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**Marking Guide**

**Biology Unit 1&2**

**2020**

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

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

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

**Question 31 (20 marks)**

(a) Calculate the percentage heat loss to the nearest whole number for; (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| (i) Producers - 3000/5000 x 100 = 60% | 1 |
| (ii) Herbivores - 365/530 x 100 = 69% | 1 |
| (iii) Carnivores - 50/65 x 100 = 77% | 1 |
| **TOTAL** | **3** |

(b) Explain the difference in heat loss between producers and carnivores. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Carnivores have a greater rate of cellular respiration which produces and releases more heat. OR  Carnivores have a higher metabolic rate per kilogram of body weight so more biomass will be converted to heat. | 1 |
| Producers photosynthesise and produce more energy (in daylight) than is lost as heat during respiration (night-time). | 1 |
| **TOTAL** | **2** |

(c) Inputs and outputs for the decomposers and detritivores are equal. Explain.

(2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Decomposers convert organic material into inorganic material through cellular respiration. | 1 |
| Organic material entering this trophic level remains until it is broken down, releasing heat (all energy outputs lead to heat release). | 1 |
| **TOTAL** | **2** |

(d) State the term used to describe these particular species. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Keystone species | 1 |
| **TOTAL** | **1** |

(e) Describe **two** ways in which these species influence an ecosystem. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Controlling the population size of species that could otherwise become dominant. * A predator species will control the numbers of a prey species that could damage the environment or outcompete other species for resources. | 1 - 2 |
| * Maintaining biodiversity and ecosystem integrity/resilience. * Presence/action of the keystone species ensures biodiversity and ecosystem resilience are maintained should environmental conditions change. | 1 - 2 |
| **TOTAL** | **4** |

(f) Many conservation scientists believe that effective ecosystem management begins with ensuring the survival of these species. Explain. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Two** points, worth **one** mark each. Examples include; | |
| * A keystone species has a disproportionate effect on its environment relative to its abundance. * If a keystone species is removed or declines, the nature of the ecosystem will change dramatically. * A keystone species has a critical role in determining and maintaining the overall relationship of plants and animals within an ecosystem. * A keystone species might maintain a particular abiotic factor that in turn influences the presence of biotic factors in an ecosystem. | 1 - 2 |
| **TOTAL** | **2** |

(g) Complete the table below by identifying **three** environmental issues caused by humans. Explain how each environmental issue has affected the biodiversity of Australian ecosystems. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **One** mark for identifying impact and **one** mark for a description, for a total of **six** marks. Examples include, but are not restricted to; | |
| **1. Habitat fragmentation**  Excessive clearing of native bushland has led to the formation of small, isolated populations of species with lowered genetic diversity.  **2. Mining/overuse of natural resources**  Causing habitat destruction, soil erosion, salinity, loss of species and biodiversity through removal of habitat.  **3. Salinity**  Clearing of too many deep-rooted trees causing water table to rise. This brings salts to the soil surface and makes the land unsuitable for plant growth.  **4. Biomagnification**  Overuse of pesticides and pollution with heavy metals has led to accumulation of non-degradable toxins up the food chain, affecting health and reproduction of higher order consumers.  **5. Deforestation**  Removal of large areas of native forest for agriculture and urban development and for the timber industry has caused the loss of species through extinction.  **6. Introduced pest species/feral animals**  Introduced species (fox, cat, cane toad, weeds) have outcompeted or predated on native species, resulting in species extinctions and loss of biodiversity.  **7. Eutrophication**  Overuse of inorganic fertilisers (containing phosphorus and nitrogen) has caused toxic algal blooms in aquatic ecosystems, leading to depletion of dissolved oxygen, disrupted food webs, decrease in diversity and fish kills. | 1 - 2 |
| **TOTAL** | **6** |

**Question 32 (20 marks)**

(a) Identify **three** biological molecules essential to the structure and function of all living organisms. For each molecule, provide **one** example. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Carbohydrates - glucose/starch/sucrose | 1 |
| Proteins - enzymes/glycoproteins/hormones | 1 |
| Lipids - cholesterol/fatty acids/myelin | 1 |
| **TOTAL** | **3** |

(b) For each of the molecules identified in part (a), explain how they are vital to cellular structure and/or function. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Molecule one** - source of fuel for cellular respiration. | 1 |
| **Molecule two** - molecules to increase rate of chemical reactions/building blocks for cellular membranes/molecular transport. | 1 |
| **Molecule three** - cellular membranes/strength/insulation. | 1 |
| **TOTAL** | **3** |

(c) Identify **two** examples for the functions of the cell membrane. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Two** points from below, **one** mark each. Examples may include; | |
| * Protective boundary from external environment. * Control movement of materials in and out of the cell. * Separates different chemicals to control chemical reactions. * Can create a surface for chemical reactions to occur. * Contains imbedded proteins for cell signalling. | 1 - 2 |
| **TOTAL** | **2** |

(d) Identify **three** major differences between prokaryotic and eukaryotic cells. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Three** comparisons between cell types for **two** marks each. Examples include; | |
| * Eukaryotes - membrane bound nucleus; Prokaryotes - no nucleus with free floating DNA. * Eukaryotes - membrane-bound organelles; Prokaryotes - no membrane-bound organelles. * Eukaryotes - large and complex; Prokaryotes - small and simple. * Eukaryotes - no plasmid DNA; Prokaryotes - often contain plasmids. * Eukaryotes - can have cell specialisation based on function; Prokaryotes - no cell specialisation. | 1 - 6 |
| **TOTAL** | **6** |

(e) Use the diagram of the eukaryotic cells above to identify and name the structures responsible for; (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| (i) protein synthesis - ribosomes | 1 |
| (ii) respiration - mitochondria | 1 |
| (iii) photosynthesis - chloroplasts | 1 |
| (iv) secretion and transport - Golgi apparatus/body | 1 |
| **TOTAL** | **4** |

(f) Two important organelles within eukaryotic cells, associated with metabolism, have double membranes. Explain how these membranes improve the biochemical function of these structures. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Membranes are heavily folded which increases the surface area. | 1 |
| A large surface area increases the rate of the associated biochemical reactions. | 1 |
| **TOTAL** | **2** |

**Question 33 (20 marks)**

(a) Calculate the following population sizes for the October survey period. Show your working and round your answers to the nearest whole number. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Males - 58 x 1 / 0 = 0 | 1 |
| Females - 60 x 52 / 48 = 65 | 1 |
| Total - 0 + 65 = 65 | 1 |
| **TOTAL** | **3** |

(b) On the grid provided, construct an appropriate graph showing the population size of male, female and total kalutas over the six-month survey period. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Title | 1 |
| Axes correct - time on x-axis; population size on y-axis. | 1 |
| Axes labelled | 1 |
| Line graph | 1 |
| Three separate lines - one for male, female and total. | 1 |
| Legend | 1 |
| **TOTAL** | **6** |

Example;

A screenshot of a computer

Description automatically generated

Population size

Time (month)

Population size of the little red kaluta over a six-month survey period.

(c) Describe any trends in the graphed data. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Female population is relatively stable for the whole survey period. | 1 |
| Male population is slightly higher than females until the October period where numbers drop dramatically to zero (0). | 1 |
| Male population size remains at zero for the remainder of the study. | 1 |
| **TOTAL** | **3** |

(d) Suggest **one** problem with the marking technique used by the researchers. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Nail polish may get scratched off while the animal is digging and feeding. | 1 |
| It could be recorded as a new individual if recaptured, distorting the data. | 1 |
| **TOTAL** | **2** |

(e) Provide reasons to explain the declining male kaluta numbers as shown in the data collected in the October and November surveys. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Two** points from below, **one** mark each. | |
| * Most male kalutas died following mating season. * Small number recorded were not yet sexually mature so still alive. * Males were not active while traps were set so females are overrepresented in the data. | 1 - 2 |
| **TOTAL** | **2** |

(f) The little red kaluta is nocturnal and rests in burrows during the day. Identify **one** advantage of this behaviour. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Examples include, but are not restricted to; | |
| * predator avoidance * desert heat avoidance | 1 |
| **TOTAL** | **1** |

While relatively little is known about the kaluta, it is not considered a threatened species.

(g) Explain the importance of collecting ongoing data on the kaluta, despite its current status. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Establish its role in the ecosystem - could be a keystone species or an indicator of ecosystem health. * Monitor any change in population size or structure. * Determine impacts of climate change/predators/invasive species/human activity. | 1 - 3 |
| **TOTAL** | **3** |

**Question 34 (20 marks)**

(a) With the aid of a labelled diagram, describe the structure of the fluid mosaic model of cellular membranes. (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Diagram should include at least **six** of the following structures and/or have labelled; | |
| * Phospholipid bilayer (label) * Phosphate head * Lipid/fatty acid tail * Tails inward and heads outward in two layers * Water-loving/hydrophilic/polar end (outside) * Water-hating/hydrophobic/non-polar end (inside) * Cholesterol molecule | 1 - 6 |
| **TOTAL** | **6** |

*\*The question does not ask specifically for protein structures. No marks are allocated for transport or integral proteins.*

Example;

A close up of a logo

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Phosphate head

Lipid/fatty acid tail head

Water-hating/ hydrophobic/non-polar tails

Phospholipid bilayer

Water-loving/ hydrophilic/polar heads

(b) Explain the importance of membrane fluidity to cellular function. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Two** points for **two** marks each. Each point should include a valid factor (**one** mark) and explanation (**one** mark). Examples include, but are not restricted to; | |
| * Allows fusion of membranes together for effective transport of materials into and out of the cell via endocytosis and exocytosis. * Can affect the distribution and positioning of proteins within the membrane, which influences the transport of molecules vital to metabolic processes. * Allows the membrane to move and change shape without rupturing. A ruptured membrane would lead to the loss cell contents and death. * Enables cytokinesis (cell division) to occur (by even cleaving) which is important for growth and repair of cells. | 1 - 2 |
| **TOTAL** | **4** |

(c) Identify **two** features common to all three structures. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Large surface area. | 1 |
| Thin/single cell surface. | 1 |
| **TOTAL** | **2** |

(d) Explain the importance of these **two** features to an organism's metabolic activity.

(4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **One** mark forreason and **one** mark for effect. Examples include, but are not restricted to; | |
| * Sufficient oxygen can be obtained from the external environment, transported to the cells and used to synthesise enough energy through cellular respiration. * Oxygen can be transported very rapidly through a thin surface (one cell thick) into the bloodstream and be rapidly delivered to the cells for cellular respiration. * Carbon dioxide can be removed/lost easily from the blood to the external environment, allowing cellular concentration gradients to be maintained. * The highly vascularised structures allow maintenance of a constant concentration gradient for both oxygen and carbon dioxide - ensures continued, rapid diffusion of gases into and out of bloodstream. | 1 - 2 |
| **TOTAL** | **4** |

(e) Explain why structures '**W**' and '**X**' differ in shape despite having a similar function. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Structure **W** is an alveolus from a vertebrate lung which takes in air.  Air has a high oxygen content and millions of alveoli comprise the lungs, allowing for efficient gas exchange. | 1 - 2 |
| Structure **X** is a part of a gill from a fish which is submerged in water.  Less oxygen is dissolved in water than air so the surface area must be much greater to obtain enough oxygen.  \*Counter-current exchange occurs in gill lamellae. | 1 - 2 |
| **TOTAL** | **4** |

**Question 35 (20 marks)**

A picture containing clock

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(a) Identify the chemical inputs, **A** and **C**, and outputs, **B** and **D** of photosynthesis as shown in the diagram above.

(2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Inputs**  A - H2O (water) and sunlight  C - CO2 (carbon dioxide) and H+ | 1 |
| **Outputs**  B - O2 (oxygen)  D - sugar (C6H12O6 or CH2O) | 1 |
| **TOTAL** | **2** |

(b) Name the substance present in the thylakoid membranes. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Chlorophyll | 1 |
| **TOTAL** | **1** |

(c) Name and describe the reactions/process occurring in the area labelled '**E**'. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Light-dependent reactions of photosynthesis. | 1 |
| Light energy is absorbed by the pigment chlorophyll found in the thylakoid membranes. | 1 |
| This energy is used to split water (H2O) into oxygen (O2) and hydrogen ions (H+). | 1 |
| **TOTAL** | **3** |

(d) Name and describe the reactions/process occurring in the area labelled '**F**'. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Light-independent reactions - Calvin cycle. | 1 |
| In the stroma the H+ from thylakoids (delivered by NADPH) and input CO2 react to form sugar molecules. (Calvin cycle) | 1 |
| Requires energy (ATP) created in light-dependent reactions. | 1 |
| **TOTAL** | **3** |

(e) Define 'enzyme'. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| A specialised protein molecule that acts as a biological catalyst. | 1 |
| Speeds up the rate of chemical reactions/reduces activation energy. | 1 |
| **TOTAL** | **2** |

(f) Explain the effect of a reduced soil pH on the enzymes and chemical reactions within the stroma. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Enzymes are sensitive to and function best at a specific pH. | 1 |
| Enzymes in the stroma would likely denature at a lower pH/more acidic environment. | 1 |
| The light-independent reactions could not take place without enzymes. (No sugar synthesised and build-up of CO2) | 1 |
| **TOTAL** | **3** |

(g) Explain how an enzyme inhibitor affects enzyme function. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **One** mark for cause and **one** mark for effect, for a total of **two** marks. Example; | |
| * Blocks active site, preventing the formation of the enzyme-substrate complex. * New substances cannot be formed as a result of the reactions being prevented. | 1 - 2 |
| **TOTAL** | **2** |

(h) Describe **two** other factors that can affect the rate at which enzymes function. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Two** marks per factor, for a total of **four** marks; **one** mark for identifying a factor and **one** mark for its description. Examples include, but are not restricted to; | |
| * **Temperature** - enzymes function best at an optimum temperature. Excess heat will result in enzymes denaturing. Low temperatures cause reactions to cease - not enough energy to help activate. * **Substrate concentration** - increasing the concentration of substrate will increase the reaction rate of enzymes until the concentration of enzymes becomes a limiting factor. * **Enzyme concentration** - More enzymes that are available = more reactions occurring at the same time and a greater volume of products formed. | 1 - 2 |
| **TOTAL** | **4** |

**End of Section Two**

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

**Unit 1**

**Question 36 (20 marks)**

(a) Explain the dynamics of the predator-prey relationship and outline the various strategies used by prey species to avoid predation.

(10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Students must provide **seven** points from below for **one** mark each. | |
| * A carnivorous animal (predator) kills another consumer (prey) for food. * A predator usually has more than one prey species on which feeds and a prey species can have more than one predator it needs to avoid. * The relationship between predator and prey is dynamic, balanced and cyclical in nature. * Abundant food and optimal environmental conditions lead to an increase in prey population numbers. * The predator population increases in response to the increase in prey. * With an increase in predation or unfavourable environmental conditions, prey numbers decline. * With decreasing numbers of (favoured) prey, the predators source other prey species and intraspecies competition increases. * Predator population starts to decline in response to competition and reduced food resources. * The decline in predator population and alternative food sources allows the recovery of the favoured prey species. | 1 - 7 |
| Students must include **three** different strategies with a description in their response worth **one** mark each. Examples include, but are not restricted to; | |
| **Mimicry**  Some animals and plant have evolved structures/morphology or behaviours that mimic other species in order to avoid predation.  **Camouflage**  Structural characteristics like hair and skin patterns help organisms to 'blend' into their surroundings and avoid being detected by predators.  **Nocturnal behaviour**  Small herbivorous animals feed at night (heat avoidance) to reduce probability of attack from overhead and terrestrial predators.  **Herding**  Grazing prey feed in large herds to reduce the likelihood of capture.  **Speed/agility**  Many prey species are very fast runners/hoppers and can escape from predatory attack with a burst of speed and endurance. | 1 - 3 |
| **TOTAL** | **10** |

(b) Outline the concept of carrying capacity. Explain how the effects of climate change could influence the carrying capacity of any given species population.

(10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Carrying capacity is the maximum population size of a species that can be supported indefinitely in a given environment. | 1 |
| Carrying capacity is determined/limited by abiotic and biotic factors of the environment - limiting factors. | 1 |
| Limiting factors can be density-dependent - the population density of a species influences these factors - competition, disease, predation, food, shelter/nests. | 1 |
| Limiting factors can be density-independent - factors that affect the population despite density - rainfall, salinity, temperature, humidity, pH, fire, drought, other catastrophic events. | 1 |
| Climate change directly affects abiotic/density-independent factors - changes in rainfall patterns, increased temperatures, bushfire frequency, extreme weather events. | 1 |
| Climate change indirectly affects density-dependent factors as a result of changes to abiotic/density-independent factors. This in turn can have a dramatic effect on the carrying capacity. | 1 |
| Environmental changes affecting carrying capacity. Students must provide at least **four** examples worth **one** mark each. Examples include, but are not restricted to; | |
| * lower rainfall affects primary productivity as a result of decreased rate of photosynthesis; leads to a decrease in plant diversity, less food for herbivores and therefore more competition. * Lower productivity of autotrophs has a flow on effect up the food chain/web. Higher order consumers cannot be supported by a reduced biomass at lower levels and may become threatened. * Reduced annual rainfall results in less recharge of the water table. Large, deep-rooted trees become water stressed and susceptible to disease. * Lower than normal water table from lower rainfall will increase plant deaths and reduce food and shelter for many animal species, increasing competition and susceptibility to disease and parasites. * Extreme weather events like drought and flooding increase mortality of plant and animal species less adapted to cope with change. Reduction in biodiversity may occur over time. * Increased average temperatures over summer months results in an increase in the frequency and intensity of bushfires, exacerbated by low rainfall and strong winds. Causes removal of food and shelter and increases likelihood of predation and disease. | 1 - 4 |
| **TOTAL** | **10** |

**Question 37 (20 marks)**

(a) Discuss the biological species concept and its limitations in defining 'species'. Explain how an understanding of the concept of 'species' is important to ecosystem conservation and management.

(10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| According to the biological species concept, a species is a group of organisms whose members can breed with each other and produce viable offspring. | 1 |
| Individuals in a species are reproductively isolated from individuals belonging to different species. | 1 |
| Biological species concept explains how reproductive isolation leads to speciation/evolution. | 1 |
| Cannot apply the biological species concept to fossilised remains as  there is no evidence of reproductive strategies. | 1 |
| Without the ability to classify fossilised remains, phylogenetic studies are not possible. | 1 |
| Cannot be applied to hybrid organisms as they 'belong' to two different species. | 1 |
| Students must provide **four** points regarding ecosystem conservation and management, worth **one** mark each. Examples include, but are not restricted to; | |
| * Allows for correct taxonomic identification in surveys. * Allows for measurement of species diversity/richness. * Improves our understanding of species habitat requirements. * Provides information regarding interaction of different species. * Provides information about ecosystem health using diversity as an indicator. * Provides information regarding population dynamics. * Allows conservation scientists to determine human impacts on species diversity and status. | 1 - 4 |
| **TOTAL** | **10** |

(b) Discuss the adaptations Australian plants possess in order to regenerate and reproduce following wildfire.

(10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Students must provide at least **five** examples from below, worth **two** marks each. **One** mark for adaptation and **one** mark for discussion of adaptation. | |
| * Epicormic buds/growth - buds are located under protective bark and sprout to form new branches and leaves following fire. *Eucalyptus* and *Banksia* species produce epicormic sprouts. * Heat-induced fruits/nuts/cones opening - many native plants, such as *Banksia* sp*.*, have resin sealed nuts/cones that can only release seeds once heat from fire has melted resin. * Thick bark/retaining dead leaves on trunk - thick bark or retained leaves (grasstrees) insulates the vascular tissues underneath and protects any epicormic buds. * Large, woody lignotubers - Trees such as *Banksia* sp*.* and mallees possess large, underground lignotubers that store starch and can produce regenerative shoots after a fire has destroyed the aboveground part of the plant. * Dry, dormant tubers - some herbaceous species of orchids lay dormant as dried tubers below ground, protected from fire. They regenerate/reshoot in post-fire, nutrient-rich soil bed. * Fleshy bulbs and rhizomes - herbaceous plants have underground stems which rapidly reshoot following fire that destroys the plant. * Smoke-induced germination - chemical compound in bushfire smoke (cyanohydrin and karrikinolide) breaks seed dormancy and stimulates the germination of seeds in the soil. The seeds of some species cannot germinate without exposure to these compounds. * Fire-activated flowering - some species, such as grasstrees, take advantage of the increased nutrient load in the soil and flower post-fire. This increases the chance of species survival by promoting reproduction. | 1 - 2 |
| **TOTAL** | **10** |

**Unit 2**

**Question 38 (20 marks)**

(a) Discuss the process of cellular respiration in the presence and absence of oxygen.

(10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Aerobic cellular respiration** requires oxygen and occurs within the mitochondria of all cells. | 1 |
| Glucose (from digestion of carbohydrates) and oxygen are required to 'fuel' aerobic respiration, which produces carbon dioxide, water and energy in the form of ATP (adenosine triphosphate).  C6H12O6 + 6O2 à 6CO2 + 6H20 + energy (36 ATP) | 1 |
| Aerobic respiration can be broken down into three distinct stages - Glycolysis, Krebs Cycle and Electron Transport. | 1 |
| Glycolysis occurs in the cytoplasm of the cell and yields 2 ATP. Glucose is converted into 2 pyruvate molecules in the absence of oxygen. | 1 |
| The pyruvate molecules enter the mitochondrial matrix (in the presence of oxygen). The Krebs Cycle occurs within the matrix - two rounds of the cycle yield 2 ATP and carbon dioxide. | 1 |
| Hydrogen ions (H+) and electrons (released) from the Krebs Cycle are carried to the highly folded inner membranes (cristae) of the mitochondria where electron transport takes place. | 1 |
| As the H+ and electrons move through the inner membranes they provide the energy for the synthesis of 32 ATP (phosphorylation). | 1 |
| **Anaerobic respiration** occurs in the absence of oxygen and only yields 2 ATP. The mitochondria are not involved in this process which occurs in the cytoplasm. | 1 |
| As with aerobic respiration, glycolysis is the first stage of anaerobic respiration. In the absence of oxygen, the pyruvate is converted into lactic acid (lactate fermentation). | 1 |
| In bacteria, yeast and plants, the pyruvate molecules are converted into ethanol and carbon dioxide (via alcoholic fermentation). | 1 |
| **TOTAL** | **10** |

(b) Explain the transport of materials throughout a plant by contrasting the structure and function of the xylem and phloem.

(10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Structure** - phloem vs xylem. **One** mark per point for a total of **five** marks. | |
| * Xylem comprised of dead cells; phloem comprised of living cells. * Xylem cell walls contain thick lignin (for strength); phloem walls contain thin cellulose. * Xylem cells include tracheids, parenchyma and vessel elements; phloem cells include sieve tube cells, companion cells and phloem parenchyma. * Xylem vessels are located deep within (the centre) of the vascular bundle/stem tissues; phloem vessels are located on the outer edges of the vascular bundle. * Xylem cells are impermeable - no osmotic movement; phloem cells are permeable to water and solutes. * Xylem cells do not have a cytoplasm and are hollow; phloem cells possess cytoplasm and line the cavity of the phloem. * Xylem cells are arranged end to end with no end walls; phloem cells are connected end to end but end walls are sieve plates. * In older plants and tree trunks, xylem is located within the stem, while phloem is found within the inner soft bark. * Conducting elements of xylem are tracheids and vessels; phloem conducting elements are sieve tubes. | 1 - 5 |
| **Function** - xylem vs phloem. **One** mark per point for a total of **five** marks. | |
| * Xylem transports water containing dissolved inorganic ions; phloem transports sugar/sucrose (products of photosynthesis) and amino acids. * Xylem flow is unidirectional from root to leaf; phloem transport is multidirectional, delivering 'food' to growth areas and storage organs (roots and tubers). * Xylem offers mechanical strength to the plant; phloem does not provide any mechanical support. * Water transport through xylem is passive and requires not energy expenditure; phloem transport is active and uses energy in the form of ATP. * Xylem transports water in an unbroken stream through capillary action using the forces of cohesion and adhesion, transpirational pull and root pressure; phloem transports nutrients around the plant through the plant via translocation. * Water moves into and out of the xylem through tracheid pits in the cell walls; materials enter and leave the phloem through osmosis, diffusion and active transport (no pits - living cells). * Water movement through/up the xylem is influenced by opening and closing of stomata/evaporation from leaves; phloem transport is influenced by diffusion gradients - pressure flow hypothesis. | 1 - 5 |
| **TOTAL** | **10** |

**Question 39 (20 marks)**

(a) Explain how molecules are transported across cellular membranes through passive and active transport.

(10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Passive transport - osmosis, diffusion, facilitated diffusion. Active transport - active transport, endocytosis (pinocytosis and phagocytosis) and exocytosis. | 1 |
| Passive transport does not require energy as molecules move down a concentration gradient (high to low). Active transport uses energy as ATP to move molecules against the concentration gradient (low to high), expel materials/waste from the cell or ingest materials into the cell via vesicles. | 1 |
| Simple diffusion across a membrane (semi-permeable) involves the movement of small, hydrophobic (non-polar) molecules like oxygen and carbon dioxide down a concentration gradient. No protein channels are required as the inside of the bilayer is non-polar. | 1 |
| Osmosis is the movement of water across a semi-permeable membrane from low solute to high solute concentration, in response to osmotic pressure. Water is polar so travels through special channels called aquaporins. | 1 |
| The movement of large, polar or ionic/charged molecules requires the assistance of protein channels and carriers that are imbedded within the phospholipid bilayer. These are specific to the molecules they transport. | 1 |
| Facilitated diffusion involves the movement of large, polar and charges molecules such as glucose, amino acids and ethylene. These molecules are transported through protein channels down a concentration gradient, without expending ATP. | 1 |
| Active transport is the movement of molecules through protein carriers, against the concentration gradient. The proteins must be supplied with energy/ATP before they can function, e.g. when a molecule is needed in greater concentrations or a waste needs to be expelled beyond passive diffusion amounts, e.g. sodium-potassium pump in nerve cells. | 1 |
| Very large particles cannot be transported across/through the membrane and must be moved via vesicles - endocytosis and exocytosis. Vesicle formation and 'bulk' transport of material is an active process requiring energy/ATP. | 1 |
| There are two types of endocytosis - phagocytosis and pinocytosis. Phagocytosis is the process by which solid particles (food, bacteria) are engulfed by the cell. Pinocytosis involves engulfing liquids. | 1 |
| Exocytosis (opposite of endocytosis) occurs when large molecules/substances produced by the cell need to be transported to other parts of the organism (hormones, enzymes, proteins). These molecules are delivered to the cell membrane in vesicles and released to the exterior. | 1 |
| **TOTAL** | **10** |

(b) Discuss the function of the digestive system and differentiate between the alimentary structures of a herbivore and a carnivore. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| The digestive system is responsible for the mechanical and chemical breakdown of food into small molecules that can be absorbed into the bloodstream and delivered to cells for metabolic processes. | 1 |
| Mechanical digestion occurs in the mouth, using teeth to macerate food; in the stomach by muscular churning, and in the small intestines via peristaltic waves. This helps to break up food into smaller pieces that have a larger surface area. | 1 |
| Chemical digestion occurs in the mouth by enzymes released by salivary glands (amylase), in the stomach by gastric juices and enzymes (protease) and in the small intestines by bile from gall bladder and enzymes from pancreas. | 1 |
| Enzymes are grouped according to the molecules they react with; Proteases break down proteins into polypeptides/amino acids.  Amylases break down carbohydrates into sugars/glucose.  Lipases break down fats into fatty acids and glycerol. | 1 |
| Products of chemical digestion are absorbed through the inner lining of the small intestines. The surface area of the lining is increased by the presence of villi and microvilli. Absorbed products/nutrients are then carried through the bloodstream and made available to cells. | 1 |
| The diet of animals can be determined by their alimentary structures for mechanical and chemical digestion. Carnivores possess adaptations for digesting meat, while herbivores are adapted to a diet of plant matter. | 1 |
| Carnivores have large canines for tearing flesh and molars crunch and grind bones. Herbivores have reduced or no canines. Incisors are prominent at front of jaw and flattened molars for grinding fibrous material. | 1 |
| Carnivore gut is adapted for digesting meat - possess own enzymes. Large stomach capacity to cater for infrequent large meals. Short small intestine and caecum usually absent because no fermentation of fibrous material needed/protein and fat are easily digested. | 1 |
| Herbivores can have hindgut or foregut digestion for processing fibrous material and cellulose - no enzymes for this process.  Foregut digesters have a large stomach, long intestine and medium caecum. Fermentation uses microbes (bacteria) to break down cellulose. Digestion is relatively quick. | 1 |
| Hindgut digestion involves a small stomach and small intestine but a large, expanded caecum.  This allows microbial fermentation of cellulose and maintains food particles for longer to extract as much nutrition as possible. | 1 |
| **TOTAL** | **10** |

**End of questions**