Government of Western Australia
Curriculum Council

WACE
Western Australian Certificate of Education

HUMAN BIOLOGICAL SCIENCE

Stage 3

WACE Examination 2011

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.

When examiners design an examination, they develop provisional marking keys that can be reviewed at a marking key ratification meeting and modified as necessary in the light of candidate responses.

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Web version of 2011/31853

Section One: Multiple-choice **(20 Marks)**

Question	Answer
1	a
2	c
3	d
4	b
5	c
6	c
7	a
8	b
9	b
10	d
11	b
12	a
13	b
14	a
15	c
16	a
17	d
18	c
19	b
20	d

Section Two: Short answer **(100 Marks)**

Question 21 **(8 marks)**

(a) Complete the table below, describing key differences between how the nervous and endocrine systems control homeostasis in the body. (4 marks)

Description			Marks
Function	**Nervous**	**Endocrine**	
Speed (reaction time)	Fast/ milliseconds for an impulse	Slower/ depends on distance to target organ/ depends on rate of blood circulation/ hours or weeks	1 mark per box
Transmission	Electrochemical/ along nerve fibres/neuron	Chemical transmission/ through the bloodstream/hormone	
			Total 4

The following parts of the question refer to the diagrams below, which represents different nervous pathways.

(b) Which diagram represents a somatic nervous pathway? (1 mark)

Description	Marks
A/top diagram	1
	Total 1

(c) What would be found in the region labelled ganglion on diagram B? (1 mark)

Description	Marks
(A group of nerve) cell bodies/ synapse/ axon endings	1
	Total 1

(d) Other than what is shown in the diagrams, describe **one (1)** structural or chemical characteristic that would differ between the nervous pathways A and B. (2 marks)

Description	Marks
One mark for characteristics, one mark for description *One mark for each pathway, if only one mentioned can only get one mark, second point must match the first for two marks* *NB: Functional not accepted*	1–2
A is a myelinated nerve fibre - B is myelinated before the ganglion but not after	
A has the neurotransmitter acetylcholine - B has the neurotransmitter acetylcholine or noradrenaline	
A has one set of nerve fibres - B has two sets/ parasympathetic and sympathetic fibres	
	Total 2

Question 22 **(12 marks)**

(a) Name the type of inheritance that controls skin colour in humans. (1 mark)

Description	Marks
Polygenic	1
	Total 1

(b) Explain how this type of inheritance results in the large variation in skin colour evident in human populations. (3 marks)

Description	Marks
Dependent on many (pairs) of genes/ not just a single pair like monogenic inheritance	1
Any two of:	1–2
(Alleles) are still dominant/recessive to one another	
(Each allele) locus has a small effect	
(Each allele) locus has an equal effect	
(Each allele) adds/contributes/interacts to overall effect	
	Total 3

(c) As well as genetic factors, the environment can affect skin colour greatly. What is found in skin that controls how light or dark the skin will be due to the effect of the environment? (1 mark)

Description	Marks
Melanocytes/ melanosomes/ melanin	1
	Total 1

(d) Explain why a person living nearer the equator could have darker skin than a person living nearer the North Pole, even though they have the same genetic code for skin colour. (3 marks)

Description	Marks
Any three of:	
Greater amount of UV at equator/ Lesser amount of UV at the North Pole	1–3
Greater exposure to UV results in more melanin or melanocytes or melanosomes production/ less exposure to UV then less melanin or melanocytes or melanosomes is produced	
Increased melanin or melanocytes or melanosomes (causes a darker skin appearance)/decreased melanin or melanocytes or melanosomes (causes lighter skin appearance)	
Genes reach full potential of expression / genes don't reach full potential of expression	
	Total 3

Structural genes, such as those that control skin colour, code for the manufacture of particular proteins. Other types of genes can influence the production of proteins and, as such, the expression of the structural genes.

(e) Describe the role of the following genes in the expression of structural genes.

(i) Regulator gene (2 marks)

Description	Marks
Any two of:	1–2
Regulator gene controls/stops the expression of one or more genes	
Regulator genes produce repressor proteins	
Repressor proteins bind to an operator gene	
Regulator genes also code for activator proteins	
Regulator gene produces a special enzyme called an inducer	
Inducer has the role of 'switching on' other genes/allow gene expression	
Inhibits transcription/block RNA polymerase	
RNA polymerase can't bind to promoter gene	
	Total 2

(ii) Promoter gene (2 marks)

Description	Marks
Any two of:	1–2
A promoter gene: is the site for the binding of RNA polymerase to DNA.	
starts the transcription process/transcription of mRNA in structural genes	
determines how much of a protein/which protein is made/increased protein production	
	Total 2

Question 23 **(11 marks)**

(a) Complete the table below (4 marks)

Description			Marks
One mark per box			1–4
	For copyright reasons these images cannot be reproduced in the online version of this document but may be viewed at http://ovrt.nist.gov/projects/vrml/h-anim/jointInfo.html.		
	Located at the shoulder	*Located in the lower arm*	
Name the type of joint	Ball and socket	Pivot	
NB: not synovial or freely moveable joints			
Describe the type/s of movement created at the joint	Rotation/flexion and extension/adduction and abduction/radial movement in any direction/circumduction (only 1 required)	Rotation (around an axis)	
			Total 4

Part (b) of this question refers to the diagram below, which shows the bones and muscles of the arm.

(b) (i) Provide the name given to the point where the muscle is attached to the bone, as indicated by the letter S. (1 mark)

Description	Marks
Insertion	1
	Total 1

(ii) Assuming that bone Q remains stationary, what will the muscles P and R do when bone T moves in the direction shown in the diagram? (2 marks)

Description	Marks
Muscle P will relax/lengthen	1
Muscle R will contract/shorten	1
	Total 2

(c) Bionic limbs and artificial joints are medical technologies that can be used to treat different medical issues.

Distinguish between a bionic limb and an artificial joint and outline a medical issue for which each is used. (4 marks)

Description			Marks
1 mark per box			1–4
	Bionic Limb	**Artificial Joint**	
What is it?	Artificial replacement of the arm/leg/limb	Replace a joint inside a limb	
Medical Issue	Patients with damage to the entire limb/ crush injuries/ amputated limb replacement/ congenital defects	Osteoarthritis/ severe bone fractures in joint/arthritis	
			Total 4

Question 24 **(15 marks)**

One of the major risk factors in cardiovascular disease is hypertension (high blood pressure). It has been controlled by the use of various drugs and by the maintenance of a healthy lifestyle. A method of prevention has now been trialled using a new drug called CYT006-AngQb. A clinical trial was carried out with 72 patients suffering from hypertension. Half of the patients were injected with 300µg of the new drug and half were injected with 300µg of a placebo. Three months after the injection, the blood pressure of the patients was taken over a 24-hour period, from 8am one day to 8am the next day.

Below is a table comparing the average systolic blood pressure for both groups of patients over the 24-hour period.

	Systolic Blood Pressure (mmHg)	
Time (24 hours)	*Patients treated with the new drug*	*Patients treated with the placebo*
8 am	145	160
12pm (midday)	138	150
4pm	142	150
8pm	140	150
12 am (midnight)	125	130
4am	132	135
8am	140	160

(a) Suggest a hypothesis for this experiment. (1 mark)

Description	**Marks**
Any one of:	1
CYT006-AngQb/the new drug reduces blood pressure	
CYT006-AngQb/the new drug causes the greatest reduction in blood pressure in the early morning.	
Any statement that includes directional change between independent variable and dependent variable.	
	Total 1

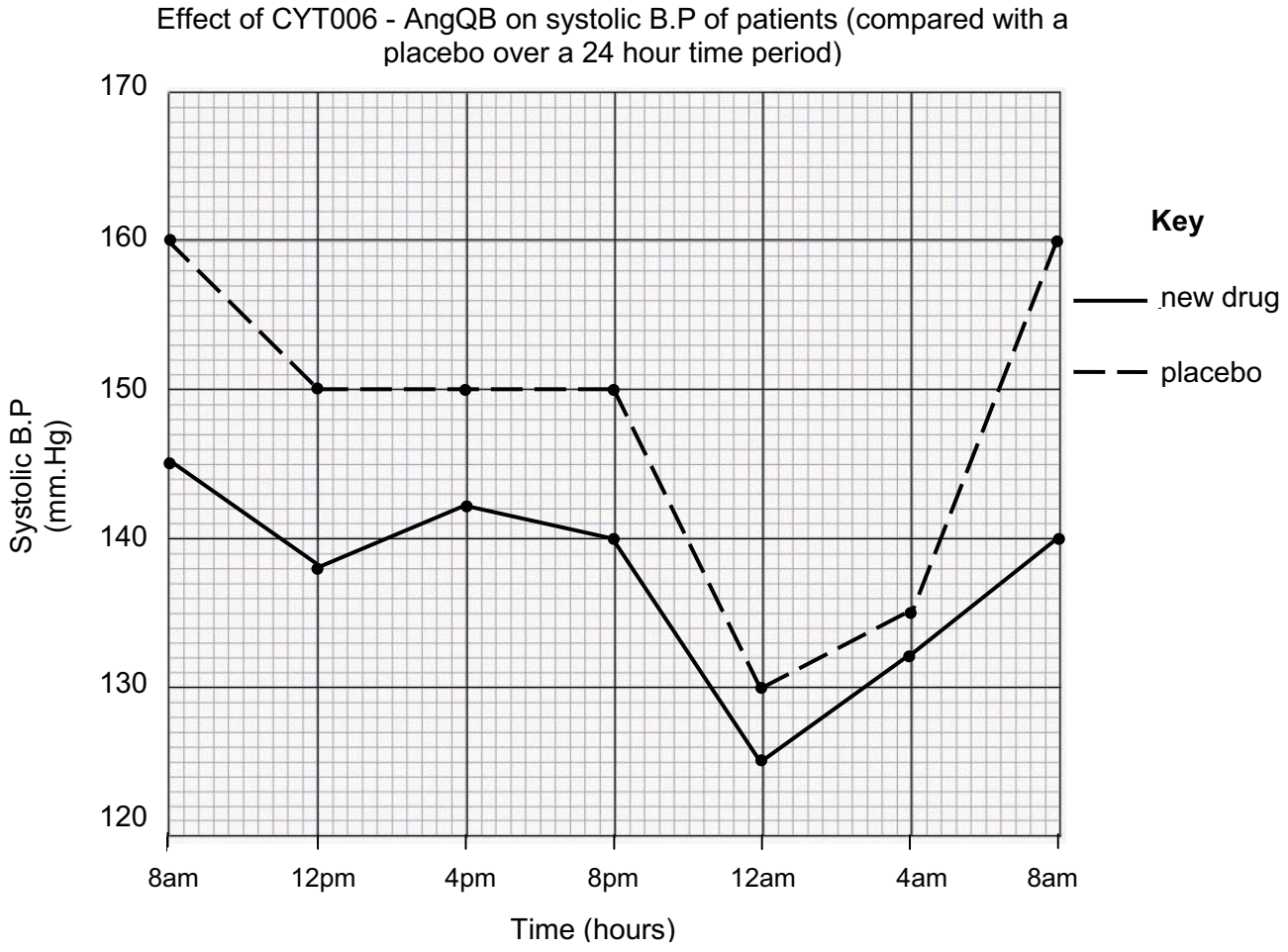
(b) Describe **two (2)** variables that were controlled in the experiment. (2 marks)

Description	**Marks**
Answer must be from data in question Any two of:	1–2
Same administration of the drug	
Amount of drug and placebo injected/ 300µg of drug and placebo injected	
Equal number of patients in each group/ 36 patients in each group	
The same amount of time from injection to measurement of blood pressure/same time of administration	
Period of time over which blood pressure was measured/ blood pressure was measured over 24 hours	
All patients suffering hypertension	
	Total 2

(c) What is the purpose of a placebo? (1 mark)

Description	Marks
Either	1
Acts as a control/comparison with the experimental variable.	
or	
Patients unaware of which injection they have so there is equal psychological effect in both groups	
	Total 1

(d) Graph the results in the table on the grid provided below. You may use pencil. (5 marks)



Description	Marks
Maximum of 3 marks for a bar graph	1
Correctly constructs axes using appropriate scale (BP on Y axis, Time on X axis)	
Correctly plots points and joins points to form a line (ruler)	1
Labelling of axes with correct name and unit	1
Identifies lines using key/labels	1
Title appropriate with both variables included and the two groups (experimental and control)	1
	Total 5

(e) (i) At which time of the day was the new drug most effective? (1 mark)

Description	Marks
8 am (does not matter if they say 1st or 2nd 8am)	1
	Total 1

(ii) At which time of the day was the new drug least effective? (1 mark)

Description	Marks
4 am	1
	Total 1

(iii) Suggest a reason for the difference between (e) (i) and (ii)? (1 mark)

Description	Marks
Sleeping/less active at 4am/ more active at 8am	1
	Total 1

(f) If a person has normal blood pressure, homeostatic mechanisms are preventing it from reaching levels that are too high. The process is controlled by centres in the medulla oblongata that receive nerve impulses from baroreceptors in some arteries.

Explain how centres in the medulla oblongata work to prevent hypertension. (3 marks)

Description	Marks
Any three of:	1–3
Inhibits sympathetic impulses/decreases noradrenaline	
Causes vasodilation of blood vessels/ increase veno dilation	
Increases parasympathetic impulses/increases acetylcholine	
Decreases heart rate/cardiac output	
Decreases blood pressure	
Decreases renal output	
	Total 3

Question 25 **(7 marks)**

Thomas underwent a series of medical tests and was found to have low calcium ion levels in his blood due to a hormonal imbalance.

(a) Which hormone would normally increase in the blood when blood calcium ion levels are low? (1 mark)

Description	Marks
Parathyroid hormone/ parathormone	1
	Total 1

(b) For the hormone described in part (a), there are several effectors in the body, one of which is bone. Identify **one (1)** other effector in the body and describe the response of that tissue and/or organ to low blood calcium ion levels. (2 marks)

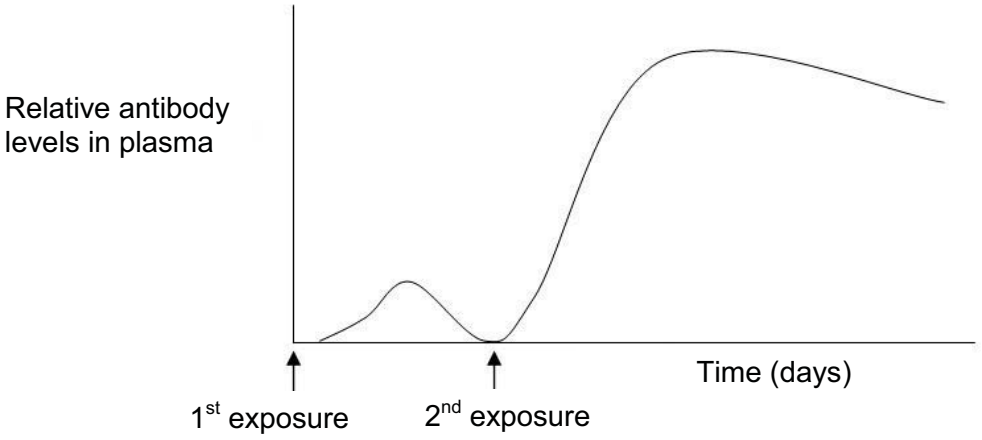
Description	Marks
Any example for 2 marks (1 for identity and 1 for response)	1–2
Small intestine - Increasing the absorption of calcium from digested food	
Kidneys/ nephron - Increasing calcium reabsorption	
	Total 2

(c) Describe how low blood calcium ion levels could affect Thomas's bone composition and muscle contraction. What problem could result from these changes? (4 marks)

Description			Marks
1 mark per box			1–4
	Bone Composition	**Muscle Contraction**	
Changes caused by low calcium ion levels	Causes calcium decreasing/leaching from the bones/ stimulates the action of PTH	Prevents attachment of myosin to actin/crossbridges/change in shape of myosin/for neurotransmission at the neuromuscular junction	
Problems resulting from the changes	Osteoporosis/ decreased bone density/ increase likelihood of fractures/ bone fragility/brittle bones	Muscle spasms/ inability to contract/ muscle rigidity/muscle cramp	
			Total 4

Question 26 **(15 marks)**

Parts (a)–(d) of this question refer to the graph below, which shows the trend in antibody levels in the blood after first and second exposures to an antigen.



(a) Describe how the antigen causes a change in the antibody levels following the first exposure. (5 marks)

Description	Marks
Any 4 points for 1 mark each	1–4
Antigens engulfed by macrophages	
Antigens presented to B cells/lymphocytes/T cells	
B cells sensitised	
B cells enlarge	
B cells clone	
B cells form plasma cells	
Antibodies are released into the bloodstream	
Plasma cells produce antibodies	1
	Total 5

(b) Using the information from the graph, describe **two (2)** differences between the responses to the first and second exposures. (2 marks)

Description	Marks
Any two of:	1–2
Response after 1st exposure takes longer to occur / antibodies don't appear immediately after the 1st exposure.	
2nd exposure peaks at a higher level/ more antibodies are produced after the second exposure/ due to memory cells	
Levels of antibodies are maintained longer after the second exposure	
	Total 2

(c) What cell type is present at the beginning of the second exposure but not at the beginning of the first exposure? (1 mark)

Description	Marks
Memory cells	1
	Total 1

(d) This graph represents active immunity. Describe **three (3)** ways in which this differs from passive immunity. (3 marks)

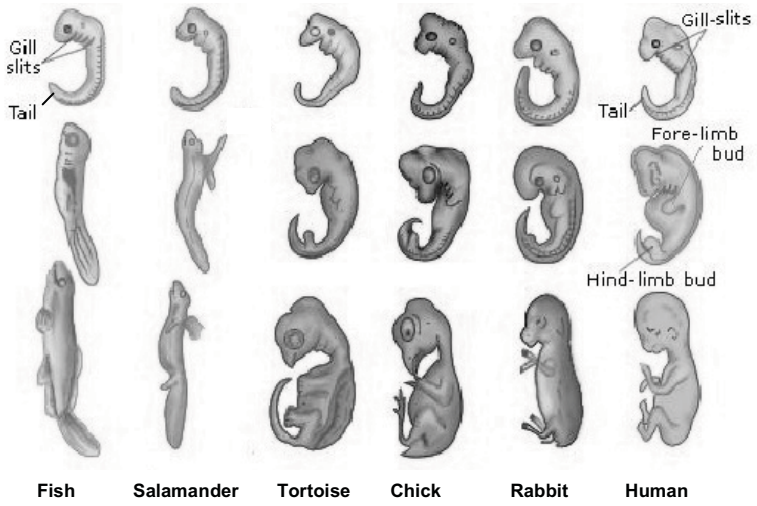
Description	Marks
Must be a comparative term to describe but does not need to state achieve and passive Any three of:	1–3
Active produces antibodies in response to antigens whereas passive is when given antibodies from another source/person.	
Memory cells produced in active immunity and not in passive.	
Active has a longer lasting effect than passive	
Passive acts faster than active.	
	Total 3

(e) Name and describe **one (1)** type of immune response apart from antibody production that is involved in fighting pathogens. (4 marks)

Description	Marks
Cell mediated immunity	1
Any three of:	1–3
Production of killer T cells	
Destroys pathogens at cellular level	
Involves Memory T cells	
T-helper cells	
Suppresser T cells	
Increase in phagocytosis/increase action or macrophages	
	Total 4

Question 27 **(11 marks)**

Parts (a) and (b) of this question refer to the diagram below.



(a) Name and describe the specific type of study shown above used to provide evidence for evolution. (2 marks)

Description	Marks
Comparative embryology/ developmental anatomy	1
Closely related organisms show similar anatomical development in the embryonic/ early stages of life	1
	Total 2

(b) Using the diagram above, explain the evolutionary relationship of human to the rabbit compared with human to the fish. (2 marks)

Description	Marks
Human more closely related to the rabbit/ human more distantly related to the fish/rabbit and human more characteristics in common/fish and human have less characteristics in common.	1
Less time since species separated / more recent common ancestor / more time since species separated / less recent common ancestor	1
	Total 2

(c) Explain how the study of DNA can provide evidence for evolution. (2 marks)

Description	Marks
The more similar the sequence of DNA/mitochondria DNA/virus the more closely related species are/or a technique example e.g. DNA hybridization	1
Therefore the more recently they shared a common ancestor/ less time since species separated	1
	Total 2

(d) When DNA is being used in the study of evolution, how can the polymerase chain reaction (PCR) technique be useful? (2 marks)

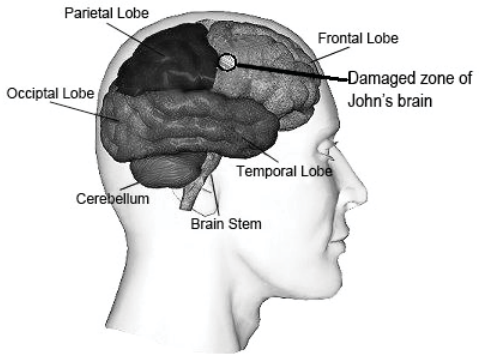
Description	Marks
(Fossils) often only have tiny samples of DNA	1
PCR amplifies tiny amounts of DNA/ Increasing the amount of material/ enabling enough of a sample to be compared	1
	Total 2

(e) The Human Genome Project has provided more supporting evidence for the theory of evolution by providing a better comparison between the DNA of modern humans and extinct hominin species. Explain how the Project could also help to treat genetically-inherited diseases. (3 marks)

Description	Marks
Any three of:	1–3
Allows faulty/ mutated genes to be identified	
Once identified the reason for the dysfunction/ abnormal protein can potentially be identified	
Potentially then genes can be replaced/ switched off/ bypassed/gene therapy	
Treated with correct protein to cure the disease/ genetic engineering	
Genetic counselling	
Develop individually specific treatments	
	Total 3

Question 28 **(11 marks)**

John was involved in a serious motorcycle accident. He failed to take a corner and was thrown head first into a brick retaining wall next to the road he was travelling on. In the hospital emergency department, it was noted that the right side of his brain had been damaged, as shown in the diagram.



(a) Name and describe the main function of the area indicated as the damaged zone of John's brain. (2 marks)

Description	Marks
1 mark for name and 1 mark for function Any one of:	1–2
Motor area/motor cortex/ cerebrum - communication between nervous and muscular system/send signals to the lower brain centres/spinal cord/motor neurons to initiate muscle movement	
Speech association area - speech formation	
Memory association area - memory/intelligence	
	Total 2

(b) Describe how **one (1)** body function will be affected by this injury. (2 marks)

Description	Marks
1 mark for function and 1 mark for describing it Any one of:	1–2
Motor/muscle function - (left side)voluntary somatic control/left side motor functions/(left) leg paralysis/(left) arm paralysis/paralysis of voluntary muscles	
Speech - altered/loss of words/inability to form words	
Memory - impairment/loss of	
	Total 2

(c) During his examination, the neurologist used the terms 'white matter' and 'grey matter'. Distinguish between white and grey matter in terms of structure and location in the brain. (4 marks)

Description			Marks
1 mark per box			1–4
	White Matter	**Grey Matter**	
Structure	Axons (nerve fibres) covered with myelin	Axons (nerve fibres) without myelin/ nerve cell bodies	
Location in the brain	Internal	External (mostly)	
			Total 4

(d) While in hospital, John was also diagnosed with Parkinson's disease.

(i) State the effect of Parkinson's disease on the brain. (1 mark)

Description	Marks
Loss of dopamine/ dopamine receptors/ dopamine neurons/ dopamine synapses/substantial nigra or basal ganglia decrease	1
	Total 1

(ii) Describe **two (2)** symptoms of Parkinson's disease. (2 marks)

Description	Marks
Any two of:	1–2
Loss of motor coordination	
Tremor/ intention tremor/ shaking	
Uncontrolled movement	
Inability to move properly/initiate movement	
Slow movement	
Muscle stiffness	
Fixed gaze	
Impaired speech	
	Total 2

Question 29 **(10 marks)**

(a) When hyperventilation occurs, a person breathes faster and more deeply than normal.

(i) What effect would this have on the level of carbon dioxide in the blood? (1 mark)

Description	Marks
Decrease	1
	Total 1

(ii) Where in the brain would this change in level be detected? (1 mark)

Description	Marks
(Respiratory centre) Medulla oblongata/ medulla	1
	Total 1

(b) A girl had the pH levels in her blood taken immediately before and after swimming 500 metres in a pool. The results showed a drop in pH from 7.4 to 7.3.

What caused this drop in pH to occur? (3 marks)

Description	Marks
Increase in acidity/ production of carbonic acid/ production of lactic acid/increase H^+ ions/$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + CO_3^-$	1
pH decrease caused by increase in carbon dioxide	1
Produced in cellular respiration/increased activity	1
	Total 3

(c) Describe **three (3)** steps that need to occur so that more oxygen can be delivered to skeletal muscles when they become very active during exercise. (3 marks)

Description	Marks
Increased rate/ depth of breathing/dilation of bronchioles	1
Increase in cardiac output/ heart rate/ blood pressure	1
Vasodilation in muscle arterioles/ blood vessels/ increase in muscle blood flow	1
	Total 3

(d) When oxygen levels are extremely low, they have an effect on the regulation of breathing. Provide **two (2)** diseases or environmental situations in which this would happen. (2 marks)

Description	Marks
Any two of:	1–2
Lung disease	
Emphysema	
Asthma	
Cancer	
Any other named lung disease	
High altitudes	
Loss of pressure in an aircraft	
Diving (without air)	
	Total 2

Section Three: Extended answer **(60 Marks)**

Question 30 **(30 marks)**

(a) During the biological evolution of hominins from the earliest australopithecines to early *Homo sapiens*, there were also significant cultural advances, including tool cultures and changing lifestyles.

Describe these advances with reference to the particular hominin groups of australopithecines, *Homo habilis, Homo erectus* and early *Homo sapiens*.

(i) Tool cultures, including manufacture and uses. (8 marks)

Tool culture names not necessary.

Description					Marks
	australopithecines	***H Habilis***	***H erectus***	**early *H sapiens***	
Tools Manufacture	Use of pebble tools/ But no evidence of manufacture/no tool culture	Pebble tools/ cores with flakes removed on **some** sides/ oldowan tools.	bifaced scrapers/more flakes removed on both sides/ pressure flaking or Used antler/bone to remove flakes (one of these) or acheulian tools.	Finer detail and complex designs/ Flake tools-edges of flakes shaped and reworked/ sharpened or Bone, antler, ivory, wood, leather as well as stone/ Attached to wooden shafts/handles/ hafting compound tools or Use of burin to make tools/First use of blades (one of these)	1–4
Tools Uses	<u>Possibly</u> used by some Aust including choppers, and scrapers for cutting meat/no tool culture	choppers/ and scrapers/for cutting meat.	As hand-axes/ Killing animals/ digging up plants/cutting meat/ producing fire/ skinning animals	Increase in variety of uses- fishing, (fish hooks, harpoons)/ preparing skins for clothing, (needles)/ building shelters	1–4
					Total 8

(ii) Changing lifestyles (8 marks)

** Must work horizontally, no evidence is a maximum of 1 mark per lifestyle discussed.*

	Description				Marks
	australopithecines	***H Habilis***	***H erectus***	**early *H sapiens***	
Use of fire	No evidence		Yes/ to cook / hunt/ protection/ warmth	Also includes torches with animal fat	1–3
Living Sites	Home bases	Home bases/ Probably slept in trees	Home bases/ caves/ some evidence of manmade shelters/huts	Manmade shelters, long houses	1–4
Obtaining food	No evidence	Small groups shared food/ Hunting and scavenging meat, gathering plants	Large cooperative hunting of small animals/ butchering sites	Large cooperative hunting of large animals, fishing	1–4
Spiritual beliefs	No evidence			Evidence of rituals, burials, artefacts with burials, cannibalism, body decoration /ochre	1–2
Art	No evidence			Mural and portable art	1–2
Language	No evidence	Possible due to speech areas in the brain (but larynx may not be developed enough)	Possible due to cooperative hunting groups	Probable due to very large groups hunting large animals	1–4
					Total 8

(b) Early *Homo sapiens* were in existence at a time that enables us to determine the date of their remains using carbon-14 dating. Explain how carbon-14 dating determines the age of fossil remains and describe **two (2)** of its limitations. (8 marks)

Description	Marks
Any six of	1–6
• Absorption of $C^{14}O_2$ by plants • In food chain Carbon-14 passed on • Measure the amount of carbon-14/radiocarbon/C-14 in the remains • Carbon-14/radiocarbon/C-14 decays into nitrogen/N-14 • Establish the ratio of carbon 14/radiocarbon/C-14 to 10^{12} carbon-12 • Carbon 14/radiocarbon-14/C-14 has a half life of 5730 years • The amount of carbon 14/radiocarbon-14/C-14 in the remains indicates the number of half lives that have passed • Multiply the number of half lives by 5730 years • Gives an absolute age/absolute age determined • Sketch a simple graph	
Limitations. Any two of: • If the remains are older than about 60 000/ 70 000 years there would be no measurable C-14 left. • The substance being tested must contain carbon/be organic • The ratio of C-14 to 10^{12}C-12 in living matter has not been absolutely constant over the past 60 000 years • The technique assumes that C-14 in animals and plants matches the level in the general environment, which in rare cases it does not • Requires a minimum amount of substance.	1–2
	Total 8

(c) If you have a large number of fossil skulls from various hominin groups, trends from more primitive to more advanced can be seen.

Describe **six (6)** features of the hominin skull and the trends you would see in these features that would determine the order of the fossils, from least to most advanced. (6 marks)

Description	Marks
Any six of: • Size of cranium/ cranial capacity increases/ cerebral cortex increases • Shape of cranium becomes more rounded/higher/ presence of a forehead • Relative size of jaw decreases • Degree of prognathism reduces/face becomes flatter • Size of teeth reduces/evenness of teeth increases • Position of the foramen magnum changes from post-central to central • Appearance of a chin/nasal bridge in more recent fossils • Size of zygomatic arches reduces • Size/presence of brow ridges reduces • Decrease in post orbital constriction	1–6
	Total 6

Question 31 **(30 marks)**

(a) Human skeletal muscle is activated by a complex relationship between nervous stimuli and the processes inside the muscle fibre.

(i) Describe the transmission of a nerve impulse at the neuromuscular junction. Include an outline of the structures and chemicals involved in the process.

(7 marks)

Description	Marks
May use a fully annotated diagram.	1–7
Any seven of:	
• The neuromuscular junction is the point where nerve fibre/motor neuron meets the muscle fibre • The axon ending/branch has an enlarged end/synaptic knob • The enlarged end/synaptic knob sits next to/fits in a depression of the muscle fibre/motor end plate • Leaving a gap/synapse • Transmission across the gap requires a neurotransmitter/acetylcholine • Which is contained in vesicles • That are located in the synaptic knob/axon ending • Using energy from mitochondria • The presence of calcium • The neurotransmitter/acetylcholine diffuses from the axon endings/axon terminals/presynaptic fibres • Across the gap/synapse to the muscle fibre • Where it binds to the receptors on the motor end plate/muscle fibre • Causing depolarization/muscle contraction/muscle stimulation	
	Total 7

(ii) The sliding filament model is used to suggest how muscle contraction occurs. Explain how this model works. (7 marks)

Description	Marks
May use a fully annotated diagram.	1–7
Any seven of:	
• Filaments pass across each other to cause the muscle to shorten • Energy from ATP is needed for this • Actin are the thin filaments • Myosin, which are the thick filaments • The actin filaments slide over the myosin filaments • Z lines/anchor points for actin to become closer together/ shortens • Sarcomere shortens • The filaments do not change in length • Calcium is released from sacroplasmic reticulum • A cross bridge/ forms myosin head connecting the filaments • Movement occurs/iron bridge pulls them over one another • The I band/region where only actin occurs shortens • The actin slide across the myosin	
	Total 7

(b) Describe the pathway taken by a nerve impulse in a spinal reflex arc and explain **three (3)** ways in which it is considered to be a protective mechanism. (8 marks)

Description	Marks
May use a fully annotated diagram.	1–5
Any five of:	
• Receptor detects the stimulus→ • Sensory neuron towards the spinal cord/dorsal root • Spinal cord • Containing connector /association/neuron • Motor neuron/ventral root→ • Effector/ skeletal muscle	
Any three of:	1–3
• Protective reflex is quick • Separate pathway up the spinal cord to the brain • Message registers at brain <u>after</u> response/automatic response • Move limbs/body/body part away from danger • Prevents over stretching/ damage to muscles	
	Total 8

(c) Sarah was listening to her iPod™ and not paying attention to the traffic as she walked home from school. She didn't hear the car behind her as she stepped off the footpath. The driver of the car sounded the horn and screeched to a halt, just missing her.

Describe **four (4)** beneficial ways that Sarah's body may have responded to this frightening situation and how these responses would have been advantageous for her. (8 marks)

Description	Marks
Mention response for 1 mark and benefit for 1 mark.	1–8
Any four of:	
• Increased stimulation of sympathetic nervous system - for 'flight or fight' response • Release of noradrenaline/ adrenaline at the heart/adrenal gland - increasing heart rate/breathing rate/glucose availability • Increases blood pressure - supplying more nutrients to muscles • Increased sympathetic stimulation of blood vessels/ arterioles/ vasoconstriction -increases blood pressure/vasodilation of blood vessel to muscles • Decreased parasympathetic stimulation - less blood flow to digestive tract/kidney/bladder • Dilation of bronchi in lungs - to increase gas exchange • Increased access to energy - for rapid movement/flight or fight • Pupils dilate - giving greater peripheral vision • Release of cortisol at adrenal cortex – increasing blood sugar	
	Total 8

Question 32 **(30 marks)**

(a) Mrs Jones had been feeling unwell for some months and was not able to cope with everyday activities. She had noticed that her neck was getting thicker, preventing her from buttoning her shirts. She visited her doctor, who after a physical examination and blood tests, diagnosed low thyroid activity, or hypothyroidism.

(i) Imagine you are Mrs Jones's doctor and are explaining how the thyroid gland works. Provide a description of the thyroid hormone feedback loop. (8 marks)

Description	Marks
May use a fully annotated diagram. *Does not require homeostatic model terms.* Any eight of:	1–8
• Hypothalamus produces TSH RF/thyroid stimulating hormone releasing factor • TSH RF travels into the anterior pituitary • Blood vessels/portal system conducts/transmits TSHRF • Pituitary gland produces TSH • TSH is released into the blood stream/general circulation • TSH stimulates the thyroid gland • TSH produces thyroid hormone/thyroxine • Thyroid hormone/thyroxin is released by the gland into the blood stream/general circulation • Thyroid hormone/thyroxin negatively feeds back to pituitary/hypothalamus controlling output of TSH	
	Total 8

(ii) Later that week, Mrs Jones is talking with her friends about her medical experience. A friend mentions that one of her family members has a thyroid disease. The doctor called it 'hyperthyroidism, or Graves' disease'.

Compare and contrast Mrs Jones's hypothyroidism with hyperthyroidism (Graves' disease). For each condition outline **two (2)** causes, **two (2)** signs or symptoms and **one (1)** treatment. (10 marks)

Description		Marks
Hypothyroidism	*Hyperthyroidism*	1–4
Any 2 points for both conditions for 1 mark each		
Causes - Lack of iodine in the diet/ surgery/ cancer/ autoimmune (Hashimoto's disease)/ radiation	*Causes* – Genetic/ immune system reaction/ cancer/adenoma secreting hormone	
Any 2 points for both conditions for 1 mark each		1–4
Signs and Symptoms - Decreases heart rate and blood pressure/ cold intolerance/ weight gain/ goitre/ poor CNS development/ slow brain function/ fatigue/ normal eye appearance/↓TH	*Signs and Symptoms* - Increases heart rate and blood pressure/ heat intolerance/ weight loss/ goitre/ normal CNS development/ hyperexcitable/ abnormal brain function/ hyperactive/ protruding eyeballs/exophthalmos/↑TH/ ↑appetite/↑sweating/fatigue	
Any 1 point for both conditions for 1 mark each		1–2
Treatment - Replacement of iodine in the diet/ Thyroid hormone/ thyroxine replacement Surgery/ surgery for goitre	*Treatment* - Drugs to block formation of thyroid hormone/ propothiouracil/ carbamazapine/ Surgery to remove all/ part of the gland/ Radioactive treatment/ radioactive iodine	
		Total 10

(b) Glucose is required in the body cells for the production of energy during cellular respiration. To maintain glucose levels in a cell, negative feedback mechanisms are necessary for more glucose to be released into the bloodstream and to enter the cell.

Identify, name the source and describe the role of **three (3)** hormones in increasing glucose levels in the bloodstream. (12 marks)

Description	Marks
Any three hormones: **Glucagon**	1
• Produced by the alpha cells/Islets of Langerhans/pancreas/endocrine pancreas/pancreatic islets	1
• Enters the liver • Glycogenolysis/breakdown of glycogen to glucose • Promotes gluconeogenesis/breakdown of lipids/amino acids • Into glucose which enters the bloodstream	1–2
Cortisol	1
• Produced by adrenal cortex	1
• Amino acids to liver for gluconeogenesis/amino acid to glucose • Glycogenolysis/breakdown of glycogen to glucose • Glucose enters the blood stream • Removal of amino acids from muscle cell	1–2
Adrenaline/ noradrenaline	1
• Produced by adrenal medulla	1
• Glycogenolysis/breakdown of glycogen to glucose • Glucose enters the bloodstream • Glycogen in muscles is acted on • Lactic acid is produced • Lactic acid is converted to glucose in the liver • Increased insulin receptor numbers on cell surface • Increased sensitivity of insulin receptors • Promotes gluconeogenesis/breakdown of lipids/amino acids	1–2
	Total 12

ACKNOWLEDGEMENTS

Section Two:

Question 21 Diagram adapted from: *Muscle Titans* (2011, 2 April). [Web log message]. Retrieved June, 2011, from www.muscletitans.com.

Diagram adapted from: *I found the cure* [Website]. (2010, July 15). Retrieved July, 2011, from www.ifoundthecure.com.

Question 23(a) Diagrams adapted from: Joints. (n.d.). Retrieved March, 2011, from http://ovrt.nist.gov/projects/vrml/h-anim/jointInfo.html.

Question 23(b) Diagrams adapted from: MacKean, D. (n.d.). *Biology GCSE & IGCSE question bank with exercises and discussions: 17.* Retrieved March, 2011, from www.biology-resources.com/biology-questions.html.

Question 27 Diagram adapted from: *Notes for zoology*. (2009, September 26). Retrieved March, 2011, from www.cssforum.com.pk/css-optional-subjects/group-d/zoology/14536-notes-zoology-16.html.

Question 28 Diagram adapted from: *CEU course: Brain anatomy and function*. (n.d.). Retrieved March, 2011, from www.neuroskills.com/edu/ceufunction1.shtml.