



HUMAN BIOLOGY

ATAR course examination 2023

Marking key

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

Section One: Multiple-choice

30% (30 Marks)

Question	Answer
1	b
2	a
3	b
4	d
5	b
6	c
7	a
8	d
9	a
10	c
11	b
12	a
13	d
14	c
15	d
16	a
17	b
18	c
19	d
20	b
21	c
22	c
23	c
24	a
25	b
26	c
27	d
28	c
29	d
30	a

Section Two: Short answer

50% (107 Marks)

Question 31

(17 marks)

- (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	
<ul style="list-style-type: none"> • breathing rate • heart rate • blood pressure • blood vessel diameter 	1–2
Total	2

- (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

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

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

Question 31 (continued)

- (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) names not needed by an indication of the sequence shown in some way	1
Total	6

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- (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

Question 32

(20 marks)

- (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)	
<ul style="list-style-type: none"> 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

- (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

Question 32 (continued)

- (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	
<ul style="list-style-type: none"> 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

Question 33

(14 marks)

- (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)		
<ul style="list-style-type: none"> • 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 trilobites fossils, a modern human skull was also located. Outline **two** ways in which this could have occurred. (2 marks)

Description	Marks	
Any two of		
<ul style="list-style-type: none"> • 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

Question 34

(21 marks)

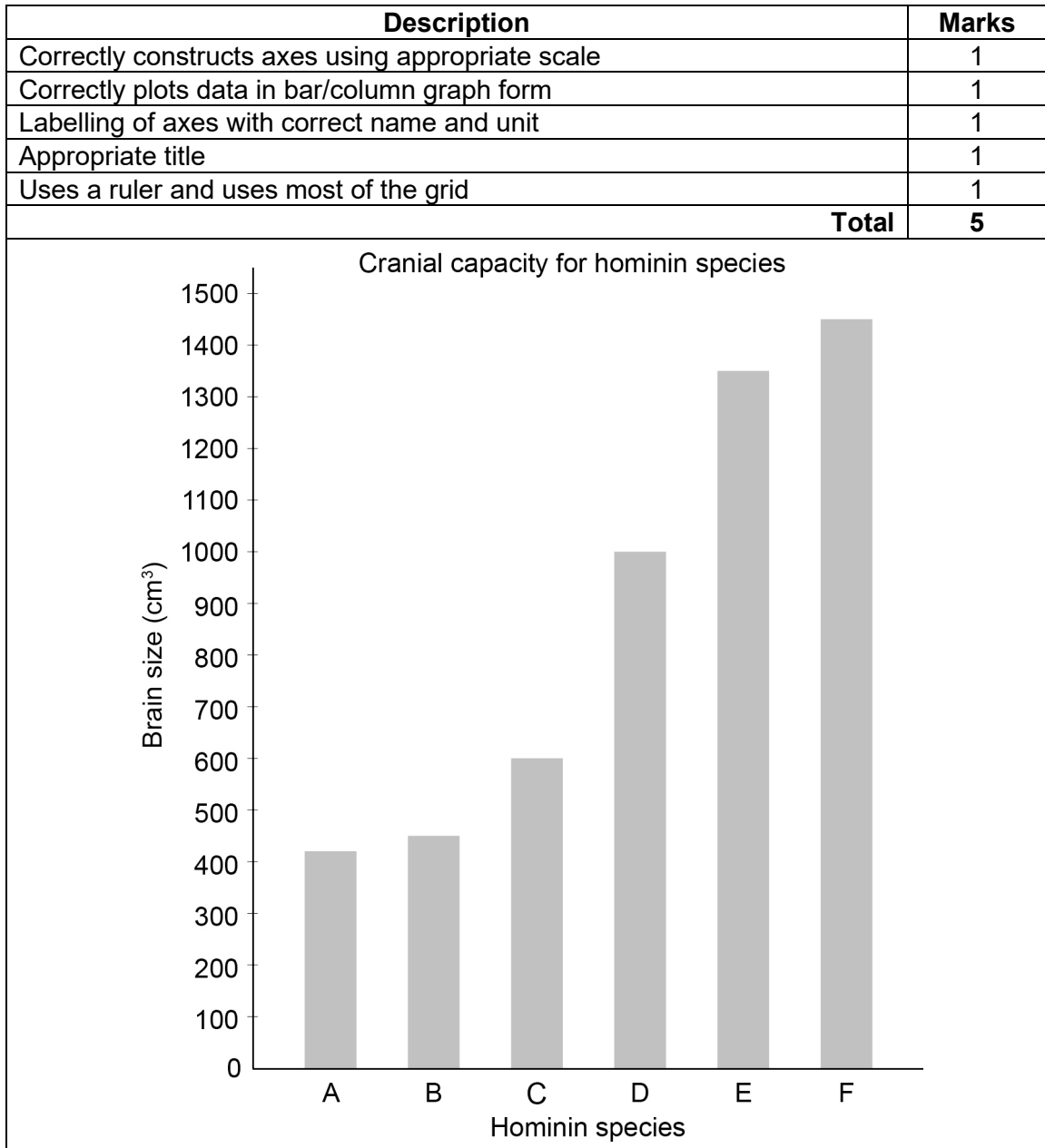
- (a) State which of the cranial capacities from the table above would belong to, (2 marks)

Description	Marks
<i>Australopithecus afarensis</i> – A	1
<i>Homo habilis</i> – 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 <i>Homo sapiens</i> while Hominin F is <i>Homo neanderthalensis</i>	1
Total	3

(c) Graph the data from the table on page 22 on the grid below. (5 marks)



(d) Comment on the evolutionary significance for the increase in brain size shown by the data. (3 marks)

Description	Marks
Any three of	
<ul style="list-style-type: none"> • 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

Question 34 (continued)

- (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	
<ul style="list-style-type: none"> • 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

Question 35

(13 marks)

- (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	
<ul style="list-style-type: none"> 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)	
<ul style="list-style-type: none"> 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

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

- (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

Question 35 (continued)

- (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)	
<ul style="list-style-type: none"> • 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

Question 36

(22 marks)

- (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

- (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
<ul style="list-style-type: none"> protein coat DNA or RNA not a living cell 	<ul style="list-style-type: none"> 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	
<ul style="list-style-type: none"> preventing the cell wall production preventing protein synthesis disrupting enzyme functioning preventing replication 	1–2
Total	3

Question 36 (continued)

- (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	
<ul style="list-style-type: none"> • 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	
<ul style="list-style-type: none"> • 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

Section Three: Extended answer

20% (40 Marks)

Unit 3

Question 37

(20 marks)

- (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	
<ul style="list-style-type: none"> • 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

Question 38

(20 marks)

- (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	
<ul style="list-style-type: none"> • decreased heart rate • decreased BP • cold intolerance • weight gain • goitre/neck swelling • slow brain functioning • fatigue 	<ul style="list-style-type: none"> • 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	
<ul style="list-style-type: none"> • increase iodine in diet • synthetic hormone tablets • surgery 	<ul style="list-style-type: none"> • 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

Unit 4

Question 39

(20 marks)

- (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)	
<ul style="list-style-type: none"> 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

Question 39 (continued)

- (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

Question 40

(20 marks)

- (a) Recall the evidence that phylogenetic trees illustrate. (4 marks)

Description	Marks
Any four of	
<ul style="list-style-type: none"> 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	
<ul style="list-style-type: none"> both show <i>A. afarensis</i> as the common ancestor to all other species in the tree both show <i>P. boisei</i> as not a direct relative to <i>Homo</i>/more distantly related to <i>Homo</i> than others both show <i>P. aethiopicus</i> as older than <i>P. boisei</i> and <i>P. robustus</i> both show <i>A. africanus</i> as older than <i>P. boisei</i> and <i>P. robustus</i> both show <i>A. africanus</i> as a direct ancestor to <i>Homo</i> species 	1–4
Subtotal	4
Differences – any six of	
<ul style="list-style-type: none"> A shows that <i>Homo</i> and <i>P. robustus</i> shared a (recent) common ancestor while B doesn't B shows that <i>P. boisei</i> and <i>P. robustus</i> shared a (recent) common ancestor while A doesn't A shows that <i>Homo</i> and <i>P. robustus</i> are closely related while B doesn't B shows that <i>P. boisei</i> and <i>P. robustus</i> are closely related while A doesn't A shows that <i>Homo</i> are more closely related to <i>P. robustus</i> while more distantly related to <i>P. boisei</i> species while B doesn't B shows that <i>Homo</i> and both <i>P. boisei</i> and <i>P. robustus</i> are the most distantly related while A doesn't A shows that <i>A. africanus</i> is a direct ancestor to <i>P. robustus</i> while B doesn't B shows that <i>P. aethiopicus</i> is a direct ancestor to <i>P. robustus</i> while A doesn't 	1–6
Subtotal	6
Total	10

Question 40 (continued)

- (c) Explain how the inclusion of the terms 'Homo', 'Australopithecus' or 'Paranthropus' in a species name 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	
<ul style="list-style-type: none"> • 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

ACKNOWLEDGEMENTS

- Question 31(d)** Adapted from: A Level Biology Student. (n.d.). *Synapse* [Illustration]. Retrieved April, 2023, from <https://alevelbiologystudent.weebly.com/135-synapses.html>
- Question 34(e)** Adapted from: Blaxland, B., & Dorey, F. (2020). *Walking on Two Legs – Bipedalism*. Retrieved May, 2023, from <https://australian.museum/learn/science/human-evolution/walking-on-two-legs-bipedalism/#:~:text=About%20seven%20million%20years%20ago,that%20helped%20them%20climb%20trees>

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