Government of **Western Australia**
School Curriculum and Standards Authority

HUMAN BIOLOGY

ATAR course examination 2019

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.

2019/62836

Section One: Multiple–choice **30% (30 Marks)**

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

Section Two: Short answer **50% (107 Marks)**

Question 31 **(11 marks)**

(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**

(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**

Question 32

(10 marks)

(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**

(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**

(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**

Question 33 **(9 marks)**

(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**

Question 34 **(18 marks)**

(a) Construct a scientific table for 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**

Question 35 **(11 marks)**

(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**

(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**

(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**

Question 36 **(16 marks)**

(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**

(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.			

Question 37 **(10 marks)**

(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**

(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	

Question 38 **(9 marks)**

(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.	

(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.	

Question 39 **(13 marks)**

(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**

(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**

Question 40 **(6 marks)**

(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**

(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**

Section Three: Extended answer **20% (40 Marks)**

Question 41 **(20 marks)**

(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**

(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**

Question 42 **(20 marks)**

(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**

(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**

Question 43 **(20 marks)**

(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**

Feet	
Feature • aligned big toe/non-opposable big toe show closer relationship to modern human/opposable toe show closer relationship to early hominids **or** • large heel bone shows closer relationship to modern human **or** • foot has both transverse and longitudinal arches show closer relationship to modern human/only one arch show closer relationship to early hominids	1
Benefit ability to support the entire weight of the body for bipedal locomotion/shock absorption when walking upright	1
Subtotal	**2**
Total	**10**

ACKNOWLEDGEMENTS

Question 43(b) Extract adapted from: Hardison, R.C. (2003). Comparative genomics. In *PLoS Biology*. Retrieved October, 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC261895/

Extract adapted from: Xia, X. (2013). In *Comparative genomics*. Retrieved October, 2019, from https://en.wikipedia.org/wiki?curid=917868

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