**Cells exam 2013**

Question 1 **DNA structure, replication and function**

Evidence Statement

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Q1** | | **Expected Coverage** | Achieve | | Merit | Excellence |
| **a.** | | **Complementary strand drawn with these 3 aspects:**   1. Bases of complementary strand are: A, T, C and G (top to bottom)   **T**  **A**  **G**  **C**  **T**  **A**  **G**  **C**   1. Strands are drawn antiparallel (see diagram and arrows, right) 2. Weak (or H) bonds between base pairs drawn and/or labelled | **In part a:**  Correct complementary bases shown  **In part a:**  Strands drawn antiparallel  **In part a:**  H / weak bonds shown | |  |  |
| **b** | **DNA self-replication.**  **descriptive labels…. something from:**  **for i**   * 2 strands of DNA molecule are ‘unzipped’ * weak H bonds between base-pairs are broken   **for ii**   * new nucleotides added to exposed bases on both strands * new bases added following the ‘base-pairing’ rules * enzyme involved: DNA Polymerase * synthesis of leading and lagging strands differs due to antiparallel nature of parental strands * each new DNA molecule contains one parental and one newly synthesised strand * identical nature of the two new DNA molecules | | | At least2 descriptive labels provided |  |  |
| **c** | **Semi-conservative:**  **term described**  Each new (daughter) DNA molecule contains one parental (original) strand and one newly synthesised strand  **significance explained**  The parental strand is used as a **template** to synthesise the new strand. Because the base-pairing rules are followed when new nucleotides are added the new DNA molecule will be **identical** to the original one (same bases in the same sequence).  **Implication evaluated:**  Idea of genetic continuity discussed. eg.All somatic cells derived from a zygote will be genetically similar (same number of chromosomes, same genes etc).  DNA replication must precede mitosis for this to be true. i.e. Allows genetic continuity. | | | Semi-conservative term described | Semi-conservative significance explained | Semi-conservative significance explained in more detail with implication evaluated |
| **d.** | **Reasons for cell division fall into these categories:**   1. **Surface area : Volume ratio OR Efficiency of transport of diffused materials**   When cells divide cell size decreases with a resulting increase in Surface area : Volume ratio.  In smaller cells the movement of materials that depends on diffusion is much more efficient because materials have less distance to diffuse.  Cells are limited in size because the outside (the cell membrane) must transport the food and oxygen to the parts inside. As a cell gets bigger, the outside is unable to keep up with the inside, because the inside grows a faster rate than the outside.  OR SIMILAR   1. **To provide new cells for growth and replacement (repair)**   Cells are required to replace those that are lost by injury, disease or other causes.   1. **Internal Cellular ratios**   When cells divide other ratios other than Surface area : Volume ratio are maintained with a corresponding maintenance of efficiencies eg.   * Nuclear : cytoplasm ratio * Organelle number : cytoplasm ratio.  1. **To allow for differentiation of cells with resulting increased efficiency**   Having a large number of small cells (rather than a small number of larger cells) allows more specialisation in function as a result of differentiation in structure, shape, and organelle components   1. **Asexual reproduction in unicellular organisms**   Mitosis is the unicellular organisms method of asexual reproduction and population increase. Each mitotic division represents one generation and a doubling of population number   1. **Provision of gametes in sexually reproducing organisms and resultant variation within their populations**   Sexually reproducing organisms produce gametes by meiosis. These gametes are genetically variable (due to the effect of independent assortment and crossing over). Successful fertilisation of gametes produces new genetically variable individuals. Variation within the population is the basis of Natural Selection and evolutionary change within the population   1. **Loss of control mechanisms of cell division in normal cells (as in cancerous cells**   Oncogenes are mutations of proto-oncogenes, genes that normally control how often a cell divides and to which degree the cell differentiates / specializes.  When mutated, the cell divides more frequently that it is supposed to. An oncogene will contribute to converting a normal cell into a cancer cell.  **8 Or any other relevant answer** | | | Reason 1 (SA:V ratio) described (ratio descr. as cell size incr. etc  A second reason described only  A third reason described only | Reason 1 (SA:V ratio) explained    A second reason explained  A third reason explained | two reasons explained and answers are linked into a coherent answer (comprehensively discussed i.e. linked to the needs of the cell)  A third reason explained and answers are linked into a coherent answer (comprehensively discussed i.e. linked to the needs of the cell) |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Not Achieved** | | | **Achievement** | | **Merit** | | **Excellence** | |
| **NØ** | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No response; no relevant evidence. | Provides any ONE statements from Achievement. | Provides any 2 or 3 statements from Achievement. | Provides any 4 statements from Achievement. | Provides any 6 statements from Achievement. | Provides any 2 or 3 statements from Merit. | Provides 4 statements from Merit. | Provides any TWO statements from Excellence. | Provides THREE statements from Excellence. |

Question 2 **Enzymes**

Evidence Statement

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Expected Coverage** | | | | | | | | | | | | | | Achieve | Merit | Excellence |
|  | **Model of enzyme action described (either ‘lock-and-key’ or ‘induced-fit’ models)**  **‘lock-and-key’ model described:**  Substrate fits into the enzymes active site (the physical place on the enzyme molecule where the reaction takes place). Shape of substrate, location of functional groups and atoms) must match that of the active site. An activated complex is temporarily formed. As the activated complex breaks down the products are formed.  **OR ‘induced-fit’ model described:**  Similar to ‘lock-and-key’ model except that the binding of the substrate to the active site results in changes to both that allows better fit and increases the stability of the activated complex and accelerates the formation of the products of the reaction.  **Effect of denaturation explained:**  Any process that causes the folding structure of a protein or enzyme to be altered causing the protein to become biologically inactive.  Enzymes unfold and lose their active site when exposed to denaturing agents, they lose their structure and cease to function as catalysts. The substrates can no longer bind to the active site, and biochemical process is therefore disrupted. Once an enzyme is denaturated and its three-dimensional structure is compromised, it will no longer be viable for use in chemical reactions. | | | | | | | | | | | | | | One model named with minimal description | One model named with explanation that includes specificity of active site |  |
|  | **Graphs used to describe effect on enzyme action (rate of reaction)** | | | | | | | | | | | | | | Graphical description of the effect of one factor  Graphical description of the effect of a second factor  Indication of denaturation for one factor  Indication of denaturation for a second factor  **If low temperature denaturation is indicated then student is limited to ONE opportunity for Achieved ONLY** | Explanation of denaturation for one factor  Explanation of denaturation for a second factor | One implication  Two implications |
| Temperature | | | | pH levels | | | Inhibitors, enzymes, heavy metals etc | | |  | | | |
| Reaction rate | |  | | Reaction rate |  | | Reaction rate | or | |  | | | |
|  | | temp | |  | pH | |  | concentration | |
| Shape: slow steady rise to optimum temp and then rapid decrease at higher temps | | | | Shape: slow deterioration either side of optimum pH, basically symmetrical curve | | | Shape: high activity at low concentrations of inhibitors etc  decreas as conc increase | | |  | | | |
| **Indication of when complete denaturation has occurred**  See symbols at:   * High temps **BUT** NOT Low temperatures * Extreme pHs * High levels of inhibitors   **If low temperature denaturation is indicated then student is limited to ONE opportunity for Achieved ONLY**  **Explanation of the effects of environmental factors:**  **Temperature:**  Low temperatures: reaction rate is slow because of the lack of thermal energy of all particles concerned. This results in fewer collisions and less energetic collisions.  High temperatures: above optimum reaction rate slows due to irreversible changes to the shape of the active site  **pH**  pH is a measure of the H+ ion (and OH- ion) concentrations.  In environments with excessive charges (due to H+ and OH- ions) these bonds are disputed, the protein chain losses its (secondary and tertiary) proteins structure and the active site will no longer receive the substrate and release the products.  **Concentration of Inhibitors, enzymes, heavy metals etc**  No inhibition occurs if inhibitor, heavy metal etc is absent. As the concentration of the inhibitor increases more and more enzyme molecules are denatured until eventually all activity ceases | | | | | | | | | | | | | |
|  | **Teacher Notes**  Inhibitors can be:   * specific i.e. exert their effects upon a single enzyme eg. many poisons and drugs * competitive i.e. which closely resembles the chemical structure and molecular geometry of the substrate. The inhibitor competes for the same active site. The inhibitor is "stuck" on the enzyme and prevents any substrate molecules from reacting with the enzyme. However, competitive inhibition is usually reversible. * Non-competitive i.e. substance that interacts with the enzyme, but usually not at the active site. The effect is to change the shape of the enzyme and thus the active site. Non competitive inhibitors are usually reversible * Irreversible i.e. form strong bonds with an enzyme, they are not displaced by the addition of excess substrate. The basic structure of the enzyme is changed so that it ceases to work. | | | | | | | | | | |  | |  |
| **Implications of the effect of TWO environmental factors: eg (there will be others)**   * Rate of reduction of enzyme activity eg. high temps inactivation occurs rapidly vs, high pHs slow decline occurs * Use by humans eg. cooking (high temps), freezing (low temps), pickling (low pHs), toxins or drugs (high conc.s of inhibitors) | | | | | | | | | | | | | |  |
| **Not Achieved** | | | | | | | **Achievement** | | | | | **Merit** | | | | **Excellence** | |
| **NØ** | | | | **N1** | **N2** | | **A3** | | | **A4** | | **M5** | | **M6** | | **E7** | **E8** |
| No response; no relevant evidence. | | | | Provides any 1 statements from Achievement. | Provides any 2 statements from Achievement. | | Provides any 3 statements from Achievement. | | | Provides any 4or 5statements from Achievement. | | Provides any TWO statements from Merit. | | Provides 3statements from Merit. | | Provides any 1 statement for Exllence. | Provides 2 statements for Excellnce |

Question 3 **Osmosis and Plasmolysis**

Evidence Statement

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Expected Coverage** | | | | | | Achieve | Merit | Excellence |
|  | **Osmosis described:** must include 3 important aspects  The (1) diffusion of water across a (2) semi-permeable membrane (3) from an area of higher water concentration to an area of lower water concentration.  **Condition explained:**  Difference in water concentrations is (usually) due to differences in solute (salt, sugar) concentrations:  Higher water concentration = lower solute concentration AND  Lower water concentration = higher solute concentration | | | | | | Osmosis described | Conditions explained |  |
|  | Passive because the cell loses water by osmosis which depends on concentrations of solutes (along a concentration gradient) rather than any energy expended **OR**  Passive because **no** substances are accumulated against a concentration gradient.  **Or similar** | | | | | | Mentions passive | Passive explained |  |
|  | **Description of changes in cells in photograph B:**  Cell has plasmolysed / lost water by osmosis / exosmosis or similar  **OR** Cell has shrunk and cell membrane has pulled away from the inside of the cell wall.  **Explanation of changes:**  Water concentration gradient occurs because the solute concentrations on both sides of the cell membrane differ (comparison with cytoplasm / vacuole) i.e. the external solution has higher solute concentrations and thus lower water concentration.  As cell reduces in volume due to water loss it exerts no (turgor) pressure on the inside of the cell wall. The cell wall is permeable and water floods into the spaces created between the cell membranes  **These ideas linked to the role of the cell membrane.**  Cell membrane acts as a semi-permeable membrane (this needs to be elaborated) i.e smaller molecules (water), can pass through but larger ones (solute), cannot.  **Or**  As the cytoplasm loses water it becomes more concentrated and water moves into it from the vacuole (this can be observed in the photo of Cell B).  i.e. role of vacuoles membrane is discussed rather than the plasma / cell membrane. | | | | | | Cell changes described | Cell changes explained | Cell changed explained in terms of turgor  Explanations linked to role of cell membrane |
| **Not Achieved** | | | | **Achievement** | | **Merit** | | **Excellence** | |
| **NØ** | | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No response; no relevant evidence. | | Provides a half reasonable statement | Provides any 1statements | Provides any statements from A | Provides any 3 statements from A | Provides any TWO statements from Merit. | Provides THREE statements from Merit. | Provides any ONE statement from Excellence. | Provides TWO statements from Excellence. |

Question 4 **Aspects of Photosynthesis**

Evidence Statement

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Expected Coverage** | | | | | | Achieve | Merit | Excellence |
|  | **Description of TWO life processes or functions:**   * Photosynthesis: use of light energy to produce food (sugars) from CO2 and H2O * Gas exchange: absorption of CO2 for photosynthesis and getting rid of excess O2 produced.  Explanation given for each cell type: **Pallisade cells:**   * Near upper surface of leaf, upright and perpendicular to light to intercept as much light as possible. * Numerous chloroplasts near incoming light to absorb as much as possible * Fewer air spaces present as most gas exchange is performed by spongy cells (nearer stoma) where gas enters leaf.   **Spongy cells:**   * Fewer chloroplasts present as most light will have been absorbed by palisade cells above. * Shape and spongy nature with high exposed surface area maximises gas exchange (CO2 absorption and loss of O2) * Proximity to stomata (less distance for diffusion) means ready access to CO2 and ability to get rid of O2, yet stomata are relatively protected by being on lower leaf surface. | | | | | | both processes  named  both processes  described | one explanation given for each cell type  two explanations given for each cell type | Fully explains |
|  | **Low light:**   * More chloroplasts in both types of cells and stuff | | | | | | describes | Explains need | Fully explains |
| **Not Achieved** | | | | **Achievement** | | **Merit** | | **Excellence** | |
| **NØ** | | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No response; no relevant evidence. | | Provides any 1/2 statements. | Provides any 1 statements | Provides any 2statements from Achievement. | Provides any 3 statements from Achievement. | Provides any 1statements from Merit. | Provides 2or 3statements from Merit. | Provides any ONE statement from Excellence. | Provides TWO statements from Excellence. |

grade boundaries.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Judgement Statement if using FOUR questions** | | | |  |
|  | **NA** | **A** | **M** | **E** |  |
| **Score range** | **0 – 10** | **11 – 18** | **19– 25** | **26 - 32** |  |