



Christ Church
Grammar School

SOLUTIONS

**Science Department
Year 11 Human Biology**

Semester 2 Examination, 2019

Question/Answer Booklet

**HUMAN BIOLOGY
UNITS 1 and 2**

Fix student label here

Student Name: _____

Time allowed for this paper

Reading time before commencing work: ten minutes

Working time for paper: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer Booklet

Multiple-choice Answer Sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction tape/fluid, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in this examination

Important note to candidates

No other items may be taken into the examination room. It is your responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of exam
Section One: Multiple-choice	30	30	40	30	30
Section Two: Short answer	9	9	90	100	50
Section Three: Extended answer	3	2	50	40	20
					100

Instructions to candidates

1. The rules for the conduct of the Western Australian Certificate of Education ATAR course examinations are detailed in the Year 12 Information Handbook 2019. Sitting this examination implies that you agree to abide by these rules.

2. **Answer the questions according to the following instructions.**

Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Section Two: Write your answers in this Question/Answer booklet. Whenever possible, confine your answers to the line spaces provided.

Section Three: Consists of three questions. You must answer two questions. Tick the box next to the question you are answering.

3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.
4. Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space page.

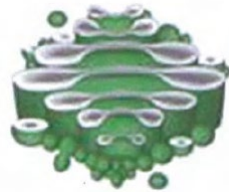
Section One: Multiple- choice

30% (30 Marks)

This section has **30** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a box through that square then shade your new answer. Do not erase or use correction fluid/tape. No marks will be given if more than one answer is completed for any question.

Suggested working time: 40 minutes.

The next two questions refer to the diagram below.



1. The organelle pictured above is the

- a. Golgi body.
- b. rough endoplasmic reticulum.
- c. smooth endoplasmic reticulum.
- d. ribosome.

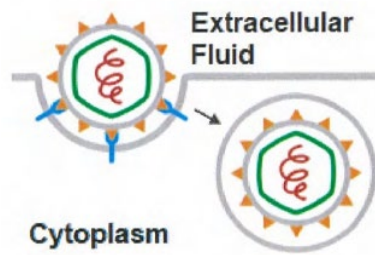
2. The function of the organelle above is to.

- a. modify and package proteins.
- b. produce proteins.
- c. break down proteins.
- d. transfer proteins across the cell membrane.

3. A microscope with an objective lens of 10X and an eyepiece lens of 4X, has a field of view of 3500 μm . If the eyepiece lens is changed to 10X, what is the new field of view?

- a. 8750 μm
- b. 14000 μm
- c. 35000 μm
- d. 1400 μm

The next question refers to the following diagram.



4. The cellular process depicted above is **best** explained as
- a. endocytosis; material is surrounded by the plasma membrane and buds off outside the cell forming a vesicle.
 - b. endocytosis; material is surrounded by the plasma membrane and buds off inside the cell forming a vesicle.**
 - c. exocytosis; material is surrounded by the plasma membrane and buds off outside the cell forming a vesicle.
 - d. exocytosis; material is surrounded by the plasma membrane and buds off inside the cell forming a vesicle.
5. Inhalation is brought about by a
- a. flattened diaphragm and contraction of the intercostal muscles.**
 - b. flattened diaphragm and relaxation of the intercostal muscles.
 - c. dome-shaped diaphragm and relaxation of the intercostal muscles.
 - d. dome-shaped diaphragm and contraction of the intercostal muscles.
6. Emphysema is a respiratory disease often associated with chronic smokers, where irritating particles damage the alveoli. Sufferers struggle to take in enough oxygen and often are fatigued. These symptoms are **best** attributed to
- a. constriction of the alveoli and damage to the blood vessels surrounding the lungs.
 - b. decreased surface area within the lungs and poor ventilation.**
 - c. vasoconstriction of the respiratory capillaries and reduced lung volume.
 - d. loss of fluid covering the lungs and increased thickness of the alveolar membranes.
7. Which of the following are characteristics of the human respiratory surfaces?
- a. dry linings, large surface area, vascular, thin membranes
 - b. moist linings, small surface area, non-vascular, thick membranes
 - c. dry linings, small surface area, non-vascular, thick membranes
 - d. moist linings, large surface area, vascular, thin membranes**

8. A laboratory technician forgot to label a cross section of a blood vessel. Which of the following descriptions would help the technician to classify the vessel?

- a. Veins have small lumens, which keep blood pressure high throughout the circulatory system.
- b. Capillary walls are thick, which help resist the high pressure in capillary beds.
- c. Veins contain the same three layers as arteries but have less smooth muscle and elastic tissue.
- d. Arteries contain valves to help push the blood away from the heart.

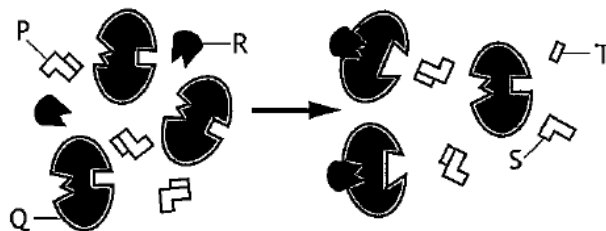
9. Which of the following substances is directly absorbed into the lymphatic system during digestion?

- a. glucose
- b. water
- c. amino acids
- d. fatty acids and glycerol

10. Which line in the table correctly identifies where bile is produced, stored and its function in the body.

	Where bile is produced	Where bile is stored	Function of bile
a.	Gall bladder	Liver	Chemically digest lipids
b.	Gall bladder	Liver	Mechanically digest lipids
c.	Liver	Gall bladder	Chemically digest lipids
d.	Liver	Gall bladder	Mechanically digest lipids

11. The diagram below shows an enzyme-catalysed reaction taking place in the presence of an inhibitor.



Which line in the table below identifies the molecules in the reaction?

	Inhibitor	Substrate	Product
a.	P	R	S
b.	Q	P	S
c.	R	P	T
d.	R	Q	T

The next two questions refer to the following information.

The table shows the normal composition of blood plasma, of fluid from the Bowman's capsule and of urine (g/100ml of fluid).

Components	Blood plasma	Fluid from Bowman's capsule	Urine
Water	91.0	99.0	96.0
Urea	0.03	0.03	2.00
Uric acid	0.004	0.004	0.05
Glucose	0.10	0.10	None
Amino acids	0.05	0.05	None
Total minerals	0.72	0.72	1.50
Proteins	8.00	none	none

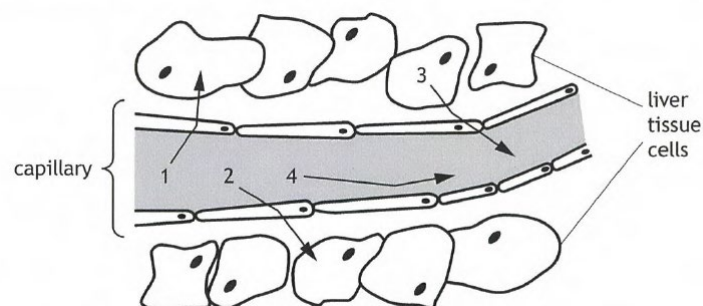
12. The urine of a person on a high protein diet would contain

- a. no urea.
- b. less than 2.00 g of urea per 100 ml.
- c. 2.00 g of urea per 100 ml.
- d. more than 2.00 g of urea per 100.

13. Proteins and fats are found in the urine because

- a. they are large molecules.
- b. both proteins and fats are reabsorbed before reaching the bladder.
- c. proteins are denatured in the liver and fats are absorbed in the small intestine.
- d. both compounds are stored elsewhere in the body.

14. The diagram below shows the movement of substances between a capillary and the surrounding liver tissue cells.



Which row in the table identifies the substances in the diagram

	Substance			
	1	2	3	4
a.	glucose	carbon dioxide	oxygen	protein
b.	oxygen	glucose	carbon dioxide	protein
c.	protein	glucose	oxygen	carbon dioxide
d.	protein	oxygen	carbon dioxide	glucose

The next two questions refer to the diagram below.



15. In the diagram above, according to movement in the direction of the arrow

- a. the bicep is the agonist and the triceps is the antagonist.
- b. the bicep is the antagonist and the triceps is the agonist.
- c. the bicep is the extensor and the triceps is the flexor.
- d. the bicep is the antagonist and the triceps is the extensor.

16. The type of joint labelled X in the diagram above is referred to as a

- a. cartilaginous joint.
- b. pivot joint.
- c. hinge joint.
- d. ball and socket joint.

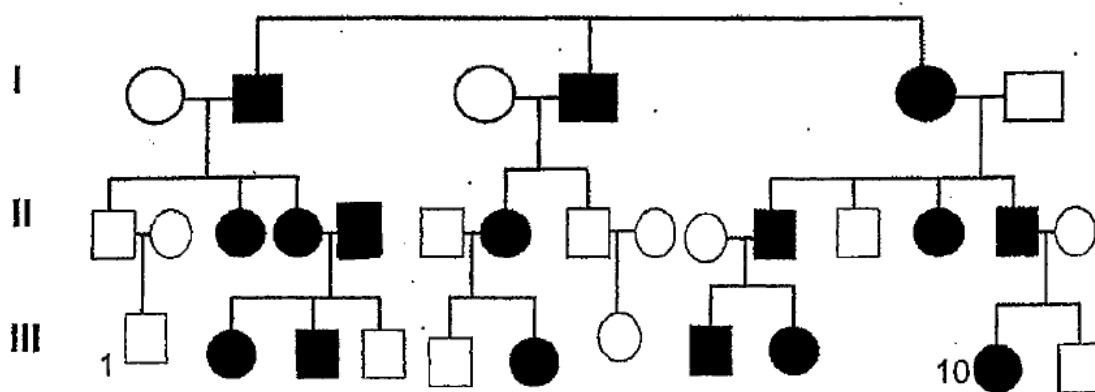
17. Osteoporosis is best described as

- a. wearing of articular cartilage.
- b. reduction in bone density.
- c. growth of bone spurs at joints.
- d. painful degeneration of bone.

18. The function of a tendon is to

- a. attach muscle to bone.
- b. attach bone to bone.
- c. protect the articular ends of bones.
- d. act as a covering for bones.

The next three questions refer to the pedigree below. Affected individuals are indicated by shading.



19. The gene for this trait is most likely inherited as

- a. an X-linked recessive trait because affected daughters have an infected father.
- b. an X-linked dominant because affected sons have an affected mother.
- c. an autosomal recessive because more individuals are not affected than are affected.
- d. an autosomal dominant because affected males and females have an affected parent.

20. Which of the following conditions could be represented by the above pedigree chart?

- a. haemophilia
- b. red green colour blindness
- c. Huntington's disease
- d. cystic fibrosis

21. If individual III.1 and III.10 had a child, what is the probability that the child would be affected?

- a. 0.25
- b. 0.50
- c. 0.75
- d. 1.0

22. The following is a list of steps that occurs in the process of mitosis:

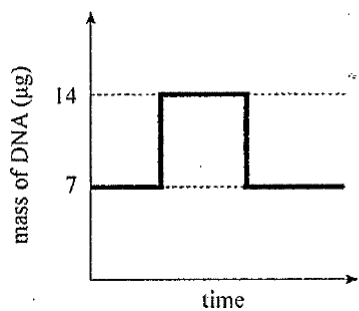
- i) formation of two daughter cells
- ii) separation of the chromatids
- iii) duplication of chromosomes
- iv) division of the cytoplasm
- v) chromatid pairs line up along the equator of the cell

Which of the following is the correct order of events in mitosis?

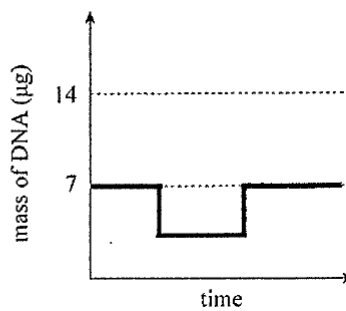
- a. i, ii, iii, iv, v
- b. iv, iii, v, ii, i
- c. iii, v, ii, iv, i
- d. v, iv, iii, ii, i

23. White blood cells are derived from stem cells in the bone marrow of healthy human beings. It has been estimated that the mass of DNA in a newly formed white blood cell is close to 7 micrograms (μg).

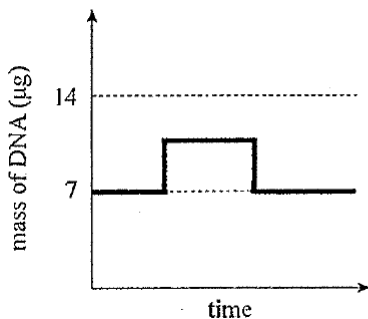
Which of the following graphs most closely represents the mass of DNA in a stem cell as it grows and divides to form a white blood cell?



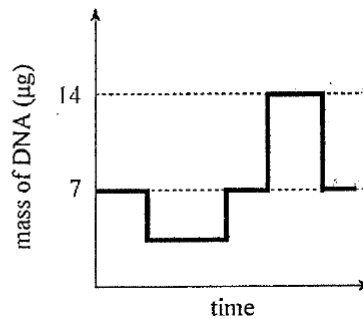
a.



b.



c.



d.

24. When a DNA molecule replicates, which of the following statements is the correct description of the two new DNA molecules?

- a. Each new DNA molecule is entirely different than the original molecule.
- b. Each new DNA molecule consists of the old strands but with nucleotides in a new order.
- c. Each new DNA molecule consists of an old strand of nucleotides and new strand of nucleotides.
- d. Each new DNA molecule consists of new strands of nucleotides with the old strands being destroyed.

25. The table below refers to stem cell potency. Which line is correct?

	Totipotent	Multipotent	Pluripotent
a.	Have the ability to produce the embryo and its membranes	Are able to produce cells with a specific function	Have the ability to produce most but not all cell in an organism.
b.	Are able to produce cells with a specific function	Have the ability to produce the embryo and its membranes	Have the ability to produce most but not all cell in an organism.
c.	Have the ability to produce most but not all cell in an organism.	Have the ability to produce the embryo and its membranes	Are able to produce cells with a specific function
d.	Have the ability to produce most but not all cell in an organism.	Are able to produce cells with a specific function	Have the ability to produce the embryo and its membranes

26. What is the major distinguishing factor that separates the embryonic stage from the foetal stage?

- a. The major event of the embryonic stage is implantation in the uterus; all development occurs during the foetal stage.
- b. All major organ systems form during the embryonic stage; the foetal stage consists mainly of rapid growth and changing body proportions.
- c. The brain forms late in the foetal stage. All other organ systems form earlier.
- d. The skeletal system is laid down during the foetal stage; otherwise organ systems form during the embryonic stage.

27. Which of the following correctly describes the composition of the foetal vessels?

- a. The umbilical vein has a high carbon dioxide concentration, the umbilical artery has a high urea content.
- b. The umbilical artery is low in glucose and oxygen.
- c. The umbilical vein is high in urea and low in carbon dioxide.
- d. The umbilical artery has a high carbon dioxide concentration, the umbilical vein has a high urea content.

28. Which of the following correctly describes the ductus arteriosus and ductus venosus?

	Ductus arteriosus	Ductus venosus
a.	Provides a bypass of the foetal liver	Provides a bypass of the foetal lungs
b.	Connects the right and left atria of the foetal heart	Carries blood from the pulmonary artery to the umbilical artery
c.	Provides a bypass of the foetal lungs	Allows blood to flow directly from the right side of the heart to the aorta
d.	Carries blood from the pulmonary artery directly to the aorta	Provides a bypass of the foetal liver

29. A couple who had been unsuccessful in having a baby wished to take advantage of the in vitro fertilization programme, using the women's own egg and the man's sperm. In this technique, the fertilised egg is placed in the woman's uterus to develop in the normal way.

Which of the following infertility problems could most easily be overcome by this method?

- a. Failure of the follicle to mature.
- b. Unstable uterine wall which greatly reduces the probability of implantation.
- c. Pelvis too small to allow normal development of the foetus.
- d. Blocked oviducts from severe infection.

30. Which sexually-transmitted disease is characterized by painful blisters that appear on the external genitalia, thighs, buttocks, cervix and vagina?

- a. gonorrhoea
- b. syphilis
- c. herpes
- d. genital warts

END OF SECTION ONE

Section Two: Short answer**50% (100 Marks)**

This section has **nine (9)** questions. Answer **all** questions. Write your answers in the spaces provided.

Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space page.

Suggested working time: 90 minutes


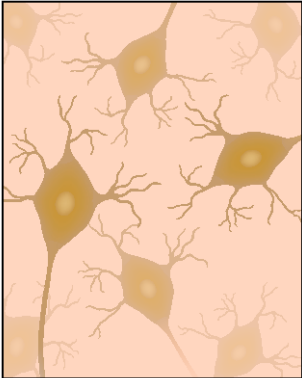
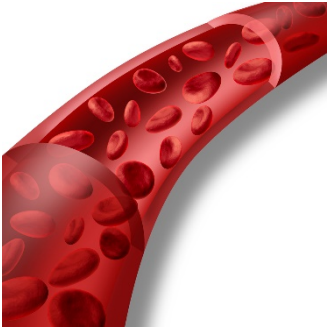
Question 31**(7 marks)**

- (a) Multicellular organisms, such as humans, involve a hierarchical organisation working together to maintain life.

Using an example, describe how cells, tissues and organs are related.(3 marks)

Description	Mark
Cells are specialised to carry out specific functions/basic building block/smallest structural and functional unit AND example (i.e. epithelial cell)	1
Groups of specialised cells/cells that have a common function make up a tissue AND example (i.e. epithelial tissue)	1
Different tissues work together to function as an organ AND example (i.e. trachea)	1
Total	3

- (b) The various tissues of the human body can be categorised into four basic tissue types. In the table below, identify the tissue type and state the function of the tissue. (4 marks)

	Tissue Type	Function
	Epithelial	Covers / lines internal and external surfaces of the body
	Nervous	Receives and transmits messages/impulses around the body
	Connective Tissue	Binds and supports other tissues

Question 32

(10 marks)

- (a) The internal environment of a cell is separated from the external environment by a thin membrane that regulates the movement of substances into and out of the cell.

In the space below, create a fully labelled diagram that identifies the main structures of the plasma membrane that are involved in the transport of substances. (5 marks)

Description	Mark
Labelled diagram must include the following for 1 mark each:	
- Bilayer	1
- Phospholipid	1
- Hydrophilic head (facing outwards)	1
- Hydrophobic tails (facing inwards)	1
- Channel/Carrier protein (span membrane with central pore)	1
<p>Example:</p> <p>The diagram illustrates a cross-section of a plasma membrane. It consists of a phospholipid bilayer where the hydrophilic heads (represented by black circles) face outwards and the hydrophobic tails (represented by vertical lines) face inwards. A channel protein, shown as a vertical oval with a central pore, spans the entire bilayer. Brackets and lines connect the labels to their respective parts: 'Bilayer' on the left, 'Phospholipid' at the bottom left, 'Hydrophilic Head' at the bottom right, 'Hydrophobic Tails' on the right, and 'Channel Protein' at the top center.</p>	
Total	5

- (b) Explain, making reference to the importance of concentration gradients, how oxygen and carbon dioxide levels are maintained in the lungs. (4 marks)

Description	Mark
Importance:	
- the greater the difference in gas concentrations/levels between air and blood	1
- the more efficient/faster gas exchange/diffusion	1
Maintained by:	
- constant flow of blood through the capillaries	1
- movement of air into and out of the alveoli	1
Total	4

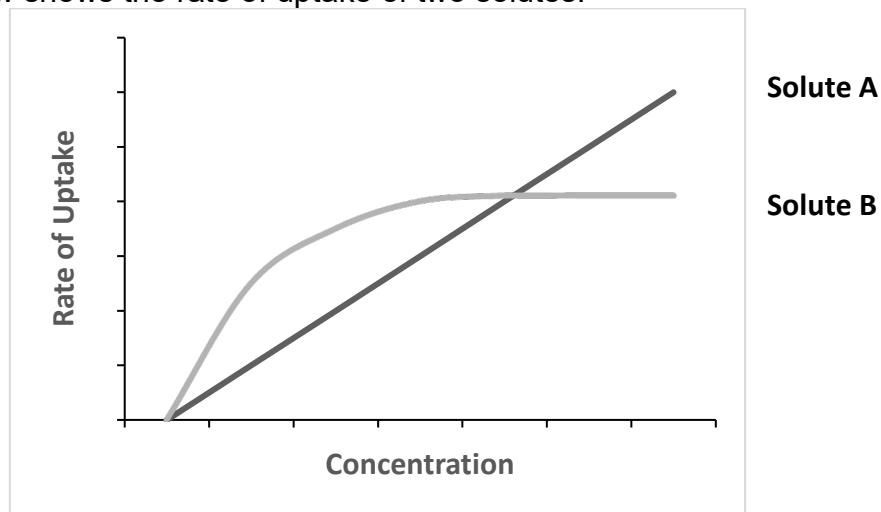
(c) State the reason that carbon dioxide moves across the alveolar membrane much faster than oxygen. (1 mark)

Description	Mark
Carbon dioxide is more soluble/polarised bonds between C=O/ability to react with water/form carbonic acid	1
Total	1

Question 33

(6 marks)

The graph below shows the rate of uptake of two solutes.



State which type of transport is represented by each solute and give an example of a material that moves by this method. (2 marks)

i. Solute A

Diffusion - Water / oxygen / carbon dioxide / alcohol / fatty acids / steroids / ions including sodium, potassium, calcium / lipids / soluble drugs

Accept Osmosis – Water also.

ii. Solute B

Facilitated Diffusion / Carrier Mediated – glucose / amino acids

(b) Describe the possible differences in the chemical nature of Solute A and Solute B in relation to their movement across the cell membrane.

(2 marks)

Any two of the following for 1 mark each:

- Polar / hydrophilic particles require facilitation / diffuse slower**
- Nonpolar / hydrophobic particles undergo diffusion quicker**
- Lipid soluble particles undergo diffusion quicker**
- Water soluble require facilitation / diffuse slower**

Question 34

(13 marks)

Once ingested, food passes through the alimentary canal and is digested.

- (a) Explain how the structure of the ileum, the third section of the small intestine, is well adapted to absorb nutrients. (4 marks)

Long / 6m / large surface area / inner lining is folded (1)

Villi / finger-like projections are present (1)

Microvilli on cells are present (1)

Thin membrane for easier diffusion (1)

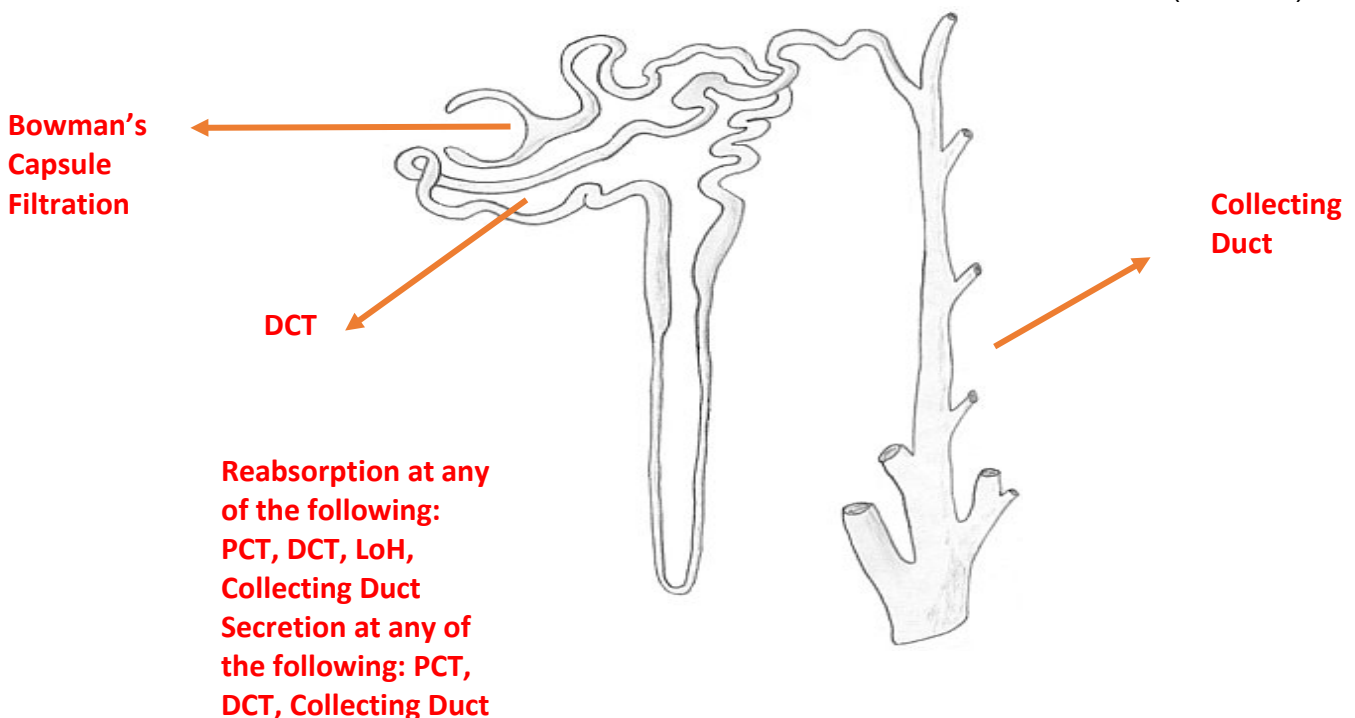
Once absorbed, these nutrients are further broken down within the body.

- (b) State the name given to the breakdown of proteins. (1 mark)

Deamination

Proteins, and their substrates, can be removed from the body via the kidney.

- (c) On the diagram below:
- (i) Label the Bowman's capsule, distal convoluted tubule and collecting duct
- (ii) Identify an area of filtration, an area of secretion and an area of reabsorption. (6 marks)



Not all wastes are removed from the body in this way.

(d) Describe the difference between elimination and excretion of wastes.

(2 marks)

Excretion is the removal of metabolic wastes from the body (1)

Elimination is the removal of indigestible foods / defecation (1)

Question 35**(10 marks)**

An experiment was conducted on the effects of fluid consumption on urine production. The experiment involved the comparison of water consumption with the consumption of saline solution. Saline solution is a sterile solution of water and salt (normally sodium chloride). The experiment involved 30 subjects, 15 who consumed one litre of water in a five minute period and 15 who consumed one litre of saline solution in the same five minute period. All subjects were required to stay in a small room maintained at a temperature of 25°C and were asked to perform minimal physical activity. Urine production over the three hours following fluid consumption was recorded for all subjects. The results for each group were averaged and are presented below:

Time (minutes)	Urine Production (ml)	
	Water consumption	Saline solution consumption
0	24	18
30	360	21
60	450	27
90	255	36
120	48	29
150	30	34
180	27	24

- (a) (i) Propose a hypothesis for the experiment. (1 mark)

Statement must include the independent and dependent variables.

Consuming saline solution will decrease urine production

OR

Consumption of water will result in an increase in urine production

- (ii) List two variables that were controlled in this experiment. (2 marks)

Any two of the following:

volume (1 litre) of fluid consumed
length of time (3 hours) of recording urine production
length of time (5 minutes) to consume fluid
temperature (25°C) for duration of experiment
minimal physical activity for both groups

b) Suggest how researchers could increase the

(i) validity of the experiment.

(1 mark)

Establish more controlled variables / improve experimental design
Specific answer referring to the experiment (must improve the design)

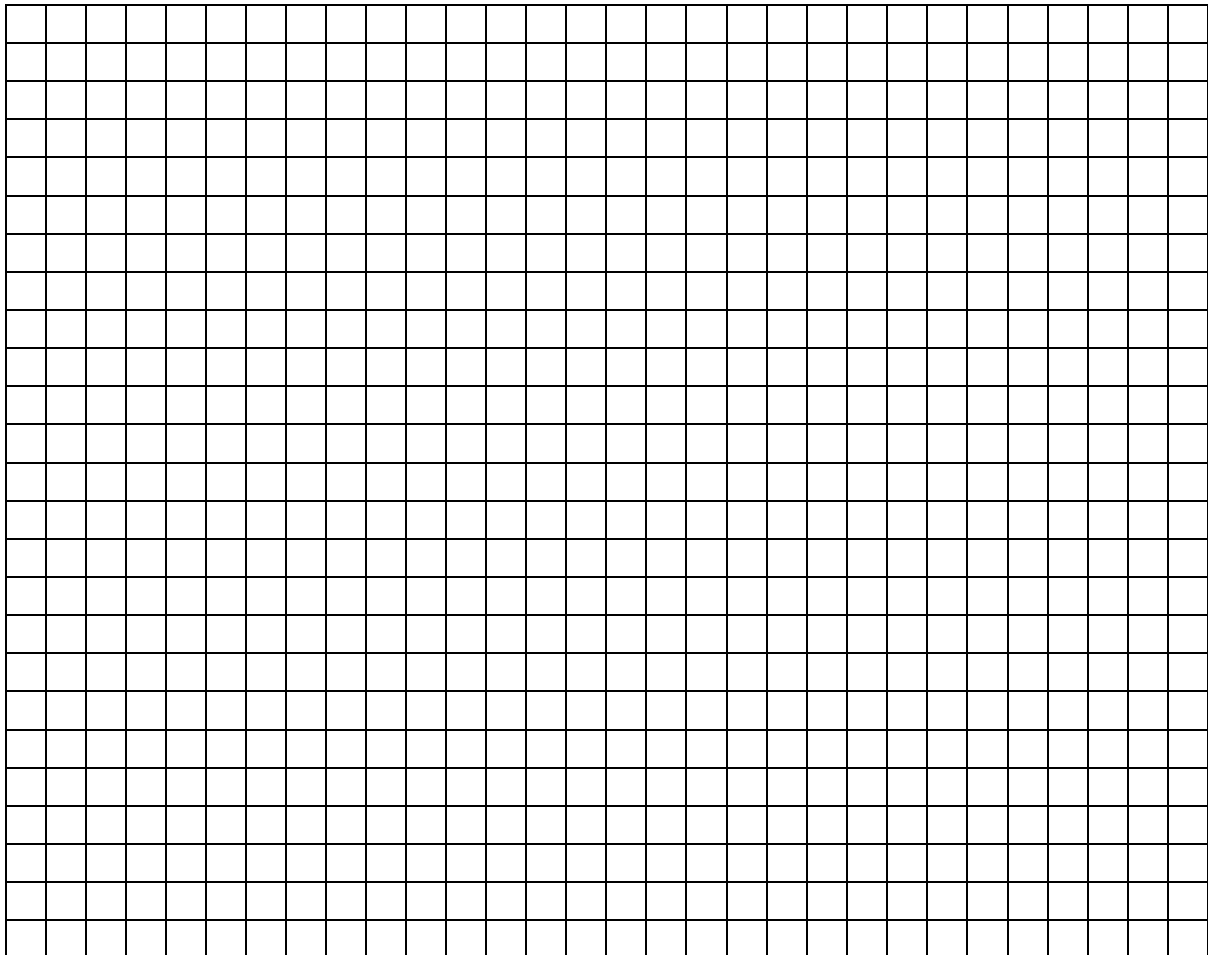
(ii) reliability of the results.

(1 mark)

Increase sample size / repeat experiment / replicate

(c) Graph the data in the table on the grid below.

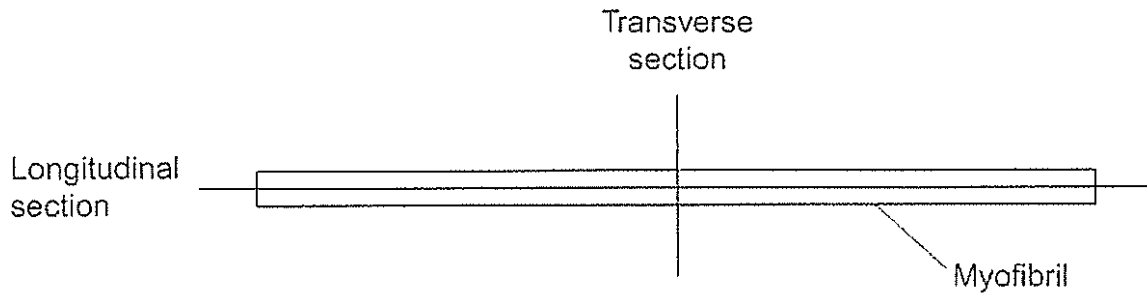
(5 marks)



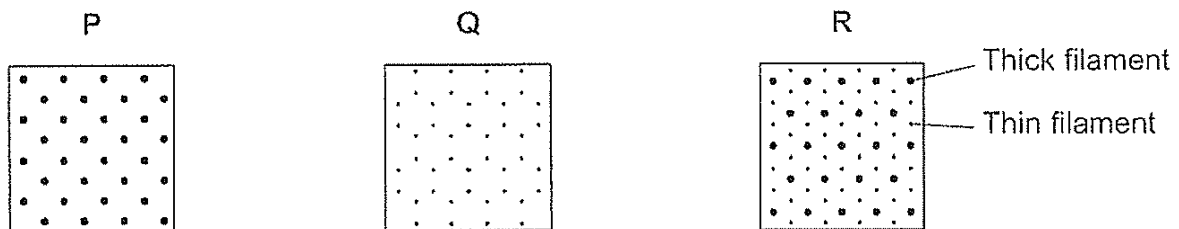
Question 36

(8 marks)

The diagram below shows how biologists cut transverse and longitudinal sections through a myofibril.



The diagram below shows transverse sections through different regions of one sarcomere in a relaxed myofibril of a skeletal muscle.



- (a) In the space below, make a simple drawing of a longitudinal section through **one** sarcomere. Show how the thick and thin filaments are arranged.

Label your diagram clearly to show where each of the sections **P**, **Q** and **R** was cut. (5 marks)

Diagram:

One complete sarcomere (long and thin) with longitudinal rods (1)
Correct pattern of thick myosin and thin actin filaments and Z-lines (1)

Labelling:

P to H-zone / region with just thick myosin filaments (1)
Q to I-band / region with just thin actin filaments (1)
R to A-band (but outside of H-zone) / region with both thick myosin and thin actin filaments (1)

(b) When the myofibril is fully contracted, one of the regions **P**, **Q** and **R** disappears.

(i) Which region disappears? (1 mark)

P

(ii) Explain what happens to the thick and thin filaments to cause the region to disappear. (2 marks)

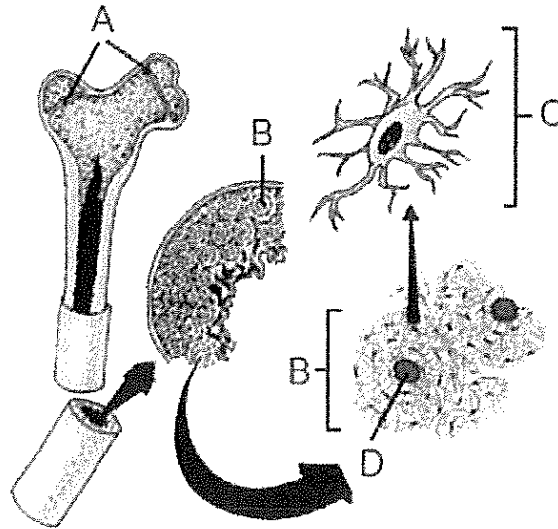
Thin actin filaments slide over / along thick myosin filaments (1)

Thin filaments meet / overlap enter region P (1)

Question 37

(1 1 marks)

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



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

A epiphyseal line / plate (1)

B Haversian system / osteon (1)

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

C bone production / structure / matrix maintenance / mechano-sensory reception (1)

D carries blood vessels (small arteries and veins) to nourish and remove waste / carry nerve fibres to stimulate bone tissue (1)

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

Red marrow – production of blood cells / erythropoiesis (1)

Yellow marrow – fat storage (1)

- (d) Suggest why the density of bone in a long bone needs to differ between the epiphysis and diaphysis. (2 marks)

Diaphysis needs dense compact bone for strength / weight bearing (1)

Epiphysis does not require the same strength, lighter to facilitate joint movement / space for bone marrow (1)

(e) Osteoarthritis is a degenerative bone disease that can be associated with ageing.

(i) State how osteoarthritis causes degeneration of the bone. (2 marks)

Degeneration of articular cartilage surrounding epiphysis (1)
Joint bones rub together and degenerate (1)

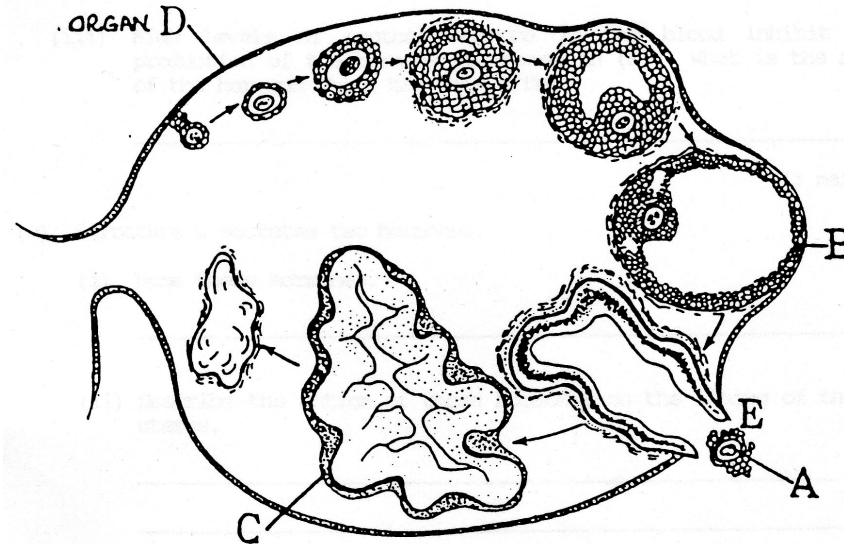
(ii) State one medical technology that is currently available for the treatment of osteoarthritis. (1 mark)

Joint replacement / artificial prosthesis / surgery (1)

Question 38

(17 marks)

The events which occur in the human ovary during one menstrual cycle are shown below in diagrammatic form.



- (a) Name the structures **A** to **D**. (4 marks)

A ovum

B Graafian follicle

C corpus luteum

D ovary

- (b) Structure **B** develops under the influence of a hormone.

- (i) Name this hormone. (1 mark)

Follicle stimulating hormone (FSH)

- (ii) Which gland secretes this hormone? (1 mark)

Anterior pituitary gland

- (iii) High levels of another hormone in the blood inhibits the production of this hormone.

What is the name of this other hormone? (1 mark)

Oestrogen

(d) (i) What event does stage **E** represent? (1 mark)

Ovulation

(ii) Name the hormone responsible for stage **E**. (1 mark)

Luteinizing hormone (LH)

(d) Structure **C** secretes two hormones.

(i) Name these two hormones. (2 marks)

Progesterone (1) and oestrogen (1)

(ii) Describe the action of these hormones. (2 marks)

Thickening, glandularisation and vascularisation of the uterus endometrium (1)
in preparation for the implantation of a fertilized ovum (1)

(iii) Describe what happens to structure **C** if pregnancy does not occur. (2 marks)

Degeneration /atrophies (1) turns into inactive scar tissue /corpus albicans (1)

e) During which day(s) of a normal human menstrual cycle would the following structures be present? (2 marks)

B days 10-14

C days 15-24

Question 39**(8 marks)**

The development of a human embryo starts with one cell and becomes over 200 cell types within the nine month gestation period.

Six days after fertilisation a hollow ball of cells has formed. To one side of this hollow ball lies a group of approximately 30 cells.

- (a) State the name that is given to this group of 30 cells and identify the cell type? (2 marks)

State	Marks
Inner cell mass	1
Identify	
(Pluripotent) Stem cells	1
Total	2

The type of cells identified above are not like any other cells found in the body.

- (b) Describe two ways in which the above cell type are different from all other cells. (2 marks)

Describe	Marks
Proliferation (or description of)	1
Can become any type of cell except embryonic membranes	1
Total	2

The developing embryo embeds into the lining of the uterus in a process called implantation. During this time, three (3) primary germ layers form.

- (c) Complete the table below by naming the primary germ layers and giving an example of the structures they will form. (4 marks)

Name of Primary Germ Layer	Example
Endoderm	Epithelium of alimentary canal/ urinary bladder/pharynx/ tonsils Any correct example
Mesoderm	Muscle tissues/ cartilage/ bone or other connective tissue/ blood vessels Any correct example
Ectoderm	nervous system

Question 40**(10 marks)**

Identical twins have the same genome. However, as they age they develop differences. These differences are said to be caused by epigenetic factors.

- (a) Identify two (2) possible epigenetic factors that could bring about differences in identical twins. (2 marks)

Identify	Marks
Stress	1
Diet	1
(Any reasonable correct answers)Total	2

- (b) Our DNA is fixed for life. Explain how it is possible for epigenetic factors to turn genes on or off causing us to express or not express a particular trait. (4 marks)

Explanation	Marks
DNA is wrapped around histones	Any 4
If tightly coiled the gene will not be expressed	
If loose gene will be expressed	
Acetylation enhances gene expression	
Methylation inhibits gene expression	
Total	4

A couple has non-identical twin boys. One has normal vision while one is colour-blind.

- (c) (i) Explain why it is possible for one non-identical twin to be born colour blind while the other is born with normal vision. (2 marks)

Explanation	Marks
Non-identical twins do not have the same genome	1
Therefore one can inherit the colour blind allele while the other does not	1
Total	2

- (ii) In order for the above situation to take place, what would be the genotype of the non-identical twin's parents? (2 marks)

Mother _____ Father _____

	Marks
Mum- $X^C X^c$	1
Dad- $X^c Y$	1
Total	2

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

This section has **three (3)** questions. You must answer **two (2)** questions. Write your answers on the lined pages provided.

Additional working space pages at the end of this Question/ Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/ continued on and write the question number being planned/ continued on the additional working space page.

Responses could include clearly labelled diagrams with explanatory notes; lists of points with linking sentences; clearly labelled tables and graphs; and annotated flow diagrams with introductory notes.

Suggested working time: 50 minutes.

Question 41**(20 marks)**

Proteins are some of the most important substances in our bodies. Enzymes speed up chemical reactions, hormones send messages around the body and antibodies help protect the body; all these substances are proteins.

(a) Describe the process of protein synthesis.

(12 marks)

Description	Marks	
Transcription	Any 12 in correct order	
Takes place in the nucleus		
DNA molecule unzips at specific gene exposing bases		
RNA polymerase creates complementary mRNA molecule		
Adenine binds to uracil not thymine		
mRNA moves through nuclear pore into cytoplasm		
Translation		
Takes place in the cytoplasm		
Ribosome attaches to mRNA molecule		
Ribosome moves mRNA 3 bases at a time		
3 mRNA bases are called a codon		
tRNA molecules bring amino acids to the ribosome		
3 tRNA bases are called an anticodon		
Anticodons join with the complementary codons		
Amino acids joined together in correct sequence		
Protein is formed		
Total		12

- (b) Describe how an enzyme carries out a catabolic reaction at an optimum temperature and explain what would happen if the temperature increased. (8 marks)

Description	Marks
Enzymes lower activation energy	
Enzyme specific to one substrate	Any 5
Lock and key hypothesis	
Substrate attaches to enzyme at active site	
Enzyme substrate complex formed	
Enzyme breaks down substrate	
Products formed	
Explanation	
Increased temperature changes shape of active site on enzyme	Any 3
Substrate no longer complementary shape	
Enzyme has been denatured	
Irreversible	
No products formed	
Total	8

Question 42**(20 marks)**

The process of meiosis gives rise to an unlimited amount of variation within the human gene pool. This variation allows our species to be diverse and therefore gives us a greater chance at survival.

- (a) Outline the process of meiosis. In your answer, explain some of the ways meiosis leads to variety within our species. (12 marks)

Outline	Marks
DNA doubles replicates	Any 10 but must be in order
Nuclear membrane disintegrates / centrioles move to opposite poles /spindle formation	
Chromatin condenses / chromosomes become visible	
Homologous pairs of chromosomes line up in double row at the equator of the cell	
Spindle contracts homologous chromosomes move to opposite poles of the cell	
Cell membrane invaginates / folds inwards / two daughter cells produced	
Two daughter cells with half / haploid number of chromosomes	
Nuclear membrane disintegrates / centrioles move to opposite poles /spindle formation	
Chromatin condenses / chromosomes become visible	
Chromosomes line up in single row at the equator of the cells	
Spindle contracts chromatids move to opposite poles of the cells	
Cell membrane invaginates / folds inwards / two daughter cells divide into four cells	
Four daughter cells with half / haploid number of chromosomes	
Explanation	
Random assortment chromosomes align independently of each other leads to a huge number of possible variations	1
Crossing over exchange of genetic material between homologous chromosomes results in changes to the chromosome leading to variation	1
Total	12

- (b) Sometimes during meiosis, an incorrect number of chromosomes can be found in gametes.
Name this type of mutation and explain how it comes about. In your answer give an example of this. (4 marks)

State	Marks
Non-disjunction	1
Explanation	
Homologous pairs fail to separate	Any 2
One cell receives one too many chromosomes/ too few chromosomes	
Gametes have either 22/ 24 chromosomes	
Example	
Down's syndrome/ Turners (any correct example)	1
Total	4

Fertilisation occurs when the nucleus of the sperm cell fuses with the nucleus of the egg cell.

- (c) Describe the features of sperm cells and how these features allow the sperm cells to reach the nucleus of the egg. (4 marks)

Description	Marks
Head contains genetic material	1
Enzymes at tip of head / acrosome allow sperm to enter egg cell	1
Flagella / tail for swimming	1
Mid piece contains mitochondria for movement / mitochondria provide energy for movement	1
Total	4

Question 43**(20 marks)**

Aerobic respiration is the process by which energy is made. Every function of the body is fuelled by this energy.

- (a) Describe the process of aerobic respiration during the complete breakdown of one molecule of glucose. In your answer, you should refer to the locations in the cell throughout this process and the amount of energy produced.

(11 marks)

Description	Marks
Glycolysis	Any 10
Takes place in the cytoplasm	
No oxygen required for glycolysis	
Glucose broken down into 2 pyruvic acid molecules	
2 ATP produced (net)	
Pyruvic acid enters mitochondria	
Oxygen required	
Kreb's cycle	
2 more ATP produced	
Electron transport system	
34 ATP produced	
(Up to) 38 ATP produced in total	
Glucose + oxygen → water + carbon dioxide + energy	1
Total	11

- (b) In which type of situation could protein be used as a respiratory substrate in place of glucose. Explain why this could be potentially fatal.

(4 marks)

Explanation	Marks
Starvation situations	1
Tissue protein can be broken down	1
Essential structures like the heart can be damaged	1
Organs cannot function and person can die	1
Total	4

- (c) If a person is carrying out heavy exercise they may respire anaerobically.

Describe anaerobic respiration and how it comes about during heavy exercise.

(5 marks)

Description	Marks
Respiration without oxygen	Any 5
Not enough oxygen available during heavy exercise	
Lactic acid formed causing muscle pain	
Oxygen debt builds up	
Rapid deep breathing after exercise repays oxygen debt	
Lactic acid combines with oxygen to reform glucose	
Aerobic respiration can begin again	
Total	5

