 170–179 | 8 | | 180–189 | 3 | | 190–199 | 1 | The **best** graph to represent this data would be (a) column. (b) line. (c) scatterplot. **(d) histogram. – Answer**

2020 Section 1 Question 21 **Science Inquiry Skills**	A pharmacist has been given the option of providing four generic versions of a drug prescribed by a doctor. Which of the following treatment courses would have the **lowest** cost? (a) Drug A costs $25.00 for 28 tablets. The standard dose is one tablet twice a day for seven days. (b) Drug B costs $30.00 for 100 tablets. The standard dose is one tablet four times a day for 14 days. (c) Drug C costs $25.00 for 28 tablets. The standard dose is one tablet twice a day for five days. **(d) Drug D costs $20.00 for 14 tablets. The standard dose is one tablet per day for five days. – Answer**

2019 Section 1 Question 17 **Science Inquiry Skills**	Scientific inquiry is based on the understanding that well-designed experiments will reveal information to help support an hypothesis. This process involves keeping certain variables constant while adjusting one variable to determine the effect on another variable. The variable that is adjusted by the experimenter is called the (a) measured variable. (b) controlled variable. (c) dependent variable. **(d) independent variable. – Answer**

2019 Section 2 Question 34

Science Inquiry Skills

A group of scientists was investigating the effect of a new form of insulin. Two subjects, both with Type 1 diabetes (diabetes mellitus), were asked to drink one litre of glucose solution. Subject A was given an injection of the standard insulin. Subject B was given an injection of the new insulin. Following the injection their blood glucose levels (BGL) were measured every 10 minutes for one hour. The scientists' computer malfunctioned just before the investigation started. As a result, they hand-wrote the measurements on a piece of paper. Their results are reproduced below.

Just before the consumption of the glucose solution Subject A's BGL was 90 mg/100 mL and subject B's was 92 mg/100 mL.

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At 40 minutes Subject A = 105 mg/100 mL and Subject B = 115 mg/100 mL.

Subject B = 100 mg/100 mL and Subject A is 96 mg/100 mL at 50 minutes.

After one hour, Subject A was at the same BGL level as that they had started and Subject B was still 5 mg/100 mL above the level at which they started.

(a) Construct a scientific table to display these data. (6 marks)

The effect of type of insulin on blood glucose level (over time)

	Blood glucose level (BGL) (mg/100 mL)	
Time (minutes)	Subject A (standard insulin)	Subject B (new insulin)
0	90	92
10	110	104
20	122	125
30	126	135
40	105	115
50	96	100
60	90	97

Description	Marks
title mentions both 'type of insulin' and 'BGL'	1
time is in first column	1
time sorted into numerical order	1
column headings	1
units only used in header row	1
correct input of blood glucose data	1
Total	**6**

(b) In terms of experimental design, the investigation was flawed due to its small sample size. Outline the benefit to investigations of having a suitable sample size. (1 mark)

Description	Marks
reduces the effect of biological variation/experimental error/improves reliability	1
Total	**1**

(c) (i) Were the numerical data collected by the investigators discrete or continuous? (1 mark)

Description	Marks
continuous	1
Total	**1**

(ii) What type of graph would they have used to display their data? (1 mark)

Description	Marks
line graph	1
Total	**1**

(d) Calculate the percentage change in BGL for Subject A from the start of the investigation to their peak BGL. Show your workings. (3 marks)

Description	Marks
Initial = 90 mg/100mL *Final = 126 mg/100mL* (126 – 90)/90 = 36/90 = 0.40 x 100 = +40% or 40% increase	1–3
shows correct working out	
numerical answer	
+ or increase	
Total	**3**

(e) In both subjects, the insulin caused a decrease in their BGL. Describe **three** cellular processes that normally occur in response to insulin. (6 marks)

Description	Marks
Two marks for each process to a maximum of six marks	
• increase glucose uptake by cells (especially muscle cells) • increases cellular respiration	1–2
• promotes glycogenesis • more glucose converted to glycogen	1–2
• promotes lipogenesis • more glucose converted to lipid/fat	1–2
• increase protein synthesis • glucose used to 'power' amino acid to protein	1–2
Total	**6**

Marking Guide – Section 3

There have been no questions on this topic for this section in the exams of recent years.