Answer **all** the questions.

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | | **1.** | Transmembrane proteins are involved in the transport of sugars across the plasma membrane.  Glucose can be moved into cells by facilitated diffusion using proteins called GLUT proteins. These proteins expose a single binding site on one side of the membrane. Glucose binds to this site and causes a change in the shape of the protein. This change moves the glucose across the membrane and releases it on the other side.   1. Explain why facilitated diffusion via GLUT proteins requires no metabolic energy.     **[2]**   1. Glucose can also be absorbed by an active process which requires metabolic energy. What is the immediate source of this energy in cells?   **[1]**   1. Explain why glucose cannot pass through a cell membrane by simple diffusion.     **[2]** | | |
| |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | | **2.** | Cells require vitamins and minerals in order to function correctly. These vitamins and minerals need to cross the plasma membrane.  Vitamins are either fat soluble or water soluble. Vitamins A, D, E and K are fat soluble.  Which of the following combinations enter a cell by facilitated diffusion?   |  |  |  | | --- | --- | --- | |  | **A** | vitamin A and calcium ions | |  | **B** | vitamin C and calcium atoms | |  | **C** | vitamin C and calcium ions | |  | **D** | vitamin A and calcium atoms |   Your answer  C:\core\files\questions\1481388992\H020BiologyAH420-01NewSAM\img\p3_01_150.png   |  | | --- | | **[1]** | | | |
| |  | | --- | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | | **3.** | Heart rate can be increased by the hormone adrenaline, which binds to cardiac cells.  Describe how adrenaline binds to cardiac cells.      **[2]** | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | | **4.** | A student tried to extract some DNA from a crushed banana at home. DNA dissolves in water but the student realised that they needed to add something to break open the nuclear envelope to release the DNA.  Suggest a suitable substance the student could use to release the DNA, **and** explain why it should work.      **[2]** | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | | **5.** | *Amoeba proteus* is a single-celled organism that lives in freshwater habitats. Fig. 1.1 is a drawing of *A. proteus*.  C:\core\files\questions\1493223382\H021BiologyAF211-012016Jun\img\p2_01a_150.png  Water continually enters an *Amoeba* from its surroundings. The contractile vacuole is an organelle that collects water from inside the cell and expels it from the cell. The contractile vacuole expands as it collects water and then fuses with the plasma membrane to release the water from the cell.   1. Name the process by which water is expelled from the *Amoeba*.   **[1]**   1. What would happen to an *Amoeba* if it had no contractile vacuole?   **[1]** | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | | **6(a).** | Describe the structure of a plasma (cell surface) membrane.        **[3]** | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | | **(b).** | A student investigated the movement of substances through the cell surface membrane of yeast cells using an indicator.   * The student was supplied with a suspension of yeast cells in a slightly alkaline solution. * The indicator used is yellow in alkaline conditions but turns red in acidic conditions.   The student mixed the indicator with the yeast suspension and labelled the tube containing this suspension **A**. The suspension was red/pink in colour.   1. The student took a small sample from tube **A** and centrifuged this sample.  After centrifuging, the student observed that the liquid portion was colourless but the cells at the bottom were red/pink.  Suggest the mechanism by which the indicator enters the cells and suggest the component of the membrane involved.  mechanism .............................................................................................................................................  component ...................................................................................................................................................   **[2]**   1. The student took a small sample from suspension **A** and added alkaline ammonia solution. There was no colour change.  What could the student conclude about the permeability of the yeast plasma membrane?     **[1]**   1. The student then took another sample from suspension **A** and boiled it. When this boiled suspension was centrifuged the liquid portion was yellow and the cells at the bottom were red/pink.  The student suggested that the liquid in the suspension was yellow because boiling the yeast had damaged the plasma membrane, allowing the indicator out of the cells.  Describe the effect of high temperature on the structure of the yeast cell membranes.  C:\core\files\questions\1494950615\H021BiologyAF211-01Jun15\img\p1_01a_150.pngIn your answer you should use appropriate technical terms, spelled correctly.             **[4]** | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | | **7(a).** | A student investigated the effect of concentration on the rate of diffusion. The student placed identical cubes of agar jelly containing phenolphthalein indicator into hydrochloric acid. Phenolphthalein is pink when alkaline but turns colourless in acidic conditions.  The student used a range of concentrations of hydrochloric acid (0.0, 0.1, 0.2, 0.4 and 0.8M) and measured the time taken for the pink colour in the agar to completely disappear using a stop watch. The student carried out three measurements at each acid concentration.  The student's results are recorded in Fig. 19.  C:\core\files\questions\1497109201\H020-BiologyA_H420-02_Practice_2\img\p22-01a_150.png   1. The student was supplied with a solution of 1M hydrochloric acid.  The student decided to make 50 cm3 of each solution required.  Describe how the student created the concentrations shown using a serial dilution technique.         **[3]**   1. Use the graph in Fig. 19 to estimate the expected time taken to completely discolour a block in 0.3M hydrochloric acid.   **[1]**   1. The student found it very hard to determine exactly when the colour completely disappeared. The results were not easily repeatable.  Describe and explain how this problem could be displayed quantitatively on the graph.       **[2]**   1. The student was using 10 mm agar blocks. The teacher suggested that using larger agar blocks could make the results more easily repeatable.  Explain why using larger agar blocks would make the results more repeatable.     **[2]** | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  | | --- | --- | |  |  | |  |  | | |

# Mark scheme

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| **Question** | | | **Answer/Indicative content** | **Marks** | **Guidance** |
| 1 |  | i | particles have (their own) kinetic energy (1) (movement) down concentration gradient (1) | 2 | **ALLOW** glucose for particles **ALLOW** from high(er) concentration to low(er) concentration |
|  |  | ii | ATP | 1 | **ALLOW** adenosine triphosphate |
|  |  | iii | phospholipids act as a barrier (1) (glucose) molecules too large (1) | 2 | **ALLOW** (glucose) not soluble in phospholipid bilayer because of polar –OH groups for 2 marks |
|  |  |  | **Total** | **5** |  |
| 2 |  |  | C | 1 |  |
|  |  |  | **Total** | **1** |  |
| 3 |  |  | (binds to) receptor in, cell surface / plasma, membrane (1) glycoprotein (1) | 2 |  |
|  |  |  | **Total** | **2** |  |
| 4 |  |  | detergent (1) works as an emulsifier / attracts phospholipid molecules and water molecules (1) it will break up the plasma / nuclear membranes (1) | 2 |  |
|  |  |  | **Total** | **2** |  |
| 5 |  | i | exocytosis; | 1 | **Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **DO NOT CREDIT pinocytosis / pino(exocytosis)**   **Examiner's Comments**  Most candidates correctly named the process as exocytosis. The most common error was to name it as ‘osmosis’. |
|  |  | ii | burst / lysis / plasma membrane would rupture; | 1 | **Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** haemolysis **DO NOT CREDIT** plasmolysis   **Examiner's Comments**  Most candidates knew that the cell would burst although a good number thought that an animal cell could become turgid and some confused this with plasmolysis. |
|  |  |  | **Total** | **2** |  |
| 6 | a |  | phospholipid bilayer containing proteins;  head / hydrophilic region, facing outwards **OR** tail / hydrophobic region, facing inwards;  ref to intrinsic **and** extrinsic (glyco)proteins / described;  idea of: glycoproteins / glycolipids, sticking out (of bilayer / membrane);     cholesterol, inside bilayer / between phospholipids; | 3 max | **Marks can be awarded for an annotated diagram** **IGNORE** ref to ‘fluid mosaic model’ **ACCEPT** glycoprotein / channel protein / carrier protein / etc. for protein **DO NOT CREDIT** ref to hyrophobic heads or hydrophillic tails   **ACCEPT** transmembrane for intrinsic **and** on surface for extrinsic  **IGNORE** ref to functions such as ‘carrier / channel’ etc.  **IGNORE** glycoproteins / glycolipids are, extrinsic / on the outside / on surface  **CREDIT** between fatty acid tails   **Examiner's Comments**  The level of difficulty in this question was generally considered to be appropriate and candidates performed well. However, where the knowledge had to be applied in an unfamiliar context candidates performed less well. The majority of candidates had a fairly good idea of the structure of the plasma membrane but it was obvious that many had not read the question or fully understood what was required. Many candidates churned out a rote-learned response about the functions of the components of the membrane without actually describing in detail the structure of the membrane – ie: how the positions of the various components actually relate to one another. Some candidates used diagrams but these were generally poorly annotated, if at all, and so gained little credit. Almost all candidates gained credit for noting that the phospholipids are found in a bilayer which also contains proteins. More able candidates correctly used the terms hydrophobic and hydrophilic in reference to the parts of the phospholipids but often failed to correctly describe their orientation in the membrane. Quite a few candidates used the terms intrinsic and extrinsic in reference to proteins but those attempting to describe the position of the proteins in the membrane often gave muddled answers and failed to gain credit. This was often confused by attempts to give the functions of the proteins which were not required. Many candidates discussed the functions of cholesterol, glycoproteins and glycolipids but again failed to fully describe their position in the membrane structure. |
|  | b | i | active transport / uptake; (transport / carrier) protein; | 2 | **Mark the first answer on each prompt line.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then = **0 marks**   **ACCEPT** intrinsic protein / transmembrane protein **DO NOT CREDIT** channel protein / extrinsic protein   **Examiner's Comments**  It was important that candidates read and understood the information given in the question. The majority of candidates gave the answer ‘facilitated diffusion’. However, since the liquid portion of the solution was colourless after centrifugation all the indicator must have entered the cells. Therefore, the only correct response must be active transport. Those candidates who realised it was active transport also achieved the second point. |
|  |  | ii | not permeable to, ammonia / NH3 / ammonium / NH+4; | 1 | Response must be specific to permeability to ammonia **CREDIT** ammonia cannot pass through membrane **ACCEPT** selectively permeable so does not allow passage of ammonia (into the cells) **IGNORE** ‘selectively / partially, permeable’ unqualified **IGNORE** ‘not permeable to alkalis’   **Examiner's Comments**  Many candidates referred to the membrane being ‘partially permeable’ or ‘selectively permeable’ which is correct, but does not fully answer the question. Since the test refers to ammonia solution the student can only conclude something about the permeability to ammonia or ammonium ions. Only the most able candidates gave the correct response – that the membrane is impermeable to ammonia or ammonium ions. |
|  |  | iii | **phospholipids** / (named) molecules, vibrate more / move around more / have more **kinetic energy**; increases, size / number, of gaps, in membrane / between phospholipids;     **bilayer**, becomes more fluid / melts;    proteins / glycoproteins, **denatured**;  **max 3**   **QWC**; **max 1** | 4 max | **IGNORE** refs to increase in permeability / leaky as the question asks about structure not properties    **CREDIT** creates gaps in membrane **ACCEPT** holes for gaps **IGNORE** ref to pores, ref to gaps created by proteins denaturing  **IGNORE** membrane / phospholipids become more fluid   **ACCEPT** description of denaturing e.g. 30 shape / tertiary structure, changes **IGNORE** enzymes denature , ref to active site  Any **two** technical terms from the list below used appropriately and spelled correctly :  **phospholipid(s)**       **bilayer** **kinetic energy** (ref to molecules - do not credit in ref to membrane or cell) **denature(d)** (must refer to proteins or glycoproteins)   **Examiner's Comments**  Most candidates have a good idea about the effects of high temperature on the structure of the membrane, however, marks were often lost as a result of imprecise wording of the responses. Many candidates appreciated that increasing the temperature increases the kinetic energy but this was often described in ways that brought to mind membranes being thrown into wave patterns that become so large that the membrane is eventually broken apart. More able candidates knew that it is the kinetic energy of individual molecules that is increased and as the phospholipids move about more at random this creates gaps in the membrane. Candidates also knew that proteins are denatured by excessive temperatures but many only referred to enzymes, perhaps forgetting that the question was about the effect of high temperature on a cell membrane and not an enzyme controlled reaction. In addition, there were numerous references to changes in the properties of the membrane such as ‘the membrane becomes leaky’ with no further qualification about changes to the structure of the membrane. |
|  |  |  | **Total** | **10** |  |
| 7 | a | i | (use a) 100cm3 measuring cylinder ✓  mix 80cm3 acid and 20cm3 water ✓  take 50cm3 of the resulting solution and add 50cm3 water ✓ repeat 50 / 50 dilution for each subsequent solution required / AW ✓ | Max 3 | **ACCEPT** annotated diagram |
|  |  | ii | 195 − 200 s ✓ | 1 | the unit must be included |
|  |  | iii | range bars ✓  longer range bar indicates more variability / less repeatable ✓ | 2 |  |
|  |  | iv | longer time taken to discolour ✓  error becomes smaller proportion of total / % error reduced ✓ | 2 |  |
|  | b |  | cut block in half ✓  measure, thickness of colourless region / distance from edge of block to coloured region ✓  divide distance (acid diffused) by time ✓ | 3 |  |
|  |  |  | **Total** | **11** |  |