

1. (a) Complete each box in the table, which compares a prokaryotic and a eukaryotic cell, with a tick if the statement is correct or a cross if it is incorrect.

	Prokaryotic cell	Eukaryotic cell
Contains ribosomes attached to the endoplasmic reticulum		
Genetic material consists of linear chromosomes		
Diameter of the cell is 1 $\mu\text{m}$		

(2)

- (b) A student was asked to describe the structure of two organelles which were present on an electron micrograph. From the descriptions below, identify the organelles and, in each case, name the internal structures underlined.

- (i) This organelle was disc shaped and had an outer envelope of two membranes. Within it was a series of further membranes which crossed the organelle like railway tracks. At intervals the membranes appeared to repeatedly double back on themselves to form stack-like structures. In the spaces between the membranes was a granular material.

Organelle.....

Internal structures .....

(2)

- (ii) This organelle had a round shape and had an outer envelope of two membranes, which was perforated in places. Within it were thin strands which did not appear to have the width or organisation of membranes. One large round structure was visible internally.

Organelle.....

Internal structures .....

(2)

(Total 6 marks)

2. (a) (i) Give **two** ways in which active transport differs from diffusion.

1.....  
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2.....  
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(2)

(ii) Sodium ions move from the surrounding solution where they are at a low concentration into the cytoplasm of a cell where they are at a higher concentration. Cyanide ions stop the functioning of the electron carrier system in mitochondria.

Use these two pieces of information to explain how the addition of cyanide ions would affect the uptake of sodium ions by a cell.

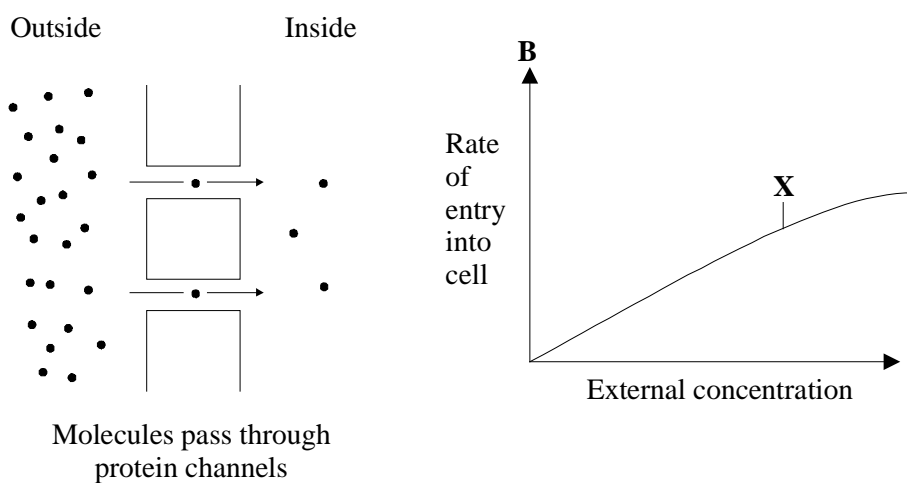
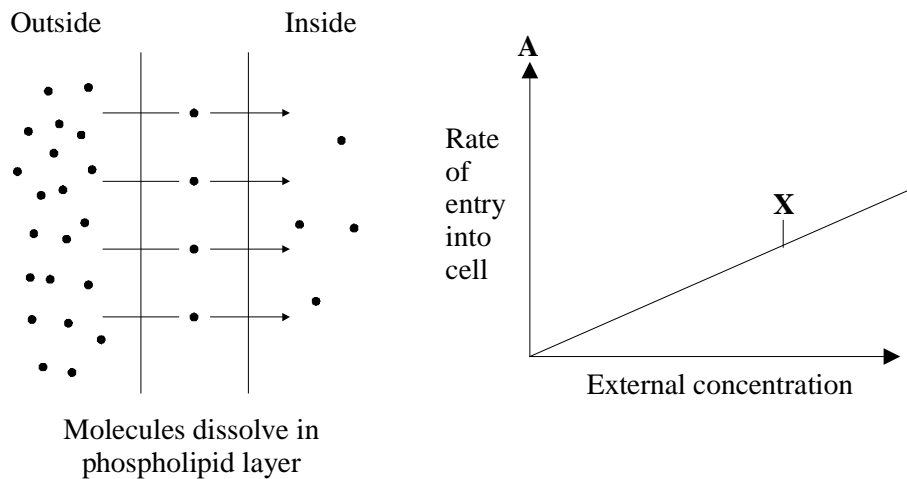
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(2)

(b) Two major routes by which molecules are thought to cross membranes are:

1. by dissolving in the phospholipid layer.
2. by passing through channels in protein molecules.

These routes are illustrated in the diagram. The graphs show the rate of entry of molecules into the cell by these two routes in relation to the external concentration of the molecules.



(i) Explain why curves are similar up to point X

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(ii) Explain what causes the shapes of the curves to differ after point X.

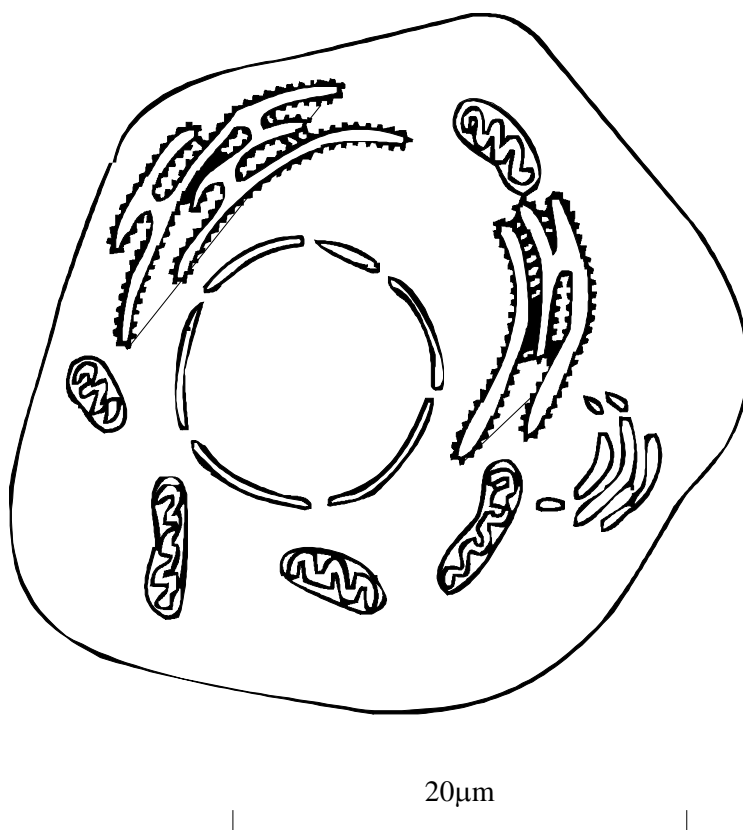
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(1)  
(Total 6 marks)

3. The diagram shows an animal cell.



- (a) The scale bar on the diagram represents a length of 20  $\mu\text{m}$ . Use this to calculate the magnification of this diagram. Show your working.

Magnification..... (2)

- (b) Use a guideline and the appropriate letter to show, on the diagram, a site in this cell where

- (i) the enzymes controlling glycolysis are found (**A**); (1)

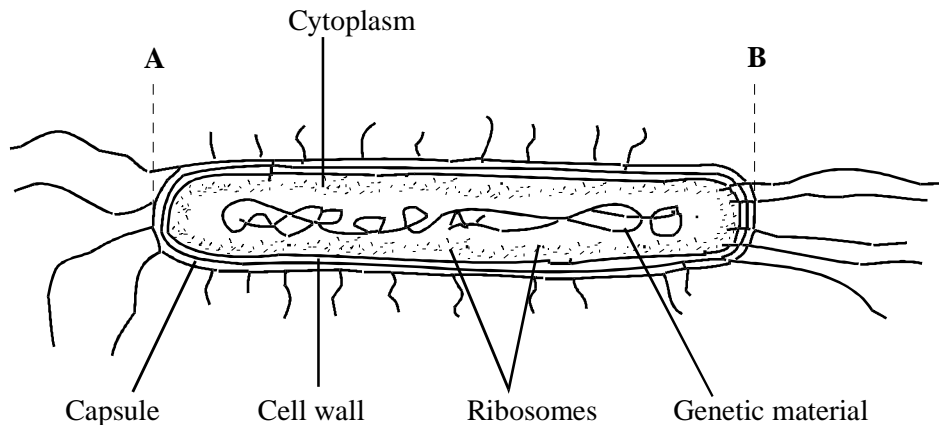
- (ii) molecules of enzymes are synthesised (**B**). (1)

- (c) The number of cristae in the mitochondria of a cell with a high metabolic activity is greater than the number in a cell with lower metabolic activity. Explain why.

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(2)  
(Total 6 marks)

4. The diagram shows an *Escherichia coli* bacterium at a magnification of x 20 000.



(a) What is the actual length of the bacterium from A to B in micrometres ( $\mu\text{m}$ )?

Show your working.

Length.....micrometres

(2)

(b) For each of the following, give **one** way in which the structure or location in *E. Coli* differs from that in a eukaryotic cell.

(i) genetic material

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.....

(1)

(ii) ribosomes

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.....

(1)

(iii) respiratory enzymes

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(1)

- (c) *E.coli* bacteria can regulate their water content by active transport of potassium ions. A decrease in the water potential of the solution around the bacteria stimulates active uptake of potassium ions.

Explain how this would help the bacteria to regulate their water content.

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(2)  
(Total 7 marks)

- 5. (a) Give **two** ways in which the structure of a bacterial cell is different from that of a eukaryotic cell.

1.....

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2.....

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(2)

- (b) Name the following structures found in bacterial cells.

- (i) a long whip-like filament used in movement

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- (ii) an organelle where proteins are synthesised

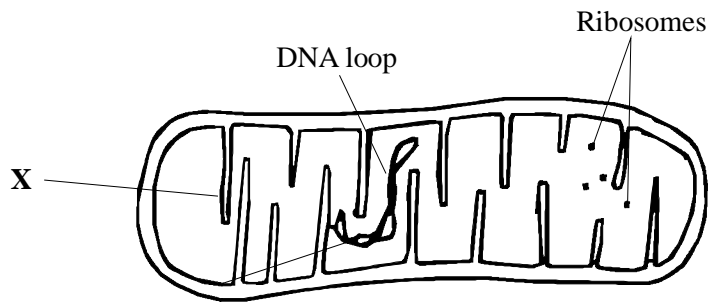
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- (iii) a small circular piece of DNA which carries genes additional to those on the main loop of DNA

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(3)  
(Total 5 marks)

- 6. The diagram shows a mitochondrion.



(a) (i) Name the part labelled **X**.

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(1)

(ii) A human liver cell contains several hundred mitochondria. A cell from a plant root has only a small number. Suggest an explanation for this difference.

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(2)

(iii) Mitochondria contain some DNA and ribosomes. Suggest the function of these.

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(2)



- (b) Mitochondria may be separated from homogenised cells by differential centrifugation. During this process the cells must be kept in an isotonic solution. Explain why.

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(2)

- (c) Ribosomes in bacterial cells differ from those in the cytoplasm of eukaryotic cells. When centrifuged at high speed, the eukaryotic cell ribosomes sediment more rapidly than bacterial ribosomes. Explain what this tells you about the difference between bacterial and eukaryotic ribosomes

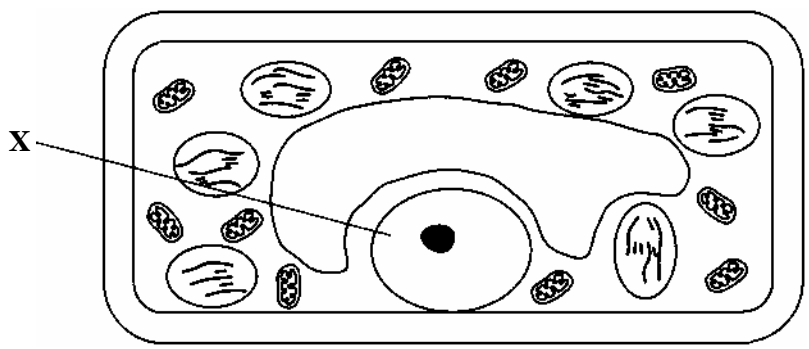
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(1)

(Total 8 marks)

- 7. (a) The drawing shows a section through a plant cell.



- (i) Name organelle X.

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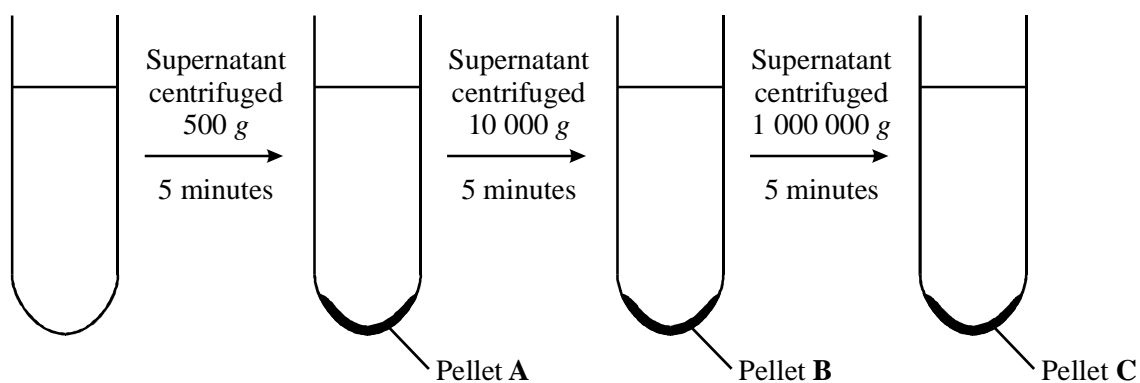
(1)

- (ii) The magnification of the drawing is  $\times 7000$ . Calculate the maximum actual length of the organelle labelled X. Show your working.

Answer .....  $\mu\text{m}$

(2)

Liver cells were broken open in an ice-cold, isotonic solution. The mixture was then differentially centrifuged in order to isolate cell organelles.



- (b) Suggest why the solution used was

- (i) ice-cold;

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 .....

(1)

- (ii) isotonic.

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(1)

(c) Which pellet contains the nuclei? Explain your answer.

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(2)

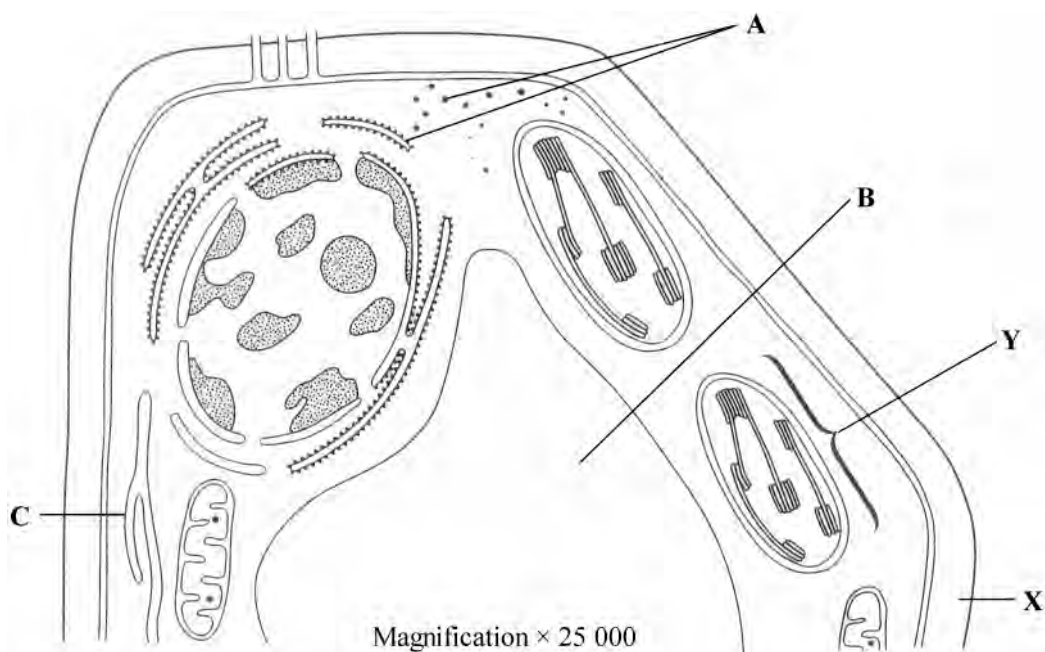
(d) Suggest **one** piece of evidence that would show that the mitochondria could still function after isolation.

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(1)

(Total 8 marks)

8. The diagram shows part of a plant cell as seen through an electron microscope.



(a) Name organelles **A**, **B** and **C**.

**A** .....

**B** .....

**C** .....

(3)

(b) Give the function of

(i) structure **X**;

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.....

(ii) structure **Y**.

.....

.....

(2)

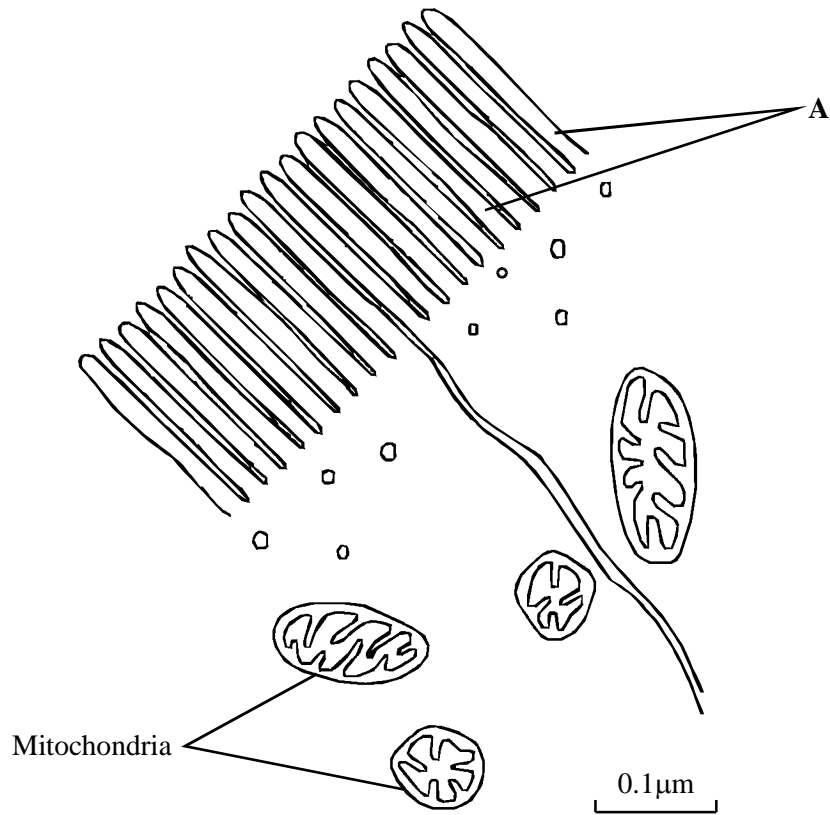
(c) Calculate the width of the structure labelled **X** in micrometres.  
Show your working.

Width ..... micrometres ( $\mu\text{m}$ )

(2)

(Total 7 marks)

9. The drawing shows an electron micrograph of parts of epithelial cells from the small intestine.



(a) (i) Name the structures labelled A.

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(1)

(ii) Explain how these structures help in the absorption of substances from the small intestine.

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.....

(1)

- (b) (i) The scale bar on this drawing represents a length of  $0.1\mu\text{m}$ . Calculate the magnification of the drawing. Show your working.

Magnification ..... (2)

- (ii) Explain why an electron microscope shows more detail of cell structure than a light microscope.

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(2)

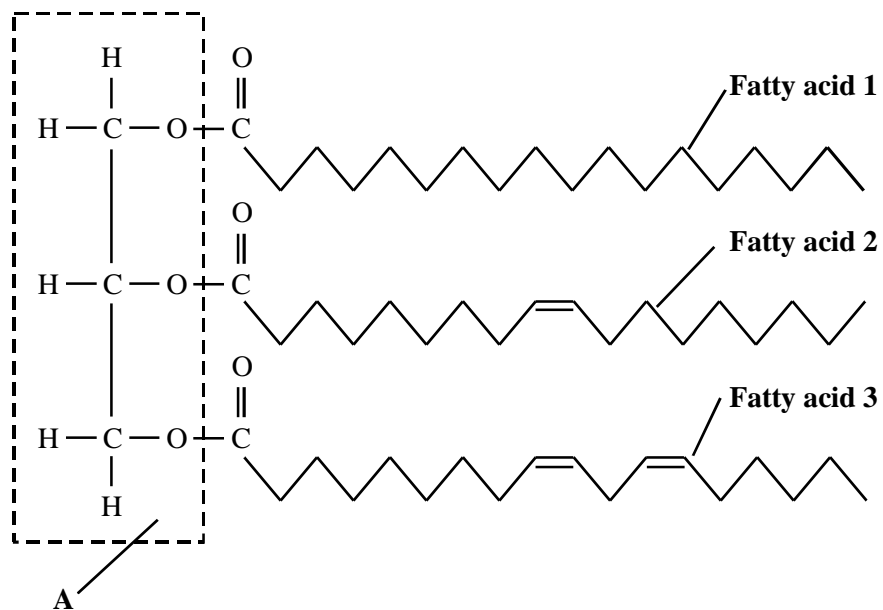
- (c) The length of mitochondria can vary from  $1.5\mu\text{m}$  to  $10\mu\text{m}$  but their width never exceeds  $1\mu\text{m}$ . Explain the advantage of the width of mitochondria being no more than  $1\mu\text{m}$ .

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(1)

**(Total 7 marks)**

10. The diagram shows a triglyceride molecule.



(a) Name part A.

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(1)

(b) With reference to named parts of the diagram, explain the difference between the terms:

(i) *triglyceride* and *phospholipid*;

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.....

(2)

(ii) *saturated* and *unsaturated*.

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(2)  
(Total 5 marks)

11. (a) Describe a chemical test you could carry out to show that a piece of coconut contains lipids.

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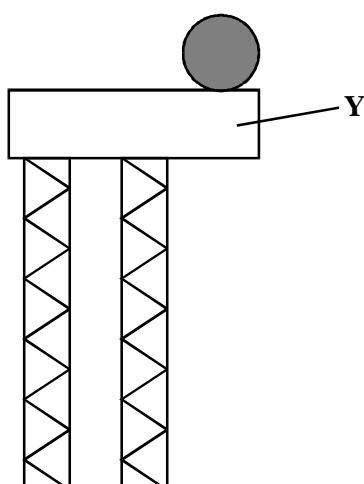
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(3)

(b) The diagram shows the structure of a phospholipid molecule,





(i) Name the part of the molecule labelled Y.

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(1)

(ii) Describe how a phospholipid molecule differs in structure from a triglyceride molecule

.....

.....

(1)

(iii) Chitin is a nitrogen-containing polysaccharide. Name **one** chemical element present in a phospholipid which would not be present in chitin.

.....

(1)

(c) An artificial membrane was made. It consisted only of a bilayer of phospholipid molecules. In an investigation, the permeability of this artificial membrane was compared with the permeability of a plasma membrane from a cell. Explain why:

(i) both membranes allowed lipid soluble molecules to pass through

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.....

(1)

(ii) only the plasma membrane allowed glucose to pass through.

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(2)

(Total 9 marks)

12. (a) (i) How many molecules are produced when a triglyceride molecule is completely hydrolysed?

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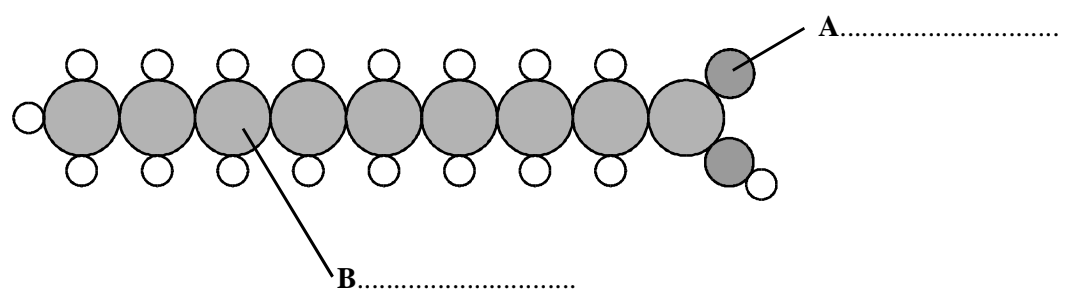
(1)

(ii) Many large biological molecules are polymers. Explain why triglycerides are **not** polymers.

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 .....

(1)

(b) Molecules can be represented in different ways. **Figure 1** shows a model of a fatty acid. It shows the different atoms that make up the molecule.



**Figure 1**

(i) Complete the diagram by naming the atoms labelled **A** and **B**.

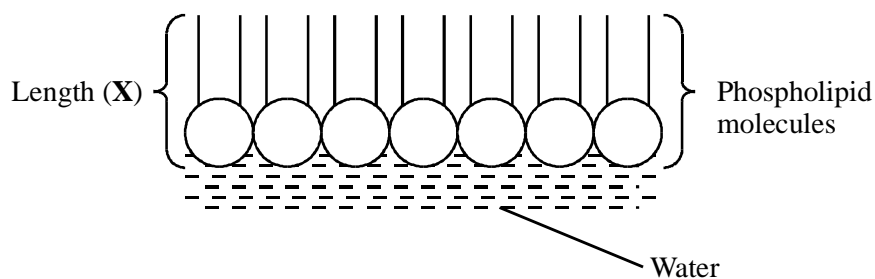
(2)

(ii) This molecule is a saturated fatty acid. Explain the meaning of *saturated*.

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(1)

- (c) A drop of phospholipid was put into a large dish of water. The drop had a volume of  $1 \text{ mm}^3$ . It spread out to form a film on the surface of the water which covered an area of  $400\,000 \text{ mm}^2$ . **Figure 2** shows the appearance of the surface film formed by the phospholipid molecules.



**Figure 2**

- (i) Calculate the length (**X**) of a single phospholipid molecule. Show your working.

Answer .....

(2)

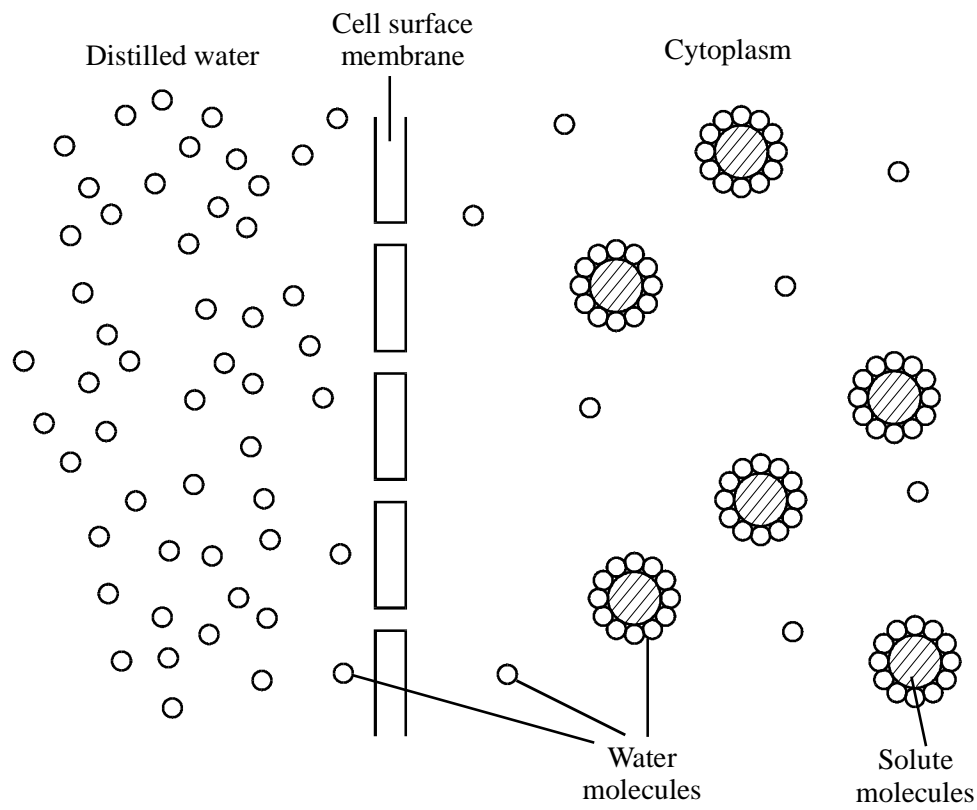
- (ii) Explain what causes the phospholipid molecules to be arranged in the way shown in **Figure 2**.

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 .....  
 .....  
 .....

(2)

**(Total 9 marks)**

13. The diagram represents part of an animal cell which has been put in distilled water.



(a) Use the diagram to:

(i) explain why the water potential of the distilled water is higher than the water potential of the cytoplasm of the cell;

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.....

.....

(2)

(ii) describe the property of the cell surface membrane which allows osmosis to take place.

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(1)

(b) Osmosis has been described as a special case of diffusion. Describe **two** ways in which you would expect the movement of water into a cell by osmosis to be similar to the diffusion of oxygen into a cell.

- 1.....
- .....
- 2.....
- .....

(2)  
(Total 5 marks)

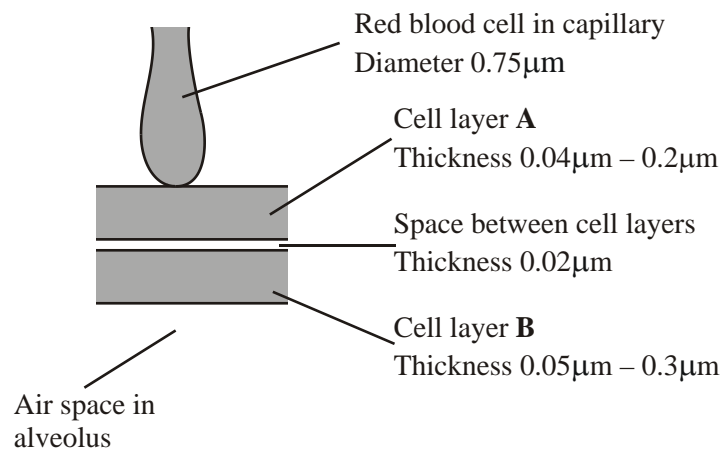
14. In the lungs, the alveoli are the site of gas exchange.

(a) A large number of small alveoli is more efficient in gas exchange than a smaller number of larger alveoli. Explain why.

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- .....
- .....
- .....

(2)

(b) The diagram shows part of an alveolus and a capillary.



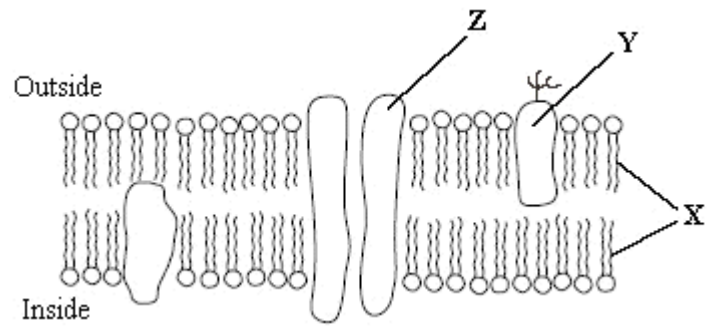
- (i) Name the type of cells in layer **B**.
- .....
- (1)
- (ii) What is the minimum distance a molecule of carbon dioxide diffuses from the blood plasma to the air space in the alveolus?
- .....
- (1)
- (c) Just before a person starts to exhale, the composition of the air in an alveolus differs from the composition of the air in the trachea.
- (i) Give **two** ways in which the composition would differ.
- 1 .....
- 2 .....
- (1)
- (ii) Explain what causes this difference in composition between the air in the alveolus and the air in the trachea.
- .....
- .....
- (1)
- (d) The partial pressure of a gas is a measure of the amount of gas that is present. The partial pressure of carbon dioxide in blood going to the lungs is 6.3 kPa. The partial pressure of carbon dioxide in an alveolus is 5.3 kPa.
- (i) Through which vessel does blood leave the heart to go to the lungs?
- .....
- (1)

(ii) Suggest why blood returning to the heart from the lungs contains some carbon dioxide.

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(2)  
(Total 9 marks)

15. The diagram shows part of a plasma membrane.



(a) Describe **two** functions of the structure made from the parts labelled **X**.

1 .....

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2 .....

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(2)

(b) Give **one** function of the molecule labelled **Y**.

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(1)

(c) The part labelled **Z** is involved in facilitated diffusion of substances across the membrane.

(i) Give **one** similarity in the way in which active transport and facilitated diffusion transport substances across the membrane.

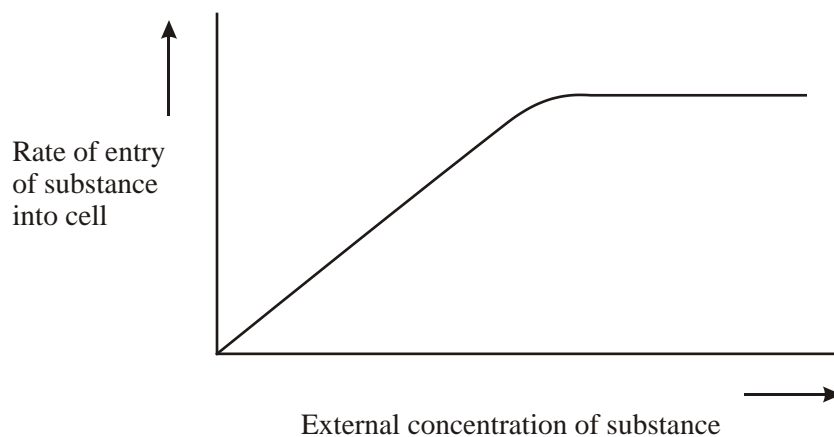
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(ii) Give **one** way in which active transport differs from facilitated diffusion.

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(2)

(iii) The graph shows the relationship between the concentration of a substance outside a cell and the rate of entry of this substance into the cell.



Explain the evidence from the graph that this substance is entering the cell by facilitated diffusion and not by simple diffusion.

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(2)

(Total 7 marks)



16. Cholera is a water-borne disease caused by the intestinal pathogen, *Vibrio cholerae*. The pathogen produces an exotoxin which acts specifically on the epithelial cells of the small intestine causing changes in membrane permeability. Individuals with cholera suffer from severe diarrhoea which may result in death.

(a) Suggest **two** precautions which could be used to prevent the transmission of cholera.

- 1 .....
- 2 .....

(1)

(b) Explain how the effects of diarrhoea on the body can be treated.

- .....
- .....
- .....
- .....

(2)

(c) (i) What is an exotoxin?

- .....
- .....

(1)

**S** (ii) Suggest why the cholera exotoxin is specific to the epithelial cells of the small intestine.

- .....
- .....
- .....
- .....

(2)

**S** (d) The cholera exotoxin affects the movement of ions through the intestinal wall. It causes the loss of chloride ions from the blood into the lumen of the small intestine. This prevents the movement of sodium ions from the lumen of the small intestine into the blood.

(i) Describe how sodium ions normally enter the blood from the cells of the intestinal wall against a concentration gradient.

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(2)

(ii) Use the information provided to explain why individuals with cholera have diarrhoea.

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(2)

**(Total 10 marks)**