



HUMAN BIOLOGICAL SCIENCE

Stage 3

WACE Examination 2013

Marking Key

Marking keys are an explicit statement about what the examiner expects of candidates when they respond to a question. They are essential to fair assessment because their proper construction underpins reliability and validity.

Section One: Multiple-choice

30% (30 Marks)

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

A= 7
B= 8
C= 8
D= 7

Section Two: Short answer

50% (100 Marks)

Question 31

(10 marks)

- (a) State the name given to the study of rock layers. (1 mark)

Description	Marks
Stratigraphy	1
Total	1

- (b) (i) Which location contains the oldest layer? Justify your answer. (2 marks)

Description	Marks
S	1
Using the principle of superposition technique	1
Matching all similar strata together results in S having the deepest layer	
Total	2

- (ii) Some of the fossils found in the rock strata can be seen in more than one location and help to provide a more precise correlation between the rock strata in different locations. State the name given to these types of fossils. (1 mark)

Description	Marks
Index fossil/ index	1
Total	1

- (c) (i) Outline **four** unique conditions needed for fossil formation to occur. (4 marks)

Description	Marks
Quick burial of specimen/ covered rapidly by sediments	1–4
Buried in soils of low pH for soft tissue	
Buried in alkaline soils for bones	
Polymerisation in amber from hardened tree sap	
Rapidly frozen in ice	
Rapidly buried in volcanic ash, with the silica then replacing bone	
Petrification with mineral deposits of soft tissue	
Charcoalification by action of fire to preserve internal structure	
Arid climates that can mummify remains	
Presence of hard body parts to fossilise (increases likelihood)	
Lack of micro-organisms present/ specimen not be exposed to oxygen	
Specimen needs to be left undisturbed by scavengers/ not eaten by animals/ not disturbed by human activity	
Specimen needs to be not disturbed by earth movements (e.g. earthquakes/ plate tectonics)	
Total	

- (ii) State **two** reasons, apart from a lack of fossil formation, that explain why there are gaps in the fossil record. (2 marks)

Description	Marks
Fossils may be:	1–2
• not recognised/ only fragments found	
• buried too deep to find/ too hard to penetrate rock layers to find older fossils	
• located in places impossible to get to	
• difficult to date due to limitations in dating methods	
• exposed and weathered before discovery/ destroyed before discovery by human activity/ geological disturbance	
• scientists can disagree on the interpretation of fossils	
Total	2

Question 32

(11 marks)

(a) Identify the endocrine gland that

(i) secretes the hormone aldosterone. (1 mark)

Description	Marks
E/ adrenal gland/ adrenal cortex/ suprarenal gland	1
Total	1

(ii) secretes a hormone that targets bone. (1 mark)

Description	Marks
A/ pituitary	1
C/ parathyroid gland	
D/ thyroid	
Total	1

(b) Describe the role of each of the following structures in the regulation of body fluid composition. (2 marks)

Description	Marks
A - increases or decreases release of ADH/ releases ADH	1
B - receptor /detect changes / osmotic pressure/ osmotic balance/produces ADH/ stimulates A to release ADH/acts as modulator	1
Total	2

(c) (i) Name the category of hormones this diagram represents. (1 mark)

Description	Marks
Steroid/ lipid (soluble)	1
Total	1

(ii) At Point 1, what feature of the cell membrane enables the hormone to cross into the cytoplasm? (1 mark)

Description	Marks
Lipid / phospholipid	1
Total	1

(d) Describe what is occurring at Points 2–5. (4 marks)

Description	Marks
2. Receptor attaches (binds) to hormone/ hormone-receptor complex forms	1
3. Enters nucleus/ through nuclear pore	1
4. Complex binds to DNA/ chromatin receptor sites/ activation of genes/ activation/ up regulation of genes	1
5. Transcription/production of mRNA/ protein synthesis	1
Total	4

- (e) The mode of action of the other category of hormones differs from the mode of action shown in the diagram. Identify **one** characteristic of the other category of hormones that makes it unique. (1 mark)

Description	Marks
Protein/amine	1
Receptor on the surface/ cell membrane (vs inside cytoplasm)	
Hormone receptor complex forms on the cell membrane/ surface (vs inside cytoplasm)	
Enzymes activated within the cytoplasm (vs in nucleus or other organelles)	
Secondary messenger within cytoplasm is activated (vs genes activated)	
Total	1

Question 33

(12 marks)

- (a) Describe how the above graph illustrates a negative feedback model. (2 marks)

Description	Marks
Negative feedback produces a response in a direction opposite to the original stimulus	1
Appropriate description with reference to graph – e.g. following the meal, blood glucose concentration is high then reduces/ reduces then rises again due to glucagon secretion	1
Total	2

- (b) (i) Name the hormone that caused the change in blood glucose concentration between times Y and Z on the graph. (1 mark)

Description	Marks
Glucagon	1
Total	1

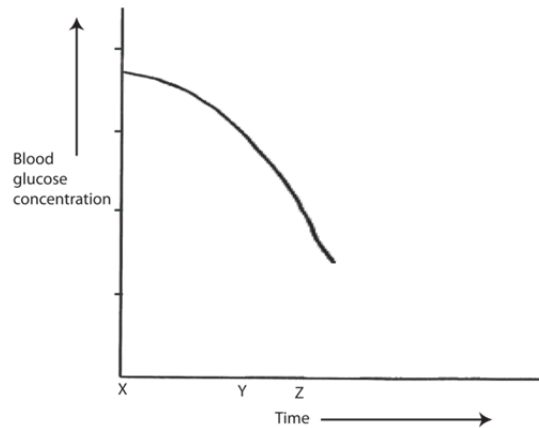
- (ii) Name the cell type and the specific location within the organ from which the hormone stated in part (b) (i) was secreted. (2 marks)

Description	Marks
Alpha cells	1
Islets of Langerhans/pancreatic islets	1
Total	2

- (iii) Describe **two** responses that led to the change in blood glucose concentration between times Y and Z on the graph. (2 marks)

Description	Marks
Glycogen conversion to glucose / glycogenolysis	1–2
Production of glucose from fat (lipids)/ gluconeogenesis (of fats/ lipids)	
Production of glucose from amino acids (protein)/ gluconeogenesis (of amino acids/ protein)	
Total	2

- (c) (i) On the axes below, draw the blood glucose levels of a person suffering Type 2 diabetes (untreated) over this same time period. (1 mark)



Example graph shown above. Note that the start of the line should technically be above the start point of the original for a person suffering type 2 diabetes. However, no marks deducted if line is started at the same point as the original.

Description	Marks
Line shows that the level remains higher for longer and slowly decreases (must decrease slower than original)	1
Total	1

- (ii) Explain the shape of your graph above in terms of glucose regulation. (4 marks)

Description	Marks
Insulin is produced/present	1-4
Cells don't respond to insulin	
Cells unable to take up glucose	
Failure to convert glucose to glycogen	
Failure to convert glucose to fat	
Cells unable to use glucose for energy / glycolysis	
Glucose levels remain higher for longer	
Total	4

Question 34

(11 marks)

- (a) Polymerase chain reaction (PCR) is a biotechnological technique used when only very small amounts of DNA are available for sampling. Describe **three** situations in which PCR would be useful. (3 marks)

Description	Marks
Tiny samples of fossils/ extinct species/ phylogenic analysis of fossils (eg Neanderthal)/ migration patterns of past humans	1–3
Shortens time to detect hereditary diseases	
Forensics to gain enough DNA at (a crime scene)	
Tissue typing for organ transplants	
Earlier detection of infectious disease (eg HIV)/ search for DNA from foreign organisms/ viruses/ bacteria	
Research-DNA cloning/ sequencing/ patterns of gene expression/ switched on or off.	
DNA profiling for identifying individuals from their unique DNA/ comparing an individual's DNA to a library of DNA from known individuals	
Total	3

- (b) There are several steps in a single cycle of PCR. The first involves the denaturing of DNA. State the purpose of the first step in the process and how is it achieved. (2 marks)

Description	Marks
To separate the DNA strands	1
Heating of double stranded DNA	1
Total	2

- (c) After the DNA is denatured, the next step in the cycle of PCR involves primers.

Explain the purpose of primers in PCR. (2 marks)

Description	Marks
Primer is a short piece of single stranded DNA	1–2
Primer binds/ anneals/ attaches to each DNA strand (by base pairing at the 3' end)/ to complementary base sequences	
Initiates/ starts replication by DNA polymerase	
Total	2

- (d) The Human Genome Project has made it possible to target disease-causing genes by using genetic probes.

- (i) Describe a genetic probe. (2 marks)

Description	Marks
Fragment (small piece) of single stranded DNA or RNA	1
Labelled with radioactive isotopes/ fluorescent markers.	1
Total	2

- (ii) A sample of DNA is being tested for Huntington's disease, a genetic disorder in which the base sequence of the gene is known.

Explain how a probe would be used to detect the abnormal gene. (2 marks)

Description	Marks
The probe is complementary to an abnormal gene	1–2
The probe binds/ joins with the abnormal gene.	
or	
The probe is complementary to a normal gene	
The probe doesn't bind/ join with the abnormal gene.	
or	
The presence of the probe indicates presence of abnormal/normal gene	
Total	2

Question 35

(12 marks)

- (a) For each of the parts identified in the diagram of the *Homo erectus* skull, describe how the skull of a typical modern *Homo sapiens* differs from that shown in the diagram and give **one** advantage for *Homo sapiens* for each change. (6 marks)

Description	Marks
X Smaller brow ridges/ presence of forehead/ smaller muscle groups	1
Eyes now protected by forehead	1
Allows for increased cranial capacity/frontal lobe	
Less energy required for muscle development and maintenance	
Y Less prognathism/ face flatter/ face more vertical/ smaller teeth/ smaller molars	1
Skull is better balanced for bipedalism	1
Allows for increased cranial capacity	
Z Larger cranial capacity/ cranium more rounded	1–2
Allows for increased size of cerebral cortex/ frontal lobe/ association areas/ description e.g. improved memory/ larger brain size	
or cranium smoother	1–2
Less energy required for muscle development and maintenance	
Total	6

- (b) (i) Identify **two** pieces of evidence, not including the skeletal remains, that archaeologists might find at the site. For each, propose the cultural behaviour associated with *Homo erectus* that the evidence suggests. (4 marks)

Description		Marks
Archaeological Evidence	Cultural Behaviour	1–4
Tool artefacts/ remains of tool manufacture	Use of hand axes/ Acheulian tools/ bifaced tools/ flaked tools	
Butchery sites/ hunting tools/ piles of animal bones	Large hunting groups/ cooperative hunting/ diet including meat	
Plant remains/ seeds in human remains/ seeds in kitchen middens	Cooperative gathering/ omnivorous diet	
Burnt bone or wood in hearths/ torches	Use of fire/cooking/warmth/light/protection	
Remains of buildings/ building tools	Living in manmade shelters/ huts/ home bases	
Total		4

- (ii) Would carbon-14 dating be a suitable technique for dating the *Homo erectus* fossil?
Justify your answer. (2 marks)

Description	Marks
No	1
No carbon-14 (isotope) would remain in the organic material to date/ <i>Homo erectus</i> is older than the maximum age required for the technique	1
Total	2

Question 36

(13 marks)

MDMA: 36.9 °C, 37.1 °C, 37.5 °C, 37.6 °C, 37.6 °C
Placebo: 36.9 °C, 37.0 °C, 37.0 °C, 37.1 °C, 37.1 °C

- (a) Present the above data in a table. (5 marks)

Core body **temperature** following administration of **placebo** and **MDMA**

Time (min)	Core body temperature with MDMA (°C)	Core body temperature with placebo (°C)
0	36.9	36.9
60	37.1	37.0
120	37.5	37.0
180	37.6	37.1
240	37.6	37.1

or

Time of day (hours)	Core body temperature with MDMA (°C)	Core body temperature with placebo (°C)
11am/11.00	36.9	36.9
12pm/noon/12.00	37.1	37.0
1pm/13.00	37.5	37.0
2pm/14.00	37.6	37.1
3pm/15.00	37.6	37.1

Description	Marks
Title	1
Time in first column (either as minutes or time of day)	1
Appropriate column headings with core body temperature as columns two and three	1
Correct units in the heading/ data only in the cells – no units	1
Data in cells correctly transferred from list 'notebook'	1
Total	5

- (b) Formulate a hypothesis for this experiment. (1 mark)

Description	Marks
MDMA/ ecstasy increases core body temperature above normal/ any statement that includes directional change between the independent variable (MDMA) and the dependent variable (core body temperature) or nil/null hypothesis	1
Total	1

- (c) Explain why each participant did not receive the same amount of MDMA: that is, they received 2 mg of MDMA per kilogram of body mass of the participant. (1 mark)

Description	Marks
Standardise amount of MDMA for each participant	1
Control for the effect of body mass	
All participants receive the same relative amount of drug	
All participants receive the same amount of drug per unit body mass	
Dose of a drug depends on body weight	
Make it a fair test	
Total	1

- (d) (i) Describe **two** variables that were controlled adequately in the experiment. (2 marks)

Description	Marks
Number of times MDMA and placebo administered	1–2
Same method of administration of MDMA and placebo (tablet)	
Room temperature	
Same amount of time from administration of MDMA/placebo to recording core body temperature	
Period of time over which participants were assembled / core body temperature recordings were taken	
All participants had both MDMA and placebo	
Total	2

- (ii) For **one** of the variables described in part (d) (i), explain why it needed to be controlled. (1 mark)

Description		Marks
Describing the effect of the stated variable on <u>core body temperature</u> (either increase or decrease core body temperature)		1
number of times MDMA and placebo administered	as increasing frequency of MDMA administration could increase core body temperature	
same method of administration of MDMA and placebo (tablet)	as injecting MDMA could increase core body temperature more/faster than ingesting MDMA/ action of the drug may be affected by digestion	
room temperature	as a hotter room could increase core body temperature / a cooler room could decrease core body temperature	
same amount of time from administration of MDMA/placebo to recording core body temperature	to allow core body temperature values at each time period to be validly compared/averaged	
period of time over which participants were assembled / core body temperature recordings were taken	to allow comparison as core body temperature of participants could increase/decrease over different time periods	
all participants had both MDMA and placebo	to control any effect of participants' health, diet, etc on core body temperature	
Total		

- (e) Using this information and data from the table, suggest what caused the observed effect of MDMA on core body temperature. (1 mark)

Description	Marks
Increased rate of (cellular) respiration/ increased metabolic rate/ metabolism	1
Total	
	1

- (f) (i) During both sessions, the research team took recordings of skin temperature for 5 hours from 10 am. Between 10.30 am and 11 am, the skin temperature increased 1 °C prior to administration of the placebo and MDMA. Explain why this occurred. (1 mark)

Description	Marks
Heat gain from warm/ warmer/ ambient/ external/ room temperature	1
Heat transfer by radiation	
Total	1

- (ii) After 12.30 pm, the skin temperature, following administration of MDMA, steadied at 0.5 °C above the skin temperature following administration of the placebo. Account for what might have caused the difference in skin temperatures between the two treatments. (1 mark)

Description	Marks
Delayed/ decreased sweating after MDMA	1
Total	1

Question 37

(10 marks)

(a) Vertebrae are joined by cartilaginous joints.

(i) Name the type of cartilage that joins vertebrae to each other. (1 mark)

Description	Marks
Fibrocartilage/ fibro	1
Total	1

(ii) Describe how the structure of the cartilage referred to in part (a) (i) suits its function. (2 marks)

Description	Marks
Parallel (collagen) fibres	1
Coarse/ thick bundles of collagen/fibres	
High proportion of collagen	
Resists compression/ absorbs shock(slight compression)/ withstands pressure	1
Total	2

(b) With reference to the structure of both cartilage and bone, determine which would heal faster following injury. Justify your answer. (4 marks)

Description	Marks
Bone would heal faster	1
Blood delivers oxygen/ nutrients/ hormones for repair	1–3
Bone is permeated with blood vessels	
Cartilage has no blood vessels running through it	
Cartilage receives requirements diffused from perichondrium/ surrounding membrane/ synovial fluid	
Total	4

(c) Osteoarthritis is a condition that is more likely to occur as people age. Describe **three** effects of this condition. (3 marks)

Description	Marks
Articular cartilage softens/ degenerates/ roughens/ wears away	1–3
Bone tissue is exposed/ bone spurs develop/ bones rub/ joint deformity/ wears away bone	
Restricting movement/ causing pain with movement	
Inflammation of the joint/ structures of the joint/ swelling of joint	
Total	3

Question 38

(8 marks)

(a) Outline what the study of epigenetics examines.

(1 mark)

Description	Marks
Changes in gene expression/ phenotype/ appearance caused by environmental mechanisms	1
Changes in gene expression/ phenotype/ appearance not due to changes in DNA sequences/ not encoded in the DNA	
Total	1

(b) (i) Height is a trait controlled by polygenes. Describe the genotype for height of Adam and compare it with the genotype for height of Michael. (2 marks)

Description	Marks
He would have many (2+) genes/pairs of alleles in the DNA controlling height	1
Adam and Michael have the (exact) same genotype for height	1
Total	2

(ii) Explain how the different heights of Adam and Michael can be attributed to epigenetics. (2 marks)

Description	Marks
(At least one) environmental factor (eg. diet/ health) has differed between Adam and Michael during their development	1
More of Michael's genes for height are not expressed/ switched off	1
More of Adam's genes for height are expressed/ switched on	
Total	2

(c) Explain what is occurring in the process labelled 'Y' in the diagram.

(3 marks)

Description	Marks
DNA less coiled/ more exposed/ unwound	1-2
Unmethylated cytosines/ no DNA methylation/ no methyl markers added	
Acetylated histones/ acetyl group added to histone	
Genes are expressed/ switched on	1
Total	3

Question 39

(13 marks)

- (a) (i) Name the type of nerve fibres found in the root labelled 'X'. (1 mark)

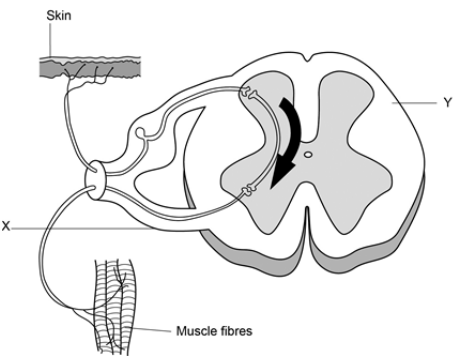
Description	Marks
Motor/ efferent/ myelinated/ effector	1
Total	1

- (ii) Identify the area shown as 'Y'. (1 mark)

Description	Marks
White matter/ ascending tracts/ descending tracts	1
Total	1

- (b) The skin and muscle fibres shown in the diagram are associated with a reflex arc.

- (i) Draw arrows on the diagram to show the direction of a nerve impulse through this reflex arc. (1 mark)

Description	Marks
	1
Total	1

- (ii) State **three** important functional properties of reflexes. (3 marks)

Description	Marks
Rapid /involves only a small number of neurons	1-3
Automatic/ Involuntary/ without conscious thought	
Requires a stimulus/ not spontaneous	
Stereotyped/ happens the same way every time	
Total	3

- (iii) State a reason why reflex arcs are important. (1 mark)

Description	Marks
Protective/ prevents (further) damage/ allows removal of danger before being aware.	1
Total	1

- (c) CIPA is a rare congenital disorder caused by a mutation that prevents the formation of nerve cells which are responsible for transmitting signals of pain.

Would these nerve cells be located closer to the skin or to the muscle fibres, as shown on the diagram? Explain your answer. (2 marks)

Description	Marks
Skin	1
Receptors for pain are at the ends of/in the sensory neuron	1
Total	2

- (d) (i) On the diagram, draw the head of an arrow on the line labelled 'A' to show the direction of impulses between the central and peripheral nervous systems. (1 mark)

Description	Marks
<p>Arrow head going away from CNS</p>	1
Total	1

- (ii) Where is information communicated to and from by the division shown as 'B' in the diagram? (1 mark)

Description	Marks
From: Skin/ muscles/ exteroceptors/ proprioceptors/ bones/ joints To: the CNS/ brain	1
Total	1

- (iii) A medical condition called hyperhidrosis is caused by an over-activity of neurons sending impulses to the sweat glands. Symptoms of the condition are normally seen when a person feels nervous or stressed.

Identify the division of the peripheral nervous system that would be affected by this condition and the main symptom you would expect to see in sufferers. (2 marks)

Description	Marks
Sympathetic	1
Excessive sweating	1
Total	2

Section Three: Extended answer

20% (40 Marks)

Question 40

(20 marks)

- (a) Outline the events involved in the nervous stimulation and subsequent contraction of skeletal muscle. In your answer include the role of calcium ions. (9 marks)

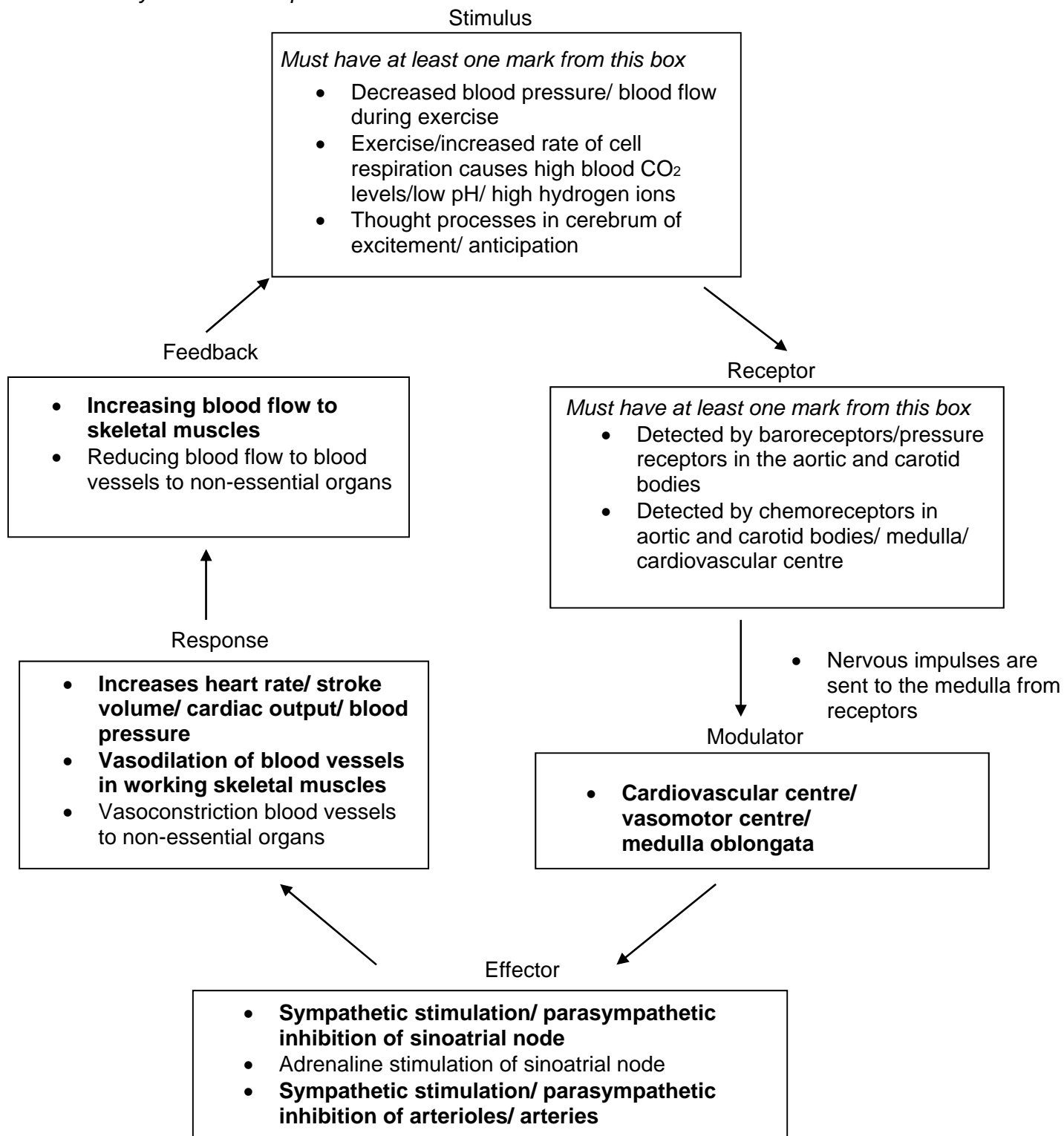
Description	Marks
Nervous impulse reaches the axon terminal of a motor neuron	1–4
*Impulse causes calcium ions to enter axon terminal	
Some vesicles undergo exocytosis	
Neurotransmitter/ acetylcholine released from vesicles	
The neurotransmitter/ acetylcholine diffuses across the gap/synaptic cleft/ synapse	
Neurotransmitter/ acetylcholine attaches to receptors located on the sarcolemma	1–5
Neurotransmitter/ acetylcholine causes sodium channels to open/ sodium ions to enter the cell/ depolarisation of muscle fibre	
The action potential is propagated over the sarcolemma/ along the fibre	
*Action potential causes calcium ions to be released	
Calcium released from sarcoplasmic reticulum	
*Calcium ions expose myosin binding sites (on the actin)	
Myosin cross bridges attach to actin	
Muscle contraction occurs / filaments slide past each other	
Following depolarisation, the sarcolemma becomes repolarised	
Total	9

***Bolded statements:** must include at least two of these points

- (b) Explain how blood flow increases to working skeletal muscles during exercise. (11 marks)

Description	Marks
Stimulus Any one of the following: <ul style="list-style-type: none"> Decreased blood pressure/ blood flow during exercise Exercise/increased rate of cell respiration causes high blood CO₂ levels/low pH/ high hydrogen ions Thought processes in cerebrum of excitement/ anticipation 	1
Receptor Any one of the following: <ul style="list-style-type: none"> Detected by baroreceptors/pressure receptors in the aortic and carotid bodies Detected by chemoreceptors in aortic and carotid bodies/ medulla/ cardiovascular centre 	1
Modulator <ul style="list-style-type: none"> Cardiovascular centre/ vasomotor centre/ medulla oblongata 	1
Effector <ul style="list-style-type: none"> Sympathetic stimulation/ parasympathetic inhibition of sinoatrial node Sympathetic stimulation/ parasympathetic inhibition of arterioles/ arteries 	1–2
Response <ul style="list-style-type: none"> Increases heart rate/ stroke volume/ cardiac output/ blood pressure Vasodilation of blood vessels in working skeletal muscles 	1–2
Feedback <ul style="list-style-type: none"> Increasing blood flow to skeletal muscles 	1
Additional points, any three of: Effector <ul style="list-style-type: none"> Adrenaline stimulation of sinoatrial node Response <ul style="list-style-type: none"> Vasoconstriction blood vessels to non-essential organs Feedback <ul style="list-style-type: none"> Reducing blood flow to blood vessels to non-essential organs Nervous impulses are sent to the medulla from receptors A rise in body temperature during exercise increases heart rate Lactic acid accumulation in more active muscles leads to vasodilation/ more blood flow Contraction of skeletal muscles assists venous return to heart increasing blood returning to heart 	1–3
Total	11

6 essential points in bold
2 points must come from the first two boxes
Any 3 of the other points



- A rise in body temperature during exercise increases heart rate
- Lactic acid accumulation in more active muscles leads to vasodilation/ more blood flow
- Contraction of skeletal muscles assists venous return to heart increasing blood returning to heart

Question 41

(20 marks)

- (a) A student studying human evolution at university was presented with two partial primate skeletons. The only parts remaining of each skeleton were the feet and pelvis. The student was asked to examine each skeleton and decide which was a modern ape and which was an extinct hominin specimen of the genus *Homo*.

Select **five (5)** distinguishing features of the pelvis and foot that could be seen in the skeletons and explain how they differed between the two specimens. (10 marks)

Description			Marks
Any five, must have at least two features from pelvis and foot			
	Modern Ape	<i>Homo</i>	
Pelvis	Acetabulum does not allow for carrying angle Vertical carrying angle/ reduced carrying angle/ no carrying angle	Acetabulum allows for carrying angle / carrying angle directed towards midline/ increased carrying angle	1–2
	Narrow and long pelvis	Bowl shaped/ broad and short pelvis	1–2
	Iliac crest is towards the back and elongated	Iliac crest located more on side and slanted	1–2
Foot	Non-aligned big toe/ opposable big toe	Big toes aligned with other toes/ non-opposable big toe	1–2
	Longitudinal arch only/ no transverse arch	Transverse and longitudinal arch	1–2
	Smaller heel/ calcaneus bone/ talus bone	Larger heel/ calcaneus bone/ talus bone	1–2
Total			10

- (b) Examining fossils and their surroundings is one method by which evolution can be shown to have occurred. However there are also many types of comparative studies that can be used to support the theory of evolution. Two of these involve studies in biochemistry, namely protein sequences and DNA.

Describe the two comparative studies, protein sequences and DNA, and explain how they show evidence for evolution. (10 marks)

Description	Marks
Protein sequences	
Proteins made of long chains of amino acids	
Determine type and sequence of amino acids/ describe method of sequencing	
Western blotting to detect specific proteins in a sample	
Using similar/ ubiquitous proteins (e.g. cytochrome c) in different species	
Compare sequence in different species	1–4
<i>Must have one point for explaining how</i>	
Species that are distantly related have more differences in their amino acid sequence/ closely related more similarities/ more time has passed since common ancestry	1
DNA	
Code/ sequence in DNA is different for different species	
Determine sequence	
Hybridisation/ forming hybrid DNA from different species/ more heat required to separate strands that have been fused from 2 species, more similar DNA/ electrophoresis/ other new methods of sequencing use of ERV's/ virus inserting into a gamete DNA to compare non-functional DNA	
Compare sequence in different species	1–4
<i>Must have one point for explaining how</i>	
Species that are distantly related have more differences in their DNA/ closely related more similarities/ more time has passed since common ancestry	1
OR	
Mitochondrial DNA	
Code/sequence in DNA is different for different species	
Determine sequence	
Hybridisation/ forming hybrid DNA from different species/ more heat required to separate strands that have been fused from 2 species, more similar DNA/ electrophoresis/ other new methods of sequencing	
Inherited only from the mother	
Higher rate of mutation than nuclear DNA	
Amount of mutation corresponds to amount of time passed	
<i>Must have one point for explaining how</i>	
Estimate closeness of relationship through maternal ancestry/useful for same species or closely related species/ more time has passed since common ancestry	1
Total	10

Question 42

(20 marks)

- (a) The Tour de France is a long and difficult road race in which the cyclists ride for many hours a day. They are in danger of overheating and are constantly provided with water along the route.

Explain why it is necessary for water replenishment during a cycling race such as the Tour de France and describe the **two** homeostatic mechanisms that lead to the cyclists drinking the water. (13 marks)

Description	Marks
Explanation for necessity (can be mentioned in the feedback)	
Increased sweating lowers body temperature	1–2
Loss of water by sweating replaced by drinking	
Sweating	1–7
Body temperature increases	
Increase due to heat production/ increased metabolic rate	
(Thermo)receptors in hypothalamus detect increased temperature	
Autonomic/ sympathetic nerve impulse triggered	
Impulse sent to sweat glands	
Sweat glands pump water to surface/ more active	
Sweat evaporates from the skin	
Removes heat energy/needs latent heat to evaporate	1–4
Thirst	
Osmotic pressure of blood increases/water level in blood decreases	
Detected by (osmo)receptors in hypothalamus	
Nerve impulse to cerebrum/cerebral cortex/ dry throat	1–4
Conscious desire to drink/ skeletal muscle/ effectors carry out response	
Total	13

- (b) A female with a defective kidney received a new kidney transplanted from a non-related male. The female patient failed to take the appropriate medication and the transplant was rejected. Describe the cell-mediated immune response that resulted in the rejection of the transplanted kidney. (7 marks)

Description	Marks
Lymphocytes/ T cells have antigen receptors on their surface	1–3
Antigen presenting cells/ macrophages display a non-self antigen from the foreign kidney/ tissue	
Antigen presenting cells/ macrophages migrate to lymph node	
Specific T lymphocyte/ T cell recognises non-self antigen/ protein	
Sensitises and enlarges	
The T lymphocyte/ T cell clones/ undergoes mitosis	
Recognition stage and development of T cells	1–4
Cytotoxic/ killer T cells produced	
Cytotoxic/ killer T cells destroy the foreign tissue/ kidney by secreting chemicals	
Helper T cells promote the action of cytotoxic/ killer T cells	
Helper T cells attract macrophages/ stimulate phagocytosis	
Suppressor T cells inhibit/ slow down immune response when completed	1–4
Memory T cells produced and remain	
Total	7

ACKNOWLEDGEMENTS

Section Two

Question 39(b) Adapted from: Lawson, R. (2007, December 26). *Spinal nervous pathway* [Diagram]. Retrieved January, 2012, from http://wikieducator.org/Nervous_System_Worksheet
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