* Copyright for test papers and marking guides remains with *West Australian Test Papers*.
* The papers may only be reproduced within the purchasing school according to the advertised conditions of sale.
* Test papers must be withdrawn after use and stored securely in the school until Thursday 2nd July, 2020.

**HUMAN BIOLOGY**

**Unit 1**

**2020**

**SOLUTIONS**

**Time allowed for this paper**

Reading time before commencing work: ten minutes

Working time: two and a half 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 fluid/tape, 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 material. 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 attempted | Suggested working time (minutes) | Marks available | Percentage of examination |
| Section One  Multiple-choice | 30 | 30 | 40 | 30 | 30 |
| Section Two  Short answer | 7 | 7 | 60 | 80 | 50 |
| Section Three  Extended answer  Part 1  Part 2 | 2 | 1 | 50 | 40 | 20 |
| 2 | 1 |
|  |  |  |  | **Total** | 100 |

**Instructions to candidates**

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2020*. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. 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. Do not use erasable or gel pens. 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. Wherever possible, confine your answers to the line spaces provided.

Section Three: Consists of two parts each with two questions. You must answer one question from each part. Tick the box next to the question you are answering. Write your answers in this Question/Answer booklet.

4. 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.

5. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

**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. Do not use erasable or gel pens. 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.

Suggested working time: 40 minutes.

1. A scientist was measuring the weights of 100 athletes; however, the scale she used was measuring one kilogram higher than the true value. This is an example of
   1. user error.
   2. human error.
   3. random error.
   4. systematic error.
2. In an experiment, saliva was mixed with a starch suspension. Samples of the mixture were placed in water baths at varying temperatures for 15 minutes and the amount of sugar released in each was determined to obtain the following results.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Temperature (ºC) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| Units of Sugar | 12 | 36 | 65 | 90 | 90 | 60 | 30 | 4 | 2 |

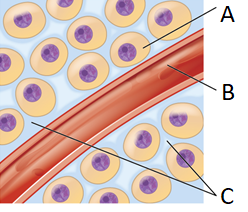
Table 2: Experiment data results obtained

These data indicate that

* 1. the activity of the enzyme increases as the temperature rises.
  2. the enzyme is most effective at a temperature of 40ºC.
  3. at temperatures higher than 30ºC, the enzyme molecules begin to deform.
  4. the activity of the enzyme decreases at temperatures above 40ºC.

1. Pancreatic cells produce and release lipase. Which of the following adaptations would you expect to find in these cells?
   1. Mitochondria with small internal membranes
   2. Large numbers of ribosomes
   3. A small surface area to volume ratio
   4. Cilia and flagella to allow for movement
2. Which of the following is the actual length of a cell that is 1 cm in length at a magnification of 100X?
   1. 0.01 mm
   2. 0.1 mm
   3. 1 mm
   4. 10 mm

Question 5 refers to the diagram below of the fluid compartments in the human body.



1. The fluid compartment represented by the letter A is referred to as
   1. lymph.
   2. intracellular fluid.
   3. interstitial fluid.
   4. extracellular fluid.
2. Which of the following correctly states the organic compound that, when aerobically catabolised, produces the most ATP?
   1. Protein
   2. Lipid
   3. Carbohydrate
   4. Deoxyribose nucleic acid (DNA)
3. Gastroesophageal reflux disease (GERD) is a condition that results in the liquid contents of the stomach to enter the oesophagus. The regurgitated liquid can cause damage to the oesophagus due to
   1. pepsin and amylase.
   2. nucleases and saliva.
   3. hydrochloric acid and pepsin.
   4. bile acids and proteases.
4. In which two body organs does the absorption of water take place?
   1. Kidneys and liver
   2. Large intestine and kidneys
   3. Liver and nephrons
   4. Kidneys and small intestine
5. Which of the following chemical equations shows the process of deamination?

1. Ammonia + carbon dioxide + energy → urea + water
2. Oxygen + carbohydrate energy + water + carbon dioxide
3. Oxygen + lipid → carbohydrate + ammonia
4. Amino acid + oxygen → carbohydrate + ammonia

10. A patient is diagnosed with cholecystitis, obstructing bile salt passage into the small intestine. As a result, the patient is unable to eat too much fat at one sitting. Which of the following organs does cholecystitis affect?

1. Pancreas
2. Liver
3. Gall bladder
4. Appendix

11.The white blood cell, red blood cell and platelet, could also be described as:

* 1. Erythrocyte, leucocyte and thrombocyte.
  2. Thrombocyte, leucocyte and erythrocyte.
  3. Leucocyte, thrombocyte and erythrocyte.
  4. Leucocyte, erythrocyte and thrombocyte.

12. Which of the following statements regarding the kidney is **correct**?

* 1. The glomerulus along with the Bowman’s capsule is known as the renal corpuscle
  2. The section of the kidney known as the medulla consists of separate renal pelvis’
  3. The renal pyramid collects the filtrate to transport to the ureters
  4. The section of the nephron, known as the Loop of Henle, is found within the renal cortex

13. In which section of mitochondria does the Krebs (Citric Acid) cycle take place?

* 1. Cristae
  2. Outer membrane
  3. Matrix
  4. Inner membrane

14. Which of the following groups correctly lists molecules which undergo facilitated diffusion?

* 1. Water, oxygen and glucose
  2. Amino acids, glucose and sodium ions
  3. Glucose, fatty acids and oxygen
  4. Sodium ions, amino acids and carbon dioxide

15. Carbon dioxide is carried in a number of ways in the blood. Which of the following methods carries the most in the blood?

* 1. The carbon dioxide is dissolved in the plasma.
  2. The carbon dioxide binds to haemoglobin to form carbaminohaemoglobin.
  3. The carbon dioxide is carried in the plasma as bicarbonate ions.
  4. The carbon dioxide is carried in the plasma as hydrogen ions.

16. The cardiac cycle is the sequence of events that occurs in one complete beat of the heart. Which of the following phases occurs after atrial systole?

* 1. ventricular systole
  2. ventricular diastole
  3. atrial diastole
  4. ventricular systole and atrial diastole

17. Elimination differs from excretion in that elimination

* 1. includes undigested materials as well as metabolic wastes.
  2. only consists of metabolic wastes.
  3. only consists of undigested materials.
  4. includes digested and undigested materials.

18. The lymphatic capillary found in the small intestine that absorbs dietary fats is known as the

* 1. duodenum.
  2. lacteal.
  3. villi.
  4. intestinal gland.

Question 19 refers to the table below.

Table 1. Weight of two babies at monthly intervals in their first 6 months after birth

|  |  |  |
| --- | --- | --- |
|  | Weight (kg) |  |
| Month | Baby #1 | Baby #2 |
| 0 | 3.2 | 2.7 |
| 1 | 4.1 | 2.9 |
| 2 | 5.4 | 3.4 |
| 3 | 5.8 | 3.9 |
| 4 | 6.2 | 4.6 |
| 5 | 6.6 | 5.5 |
| 6 | 7.2 | 6.4 |

19. Which of the following graphs is the most appropriate way to represent the data in the table above?

* 1. Histogram
  2. Bar graph
  3. Line graph
  4. Pie chart

20. Humans require nutrients for biochemical processes to occur efficiently. Which of the following is **not** a metabolic reason as to why the body is made up mostly of water?

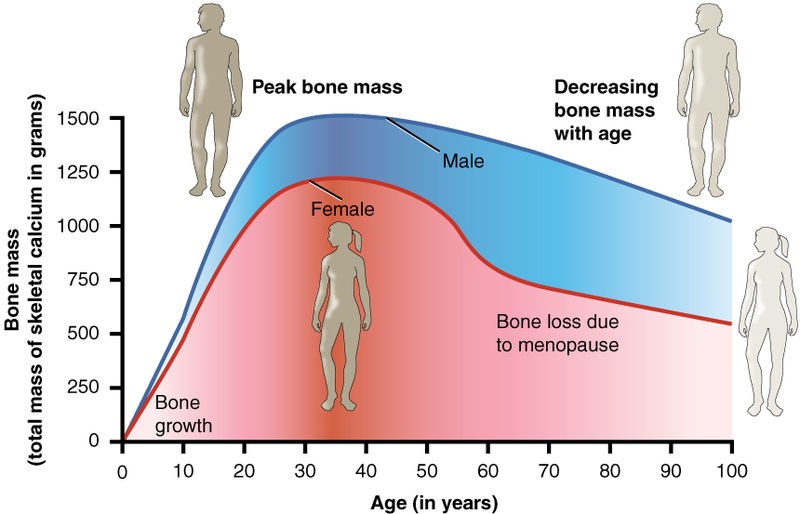
Water acts as a

* 1. reactant in metabolic reactions.
  2. universal solvent.
  3. medium for metabolic reactions.
  4. transport medium.

21. Intestinal absorption of some substances is an active process. This means that:

* 1. The villi must actually move to enable molecules of food to be absorbed by pinocytosis
  2. Products of digestion diffuse quickly across the membranes
  3. energy is expended for the absorption of some substances against a concentration gradient
  4. The absorption of some substances occurs most readily when there is maximum movement of the intestines

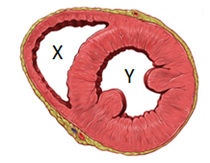
Question 22 refers to the information about age and bone mass below.



22. The average yearly rate of bone loss in women between the ages of 60 and 100 is

* 1. 5.
  2. 5.5.
  3. 6.25.
  4. 6.75.

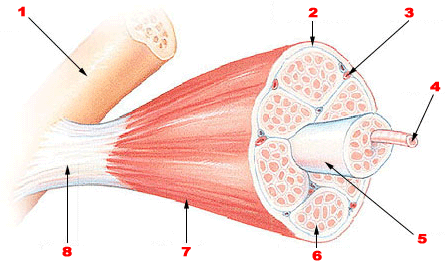
Question 23 refers to the short axis (horizontal cut) section diagram of the anterior view of the heart below.



23. The section of the heart labelled as Y is the

* 1. right ventricle.
  2. left ventricle.
  3. right atrium.
  4. left atrium.

Question 24 and 25 refer to the diagram of the skeletal muscle below.



24. The section of the muscle identified at number 4 is known as a

* 1. myofibril.
  2. myofilament.
  3. sarcomere.
  4. muscle fibre.

25. When a muscle is at rest, it is not completely relaxed but is in a state of partial contraction. This is referred to as

* 1. flexion.
  2. muscle fatigue.
  3. muscle tone.
  4. muscle protraction

26. Which of the following correctly lists the form and location that nutrients are absorbed in the digestive system?

|  |  |  |
| --- | --- | --- |
| (a) | Proteins | Blood capillary in small intestine |
| (b) | Glycerol | Lymph capillaries in the large intestine |
| (c) | Sucrose | Blood capillaries in the small intestine |
| (d) | Amino acids | Blood capillaries in the stomach |

27. In which part of the digestive tract are Goblet cells, which secrete mucus, most common?

* 1. Oesophagus
  2. Small intestine
  3. Stomach
  4. Large intestine

28. Ethanol can directly cross the cell membrane because it is a

* 1. hydrophobic molecule.
  2. small uncharged polar molecule.
  3. large uncharged polar molecule.
  4. charged ion.

29. Energy in human cells is stored as

* 1. glycogen.
  2. glucose.
  3. ADP.
  4. ATP.

30. If the epithelial cells of the respiratory system are damaged, which of the following will **not** occur?

* 1. Filtration of particles of dirt and debris
  2. Reduced exchange of carbon dioxide and oxygen
  3. Temperature of the air will remain too high or too low
  4. Reduced movement of lungs during inhalation

**End of Section One**

**Section Two: Short answer 50% (80 Marks)**

**Question 31 (14 marks)**

The diagram below shows a model cell used by a student to investigate osmosis.

1. The fluid mosaic model is commonly used to describe the structure of the plasma membranes. Describe the features of the fluid mosaic model. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Fluid = all parts of the membrane are constantly moving/ not fixed in place | 1 |
| Mosaic = the membrane is made up of many different types of molecules (proteins, phospholipids, cholesterol etc) | 1 |
| **Total** | **2** |

Four model cells, labelled A, B, C and D, were constructed and contained 0%, 5%, 10% and 20% glucose solutions respectively. The model cells were weighed then suspended in four test tubes containing a 10% glucose solution. One hour later the model cells were removed and reweighed.

(b) In the space below, construct a table that the results could be recorded in. Include a heading for your table.

(4 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Independent variable on the LHS (cell model and glucose concentration) | 1 |
| Dependent variable on the RHS (Change in mass). ½ only if the last column is not included. | 1 |
| Units included | 1 |
| Table heading including both variables | 1 |
| **Total** | **4** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Cell Model* | *Glucose solution concentration (%)* | *Initial Mass (g)* | *Final Mass (g)* | *Change in Mass (g)* |
| *A* | *0* |  |  |  |
| *B* | *5* |  |  |  |
| *C* | *10* |  |  |  |
| *D* | *20* |  |  |  |

*Table: The effect of solute concentration on the movement of water in a model cell*

**One out of the first two marks given if only the LHS & RHS incorrect.**

(c) Predict which model, A, B, C or D, would have the greatest increase in mass after the given hour. Give a detailed explanation for your answer. (5 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Model D | 1 |
| Glucose molecules are large so can’t move through the membrane | 1 |
| Water molecules are small so can fit through pores in the membrane | 1 |
| Higher osmotic pressure/higher glucose(solute) concentration in the model cell | 1 |
| Water moves into the model cell by osmosis increasing its mass | 1 |
| **Total** | **5** |

**Comments**

Must read the start of the question, which says that the student is investigating OSMOSIS.

(d) What is the name given to the type of solution in the test tube of Model C?

(1 mark)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Isotonic | 1 |
| **Total** | **1** |

(e) The student repeated the experiment three times. Describe why scientists undertake multiple tests and calculate mean results. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Reduce effect of random errors | 1 |
| Increase overall reliability | 1 |
| **Total** | **2** |

**Question 32 (9 marks)**

Jasmine was interested in learning more about the digestive system. She took a bite of white bread and left it in her mouth for a long period of time. After it became mushy, it started to taste sweet.

1. Explain why bread becomes mushy and starts to taste sweet when left in the mouth for an extended period. (5 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Any 5 of the following: | |
| Salivary glands in mouth produce saliva | 1-5 |
| Saliva is majority water/contains mucus |
| Lubricates/moistens the bread making it soft/mushy |
| Saliva also contains amylase |
| an enzyme (or states that it chemically breaks down) that breaks down carbohydrates/large starch molecules |
| into maltose/smaller sugar molecules (NOT broken down into glucose or **simple** sugars in the mouth) |
| **Total** | **5** |

Once swallowed, the bolus of bread passes through the oesophagus, into the stomach and then the intestines where it is further broken down.

1. Describe the mechanical digestion which occurs in the stomach. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Churning | 1 |
| Wave-like muscle contractions/contracts in a variety of ways | 1 |
| Three muscle layers involved | 1 |
| Circular, oblique and longitudinal | 1 |
| **Total** | **4** |

**Question 33 (7 marks)**

Increased BUN levels can be due to prerenal, renal and postrenal factors.

1. Describe how decreased blood flow through the kidneys can result in excess urea in the blood. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Decreased blood flow into **glomerulus** | 1 |
| **Glomerular filtration** is reduced | 1 |
| Less urea is filtered into **glomerular capsule/renal tubule** | 1 |
| **Total** | **3** |

**Comments**

Must use the specific key terms (in bold)

1. On the diagram below, label an arrow to identify **one** location where glucose is reabsorbed and **one** location where hydrogen ions (H+) are secreted. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Correct identification of glucose reabsorption site   * PCT | 1 |
| Correct identification of hydrogen ion secretion site   * Distal convoluted tubule / proximal convolluted tubule | 1 |
| Must identify that reabsorption is OUT OF and secretion INTO the tubules (correct direction of arrows) | 1 |
| **Total** | **3** |

1. Outline why lungs are also considered to be an excretory organ. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Removes metabolic wastes/water and carbon dioxide | 1 |
| **Total** | **1** |

**Question 34 (19 marks)**

The Health Department of WA runs several initiatives to help increase the community’s physical activity levels. One type of exercise that is often undertaken is weightlifting.

1. During weightlifting sessions, people often feel a burning sensation in the muscle group they are working. Explain why this occurs. (5 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Anaerobic metabolism | 1 |
| Occurs in lack/absence of oxygen | 1 |
| Glycolysis occurs | 1 |
| Occurs in cytoplasm only | 1 |
| Lactic acid produced | 1 |
| **Total** | **5** |

1. Explain why endurance athletes load up on carbohydrates prior to running marathons. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Glycogen is stored in muscles (NOT glucose) | 1 |
| Used as a quick energy reserve | 1 |
| For release of ATP | 1 |
| Through aerobic respiration | 1 |
| **Total** | **4** |

**Comments**

**Some students described that carbohydrates release the most energy, but that is incorrect. Fat releases the most amount of energy.**

1. Describe why there is an increase in blood flow to the lungs during exercise.

(3 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Any three of the following | |
| Compensate for increased breathing rate | 1-3 |
| Maintain concentration gradient |
| In capillaries around the alveoli |
| Increased heart rate |
| **Total** | **3** |

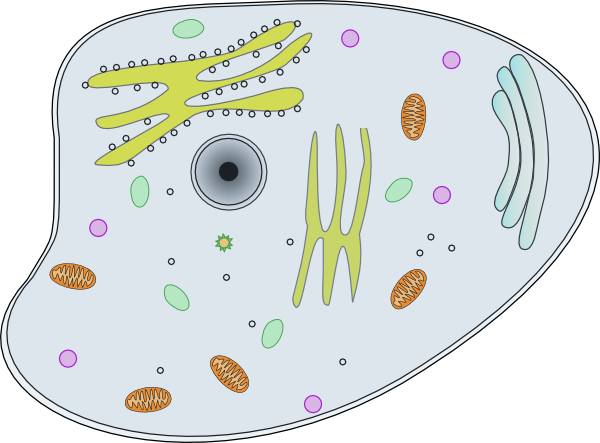
Poor breathing technique during exercise can result in fatigue and dizziness. Often weightlifters inhale when lowering the weights and exhale when straining and lifting the weights.

1. Explain the mechanisms involved in inhalation. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Diaphragm contracts / flattens | 1 |
| Intercostal muscles contract | 1 |
| Ribs pulled upwards and out | 1 |
| Lung volume increases | 1 |
| Lung pressure decreases so air moves in | 1 |
| Until pressure becomes equal | 1 |
| **Total** | **6** |

**Question 35 (15 marks)**

The diagram below illustrates a simplified version of an animal cell.



**C**

**F**

**E**

**B**

**As**

**D**

1. Identify the following organelles from the diagram above: (2 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| C: Centriole | 1 |
| D: Golgi body/apparatus/network | 1 |
| **Total** | **2** |

1. Describe the function of organelle A and describe how it differs in structure from organelle E. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Organelle A function: Provides a surface for chemical reactions and allows storage and transport of materials | 1 |
| Structural difference: Organelle A has ribosomes, whilst organelle E does not | 1 |
| **Total** | **2** |

1. Organelle F entered the cell via a process known as endocytosis. Describe this process. (5 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Any five of the following | |
| Vesicular transport | 1-5 |
| Active process / requires energy/ATP |
| Cell membrane folds around material until enclosed |
| Vesicle is formed and is pinched off |
| Pinocytosis takes liquids in |
| Phagocytosis takes solids in |
| **Total** | **5** |

1. Describe how the structure of the cell membrane allows for transport of materials via exocytosis. (2 marks)

**Most students didn’t answer the question here. Must link structural features of the cell membrane that allow transport by exocytosis.**

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Vesicles are made of the same phospholipid bilayer as cell membrane allowing for attachment | 1 |
| Membrane is fluid / contain cholesterol, so can change shape | 1 |
| **Total** | **2** |

Erythrocytes (red blood cells) are specialised cells that carry out a specific function.

1. Discuss two structural features of red blood cells that enable them to carry out its function. (4 marks)

**Set out your answer to clearly show what your two structural features are. Don’t write paragraphs that waffle.**

1. **Biconcave discs….**
2. **No nucleus….**

***Any two structural features and associated functional advantage***

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Structural feature: Bi concave discs  Functional Advantage: Increases SA for oxygen exchange/ thicker edges give a larger volume for carrying haemoglobin molecules | 1  1 |
| Structural feature: Contain haemoglobin  Functional Advantage: Haemoglobin can combine with oxygen to form oxyhaemoglobin to transport it around the body | 1  1 |
| Structural feature: No nucleus  Functional Advantage: More room for haemoglobin molecules and therefore can transport more oxygen | 1  1 |
| ***Note: Surface area and area are not the same thing.***  ***Biconcave structure gives a larger SA for oxygen/gas exchange***  ***Thinker edges/ no nucleus gives a larger area for haemoglobin*** |  |
| **Total** | **4** |

**Question 36 (17 marks)**

Rigor mortis is the rigidity of the body after death, characterised by stiffening of the limbs. Chemical changes in the muscles cause a continual flood of calcium ions into the contractile units of the muscle fibres.

1. State the name given to the contractile unit of a muscle fibre. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Sarcomere | 1 |
| **Total** | **1** |

1. Describe the sliding filament theory involved in muscle contraction. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| When muscles contract, sarcomere shortens / Z-lines are pulled closer together | 1 |
| Calcium is required to expose actin binding site | 1 |
| Cross bridges are formed between thin and thick filaments | 1 |
| Thin filaments slide over thick filaments  **No marks given if you state that actin slide over each other. Actin slide myosin (not other actin)** | 1 |
| Myofilaments do not change length/ remain the same length | 1 |
| ATP is required | 1 |
| **Total** | **6** |

The contraction of skeletal muscles on joints results in movement of the body, such as arms and legs.

1. Describe how the actions of muscles result in movement and provide a specific example to demonstrate your answer. (5 marks)

|  |  |
| --- | --- |
| **Description** | **Any 5 Marks** |
| Antagonistic muscle action/ muscles work in antagonistic pairs | 1 |
| Working muscle is prime mover and/or agonist | 1 |
| Relaxing muscle is antagonist | 1 |
| Stabiliser/fixator stabilises the origin of the agonist and joint | 1 |
| Synergists act indirectly to steady a joint during movement/help the prime mover and prevent unwanted movement | 1 |
| Appropriate example given, i.e. bicep (agonist), tricep (antagonist) and rotator cuff (stabiliser) | 1 |
| During flexion the angle at the elbow decreases (or opposite explanation for extension) | 1 |
| **Total** | **5** |

During physical activity, heart rate increases. Although a single organ, the heart functions as a double pump.

1. Describe how the circulatory system distributes blood around the body.

(5 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Pulmonary circuit | 1-5 |
| Pumps blood to lungs to be oxygenated |
| Systemic circuit |
| Pumps oxygenated blood to body |
| Blood moves through arteries to capillaries and then veins **(must be in order)** |
| Valves within veins/ between chambers of the heart ensure unidirectional flow |
| High pressure in arteries ensure unidirectional flow |
| **Total** | **5** |

**End of Section Two**

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

Section Three consists of **four** questions.

Questions 38 and 39 are from Part 1. Question 40 and 41 are from Part 2. Answer **one** question from Part 1 and **one** question from Part 2.

Use black or blue pen for this section. Only graphs and diagrams may be drawn in pencil. Responses can include: labelled diagrams with explanatory notes; lists of points with linking sentences; labelled tables and/or graphs; and/or annotated flow diagrams with introductory notes.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 50 minutes.

**Part 1**

Choose **either** Question 38 **or** Question 39.

Indicate the question you will answer by ticking the box next to the question. Write your answer on pages 27 - 31. When you have answered your first question, turn to page 32 and indicate on that page the second question you will answer.

**Question 38 (20 marks)**

The requirements of cells differ both between cell types and over time. Biochemical processes occurring in the cell during these times are controlled by the presence of enzymes.

1. Briefly describe the role of an enzyme and explain how an enzyme’s function can be altered due to the presence of other molecules. (12 marks)

**Cannot discuss temperature or pH because they are not molecules. Cannot discuss enzyme concentration as the question asks from ‘other molecules’.**

|  |  |
| --- | --- |
| **Description** | **Mark** |
| **ROLE OF ENZYMES** | **MAX 4 MARKS** |
| Biological catalyst | 1 - 4 |
| Lowers the activation energies of chemical reactions |
| Not consumed in the reaction / reusable |
| Increases the rate of reaction / speed of the biochemical process |
| Enzymes are specific for a substrate/active site of the enzyme only matches the substrate |
| Lock and key model / Induced fit model |
| **MOLECLES AFFECTING ENZYME FUNCTIONING** | **ANY 3 factors out of 4** |
| Inhibitors | 1 - 3 |
| Molecule binds to the enzyme’s active site to stop it from binding to the substrate |
| Presence of inhibitors decreases reaction rate |
| Co-enzymes and Co factors | 1 - 3 |
| Co enzymes are organic molecules & Co factors are inorganic molecules/ Both bind to enzyme to change its shape to allow function |
| Presence of cofactors/ co enzymes increases reaction rate |
| Concentration of substrates | 1 – 3 |
| Increases reaction rate due to increased collisions |
| until all enzyme active sites are used up |
| Concentration of products | 1-3 |
| Decreases reaction rate due to decreased successful collisions |
| Fewer successful collisions between enzymes and substrate as products get in the way |
| **Total** | **12** |

The nutritional requirements for cells are obtained through the digestive system. The supply of these nutrients is facilitated by secretions that are released into the digestive organs.

(b) Describe the components of gastric juice and their functions. (8 marks)

**Gastric = stomach. Don’t talk about pancreatic juices (they are from the pancreas) or intestinal juices (they are from the small intestine).**

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Pepsin/pepsinogen | 1-8 |
| Breaks down proteins into amino acids |
| Hydrochloric acid |
| Creates/ maintains optimum pH for gastric enzyme pepsin |
| Kills bacteria |
| Mucus |
| Protects the stomach wall from the acid and digestive enzymes |
| Lubricates food |
| **Total** | **8** |

**Question 39 (20 marks)**

A chef has accidentally cut herself with a knife. The chef is calm, as she believes she has cut a vein and not an artery.

(a) Explain two observations the chef could make to determine if she has cut a vein or an artery and describe the sequence of events that would occur that would eventually lead to the development of a dry clot and the formation of a scab.

(10 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| **Observations to determine if she has cut a vein or an artery** | |
| Vein - the blood flows slowly out of the wound / Artery- blood squirting out rhythmically, in time with her heartbeat. | 1-2 |
| Vein - the blood is dark red or purplish / Artery blood is bright red |
| **Sequence of events leading to a dry scab forming** | |
| Muscles in the walls of the ruptured vessels contract | 1-8 |
| Platelets stick to ruptures blood vessel |
| Platelets become activated) |
| Platelets release chemicals that attract more platelets (and cause vasoconstriction |
| Aggregation / gathering of platelets causes a platelets plug to form (not a clot yet) |
| Fibrinogen ( a plasma protein) is converted into insoluble fibrin |
| Fibrin form a mesh network that covers the platelet plug |
| Fibrin traps RBCs and platelets causing the formation of a blood clot |
| Platelets contract, pulling ruptured vessel together |
| As contraction occurs, serum is squeezed out, causing the clot to dry. |
| The dry clot is now a scab. |
| **Total** | **12** |

(b) Describe the lymphatic system and explain how it works in conjunction with the circulatory system, describing what would occur if the lymphatic system became blocked in the lower leg of a patient. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| One-way drainage system | Max 8 marks |
| Fluid leaks out of blood vessels/ capillaries |
| Interstitial fluid pools in between cells and tissues |
| Collected by lymph vessels |
| Fluid is now called lymph |
| Lymph vessels contain valves |
| Passes through lymph nodes |
| Pathogens are filtered from lymph |
| Returns tissue fluid to circulatory system |
| Lymph moved by muscle contraction |
| Lymphatic system produces WBC/leukocytes |
| Circulatory system moves immune cells around body |
| **What would occur if the lymphatic system became blocked in the lower leg of a patient – Must have 2 points to receive full marks for this Qu** | |
| Interstitial fluid would not be removed leading to | 1 |
| Swelling / oedema / lymphedema in the lower leg | 1 |
| **Total** | **10** |

**Part 2**

Choose **either** Question 40 **or** Question 41.

Indicate the question you will answer by ticking the box next to the question. Write your answer on the pages provided.

**Question 40 (20 marks)**

There are six main methods in which materials are transported across cell membranes.

(a) Describe how four (4) of these methods occur, the type of material that is transferred and a specific example of where it occurs in the body.

(12 marks)

*Any 4 methods, 3 marks each.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Method** | **How method occurs** | **Body part** | **Type of material** |
| Diffusion | * Liquid/gas particles randomly move from an area of high to low concentration. * Particles keep moving until they have evenly spaced themselves out in the available area.   (1 mark) | * PCT and Loop of Henle of kidneys. * Alveoli of lungs * Villi of small intestine * Mouth and Stomach wall * Large intestine     (1 mark) | * Oxygen and carbon dioxide. * Alcohol      * Fat soluble vitamins.   (1 mark) |
| Facilitated diffusion | * Particles move from an area of high to low concentration THROUGH a carrier protein. * Particle binds to carrier protein, protein changes shape and moves particle to other side.   (1 mark) | * Kidneys * Small intestines, * Liver         (1 mark) | * Substances that are too large to fit through the plasma membrane, such as glucose / amino acids.     (1 mark) |
| Osmosis | * The movement of a solvent (usually water) from an area of high to low concentration THROUGH a semi-permeable membrane.   (1 mark) | * Kidney nephrons and small intestines. * All cells of the body. * Large intestines * Stomach wall     (1 mark) | * Water.                 (1 mark) |
| Active transport | * Liquid/gas particles move from an area of low to high concentration across the cell membrane.      * Large molecules are taken across the cell membrane via carrier proteins     (1 mark) | * PCT * Small intestine/villi * Kidneys * Small intestines, * Liver * Fat soluble molecules through any cell membrane.     (1 mark) | * Glucose * Amino acids * Na+ / K+ * Steroids * Some vitamins.     (1 mark) |
| Endocytosis | * When a cell surrounds some extracellular material with a fold of the cell membrane. * The enfolding membrane then breaks away, and the material is enclosed within the cell in the form of a small membrane-bound vesicle. * Two types, phagocytosis (solid engulfing) and pinocytosis (liquid engulfing).   (1 mark) | * White blood cells/leucocytes. * All cells carry out pinocytosis, therefore any organ.                     (1 mark) | * Pathogens      * Any liquid.                           (1 mark) |
| Exocytosis | * When the contents of a vesicle are pushed out through the cell membrane. * The membrane around the vesicle fuses with the cell membrane and the vesicle contents are passed to the exterior.     (1 mark) | * Mammary glands. * Saliva glands * Pancreas * Liver * Gastric pits. * Hormonal /endocrine gland.           (1 mark) | * Milk      * Saliva * Digestive enzymes * Hormones           (1 mark) |

(12 marks)

**A table like the one above is recommended for questions like this. It is succinct and easy for the marker to follow.**

Active processes are involved in the formation of urine as it passes through the nephron allowing the body to regulate chemical composition of body fluids.

(b) State what substances are actively removed and added to the filtrate, giving reason for their movement. (8 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| **Two** of the following for 1 mark each (selective reabsorption): Marks given for the first two substances. | 1-4 |
| * Glucose * Amino acids * Vit C * Potassium ions * Salts (Na+, Cl-) |
| **Two** of the following for 1 mark each (tubular secretion):  Marks given for the first two substances. |
| * H+ ions * Electrolytes i.e. K+, HPO4-2, SO4- * NH3 / NH­4+ * Drugs * Wastes – urea/uric acid/creatinine |
| Glucose / Amino acids / Vit C are reabsorbed for their nutritional properties. | 1 |
| Ions reabsorbed to increase blood osmolarity / assist in osmosis / move water back into blood from filtrate | 1 |
| H+ ions for blood pH levels | 1-2 |
| ­Wastes/Drugs/Toxins could accumulate |
| High levels can have harmful effects on the body |
| **Total** | **8** |

**Comments**

**It is important to read the question properly, as it asked for the substances that are ACTIVELY removed. Hence, one mark was taken off for describing glomerular filtration, without stating that it is a passive process.**

**Water is NOT actively transported, as osmosis is a passive process.**

**Question 41 (20 marks)**

1. Explain how oxygen is exchanged in the lungs and transported throughout the body. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| **Oxygen exchange:** | |
| Diffusion | 1 |
| Occurs within alveoli | 1-6 |
| 1 cell thick / simple squamous epithelium (‘thin’ wall is not sufficient for the mark) |
| short distance for oxygen to travel/diffuse |
| goes with concentration (diffusion) gradient / moves from higher to lower concentrations |
| Doesn’t require ATP / energy |
| Become evenly spread over the space available |
| Dependent on air flow into the lungs / ventilation |
| And **blood flow i**n the capillaries / perfusion |
| Requires moist environment for gases to dissolve |
| **Transportation:** | |
| small amount of oxygen dissolved in plasma | 1-3 |
| majority of oxygen attached to haemoglobin / oxyhaemoglobin |
| carried within RBCs/erythrocytes |
| heart pumps blood around the body |
| **Total** | **10** |

**The question asked for the explanation of OXYGEN exchange. There is no need to discuss the exchange of carbon dioxide.**

ABO blood groups were discovered over 100 years ago. Prior to this, all blood was thought to be the same and the outcomes of blood transfusions were often tragic. ABO typing is now used to determine a person’s blood group prior to surgeries that may require blood transfusions.

1. Describe how blood groups are determined and explain the importance of having this completed prior to a blood transfusion. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| (four) blood groups are A, B, AB and O | 1-8 |
| Determined by antigens on the RBC/erythrocyte |
| Opposite antibodies are found in the plasma |
| Group A has A antigens and B antibodies |
| Group B has B antigens and A antibodies |
| Group AB has A & B antigens and no antibodies |
| Group O has no antigens and A & B antibodies |
| **ABO** testing determines blood group (must have the name of test) |
| Blood samples are mixed with antibodies A and B |
| Blood groups are determined by genes |
| If wrong blood is transfused, immune system reacts to new RBCs | 1-2 |
| New RBCs agglutinate/coagulate/clump together |
| Can result in organ failure/death |
| **Total** | **10** |

**A table is recommended to summarise the blood groups against their antigen and antibodies.**

**End of Questions**

**ACKNOWLEDGEMENTS**

**Question 5** BC Campus: Rice University. (N.D.). Anatomy and Physiology. Fluid Compartments in the Human Body [Image]. Retrieved 27th November, 2019, from:

<https://opentextbc.ca/anatomyandphysiology/chapter/26-1-body-fluids-and-fluid-compartments/>

**Question 22** Patrick J. Lynch. (2006). Heart normal short axis [Image]. Retrieved 28th October, 2019, from: <https://commons.wikimedia.org/wiki/File:Heart_normal_short_axis_section.jpg>

**Question 23** OpenStax College. (2013). Anatomy and Physiology, Connexions Website. *Age and Bone Mass* [Graph]. Retrieved 15th December, 2019, from:

<https://commons.wikimedia.org/wiki/File:615_Age_and_Bone_Mass.jpg>

**Question 24** Fran Rogers. (2007). Skeletal Muscle [Image]. Retrieved 28th October, 2019, from: <https://commons.wikimedia.org/wiki/File:Skeletal_muscle.png>

**Question 25** Fran Rogers. (2007). Skeletal Muscle [Image]. Retrieved 28th October, 2019, from: <https://commons.wikimedia.org/wiki/File:Skeletal_muscle.png>

**Question 33** CKRobinson. (2007). Unlabelled diagram of a mammalian nephron [Image]. Retrieved 2nd October, 2019, from: <https://commons.wikimedia.org/w/index.php?curid=45678885>

**Question 35** Shared by OCAL. (2010). Animal Cell Clip Art [Image]. Retrieved 16th October, 2019, from: <http://www.clker.com/clipart-animal-cell.html>

**Question 37** OpenStax College. (2013). Anatomy and Physiology, Connexions Website. *Types of Cartilage.* Retrieved 18th December, 2019, from: <https://commons.wikimedia.org/wiki/File:412_Types_of_Cartilage-new.jpg>

**Question 37** Darshani Kansara. (2014). Bone Connective Tissue [Image]. Retrieved 29th October, 2019, from:

<https://commons.wikimedia.org/wiki/File:Bone_connective_tissue.jpg>