**BIOLOGY**

**UNITS 1 & 2**

**2018**

**MARKING GUIDE**

**Section One: Multiple-choice 30% (30 marks)**

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

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

**Question 31 20 marks**

A biology student was making microscope slides from a plant she had found in her garden. Below is a cross-section from a part of the plant.

(a) Identify the cells labelled J and K in the image above and state their location in a plant. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| J – Spongy mesophyll; leaf./ Under palisade mesophyll/Epidermis | 1 – 2  |
| K – Vascular/Xylem cells; leaf, stem and roots. / Phloem | 1 – 2  |
| **TOTAL** | **4** |

(b) Identify the major role of each of these cells in a plant. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| J – Photosynthesis. | 1  |
| K – Water transport./ transpiration/ sugar transport | 1  |
| **TOTAL** | **2** |

(c) Describe what would happen if the student placed cell **‘J’** into a concentrated salt solution. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Cell would lose water via osmosis. | 1  |
| Plasmolysis would occur. | 1  |
| **TOTAL** | **2** |

(d) Identify the organelle shown in the diagram below and describe its role in the cell. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Chloroplast | 1  |
| Location of photosynthesis. | 1  |
| Synthesis of glucose from water, oxygen and light energy. | 1 |
| **TOTAL** | **3** |

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Cell would lose water via osmosis. | 1  |
| Plasmolysis would occur. | 1  |
| **TOTAL** | **2** |

(e) Name the structures labelled W, X and Y. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| W – Thylakoid  | 1  |
| X – Stroma  | 1  |
| Y – Grana (granum) | 1 |
| **TOTAL** | **3** |

(f) Explain how each of these structures contributes to the process that occurs within this organelle. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| W – Thylakoids contain chlorophyll.  Allows trapping of light energy for light-dependent reactions. | 1 – 2  |
| X – The stroma is the fluid-filled inner space of the chloroplasts. Contains molecules and enzymes required for photosynthesis. Glucose made here or calvin cycle or Light independent reactions | 1 – 2  |
| Y – Grana are stacks of thylakoids. Increases surface area, maximising photosynthetic reactions. | 1 – 2  |
| **TOTAL** | **6** |

**Question 32 20 marks**

31.

(a) (i)

 Blue Wrens

 Predatory Spiders Mushroom fungus

 Native Parrots Beetles

Wild Grass Jarrah Tree

(2)

(ii) Native Parrots, Beetles, Predatory spiders, Blue Wrens (1)

 (iii) Predatory Spiders (1)

(b) (i) Correct shape (1), correct scale (1)

(ii) Most biomass that enters a trophic level is lost as heat(1)

 Due to respiration (1) Biomass decreases (1)

(c) (i) Mushrooms are decomposers (1) that breakdown dead/wastes/organic

 matter to inorganic matter (1) Releases nutrients into soil/ecosystem (1) Release Carbon into atmosphere

(ii) photosynthesis or Glucose (1)

 use – CO2 + H2O or inorganic material

(d) (i) Decrease in biomass (1) / add nutrients to soil (1) / decrease

In biodiversity (1) / result in native seed germination (1)/ Native plants regenerate (1)

 Any 2 = two marks

 (ii) Increased competition (1) / decrease in biodiversity (1)

 (e) Creation of National Park (1) Regeneration/reforestation/ revegetation (1)

 Education Awareness programs (1) Wildlife refuges (1) Limit Burnoffs (1)

Legislation to protect forests (1)Monitor species numbers (1) Remove invasive species (1) Lower recreation in area (1) Maintain good fencing (1)

**Question 33 20 marks**

(a) Define the following terms;

 Osmosis (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Movement of water from high concentration to low concentration across a selectively permeable membrane | 1 |
| **TOTAL** | **1** |

 Osmotic Potential (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| The tendency of water to move into a solution | 1 |
| with a greater concentration of dissolved solutes (osmolarity). | 1 |
| The amount of H2o that will move across a semi permeable membrane | 1 |
| **TOTAL** | **2** |

A biology student wanted to compare the sugar content of various citrus fruits – orange, mandarin, lemon, lime and grapefruit. He obtained one piece of each type of fruit and extracted the juice. The juice from each fruit was carefully decanted into five separate dialysis tubes and placed into beakers of distilled water. The tubes were left for six hours and the volume of liquid inside the tubes was then measured. The data collected are presented in the table below.

**Table 1** - *Volume of liquid in dialysis tubes after six hours.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of fruit (juice)** | **Volume of liquid in tubing** (mL) | **Change in volume (mL)** | **Change in volume (%)** |
| Initial | After six hours |
| Orange | 100 | 160 | **60** | **60** |
| Mandarin | 80 | 130 | **50** | **62.5** |
| Lemon | 80 | 115 | **35** | **43.75 (44)** |
| Lime | 50 | 70 | **20** | **40** |
| Grapefruit | 130 | 195 | **65** | **50** |

(b) Calculate the percentage increase in volume for each fruit juice in the dialysis tubes. Write the answers in the 'Change in volume (mL)' and ‘Change in volume (%)’ columns in the table above. (2 marks)

 \*NB – *allocate* ***one (1)*** *mark for calculating volume difference and* ***one (1)*** *mark for calculating percentage difference.*

(c) Propose a suitable hypothesis for this experiment. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| The greater the sugar content of the juice, the greater the movement of water into the tube (osmosis). | 1 – 2  |
| **TOTAL** | **2** |

(d) Identify the following variables in the experiment;

 Independent (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Type of fruit (juice)/sugar content of juice. | 1 |
| **TOTAL** | **1** |

 Dependent (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Volume of water movement/percentage increase in volume of tube. | 1 |
| **TOTAL** | **1** |

(e) Construct an appropriate graph of the data on the grid below. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Column graph with correct plotting. | 1 |
| Title with both variables. | 1 |
| Correct X and Y axes with appropriate scale. | 1 |
| Labelled axes with units. | 1 |
| **TOTAL** | **4** |



(f) Write a conclusion for the experiment based on the data presented in your graph. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Mandarin (juice) contained more sugar than the other fruits and the lime (juice) contained the least. | 1 |
| Final percentage (%) increase in volume of the mandarin juice was the greatest. | 1 |
| More water moved into the tube (via osmosis) because the mandarin juice had a greater osmolarity than the other fruit juices. | 1 |
| **TOTAL** | **3** |

(g) Identify **two (2)** variables that should have been controlled in this experiment.

 (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| *Two (2) from below for a total of two (2) marks;*Same amount of juice inside the tube.Temperature of all liquids should be the same.Same sized beakers.Same volume of distilled water.Time in beaker*Other reasonable responses acceptable.* | 1 – 2  |
| **TOTAL** | **2** |

(h) Suggest **two (2)** changes that could be made to improve the fairness and/or validity of the data from this experiment. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| *Two (2) from below for a total of two (2) marks*;Initial volume of juice should be the same.More trials required (with more pieces of fruit).Longer or shorter timeframe for experiment. Testing different types of sugar.Remove solutes (other than sugar) from fruit juice to reduce osmosis due to presence of ions/salts etc.Process juices to release all liquid and sugars from the little juice vesicles/sacs.Control group | 1 – 2  |
| **TOTAL** | **2** |

**Question 34 (20 marks)**

(a) Define ‘gas exchange’. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Movement of respiratory gases (O2 and CO2) into and out of an organism./ blood /leaf | 1 |
| This occurs by diffusion across a gas exchange surface. | 1 |
| **TOTAL** | **2** |

(b) The structure and function of organisms within the Animal Kingdom is highly diverse. Identify **two (2)** factors that influence gas exchange in animals. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| The environment in which they live. | 1 |
| The animal’s body form – size and shape./ SA:Vol easier | 1 |
| Moisture/ conc gradient/ Thin membrane | 1 |
| **TOTAL** | **2** |

As the structures of living organisms increase in complexity, transporting materials into and out of cells becomes more difficult.

(c) Explain **two (2)** challenges faced by multicellular organisms in cellular transport, in comparison to unicellular organisms. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Very large surface area of cell membranes (combined)
* that are not in direct contact with the external environment.
 | 1 - 2  |
| * Materials/molecules must travel a greater distance
* through a specialised transport system.
 | 1 - 2  |
| * Larger Quantitiy of materials required
 | 1 |
| **TOTAL** | **4** |

(d) Complete the table below regarding gas exchange in different animals. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Insect**Spiracles and tracheal tubes.Diffusion into tissues.  | 1 – 2  |
| **Paramecium**Cell membrane (of single-celled organism).Diffusion into cytoplasm. | 1 – 2  |
| **Amphibian**Skin and alveoli in lungs (lining of mouth).Diffusion into bloodstream/capillary beds under skin.  | 1 – 2  |
| **TOTAL** | **6** |

(e) Describe how the synthesis of organic macromolecules differs between autotrophs and heterotrophs. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Autotrophs synthesise all their own organic molecules from inorganic molecules. These molecules are taken in from the eternal environment. | 1 - 2  |
| Heterotrophs must synthesise organic molecules from existing organic compounds they contain or ingest.These compounds are broken down (during digestion) and re-built into new compounds required by the organism. | 1 - 2 |
| **TOTAL** | **2** |

(f) Identify the chemical elements used to synthesise the basic structure of the following polymers;

 (i) Carbohydrates and lipids. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Carbon, hydrogen and oxygen. (*Must list all for 1 mark*) | 1 |
| **TOTAL** | **1** |

 (ii) Proteins. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Carbon, hydrogen, oxygen and nitrogen.(*Must list all for 1 mark*) | 1 |
| **TOTAL** | **1** |

**Question 35 (20 marks)**

Every living cell is enclosed by a membrane.

(a) Outline **two (2)** main functions of the cell membrane. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Control the transport of molecules into and out of the cell. | 1 |
| Enclose the cells contents and keep them separated from the external environment. | 1 |
| **TOTAL** | **2** |

(b) Explain how the structure of a cell’s membrane allows it to carry out each of these functions. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| The membrane is comprised of a phospholipid bilayer that is impermeable to water-soluble molecules.  | 1 |
| The bilayer has a hydrophilic head on the outside and a hydrophobic tail on the inside.  | 1 |
| Only small, lipid-soluble molecules can diffuse through the membrane. E.g. gases and steroids. | 1 |
| The formation of the bilayer also keeps the water-soluble contents and extracellular fluid from moving freely through the membrane. | 1 |
| Special proteins are embedded within the phospholipid bilayer for transport of large molecules, ions or water-soluble molecules.  | 1 |
| Cholesterol molecules located within the bilayer help with structural integrity and membrane fluidity. Keeps the membrane intact. | 1 |
| **TOTAL** | **6** |

(c) In the space below, construct a labelled diagram of a cell membrane, using the fluid mosaic model. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Phospholipid molecule with hydrophilic head and hydrophobic tail. | 1  |
| Two layers of the phospholipid molecules, tails facing inward. | 1 |
| Cholesterol molecule embedded in bilayer. | 1 |
| Protein channel (water-soluble molecules) for facilitated diffusion. | 1 |
| Carrier protein for facilitated diffusion and active transport. | 1 |
| At least **one (1)** other molecule. E.g. integral protein, glycolipid, glycoprotein or alpha-helical transmembrane glycoprotein. | 1 |
| **TOTAL** | **6** |

See example below.



Carrier protein

Protein channel

Phospholipid molecule

Phospholipid bilayer

Hydrophobic tail head

Hydrophilic head

Cholesterol molecule

(d) Mitochondria are enclosed within a cell membrane. Explain how the structure of this membrane influences the processes that occur within the mitochondria. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| External membrane of mitochondria controls entry and exit of molecules involved in cellular respiration. | 1 |
| Internal membrane is highly folded to increase surface area for cellular respiration reactions. | 1 |
| Inner membrane provides attachment for enzyme activities in cellular respiration. | 1 |
| **TOTAL** | **3** |

During the process of DNA extraction, cells are placed within a solution containing detergent.

(e) Describe the effect of detergent on the cell membrane and suggest why it is used in DNA extraction. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Detergent is an emulsifying agent that separates the lipid molecules of the phospholipid bilayer. | 1 |
| Membranes of the cell and the nucleus are broken down and the DNA is released. | 1 |
| Detergent does not damage the DNA or any proteins in the cell. | 1 |
| **TOTAL** | **3** |

**End of Section Two**

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

This section contains **four (4)** questions.

Questions 36 and 37 are from Unit 1. Questions 38 and 39 are from Unit 2. Answer **one (1)** question from Unit 1 and **one (1)** question from Unit 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.

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: 50 minutes

**Unit 1**

**Question 36 (20 marks)**

(a) Discuss the ways in which human activities can act to decrease

 biodiversity and how they can act to restore biodiversity. (10 marks)

Decrease biodiversity through:

 Habitat destruction (1) due to mining/housing/farming crops (1)

High levels of pollution (1) such as greenhouse effect/heavy metals/eutrophication (1)

Unrestricted hunting seasons (1)

Introduced species (1)

 Restore biodiversity through:

 Gene/seed banks (1)

The creation of national parks and refuges (1)

Reducing hunting seasons (1)

Legislation that controls habitat destruction (1)

Captive breeding programmes (1)

Remove introduced species (1)

 b) A biologist writing an environmental impact report made the statement:

 “This ecosystem is a web of interactions and relationships between individuals within a species and between species”

Describe the relationships and interactions that can occur between individuals

that occupy the same ecosystem. (10 marks)

 Relationships include:

 Competition (1) individuals require the same resources (1)

Predation (1) one individual consumes another individual (1)

Parasitism (1) one individual lives off another individual without

consuming it (1)

 Mutualism (1) two individuals live in close association and

benefit each other (1)

Commensalism (1) two individuals live in close association in which one benefits and the other remains unaffected (1)

 Saprophitism (1) one individual lives off the dead remains of another (1)

 Any 5 pairs = 5 marks

**Question 37 (20 marks)**

Carolus Linneas (1707 – 1778) was a Swedish botanist who developed the first classification system. He classified 4000 species of animals and plants using a system of binomial nomenclature that is still used in modern taxonomy.

(a) Describe the process of organising and naming living things and explain the importance of this classification system to biologists. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| First step in binomial nomenclature is to place an organism into its Kingdom first, based on cell structure and/or distinguishing features. | 1 |
| Organisms that are more closely related will have more characteristics/features in common than more distantly related organisms. | 1 |
| Organisms are assigned to the next hierarchical divisions/taxa – phylum, class, order, family, genus and species.  | 1 |
| Organisms are categorised into taxa based on shared characteristics evolutionary relationships and methods of reproduction.  | 1 |
| *Students must include* ***six (6)*** *points from below for* ***six (6) marks****.* |  |
| Modern technology has;* allowed relationships to be established by comparing DNA, proteins and molecular sequences.
* helped to classify species and reclassify organisms into more appropriate taxa.
 | 1 - 2 |
| This taxonomic system is nested - specific to general.  | 1 |
| With increasing taxonomic rank, related taxa are grouped into more inclusive taxa at a higher level. | 1 |
| Fundamental unit of classification is the species. Each member of a species is assigned a unique and defining two-part name (binomial). | 1 |
| The binomial name represents the genus and species of the organism and usually uses Latin words. Species name is *italicised*. | 1 |
| The binomial system is important because it allows scientists to accurately identify individual species without any confusion.  | 1 |
| Classification used to analyse information about organisms – relationships with other organisms, diversity and observing patterns. | 1 |
| Important for communication and collaboration amongst scientists around the world.  | 1  |
| Standardised classification system (scientific names) prevents confusion – no common names used. | 1 |
| Description of species concept- Individuals can interbreed and produce fertile offspring | 1 |
| **TOTAL** | **10** |

(a) Define the term “carrying capacity”. Identify and discuss the factors that could lead to an increase in the carrying capacity of an ecosystem.

 (10 marks)

Carrying capacity is the maximum number of individuals that can be supported by the environment (1) without there being any environmental degradation (1)

Carrying capacity increased by:

Increasing biomass of producers (1) will increase food resources (1)

Decrease competition (1)

Increased temperatures (1) will increase photosynthesis (1) to increase food resources (1)

Increased availability of water (1) will increase photosynthesis (1)

Improved soil quality (1) will increase biomass of producers (1)

 Any 10 = 10 marks

**Question 38 (20 marks)**

(a) Describe the action of enzymes in all living things and outline the factors that can affect their function. Use a diagram to support your answer.

 (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Enzymes are proteins that speed up all chemical reactions within organisms. Reduce activation energy required to start a chemical reaction. Biological catalysts. | 1 |
| Catabolic reactions – break down substances into smaller molecules that can be taken up by cells/transported through membranes. Anabolic reactions – building substances from smaller molecules for growth, repair and reproduction. | 1 |
| Action of enzymes described by ‘lock and key’ model or ‘induced fit’ model. Enzymes are specific to their substrates. Each enzyme has an active site that binds with a given molecule/s. | 1 |
| Enzymes are recycled after the reaction. Once released from the end product/s they are able to react with another set of molecules. Reduces energy expended by cells. | 1 |
| Enzymes can work in either direction. Dependent upon amount of products and substrate present. | 1 |
| Diagram of an anabolic or catabolic reaction. Must show substrate and enzyme with active site (1), enzyme-substrate complex (1) and enzyme released from product (1). | 1 – 3  |
| Enzyme function can be affected or reduced by pH, temperature, enzyme or substrate concentration, inhibitors and co-enzymes. Enzymes have an optimal range in which they function best. | 1 |
| Enzymes affected by high temperature and pH can denature. The tertiary structure of the enzyme is broken and active site affected so it cannot bind with substrate.  | 1 |
| Inhibitors- Bind active site- CompetitiveBind to somewhere other than active site- non competitive | 1 |
| Co- enzymes bind to alter the active site to allow substrate binding | 1 |
| **TOTAL** | **10** |



(b) Explain the process of cellular respiration in plants and animals. In your discussion, include the acquisition of molecules essential to its component chemical reactions. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Cellular respiration occurs within the cytoplasm and mitochondria of both animal and plant cells.  | 1 |
| Cellular respiration uses glucose and oxygen to produce energy in the form of ATP (adenosine triphosphate) from ADP and Pi. **C6H12O6 + 6O2 🡪 6CO2 + 6H2O + 36 ATP**  | 1  |
| Plants are autotrophs and obtain glucose and oxygen from photosynthetic reactions that take place in chloroplasts of cells (in leaves). | 1 |
| Photosynthesis utilises energy from the sun to convert water (H2O) and carbon dioxide (CO2) into glucose and oxygen (O2). **sunlight****6CO2 + 6H2O C6H12O6  + 6O2**  **chlorophyll** | 1 – 2 |
| Animals are heterotrophs. Glucose for cellular respiration is obtained from food (carbohydrates) that is consumed, digested and absorbed into the bloodstream.  | 1 |
| Animals obtain O2 from their external environment, which is diffused into blood or tissues via a specialised gas exchange surface or structure/s. | 1 |
| Cellular respiration begins in the cytoplasm with **glycolysis**. Glucose is converted into pyruvate through a series of reactions in the absence of oxygen. 2 ATP are formed from glycolysis. | 1 |
| The pyruvate molecules enter the mitochondria. In the presence of oxygen, a series of chemical reactions take place in which O2 and pyruvate are converted into CO2 and H2O. | 1 |
| 34 molecules of ATP are produced within the mitochondria, for a total of 36 ATP from one molecule of glucose. | 1 |
| **TOTAL** | **10** |

**Question 39 (20 marks)**

(a) Describe the structures and mechanisms involved in the transport of water from the soil, through a plant and back into the atmosphere. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Transpiration** is the main mechanism influencing the movement of water up the plant. Water on the (spongy and palisade) cells evaporates and is lost from the leaf through the stomata. | 1 |
| Loss of water from the leaf creates a solute concentration gradient so water is pulled through plant along the gradient (of increasing solute concentration. | 1 |
| Water is drawn from xylem in the leaf to replace the water lost to the atmosphere.  | 1 |
| Constant replacement of water in leaves from the xylem causes water to be taken up by the roots from the soil.  | 1 |
| Water is taken up by root hair cells by osmosis and moves from cell to cell (osmotically along gradient) until it reaches the xylem. | 1 |
| Xylem are vessels involved in water transport. Made from dead xylem cells joined end to end. The cells have no end walls and form a continuous tube from root to leaf.  | 1 |
| Water enters the xylem to replace water that has been drawn up the plant (caused by loss from stomata in leaves).  | 1 |
| Water molecules stick together (**cohesion-tension**) to create an unbroken column of water through the plant. The upward pull on the ‘sticky’ water molecules creates tension (negative pressure) to help uptake and movement up the plant. | 1 |
| Water entering the roots hair cells creates a weak ‘push’ effect (**root pressure**). This helps water movement up the plant.  | 1 |
| When the stomata are closed, the movement of water ceases or slows significantly. Occurs at night or hot conditions. | 1 |
| **TOTAL** | **10** |

(b) Distinguish between the **three (3)** main types of closed circulatory systems found in the Animal Kingdom. Use specific examples to support your answer.

 (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Three (3) types of closed circulatory systems in the animal kingdom include;* Vertebrate closed single circulation – sharks, fish, rays.
* Vertebrate closed double circulation – all other vertebrates such as mammals, birds, reptiles.
* Invertebrate closed systems – worms (annelids/earthworms).
 | 1 – 3  |
| In closed circulatory systems, the blood is transported around the body of an animal within vessels – arteries, veins, capillaries.  | 1 |
| **Single circulation** * Two (2) chambered heart (ventricle and atrium) in one direction. Blood is returned to heart after every circulation of the body.
* Blood is oxygenated at the gills where it loses pressure. Flows through vessels around body at low pressure. Molecules diffuse from capillaries to cells.
 | 1 – 2  |
| **Double circulation*** Usually four (4) chambered heart with left and right side. Two atria and two (2) ventricles. Amphibians have three chambers (two atria and one ventricle) due to gas exchange at skin.
* Deoxygenated blood enters right side of heart and pumped to lungs. Oxygenated blood returns to left side of heart and pumped to the body.
 | 1 – 2  |
| **Invertebrate closed circulation*** Aortic arches in the head represent ‘heart’. Each segment contains a series of capillary networks connected by larger vessels (dorsal and ventral).
* Blood is pumped through ventral vessel and sent to capillary networks where it is oxygenated. Then returns to aortic arches via dorsal vessel (contracts to move blood to head).
 | 1 – 2  |
| **TOTAL** | **10** |