



HUMAN BIOLOGICAL SCIENCE

Stage 3

WACE Examination 2010

Final Marking Key

This 'stand alone' version of the WACE Examination 2010 Final Marking Key is provided on an interim basis.

The Standards Guide for this examination will include the examination questions, marking key, question statistics and annotated candidate responses. When the Standards Guide is published, this document will be removed from the website.

Section One: Multiple-choice

(20 Marks)

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

A =4
B =7
C =4
D =5

Section Two: Short answer

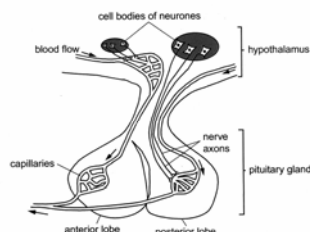
(100 Marks)

Question 21

(11 marks)

Many homeostatic mechanisms are regulated by the hypothalamus

The diagram below shows the relationship between the hypothalamus and the pituitary gland.



- (a) Describe the processes leading to the secretion of hormones from the anterior lobe into the bloodstream. (3 marks)

Description	Marks
Stimulation of the hypothalamus (nervous/hormonal/neg.feedback)	1
Releasing factors travel through the blood/portal system to the anterior pituitary gland	1
Releasing factor stimulates release of hormone from anterior pituitary	1
	Total 3

- (b) Explain why the posterior lobe is **not** considered to be a true endocrine gland. (2 marks)

Description	Marks
Hormones are produced in the hypothalamus	1
Pass down to the posterior pituitary via axons/nerves/neurosecretory cells	1
	Total 2

- (c) Use the two hormones released by the anterior lobe of the pituitary gland to complete the following table. (4 marks)

Description			Marks
1 mark per point in each box			1-4
	Target Cells/Organs	Function/s	
<i>ACTH</i>	Adrenal cortex	Stimulates secretion of corticosteroids/cortisol	
<i>LH</i>	Females-Ovaries/ ovarian follicle or Males-testes/interstitial cell of testes	Females-Ovulation/maintenance of corpus luteum or Males-secretion of testosterone	
			Total 4

- (d) The hypothalamus also regulates the production of adrenalin.

However, the pathway taken from the hypothalamus to the adrenal gland differs markedly from the pathway taken through the pituitary gland to other target cells.

Explain. (1 mark)

Description	Marks
An autonomic/sympathetic nerve impulse (0 marks if say cortex)	1
	Total 1

- (e) Progesterone production is dependent on the hypothalamus. If progesterone levels in the bloodstream are low, the hypothalamus responds. Describe this response. (1 mark)

Description	Marks
An increase in secretion of FSH/gonadotropin releasing factor/FSH releasing factor	1
	Total 1

Question 22

(9 marks)

A biologist is studying animal life in Antarctica, where the average daily temperature is -50°C . His work requires him to be in the open air making observations for long periods of time.

- (a) Describe one behavioural modification he would need to make, apart from wearing warmer clothing, when outside observing animals. (1 mark)

Description	Marks
Any 1 point for 1 mark	1
Continuous movement/exercise	
Eating high energy (high calorie/high kilojoule/fatty)/more foods/hot drinks	
Huddling/curling/reduce surface area	
Hot packs	
Shelter	
	Total 1

- (b) Physiological mechanisms are also essential for the scientist to maintain his core temperature in these freezing conditions.

Some of these are under nervous control and others are controlled by the endocrine system.

- (i) Name **two (2)** mechanisms that his nervous system would control and explain how they would maintain his core temperature. (2 marks)

Description	Marks
<i>No marks for just naming. Need the full answer for one mark each.</i>	1
Shivering - contraction of skeletal muscles producing heat	
Vasoconstriction – reduced diameter of skin arterioles/blood vessels reduces heat loss/reduces blood flow to skin	1
	Total 2

- (ii) What is the modulator for the control of body temperature? (1 mark)

Description	Marks
Hypothalamus	1
	Total 1

- (c) Two other biologists are studying other animal species in completely different conditions to that in Antarctica. One is in a hot desert and the other in a tropical rainforest. Both climates have a similar average daily temperature of 34°C. However, the biologist in the desert feels reasonably comfortable at this temperature, whereas the one in the tropical rainforest finds it very uncomfortable. Explain why. (1 mark)

Description	Marks
Any 1 point for 1 mark	1
There is more cooling effect from sweating in the desert as the air is dry and the water can evaporate	
There is less cooling effect from sweating in the tropical rainforest as humidity is high/ air is saturated and the water can't evaporate	
	Total 1

- (d) After a period of time without nourishment, the blood volume of the biologist in the desert would change more than that of the biologist in the tropical rainforest.

- (i) Describe the change that would occur to the biologist in the desert. (1 mark)

Description	Marks
The blood volume would reduce	1
	Total 1

- (ii) Explain your answer to part (d) (i). (1 mark)

Description	Marks
Higher level of sweating/evaporation (causes greater water loss from the blood).	1
	Total 1

- (iii) Explain how this change could affect his blood pressure. (2 marks)

Description	Marks
Low blood volume means less blood pumped through the heart,/lowering cardiac output	1
and therefore lowering blood pressure	1
	Total 2

Question 23

(12 marks)

A new drug called Lantus, containing insulin glargine, was approved in 2000 for the treatment of patients who were unable to produce sufficient insulin. Drugs containing NPH insulin had been widely used in the past. Many controlled clinical studies were carried out to enable this approval to be made.

The table below shows the average results produced in some of these trials.

Time after injection (hours)	Glucose Usage (mg/kg/min)	
	Lantus	NPH insulin
1	0.2	0.4
2	0.5	1.0
4	1.2	3.0
6	1.2	3.4
8	1.0	2.6
10	1.0	1.8
12	1.0	1.2
14	1.0	0.4
16	1.0	0.3
18	1.0	0.2
20	1.0	0.1
22	1.0	0.0
24	1.0	0.0

Note : For insulin to be effective, it needs to be able to maintain glucose usage above 0.4mg/kg/min

- (a) From which disease would these patients be suffering? (1 mark)

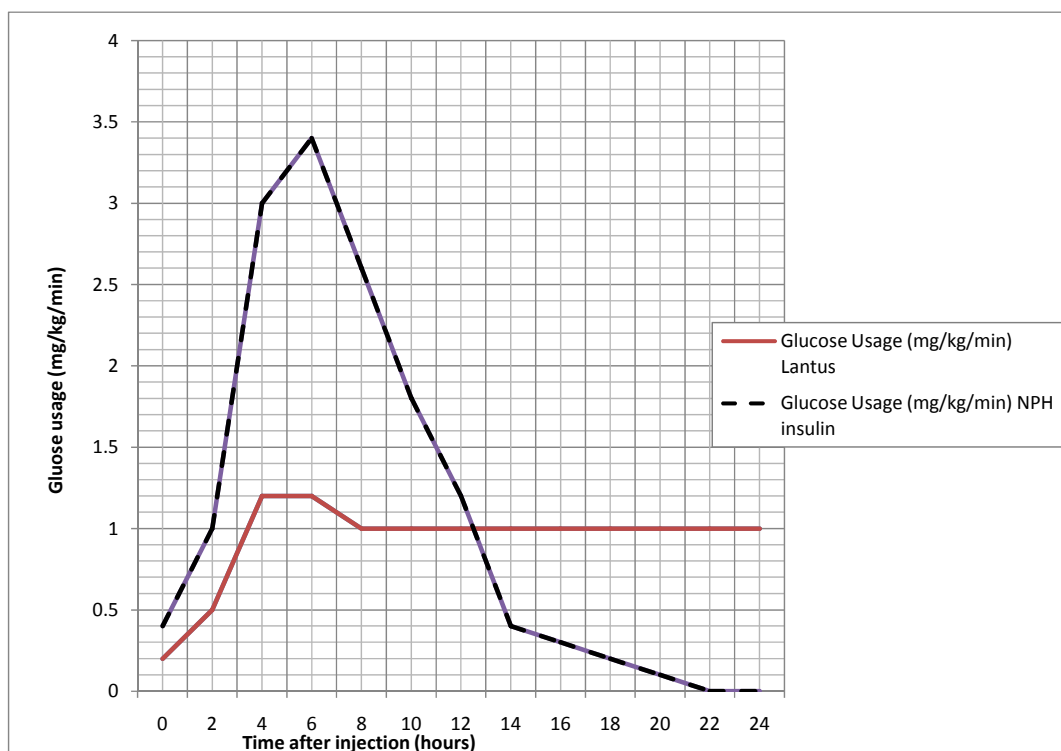
Description	Marks
Diabetes type 1 / insulin dependent diabetes / diabetes mellitus / juvenile diabetes	1
Total 1	

- (b) Describe how **two (2)** variables would be controlled in this experiment. (2 marks)

Description	Marks
Any 2 points for 1 mark each	1-2
The amount of insulin/drug per day the same for each patient	
The concentration of insulin/drug the same for each patient	
If using the same group for each type of insulin have a randomised group of adults/ children for both NPH and Lantus	
Carried out over the same period of time	
Delivery method same for each patient	
Other factors in people's health/diet taken into account any in this i.e. age, fitness, weight, etc.	
1 mark only.....must be more than a simple list	
Total 2	

(c) Graph these results on the grid provided below.

(5 marks)



Description	Marks
<i>Deduct 1 mark for each point missed</i>	
Two correctly plotted line graphs on the same grid	1
Title must include time and glucose usage	1
Accurately plotted points / straight lines connect points	1
Label x (time) and y (glucose usage) axis must have units	1
Correct scale take up half across grid	1
No extrapolation (no line back to zero)	1
Key for lines/identify lines	1
Bar/column graph maximum 2 marks	Total 5

(d) Using the data from the graph, explain why Lantus would have an advantage over traditional NPH insulin. (2 marks)

Description	Marks
It remains effective for at least 22 hours/day or NPH only lasts 16 hours or NPH lasts 6 hours less than Lantus	1
Less fluctuations/more stable	1
so would only need to be administered once a day	1
	Total 2

(e) Describe **two (2)** processes involved in 'glucose usage'. (2 marks)

Description	Marks
Any 2 points for 1 mark each	1-2
(Cellular respiration) – breakdown of glucose	
(Glycogenesis) – conversion of glucose to glycogen in the liver and muscles	
(Lipogenesis) – conversion of glucose to lipids/fats in adipose tissue	
Protein synthesis – increased rate of glucose usage	Total 2

Question 24

(9 marks)

- (a) List, in order of impulse transmission, the neurons involved in a spinal reflex arc.

(1 mark)

Description	Marks
Any 1 point for 1 mark	1
Must name all three in order for 1 mark Sensory/afferent (neuron)– interneuron/connector (neuron)/association (neuron) – motor/efferent (neuron)	
Must name both in order and state that it is monosynaptic for 1 mark Without interneuron still correct as could be monosynaptic = Sensory/afferent (neuron)– motor/efferent (neuron)	
	Total 1

- (b) Explain why conscious thought would be a disadvantage in a reflex behaviour. (2 marks)

Description	Marks
It would slow down the response time	1
and as the rapid response is protective/damage could be caused	1
	Total 2

- (c) In a reflex arc, as in all nerve pathways, an impulse travels in only one direction. Explain why.

(2 marks)

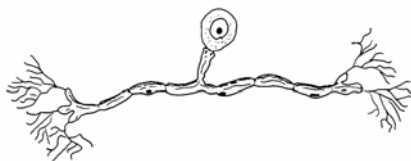
Description	Marks
During the refractory/repolarisation period	1
The neuron is unable to be stimulated to begin another action potential during and for a few milliseconds/short time after another action potential.	1
or Synapse only permits travel in one direction	1
Neurontransmitter only released from terminal end plate	1
	Total 2

- (d) When a nerve impulse reaches the end of an axon, it cannot go any further as it reaches a gap called a synapse. Explain how the impulse can continue on to the next neuron.

(2 marks)

Description	Marks
Neurotransmitters/chemicals are released from vesicles/from end of axons	1
and diffuse/move across the synapse to receptors on the next neuron	1
Annotated diagram OK	
	Total 2

- (e) One of the types of neurons involved in the reflex arc is classified as unipolar. The diagram below shows the general structure of a unipolar neuron.



- (i) Name the type of neuron that is unipolar. (1 mark)

Description	Marks
Sensory/ afferent neuron	1
	Total 1

- (ii) Explain why it is classified as unipolar. (1 mark)

Description	Marks
Dendrites and axons are continuous /the cell body lies to the side/lateral only has one long extension, the axon	1
	Total 1

Question 25 (9 marks)

The polymerase chain reaction (PCR) is a process that has revolutionised molecular biology.

- (a) Describe the **three (3)** steps involved in the PCR process. (3 marks)

Description	Marks
Students can use the terminology '(i). denaturing, (ii) annealing/ hybridization and (iii) synthesis/primer extension but this is not essential providing they have a description of the three steps in the correct order.	1
(i) (Denaturing) – heating of DNA to separate the strands	
(ii) (Annealing or hybridization) - A primer (small single strand of DNA) bind to complementary base sequences and start the replication	1
(iii) (Synthesis or primer extension) - Segments of single stranded DNA are replicated/ amplification through a repeated series of cycles	1
	Total 3

- (b) Name the enzyme that controls the PCR process. (1 mark)

Description	Marks
DNA polymerase / taq polymerase	1
	Total 1

(c) Name one application of the PCR process. (1 mark)

Description	Marks
Any 1 point for 1 mark	1
DNA profiling/forensic analysis/genotyping/sequencing/finger printing/paternity	
Medical research/ identifying abnormal DNA sequences/ mutations in genes that cause disease/specific disease	
DNA amplification	
Fossil identification/phylogenetic trees	
Total 1	

(d) The photograph below shows the equipment used in the process of electrophoresis, which is used widely in molecular biology.



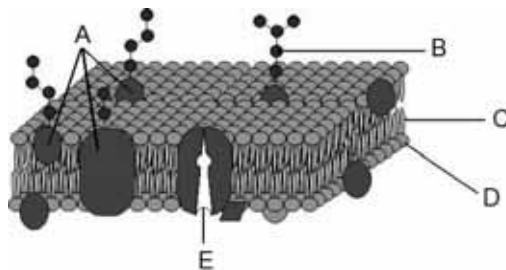
Explain how this process works. (4 marks)

Description	Marks
Any 4 points for 1 mark each	1-4
DNA/protein placed at negative end of gel bed	
An electric current is passed through the gel/ voltage applied across the gel	
The negatively charged DNA/protein move towards positive charge at the opposite end of the tank	
The DNA/protein pieces move through the gel at different speeds/ smaller pieces move faster than large ones	
Forming bands/bar code representing different segments/ sizes of DNA/protein. Sketch OK if show bands	
Total 4	

Question 26

(10 marks)

The following questions refer to the diagram of the cell membrane shown below.



- (a) Structures C and D make up the majority of the cell membrane. Of what types of molecules are these structures composed? (1 mark)

Description	Marks
Phospholipids/Lipid with phosphate attached	1
	Total 1

- (b) Steroids and fatty acids diffuse easily through the part of the cell membrane made up of C and D, while water must take a different path through the membrane. Explain why. (2 marks)

Description	Marks
Phospholipids and steroids & fatty acids are like substances/ /both are fat/lipid molecules /lipophilic/fat soluble	1
Water is not a lipid soluble molecule/membrane hydrophobic	1
	Total 2

- (c) Name structure E and explain how it is essential to active transport. (3 marks)

Description	Marks
E is a carrier protein/ pump/ ion pump/ ABC pump/ electrogenic ion pump / sodium potassium ion pump	1
Specific molecules bind to specific carrier proteins which requires energy/ATP	1
The molecule is moved to and released on the other side of the cell membrane	1
	Total 3

- (d) Identify the process that creates the molecules labelled A. (1 mark)

Description	Marks
Protein synthesis/translation	1
	Total 1

- (e) Explain how DNA is involved in the process identified in part (d). (3 marks)

Description	Marks
Any 3 points for 1 mark each	1-3
DNA determines which protein/amino acid sequence is made	
Protein synthesis involves a copy/template of DNA being made	
RNA copy of DNA is made/transcription of DNA into mRNA	
Three bases/triplet base of DNA code determine one amino acid	
Total 3	

Question 27

(12 marks)

Martha's Vineyard is an island off the east coast of the United States. It was first settled in the seventeenth century by a group of English immigrants. During the 1700s and 1800s, the island had an extraordinarily large proportion of individuals with genetically-inherited deafness. At this time, the US mainland had a 1 in 6000 deaf population, while Martha's Vineyard had a 1 in 155 deaf population. The reason for this difference was caused by the evolutionary mechanism known as the 'Founder effect'.

In the last century the difference between the proportion of the deaf population in Martha's Vineyard and mainland USA has diminished. Today Martha's Vineyard does not have a significantly large deaf population.

- (a) Explain how the Founder effect would have caused the large number of deaf individuals in Martha's Vineyard during the 1700s and 1800s. (4 marks)

Description	Marks
Any 4 point for 1 mark each	1-4
Small (isolated) sample of original population	
This sample is not genetically representative of original population.	
With some/more individuals carrying the genes for deafness	
Restricted breeding/ inbreeding among population/ restricted gene pool	
Frequency of deaf gene maintained/increased over time	Total 4

- (b) Suggest a factor that would have changed in the 1900s to result in the reduced incidence of genetically-inherited deafness in the Martha's Vineyard population. (1 mark)

Description	Marks
Any 1 point for 1 mark	1
(Increased) migration from mainland to the island	
Interbreeding/gene flow with mainland increased/ less restrictive breeding	
Random genetic drift/chance events	
Total 1	

- (c) Identify another example of a specific population with a high incidence of a genetically-inherited disease. State the population and the disease in your answer. (2 marks)

Description	Marks
Any disease for 1 mark and matching population for 1 mark	1–2
Tay-Sachs disease in Ashkenazi/ Jewish population	
Achromatopsia in Pingelap population	
Thalassaemia in Greek population	
Polydactyly in Amish population	
Dwarfism in Amish population	
Sickle-cell anaemia in African population	
<i>Any other reasonable answer</i>	
	Total 2

- (d) A mutation is another type of evolutionary mechanism that can affect frequencies of alleles in populations. Explain the difference in consequences between a mutation occurring in a somatic cell and one occurring in a gamete. (1 mark)

Description	Marks
Somatic affects only the individual, gamete is inheritable change	1
	Total 1

- (e) If a mutation is advantageous to the survival of an organism, what would you expect to happen over time? (1 mark)

Description	Marks
Increase in frequency (of the mutant gene/ variant allele in a particular gene pool.)	1
	Total 1

- (f) Identify and describe a technique that may one day provide a cure for disadvantageous mutations. Include an example of a mutation that could be treated with the technique you have identified. (3 marks)

Description	Marks
Any technique – 1 mark for name, 1 mark for description and 1 mark for example	1–3
Gene therapy	
Replacing faulty genes with healthy ones	
Example – Cystic Fibrosis / Huntington’s / sickle cell anaemia / muscular dystrophy / or any other single gene disorder	
or	
Cell replacement therapy / Tissue regeneration	
Cloning stem cells to make new cells / tissues / organs to replace faulty ones	
Example – Parkinson’s / Multiple Schlerosis / Alzheimer’s / or any other reasonable answer	
	Total 3

Question 28

(7 marks)

Pharmaceuticals are chemical substances, commonly referred to as ‘drugs’, which are used in the treatment, cure and prevention of disease. Many different drugs can be classed as pharmaceuticals.

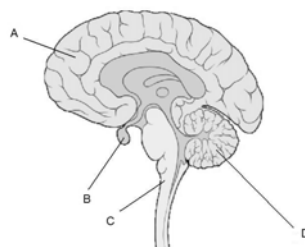
- (a) Describe the difference between the pharmaceuticals known as antibiotics and antivirals. (1 mark)

Description	Marks
Antibiotics affect/treat bacteria, while antivirals affect/treat viruses/coat normal cells as form of protection	1
	Total 1

- (b) Explain why neither antibiotics nor antivirals would be effective in the treatment of Alzheimer’s disease. (1 mark)

Description	Marks
Any 1 point for 1 mark	1
The disease is not caused by a pathogen/is not infectious	
Is believed to be caused by genetic and/or lifestyle/degenerative/environmental factors	
	Total 1

The following parts of question 28 refer to the diagram of the brain shown below.



- (c) Alzheimer’s disease is a form of dementia that can cause memory loss, confusion and mood swings. Given these symptoms of Alzheimer’s disease, which part of the brain (labelled A-D) above would you expect to be most affected by this disease? (1 mark)

Description	Marks
A / cerebrum/cerebral cortex / frontal lobe	1
	Total 1

- (d) Identify the part of the brain in the diagram opposite (labelled A-D) that maintains balance and posture. (1 mark)

Description	Marks
D / cerebellum	1
	Total 1

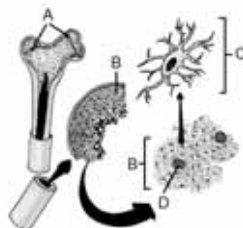
- (e) The structure identified in part (d) receives information from many areas of the body to aid in the maintenance of balance and posture. List **three (3)** structures found in the body that provide information to this part of the brain. (3 marks)

Description	Marks
Any 3 points for 1 mark each	1–3
A/Cerebrum	
Saccul & Utricle	
Semicircular canals	
Inner ear – <i>if haven't mentioned semicircular canal or saccul & utricle</i>	
Stretch receptors/proprioceptors/joint receptors in muscles/joints	
Eyes	
Pressure receptors of feet	
Total 3	

Question 29

(11 marks)

The diagram below represents the microscopic and microscopic structure of human bone.



- (a) Identify the structures labelled A and B. (2 marks)

Description	Marks
A = Epiphyseal Line/plate	1
B = Haversian System/ Osteon.	1
Total 2	

- (b) State the function of the structures labelled C and D. (2 marks)

Description	Marks
C = exchange nutrients & wastes with blood/ calcium homeostasis/ matrix maintenance/bone production/ mechano-sensory receptor/bone structure	1
D = carries blood vessels/small veins and arteries to nourish and remove wastes from bone/ carry nerve fibres to stimulate bone tissue	1
Total 2	

- (c) There are two types of bone marrow in a long bone: red and yellow. How do they differ in function? (2 marks)

Description	Marks
Must specify Red and Yellow	
Red – production of blood cells /erythropoiesis	1
Yellow – fat storage	1
Total 2	

- (d) Suggest why the density of bone in a long bone needs to differ between the epiphysis and diaphysis. (1 mark)

Description	Marks
The diaphysis need dense compact bone for strength/weight bearing/epiphysis role doesn't require same strength, lighter to facilitate joint movement/space for bone marrow.	1
	Total 1

- (e) Osteoporosis and osteoarthritis are both degenerative bone diseases that can be associated with ageing.

Distinguish between them and state one medical technology that is currently available for the treatment of each of these diseases. (4 marks)

Description	Marks
Osteoarthritis = loss/ wearing away of cartilage at joints	1
Osteoporosis = loss of calcium/bone density/weakening of bones	1
Osteoarthritis = joint replacement/anti-inflammatories /heat & cold therapy/muscle relaxants/antidepressants/sleep medications/topical creams/nerve stimulation (TENS)/acupuncture/therapeutic massage/fusion/ osteotomy (realigning the joint)	1
Osteoporosis = calcium supplements/hormone replacement therapy/medications to increase bone density(or specific examples)/vitamin D/weight bearing activity	1
	Total 4

Question 30

(10 marks)

- (a) In primates, evolutionary trends can be seen in the level of dependency offspring have on their parents.

- (i) Describe this trend. (1 mark)

Description	Marks
Increasing length (of time of dependency)	1
	Total 1

- (ii) Explain how this may increase the survival chances of a primate species. (1 mark)

Description	Marks
Any 1 point for 1 mark	1
Period of learning is increased/ More time for ideas and techniques to be passed on	
Less competition/greater protection with other offspring/greater parental care	
	Total 1

(b) Increased opposability is another trend evident in primate evolution. The human thumb shows the greatest opposability of all primates; however, the big toe has completely lost this function.

(i) What advantage do humans have over other primates, due to their highly-opposable thumb? (1 mark)

Description	Marks
Any 1 point for 1 mark	1
Able to manipulate objects with more precision	
Enables the precision grip /finer motor skills.	
Total 1	

(ii) Explain why non-opposability of the big toe is advantageous to humans. (1 mark)

Description	Marks
Any 1 point for 1 mark	1
Foot is weight bearing (rather than grasping) in function/acts as lever for "push off"	
Big toe is to aid in support/balance when standing and lift off in the striding gait	
Total 1	

(c) The skulls below show evolutionary trends in the hominins. These are not placed in the correct evolutionary sequence.



(i) Using the letters A-D, place these skulls in the correct evolutionary sequence from most primitive to most recent. (1 mark)

Description	Marks
C, A, D, B (Names not needed)	1
Total 1	

- (ii) Identify **three (3)** evolutionary changes evident in the diagrams and suggest why each of these changes may have occurred. (3 marks)

Description	Marks
Any 3 points for 1 mark each	1-3
Cranium becoming more rounded / generally an increase in cranial capacity - allows for increased size of cerebral cortex	
Flatter face/smaller jaw/ face more under cranium/ reduced prognathism – allows for increase in brain size/better balance/bipedalism change in diet	
Appearance of a chin – gives increased tongue movement for speech/change in diet	
Reduced brow ridges – eyes protected by forehead/frontal lobe increased/increased cortex	
Reduced zygomatic arches due to diet changes/speech	
Smaller teeth – change in diet	
<i>Must have both the change and the reason to gain one mark. If just list changes – only 1 mark</i>	
Total 3	

- (d) The change to bipedalism during hominin evolution was advantageous in many ways. One was improved cooling of the body surface. Suggest **two (2)** reasons why bipedalism results in improved cooling of the body surface. (2 marks)

Description	Marks
Upright stance/ being vertical reduces the amount of the body surface that is directly hit by the Sun's rays	1
There is more of the body further from the ground enabling more air movement/so cooling by convection/temperatures are slightly lower than ground temperature.	1
Total 2	

Section Three: Extended answer

(60 Marks)

Question 31

(30 marks)

Scientists have been recently analysing a new hominin fossil specimen discovered in Ethiopia named *Ardipithecus ramidus* and nicknamed "Ardi". This specimen is the oldest most complete hominin skeleton to be found and is dated at 4.4 million years old. Although it is believed that Ardi would have been a good climber and spent much of her time in the trees, her skeleton shows characteristics that indicate she could employ bipedal locomotion.

- (a) Identify the features of the spine, pelvis and leg of a skeleton one might look for to conclude that it was bipedal. Explain the significance of these features to bipedal locomotion. (10 marks)

Description	Marks
Any 5 features for 1 mark each, with matching explanation for 1 mark each	
<i>At least 1 must be spine, 1 must be pelvis, 1 must be leg</i>	
Spine with explanation	1–2
Pelvis with explanation	1–2
Leg with explanation	1–2
Any two others with explanation	1–4
<ul style="list-style-type: none"> • S-shaped curve to vertebral column - enable head to be balanced on top of vertebral column/ absorbs shock whilst walking • Wedge shaped lumbar vertebrae - contributes to forming spinal curvature • Increased thickness of vertebrae - for weight bearing on two legs • Spine is vertical/S shaped – transmits weight/centre of gravity through the centre of the body • Increased size of vertebral spines for increased muscle attachment • Sacrum held tightly to ilium by ligaments - creates stability • Bowl shaped pelvis - gives support to abdominal organs/ large surface for attachment of muscles • Width of pelvis - is important for the carrying angle/ attachment of muscles involved in maintaining posture • Height of pelvis/pelvis short from top to bottom - increases stability when upright • Acetabulum is deep – facilitates carrying angle and larger femoral head • Carrying angle of femur – transmits weight directly under the centre of the body/enables balance/transfer weight when one leg is moving (off the ground)/lower center of gravity • Length of femur - to increase stride/gait/more energy efficient travel • Longer leg:arm lowers center of gravity • Two-part hinge knee joint - ligament attachments prevent over-extension of the leg/locks knee when swinging forward • Outer/lateral condyle - more robust for load bearing • Medial condyle enlarged – to compensate for carrying angle and facilitate articulation with tibia 	
	Total 10

(b) Ardi is the oldest hominin specimen found to date, but scientists are yet to discover the “missing link” between other primates and humans. This is one example of a gap in the fossil record, where no significant fossils have been found for a particular species at a particular time.

(i) Outline how the fossil record provides evidence for evolution. (4 marks)

Description	Marks
Any 4 points for 1 mark each	
<ul style="list-style-type: none"> Fossil record shows all of the fossil evidence which has been found in the Earth’s strata It provides physical evidence about which organisms lived on Earth in the past And provides examples of intermediate organisms between species which may not exist today Allows scientists to create evolutionary links between species And to help establish recent common ancestry Determine diet and teeth from vegetation-fossil pollen Fossil record indicates increase in complexity and diversity Fossil record has complete sequences 	1–4
	Total 4

(ii) Examine the reasons why there are gaps in the record. (8 marks)

Description	Marks
Any 8 points for 1 mark each	
<p>Fossil formation is rare because</p> <ul style="list-style-type: none"> Scavenging, scattering and eating of organisms prevents fossilisation Need to be protected from decay by micro-organisms Need to be covered rapidly/lack of oxygen/alkaline soils/peat soils ie low pH and no oxygen/sedimentary rocks (only 1 mark for conditions) Need to be left undisturbed while sediments form rock Most fossils form from solid body parts such as bone/teeth but many organisms do not have hard structures Soft body parts can leave impressions but may be too shallow to be preserved <p>Fossils can be destroyed by</p> <ul style="list-style-type: none"> Earth movements/erosion/weathering Human activity eg. construction/site development <p>Finding fossils can be difficult because</p> <ul style="list-style-type: none"> Fossils may not be recognised May not be looking in the right place May be buried too deep to find/too hard to penetrate rock layers to find older fossils Difficult to date due to limitations in dating methods Exposed and weathered before discovery 	1–8
	Total 8

- (c) It is possible that scientists may find more fossil remains at the same site where they found Ardi. If they were to find a bone fragment of another organism but were unable to date it using absolute dating techniques, describe **two (2)** possible relative dating methods they could use instead. Assuming this bone fragment is found in a layer beneath the one Ardi was found in, determine the relative age it could be assigned by each dating technique. Include in your answer a reason why the assigned relative age could be flawed. (8 marks)

Description	Marks
<ul style="list-style-type: none"> • Stratigraphy/ Correlation of rock strata/ process of superposition/Index fossils used to help correct errors 	1
<ul style="list-style-type: none"> • Layers of sedimentary rock at the top are younger than those at the bottom further down the strata the fossil is found the older it is 	1
<ul style="list-style-type: none"> • Bone beneath Ardi means in an older rock stratum and it must be older (than 4.4 million years) 	1
<ul style="list-style-type: none"> • Could be wrong because - disturbances to the layers of sediments by earth movements/human action/animal burial/digging could have misaligned the positions of fossils 	1
<ul style="list-style-type: none"> • Fluorine dating 	1
<ul style="list-style-type: none"> • Bones left in soil will have ions replaced with fluoride ions, older fossils at a site will contain more fluoride ions than younger fossils 	1
<ul style="list-style-type: none"> • Bone has been in the soil longer than Ardi, should have more fluoride and must be older (than 4.4 million years) 	1
<ul style="list-style-type: none"> • Could be wrong because – amount of fluoride ions in the soil can change over time due to environmental factors meaning more or less could be in the bone unrelated to its age 	1
	Total 8

Question 32

(30 marks)

- (a) If you carry out a high level of physical activity, the osmotic pressure in your cells is increased, stimulating **two (2)** types of feedback mechanisms that enable your cells to regain optimum water levels.

In the situation described above, explain how homeostasis is maintained by

- (i) hormonal control (8 marks)

Description	Marks
Any 8 points for 1 mark each	
<ul style="list-style-type: none"> • Osmoreceptors in the hypothalamus • detect high osmotic pressure/low water concentration in the blood and • sends an impulse to the posterior pituitary gland • which increases secretion of antidiuretic hormone/ADH into the bloodstream • to increase re-absorption of water from • distal convoluted tubule and collecting duct/nephron tubule • it increases the permeability of the tubule wall • allowing osmosis to occur/allowing facultative reabsorption • due to the osmotic gradient • created by the high concentration of ions in the renal medulla • resulting in decreased osmotic pressure 	1–8
Annotated feedback loop OK	Total 8

- (ii) conscious action (4 marks)

Description	Marks
Any 4 points for 1 mark each	
<ul style="list-style-type: none"> • Osmoreceptors in the thirst centre • of the hypothalamus detect high osmotic pressure/low water concentration in the blood and • In the cerebral cortex • a conscious feeling of thirst occurs and the person drinks • water is absorbed into the blood • water enters the cells and regains optimal level/decreases osmotic pressure 	1–4
	Total 4

- (b) The nephron of the kidney plays a key role in maintaining homeostasis of body fluid composition by removing the appropriate levels of water from the body.

Describe **two (2)** processes occurring in the nephron that assist with water homeostasis.

(6 marks)

Description	Marks
Any 6 points for 1 mark each	
<p>Not expected to name/remember the parts of the nephron. Must mention both filtration and re-absorption</p>	
<ul style="list-style-type: none"> • Force of blood pressure as capillaries enter the nephron/ in the glomerulus • Filtration forces small molecules including water into the Bowman's/glomerular capsule/nephron • Re-absorption from filtrate of essential materials • Increasing osmotic pressure in the blood • Water then moves from the tubule to the blood/is reabsorbed • by osmosis <p><i>Could also mention the -</i></p> <ul style="list-style-type: none"> • Sodium pump at the Loop of Henle setting up a gradient for osmosis in the collecting duct • A high solute concentration in the renal medulla is maintained by • sodium ions being reabsorbed by active transport and • ascending loop of Henle/tubule walls being impermeable to water 	1-6
	Total 6

- (c) Fred is 55 years old and has been told by his doctor that he is suffering from hypertension (high blood pressure).
- (i) Suggest reasons why Fred may be suffering from hypertension and describe **two (2)** different types of treatments that the doctor may have discussed with him. (5 marks)

Description	Marks
Any 3 points for 1 mark each	1-3
<ul style="list-style-type: none"> • Excess weight/obesity • Lack of exercise • Stress • High salt intake • High alcohol intake • Genetic factors • Ageing/arteriosclerosis • High saturated fat diet • Disorders of body organs. Eg. heart, kidney, adrenal gland, aorta. • Drugs eg. Stimulants such as amphetamines, coffee/ diet pills/ some allergy pills/ nicotine/cigarette smoking 	
Any 2 points for 1 mark each	1-2
<ul style="list-style-type: none"> • Lifestyle changes (or mention two of these) – eg. Reduced/healthier diet, reduced salt intake, increased exercise, reduced alcohol, stop smoking. • Medication – (or mention two of these by name or description) eg. diuretics (increase water and salt loss)/beta blockers (reduces pulse rate)/alpha blockers (widen blood vessels)/ calcium channel blockers (widen blood vessels) ACE inhibitors (relax and widen blood vessels)/ angiotensin II receptor blockers (widen blood vessels). 	
Total 5	

- (ii) If Fred follows all of the doctor's advice his blood pressure may be maintained at a normal level. Describe the homeostatic mechanisms under nervous control that would work to maintain Fred's blood pressure within the normal range. (7 marks)

Description	Marks
Underlined are essential 4 points Any 3 of the other points for 1 mark each	1-7
<ul style="list-style-type: none"> • High blood pressure stretches arteries • <u>Baroreceptors/pressoreceptors in carotid and aortic bodies</u> • <u>Relay impulses to cardio-vascular/ vasomotor centre of medulla (oblongata)</u> • To inhibit sympathetic impulses • Causing vasodilation of blood vessels • Also an increase in parasympathetic impulses • Decreases output of adrenaline/noradrenaline from adrenal gland • <u>Decreases heart rate/ cardiac output</u> • Both cause a <u>decrease in blood pressure.</u> • Feedback continues to again increase blood pressure if it falls below normal. 	
Annotated loop diagram OK	Total 7

Question 33

(30 marks)

(a) John was not immunised against whooping cough when he was an infant. As a teenager he was exposed to the pathogen that caused the disease and became very ill. Jennifer was vaccinated as an infant and when exposed as a teenager she did not contract the disease and showed only very minor symptoms.

(i) Describe the processes that occurred in Jennifer’s immune system at the time of vaccination.

(15 marks)

Description	Marks
Process occurring <ul style="list-style-type: none"> • An antigen necessary to cause an immune response • Jennifer has had a weakened/dead antigen preparation in the form of a vaccine. • Macrophage engulfs the pathogen/vaccine and • displays the antigen on its surface • Specific B and T lymphocytes recognize the antigen, • are sensitized and enlarged and mitosis/cloning occurs • B lymphocytes produce plasma cells • capable of producing antibodies • Antibodies move throughout the bloodstream • to inactivate antigens. • Actions of antibodies, antigen-antibody complex • Destroy by agglutination/ neutralization/ enhanced phagocytosis /leakage/ dissolving • T lymphocytes produce Killer T cells • which move to the site of infection. • to destroy antigen • Actions of killer T cell sensitize other lymphocytes/enhance phagocytosis • Memory B and T cells are also produced for the secondary response. 	1–15
	Total 15

(ii) Explain the difference between Jennifer’s response and John’s response when they were exposed as teenagers to the pathogen. **(5 marks)**

Description	Marks
<ul style="list-style-type: none"> • John did not have memory cells (due to lack of immunisation) • It therefore it took a lot longer for the immune response to occur causing him to contract the disease/display major symptoms • John has primary response Jennifer has secondary response • Jennifer had memory cells (due to immunisation.) • Therefore the immune response could occur more quickly • Destroying the pathogen before it had a significant effect/sickness/major symptoms/disease. 	1–5
	Total 5

(b) Describe how vaccines could be produced by recombinant DNA techniques. (10 marks)

Description	Marks
<p>Any 10 points for 1 mark each</p> <ul style="list-style-type: none"> • The transfer of genes from one organism to another • The gene/segment of DNA for the antigen is isolated by cutting it at a recognition site • by the use of a restriction enzyme. • The enzyme cuts the DNA on either side of the gene in a staggered cut/blunt end • so unpaired nucleotides (overhang at the break) to produce sticky ends • A plasmid (a circular strand of DNA inside a bacterial cell) is removed from a bacterium • The plasmid is cut with the same type of restriction enzyme to • also create complimentary sticky ends • (Another enzyme called) DNA ligase • is used to join the sticky end of the isolated gene and the plasmid together • The required gene and plasmid are called Recombinant DNA • Plasmid/viral (nucleic acid) is termed a vector • inserted into the bacterial cell • The bacteria is then cloned/reproduced to • produce large amounts of the gene or its product, e.g. vaccine <p>Annotated diagram OK if labelled with these key points</p>	<p>1–10</p>
	Total 10

ACKNOWLEDGEMENTS

Section One

- Question 3** X-ray image from: Romanes, G., J. (1981). *Cunningham's textbook of Anatomy*. (12th ed.). Oxford University Press. Retrieved February, 2010, from Answers.com website: www.answers.com
- Question 6** Diagram adapted from: Surmeno. (2006). *Hormone levels in natural menopause*. Retrieved March, 2010, from Flickr website: www.flickr.com/photos/60755062@N00/215294270/
- Question 7** Diagrams of primate skulls from: Lancaster, W., C. (n.d.). *Lab 13-Orders Primates & Scandentia*. Retrieved February, 2010, from California State University website: www.csus.edu/indiv/l/lancasterw/bio168/LABS%20BIO168-03/Lab%2013-Scandentia%20and%20Primates%20BIO168-05.htm
- Question 20** Diagram adapted from: Stephan, P. (2009). *How to do arm Lymphedema exercises*. Retrieved February, 2010, from About.com website: http://breastcancer.about.com/od/lifeaftertreatment/ss/arm-lymphedema-exercises_7.htm

Section Two

- Question 21** Diagram of cell bodies of neurones from: *Advanced GCE Human Biology Exam 2867 – Genetics Homeostasis and Ageing*. Oxford Cambridge and RSA Examinations. p.12, q. 4.
- Question 26** Diagram adapted from: Boumphreyfr. (2009). *Cell membrane3*. Retrieved January, 2010, from Wikimedia Commons website: http://commons.wikimedia.org/wiki/File:Cell_membrane3.png
- Question 28** Image adapted from: Lynch, P.J. (2006). Retrieved December, 2009, from Wikimedia Commons website: http://commons.wikimedia.org/wiki/File:Brain_human_sagittal_section.svg
- Question 29** Diagram A, B & C adapted from: Merriam-Webster Inc. (n.d.) *Bone*. Retrieved April, 2010, from Merriam-Webster Online website: www.merriam-webster.com/art/med/bone.htm
- Diagram D adapted from: Skalar. (n.d.). *Construction of bone*. Retrieved April, 2010, from Kulturystyka.pl website: <http://kulturystyka.pl/budowa-kosci-art-by-skalar/>.
- Question 30(c)** Diagrams A and D adapted from: Terrebonne Parish History & Genealogy. (n.d.). Retrieved March, 2010, from: www.terrebonneonline.com
- Diagram B from: Foley, J. (n.d.). Retrieved March, 2010, from Talk Origins Archive website: www.talkorigins.org
- Diagram C from: Ecotao Enterprises website. (n.d.). Retrieved March, 2010, from: www.ecotao.com