



HUMAN BIOLOGY

ATAR course examination 2017

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

Section Two: Short answer

50% (100 Marks)

Question 31

(9 marks)

- (a) What type of neuron is shown in the diagram? (1 mark)

Description	Marks
Sensory/afferent/unipolar/pseudo-unipolar	1
Total	1

- (b) How does the position of the cell body in other types of neurons differ from the position shown in the diagram? (2 marks)

Description	Marks
In line with the rest of the neuron/fibre/axons and dendrites	1
Different distance from either end/centrally positioned in an interneuron/closer to dendrites in a motor neuron	1
Total	2

- (c) Complete the table below to outline
- three**
- of these differences. (6 marks)

Description			Marks
1 mark per box			
	Nervous system	Endocrine system	1–6
Speed of action	rapid/within milliseconds/seconds	slow/from seconds to days	
Duration of action	short/stops quickly/stops when stimulus stops	longer lasting/can continue long after stimulus stops	
Specificity of message.	local/specific	more general/widespread	
Total			6

Question 32

(13 marks)

- (a) Reported cases of TTX poisoning have been caused by the ingestion of contaminated food. Is the ingestion of contaminated food classified as direct or indirect disease transmission? (1 mark)

Description	Marks
Indirect	1
Total	1

- (b) In the entertainment media, the zombie disease is usually transmitted by a bite from an infected person. What type of disease transmission would this be? Describe how the pathogen would be transmitted. (3 marks)

Description	Marks
Direct/transfer of body fluids	1
Pathogens found in saliva	1
Bite penetrates skin barrier/pathogens transmitted into blood stream	1
Total	3

(c) Whether analysing the fictional zombie disease or zombie symptoms caused by TTX, many zombie symptoms are due to its effects on various parts of the nervous system. Using your knowledge of the functions of the nervous system, complete the table below by identifying where the dysfunction would most likely occur to bring about the stated zombie symptoms. Provide a scientific reason for your choice. (6 marks)

Description			Marks
1 mark per box			
Zombie symptom	Structure/s of the nervous system affected	Reason	1–6
Jerky movements when walking	<ul style="list-style-type: none"> Cerebellum/motor neurons/cerebrum/primary motor area 	<ul style="list-style-type: none"> Cerebellum – Coordinates muscle movements Motor neurons – not sending impulse to muscles Cerebrum/primary motor area – not sending message to muscles 	
Reduced perception of pain stimulus	<ul style="list-style-type: none"> Pain receptors/sensory neurons/cerebrum/primary sensory somatic area 	<ul style="list-style-type: none"> Pain receptors – not detecting stimuli Sensory neurons – not sending impulse to CNS Cerebrum/primary sensory somatic area – message received but not interpreted 	
Inability to speak	<ul style="list-style-type: none"> Cerebrum/frontal lobe/temporal lobe/Broca's area/Wernicke's area 	<ul style="list-style-type: none"> Cerebrum/frontal lobe – Controls decision making/processing Frontal lobe/Broca's – formation of speech Temporal lobe/Wernicke's – understanding of language 	
Total			6

Question 32 (continued)(d) Outline **three** differences between antibiotics and vaccines.

(3 marks)

Description	Marks
Any 3 of:	
Antibiotics only treat bacterial infections, while vaccines treat bacterial and viral infections.	1–3
Antibiotics usually taken orally, vaccines usually injected	
Antibiotics are chemical compounds, vaccines made from dead or weakened organisms (or products of organisms)/use of DNA technology	
Antibiotics work by killing pathogen/inhibiting pathogen growth, vaccines work by providing immunity against a pathogen	
Antibiotics help to heal the infected individual; vaccines help prevent disease transmission/antibiotics are a cure while vaccines are a prevention	
Antibiotics effective during time of infection while vaccines provide long lasting effect/provide memory cells	
Antibiotics given after contraction of disease, vaccines given before/while healthy	
Total	3

Question 33

(11 marks)

- (a) Identify **three** errors in the graph. (3 marks)

Description	Marks
Any 3 of:	
Poor title with only one variable	1–3
Plotting errors Eg. 10% salt line at 50 (should have been 82 at 120 mins) 30% salt line at 85 (should have been 51 at 0 mins) all start at the same point on –30 mins	
Vertical axis missing axis label/unit	
No key	
–30 min plot in wrong position on X axis	
Total	

- (b) Why was urine collected from each volunteer 30 minutes prior to their drinking 1 litre of their solution? (2 marks)

Description	Marks
To use as a comparison/as a control	1
To determine the amount of urine produced under normal conditions/baseline conditions	1
Total	2

- (c) Identify **two** variables **not** indicated in the information for this question that needed to be maintained across all three groups during the investigation to ensure a fair test was conducted. (2 marks)

Description	Marks
Any 2 of:	
Temperature participants kept in	1–2
Activity level of participants	
Age of participants/gender balance	
Food intake of participants	
Fluid intake in the hours before the investigation	
Healthy/no diseases of the kidney/no pre-existing conditions/all have disease	
Total	2

- (d) State **one** factor that is changed in the normal internal environment due to the drinking of 1 litre of 30% salt solution. (1 mark)

Description	Marks
Water concentration in blood has decreased	1
Osmotic pressure in blood has increased	
Salt/sodium amount in blood has increased	
Total	1

- (e) At what time would the blood concentration of ADH be the lowest for the people in Group 1? Justify your answer. (3 marks)

Description	Marks
Between 30 min – 60 min/60 mins	1
Allow more urine to be produced	1
Reducing amount of fluid in blood/less water to be reabsorbed	1
Total	3

Question 34**(12 marks)**

- (a) (i) Why did the blood pH levels change? (2 marks)

Description	Marks
Increase in activity/metabolism/energy/cellular respiration/production of CO ₂	1
(causing) Increase in hydrogen ion concentration/higher acidity/greater production of carbonic acid/production of lactic acid	1
Total	2

- (ii) Describe the events that enable this change in the breathing rate to occur. (4 marks)

Description	Marks
Detected by chemoreceptors/carotid and aortic bodies	1
Send nerve impulses to the respiratory centre/medulla oblongata	1
Nerve impulses sent to respiratory muscles/diaphragm/intercostal muscles	1
Increased contraction of respiratory muscles	1
Total	4

- (b) Under normal circumstances, the level of oxygen in the blood does not influence breathing rate. Under what circumstance will it have an effect and what effect will it be? (2 marks)

Description	Marks
When oxygen falls to very low levels	1
Causes increase in breathing rate	1
Total	2

- (c) How could gene therapy and cell replacement therapy be combined as a treatment? (4 marks)

Description	Marks
Stem cells would be taken from the patient	1
Mutant gene is replaced by normal gene	1
Cells multiplied	1
Cells transferred back into the patient	1
Total	4

Question 35

(10 marks)

- (a) Complete the table below, which is based in the diagram shown above. (5 marks)

Description		Marks
1 mark per box		
What is required for Step X to proceed?	Heat	1–5
What happens to the DNA at Step X?	Denature/separate	
What is the process occurring at Step Y?	Annealing/Hybridization/primers added to complementary strand	
What is added at Step Z?	Taq polymerase/DNA polymerase	
At what temperature does Step Z occur?	68 °C – 72 °C	
Total		5

- (b) Why is amplification of DNA created by PCR useful in the study of human evolution? (1 mark)

Description	Marks
Provides testable amounts of DNA/provides large amounts of DNA/magnifies the fossil quantities/most fossil DNA found in minute quantities	1
Total	1

- (c) Match the circumstances (i) and (ii) to the most likely sequence of events – A, B or C. Write A, B or C below. (2 marks)

Description	Marks
(i) A	1
(ii) B	1
Total	2

- (d) On the basis of the information provided, identify the circumstance that would probably result in the best preserved and complete fossil specimen. Provide a reason for your answer. (2 marks)

Description	Marks
(i) /avalanche	1
Most protected from decay/micro-organisms/oxygen/scavengers	1
Total	2

Question 36

(11 marks)

- (a) According to the information in the diagram, is Graves' disease a type of hypothyroidism or hyperthyroidism? (1 mark)

Description	Marks
Hyperthyroidism	1
Total	1

- (b) Identify **two** symptoms you would expect someone with Graves' disease to display. (2 marks)

Description	Marks
Any 2 of:	
Increased metabolic rate	1-2
Higher than normal temperature	
Accelerated heart rate/heart palpitations	
Muscle weakness/trembling	
Sensitivity to heat	
Diarrhoea	
Sleeping difficulties	
Anxiety	
Sweating	
Irritability	
Nervousness/agitation	
Changes in menstruation	
Enlarged thyroid	
Weight loss	
Increased appetite	
Bulging eyeballs	
Total	2

- (c) Explain how Graves' disease can be treated. (3 marks)

Description	Marks
Any 3 of:	
<ul style="list-style-type: none"> • Removal of thyroid gland/surgery on thyroid gland • Radioactive iodine • Antithyroid/iodo blocker drugs 	1
<ul style="list-style-type: none"> • Thyroid cells damaged/killed/not functioning 	1
<ul style="list-style-type: none"> • Replacement of thyroxine (T4)/Triiodothyronine • Synthetic hormones as replacement 	1
Total	3

- (d) Describe the process that, under normal circumstances, stimulates the release of thyroid stimulating hormone (TSH) from the pituitary gland. (5 marks)

Description	Marks
Low levels of thyroxine/thyroid hormones/decreased metabolism/decreased body temperature	1
Stimulates receptors in hypothalamus	1
Triggers release of TSHrf/releasing factors	1
Factors travel through blood capillaries	1
Stimulate anterior pituitary gland	1
Total	5

Question 37

(11 marks)

- (a) Name **two** mechanisms that would be activated in this situation. (2 marks)

Description	Marks
Any 2 of:	
Shivering	1-2
Increased metabolic rate	
Vasoconstriction	
Total	2

- (b) As the set point falls from 41 °C back to 37 °C other mechanisms respond to the lower body temperature by increasing heat loss.

Name and describe **one** of these mechanisms. (3 marks)

Description	Marks
Vasodilation	1-3
Increasing diameter/widening of skin arterioles/blood vessels	
Brings heat to the body surface/brings blood to the surface/increase radiation	
or	
Sweating	
Uses heat/latent heat from the body	
To evaporate water/cause evaporation	
Total	3

Question 37 (continued)

- (c) Explain how a bacterial pathogen stimulates the hypothalamus to reset the thermostat and therefore results in a fever. (4 marks)

Description	Marks
Any 3 of:	
Macrophages respond to entry of pathogen/bacteria	1–3
Macrophage ingests pathogen/bacteria	
Macrophage produces interleukin 1/chemicals	
Bacteria/pathogen releases endotoxins/toxins/pyrogens	
Cytokines produce pyrogens	
Pyrogens/interleukin 1 released into blood	
Pyrogens alter body's temperature sensors (making the body think it is cooler than it actually is)	
Hypothalamus responds to pyrogens/hypothalamus responds to interleukin 1/hypothalamus responds to chemicals released from macrophage	1
Total	4

- (d) Describe **one** way in which the increased body temperature associated with a fever assists in fighting a pathogen during an infection. (2 marks)

Description	Marks	
Any 1 – for 2 marks		
Increases effect of interferon Which interferes with viral replication/viral reproduction	1–2	
Increases production of killer T cells Which speed up the specific/cell mediated immune response		
Increases metabolic rate Which speeds up tissue repair		
Increases heart rate/blood flow Enables lymphocytes to reach sites of infection faster		
Creates non-optimum temperature/high temperature Which inhibits/kills pathogen		
Total		2

Question 38

(13 marks)

- (a) (i) Which relative dating method could be used to date the fossil specimens and artefacts within the cave by comparing them to each other? (1 mark)

Description	Marks
Principle of Superposition/Stratigraphy	1
Total	1

- (ii) Using the relative dating method identified in part (a)(i), state which layer in the cave is the oldest. Justify your answer. (3 marks)

Description	Marks
Layer 1	1
Is laid down first/beneath all other layers	1
Further down a layer the older a layer is	1
Total	3

- (b) In layer 2, an index fossil was found. Explain what an index fossil is and how it helps archaeologists investigating a site. (3 marks)

Description	Marks
Are widely distributed fossils	1
Were on earth for only a limited time period	1
Can correlate rock strata to other known strata/other locations	1
Total	3

- (c) (i) What name is given to this type of tool? (1 mark)

Description	Marks
Acheulean/hand axe/bifaced hand axe	1
Total	1

- (ii) Who is the first hominid believed to have made this type of tool? (1 mark)

Description	Marks
<i>Homo erectus</i>	1
Total	1

Question 38 (continued)

- (d) (i) Name the hominid specimen shown above and state **one** distinguishing feature shown in the diagram that enables it to be identified. (2 marks)

Description	Marks
<i>Homo neanderthalensis</i> /Neanderthal	1
Lack of chin/occipital bun/lack of forehead/elongated skull/depression (the suprainiac fossa) at back of skull/flared zygomatic arch	1
Total	2

- (ii) In which layer of the cave would you expect this fossil to have been found? Provide a reason for your answer. (2 marks)

Description	Marks
Layer 4/5/4 & 5	1
Is younger than hominid that made tools in layer 3/Neanderthal existed at 100 000 years ago	1
Total	2

Question 39

(10 marks)

- (a) The studies described above outline how mustard gas has been shown to cause mutations. Mustard gas can therefore be classed as a (1 mark)

Description	Marks
Mutagen	1
Total	1

- (b) Auerbach and Robson were studying chromosomal mutations. Describe **two** types of these mutations that can occur in organisms. (4 marks)

Description	Marks
Any 2 – 1 mark for naming, 1 mark for description	
Insertions – extra base pairs are added into the DNA/chromosome.	1–4
Duplications – a section of DNA/whole chromosome is repeated	
Deletions – a section of DNA is lost/removed	
Translocations – a section of one chromosome attaches to another chromosome	
Inversions – a broken segment is reversed and reinserted into a chromosome	
Non-dysjunction – extra or missing chromosome	
Total	4

- (c) The 2014 study examined mutated genes. Describe how this type of mutation differs from a chromosomal mutation. (2 marks)

Description	Marks
Occurs a single gene loci/doesn't involve the whole chromosome	1
Change in one (or a few) nucleotide bases/substitution, insertion, or deletion of nucleotide bases	1
Total	2

- (d) Explain why Auerbach and Robson studied the offspring flies, not the parent flies, and what information this gave about the type of mutations that occurred. (3 marks)

Description	Marks
Any 3 of:	
Trying to see if mutation can be passed on/was passed generation to generation	1–3
Mutations had to occur in the germ cells/reproductive cells/mutation present in gametes of parents	
Mutations were germline/not somatic mutations	
Mutations should have been found in all cells of the offspring	
Total	3

Section Three: Extended answer

20% (40 Marks)

Question 40

(20 marks)

- (a) All bipedal hominids have many features in common. However, the species of genus Australopithecus and genus Paranthropus display differences from the species of genus Homo.

Identify **four** differences that may be observed in the various species of that Australopithecus and Paranthropus when compared with those species that belong to genus Homo. For each of the four differences identified, state how it differs from the genus Homo. (8 marks)

Description		Marks
Any four of:		
Australopithecus/Paranthropus	Homo	1–8
Smaller cranial capacity	Larger cranial capacity	
Post central foramen magnum	Central foramen magnum	
More prognathic face	Flatter face	
Face large in comparison to cranium (Homo towards opposite)	Large cranium in comparison to face	
Heavier/larger jaw	Light jaw	
Larger molars/premolars /Greater difference in size of incisors to molars/less even size of teeth	Even teeth size	
Sagittal crest (in some species)	No sagittal crest	
Longer arms	Shorter arms	
Narrower pelvis	Broad pelvis	
Funnel/barrel shaped rib cage	Smaller rib cage	
Long curving fingers	Short fingers	
Less mobile thumb	Opposable thumb	
More mobile wrist/ankle joint	Less mobile wrist/ankle joint	
Total		8

- (b) A group of archaeologists found two fossil skeletons. One, found in Africa, was identified as *Australopithecus afarensis* and the other, found in Europe, was identified as *Homo sapiens*.

State which absolute dating method would be most appropriate to determine the age of each fossil and the reason for your choice. Describe each of these methods. (12 marks)

Description				Marks
6 marks per species				
Species	Dating – 1 mark	Reason for choice – 1 mark	Method – 4 marks	
<i>Australopithecus afarensis</i>	Potassium argon dating	Can date beyond 100 000 to 200 000 years /A. afarensis in Africa 3 to 4 million years ago.	<ul style="list-style-type: none"> Based on the decay of potassium-40 into calcium and argon The ratio of potassium-40 to argon-40 determines the age Potassium has a half-life of 1.25–1.3 billion years Rocks/volcanic rocks are dated 	1–12
<i>Homo sapiens</i>	Carbon 14 dating/radiocarbon dating	Can date up to about 60 000 to 70 000 years /H. sapiens in Europe from about 45 000 years ago	<ul style="list-style-type: none"> Based on the decay of carbon-14 into nitrogen The ratio of carbon-14 to carbon-12 determines the age Carbon-14 has a half-life of 5730 years The carbon in the fossil skeleton/organic material is dated. 	
Total				12

Question 41

(20 marks)

For each inherited genetic disease, identify a population in which the disease is prevalent, outline the cause and main symptoms experienced by affected individuals and describe how the disease is inherited and the effect it has on the gene pool of populations.

(a) sickle-cell anaemia

(7 marks)

Description	Marks
Population – Black African populations/India/SE Asia/Italy	1
Cause – Mutation of the gene responsible for red blood cell/haemoglobin production	1
Symptoms – <ul style="list-style-type: none"> • Red blood cells that have a sickle shape • Reduces oxygen carrying ability of red blood cells • Fatigue/shortness of breath/anaemia/pain/swelling and inflammation of hands or feet/bacterial infections/sudden pooling of blood in spleen/liver congestion/lung and heart injury/leg ulcers 	1–2
Inheritance – Recessive trait/passed from affected parents/passed from two carrier parents	1
Effect on gene pool (any 2) – <ul style="list-style-type: none"> • Individuals homozygous for condition usually die early/disease can be fatal • Individuals heterozygous for the condition are called 'sicklers'/have sickle-trait • Heterozygous individuals are resistant to malaria/increases sickle cell allele frequency in population 	1–2
Total	7

(b) Tay–Sachs disease

(6 marks)

Description	Marks
Population – Ashkenazi Jew/Jewish people (from Eastern Europe)/Cajun	1
Cause – Missing enzyme essential for fat metabolism	1
Symptoms – <ul style="list-style-type: none"> • Build-up of fatty substances in the nervous system • From a few months of age mental and physical disabilities develop quickly (eg. blindness, deaf, unable to swallow, atrophied, paralytic) 	1–2
Inheritance – Recessive trait/passed from two carrier parents	1
Effect on gene pool (any 1) – <ul style="list-style-type: none"> • Affected individuals die in childhood/die before reproductive age • Carrier couples choose not to reproduce • Heterozygous individuals are resistant to TB/increases Tay-Sachs allele frequency in population 	1
Total	6

(c) thalassaemia

(7 marks)

Description	Marks
Population – Populations around Mediterranean Sea/Greek/Italian	1
Cause – Mutation of the gene responsible for red blood cell/haemoglobin production	1
Symptoms – <ul style="list-style-type: none"> Defects in the formation of haemoglobin/abnormal shape haemoglobin Sufferers have fewer functioning red blood cells Sufferers can have anaemia/iron deficiency/bone malformations/heart defects/enlarged spleen/slow growth rates 	1–2
Inheritance – Recessive trait/passed from affected parents/passed from two carrier parents	1
Effect on gene pool (any 2) – <ul style="list-style-type: none"> More mutations in red blood cell formation increases the severity of the disease/can inherit multiple mutations Individuals affected with mild thalassaemia only have 1–2 mutations/Individuals affected with severe thalassaemia have 3–4 mutations More mutations found in gene pool greatly increases mortality rate Resistance to malaria/increases thalassaemia allele frequency in population 	1–2
Total	7

Question 42**(20 marks)**

(a) Describe how a nerve impulse is propagated along a myelinated nerve fibre. How does a nerve impulse propagated along an unmyelinated nerve fibre differ? (10 marks)

Description	Marks
Any 8 – Description	
Depolarisation occurs	1–8
at the Nodes of Ranvier along the fibre /the impulse jumps from node to node/saltatory conduction	
Cell membrane becomes permeable to sodium ions	
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)	
Inside the membrane becomes negative relative to the outside	
Needs to reach threshold –55mV	
A sodium–potassium pump acts	
transports sodium ions out of the cell	
transports potassium ions into the cell	
Returns to a polarised/resting state/neuron repolarised	
Hyperpolarisation occurs	
Action potential triggers depolarisation in adjacent membrane region	
2 marks – Difference	
Slower	1–2
Continuous/doesn't jump from node to node	
Total	10

- (b) Human growth hormone was originally extracted from the pituitary glands of cadavers (dead human bodies). It was a very difficult and unsafe procedure and there was often a shortage of the hormone. However, scientists succeeded in developing this hormone in bacteria by using recombinant DNA technology.

Describe the process that produces human growth hormone by recombinant DNA technology. (10 marks)

Description	Marks
Any 10 of	
The gene/segment of DNA is isolated/identified/located	1–10
It is at a recognition sites	
Cut by a restriction enzyme.	
The enzyme cuts the DNA on either side of the gene	
(The enzyme cuts the DNA) in a staggered cut	
Unpaired nucleotides overhang at the break	
Produced sticky ends	
A plasmid/a circular strand of DNA is removed from a bacterium	
The plasmid is cut with the same type of restriction enzyme	
Creates sticky ends	
The sticky ends (of the isolated gene and the plasmid) are joined together	
Joined by DNA ligase	
The combined gene and plasmid are inserted into the bacterial cell/transformation occurs	
The bacterial cell is cloned/mitosis/divides	
Large amounts of the gene or its product/human growth hormone is produced	
Multiplied/cultured/grown in vats before product can be harvested	
Total	10

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