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 μm		

(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 <u>stack-like structures</u>. 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 <u>thin strands</u> 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.....

.....

2.....

.....

(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.

.....

.....

.....

.....

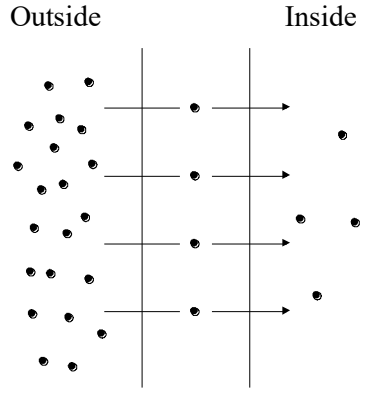
(2)

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

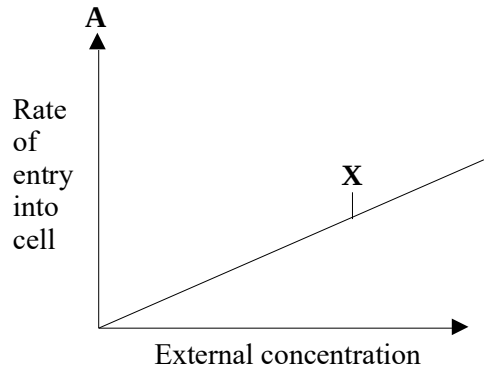
1. by dissolving in the phospholipid layer.

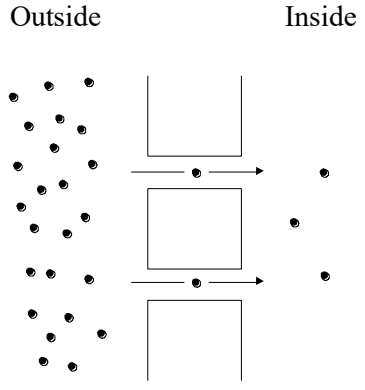
2. by passing through channels in protein molecules.

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.

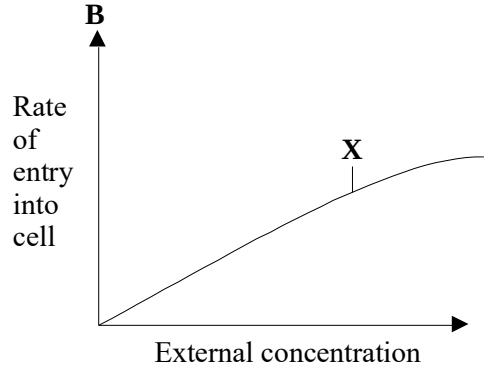


Molecules dissolve in phospholipid layer





Molecules pass through protein channels



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

.....

.....

.....

(1)

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

.....

.....

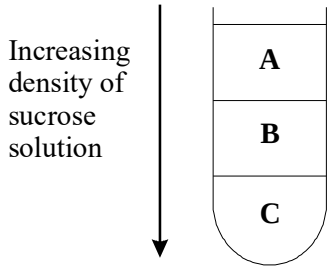
.....

(1)

(Total 6 marks)

3. Cell organelles can be separated by centrifuging a cell extract in a sucrose density gradient. The organelles settle at the level in the sucrose solution which has the same density as their own.

Some animal cells were broken open and the cell extract centrifuged in a sucrose density gradient. Three distinct fractions were obtained, **A**, **B** and **C**, as shown in the diagram.



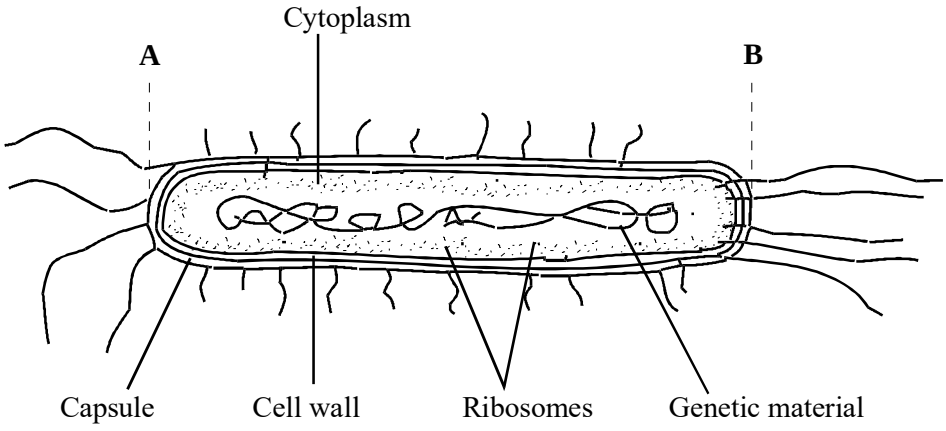
One fraction contained nuclei, one contained ribosomes and a third contained mitochondria.

Complete the table by identifying the organelle in each fraction and describing one function of each organelle.

Fraction	Organelle	Function
A		
B		
C		

(Total 4 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 (μm)?

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

.....

.....

(1)

(ii) ribosomes

.....

.....

(1)

(iii) respiratory enzymes

.....

.....

(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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.....

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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.....

.....

2.....

.....

(2)

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

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

.....

(ii) an organelle where proteins are synthesised

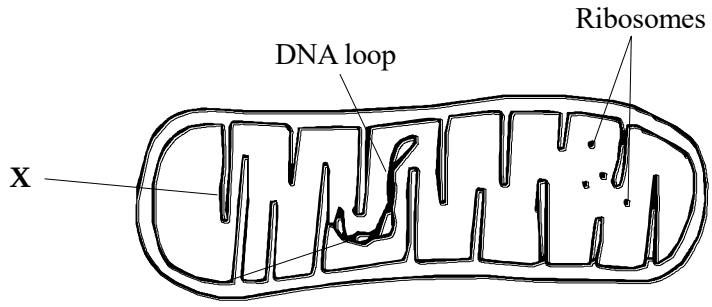
.....

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

.....

(3)
(Total 5 marks)

6. The diagram shows a mitochondrion.



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

.....

(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.

.....

.....

.....

.....

(2)

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

.....

.....

.....

.....

(2)

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

.....

.....

.....

.....

(2)

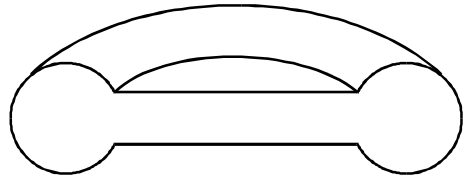
(c) Ribosomes in bacterial cells differ from those in the cytoplasm of eukaryotic cells. When centrifuged at high speed, the eukaryotic cell ribosomes sediment more rapidly than bacterial ribosomes.
Explain what this tells you about the difference between bacterial and eukaryotic ribosomes

.....

.....

(1)
(Total 8 marks)

7. The diagram shows a cross-section of a typical red blood cell. Red blood cells can carry both oxygen and carbon dioxide. Each cell has a thinner central area as shown in the diagram.



(a) Explain **one** advantage of the shape of red blood cells.

.....

.....

.....

.....

(2)

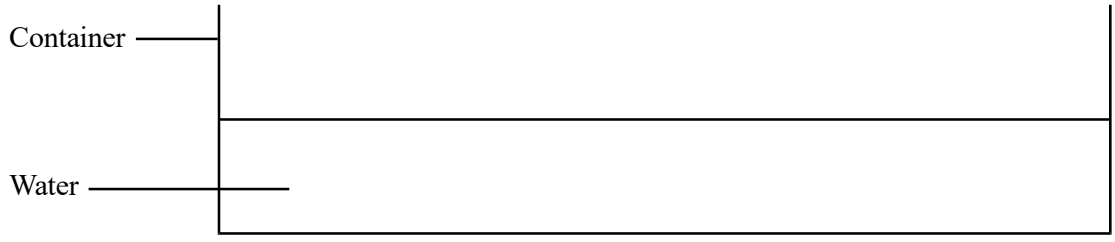
(b) Red blood cells do not have a nucleus or rough endoplasmic reticulum.
Give **one** function that red blood cells are therefore unable to carry out.

.....

(1)

(c) In an experiment, the phospholipids were extracted from the surface membrane of a single red blood cell. They were placed on the surface of water and allowed to spread out.

(i) Using  to represent a single phospholipid molecule, draw on the diagram how you would expect **ten** phospholipid molecules to be arranged on the water surface.



(2)

(ii) The area of water covered by the phospholipid molecules was calculated. This area was given an arbitrary value of 1. The surface area of an intact red blood cell was measured on the same scale. What would you expect the arbitrary value of the red blood cell surface area to be? Explain your answer.

Arbitrary value .....

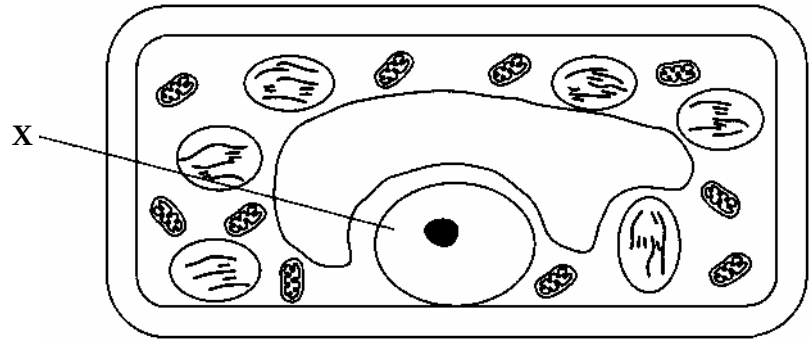
Explanation .....

.....

(2)

(Total 7 marks)

8. (a) The drawing shows a section through a plant cell.



(i) Name organelle **X**.

.....

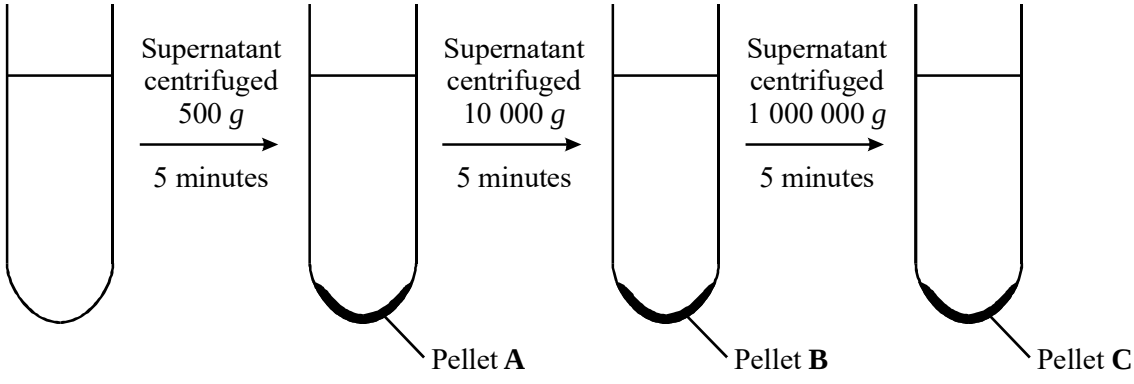
(1)

(ii) The magnification of the drawing is × 7000. Calculate the maximum actual length of the organelle labelled **X**. Show your working.

Answer ..... μm

(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;

.....

.....

(1)

(ii) isotonic.

.....

.....

(1)

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

.....

.....

(2)

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

.....

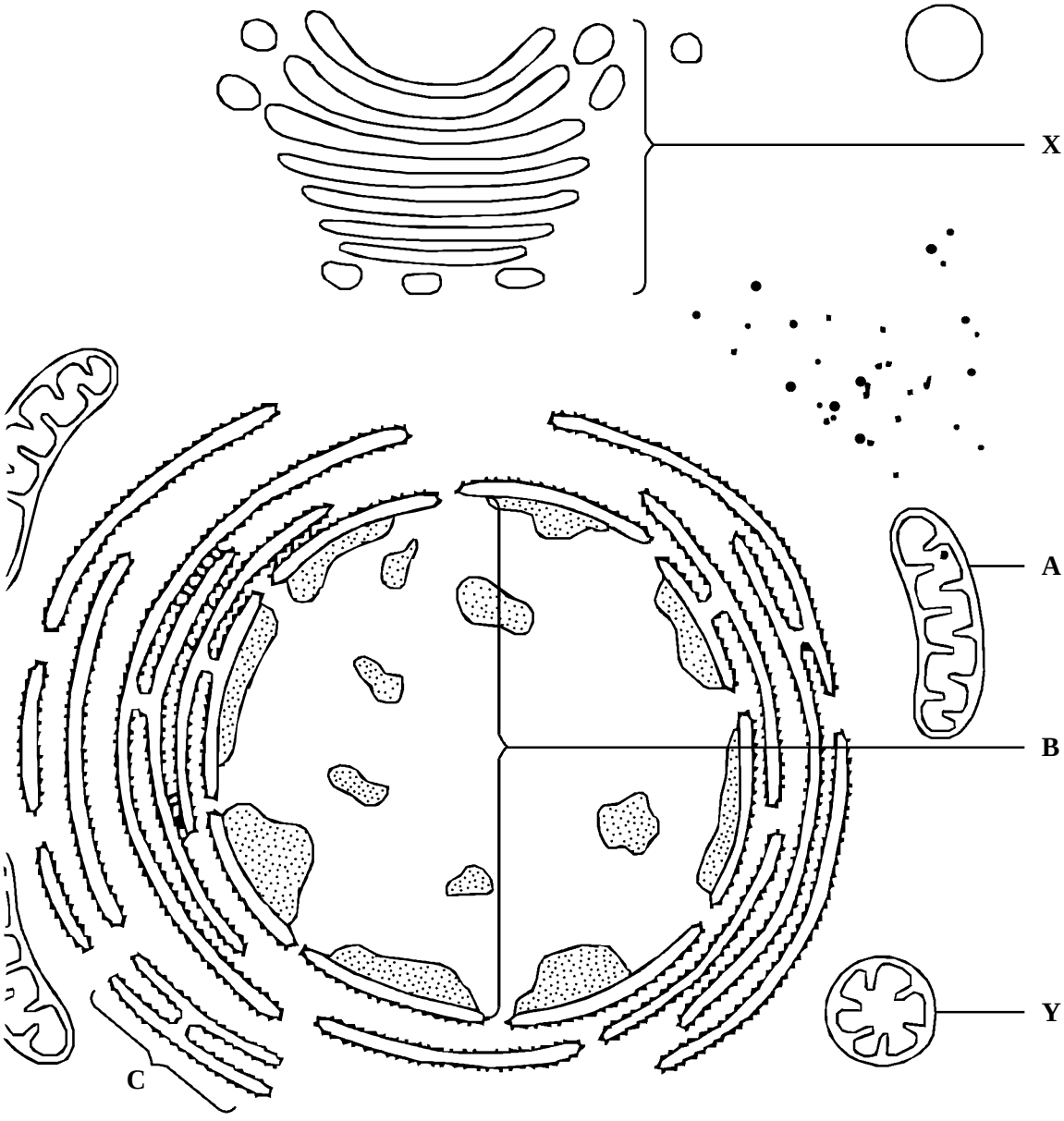
.....

.....

(1)

(Total 8 marks)

9. The diagram shows part of an animal cell as seen through an electron microscope.



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

A .....

B .....

C .....

(3)

(b) Describe the function of organelle **X.**

.....

.....

.....

.....

(2)

(c) The actual diameter of organelle **Y** is 0.5 pm.μm.

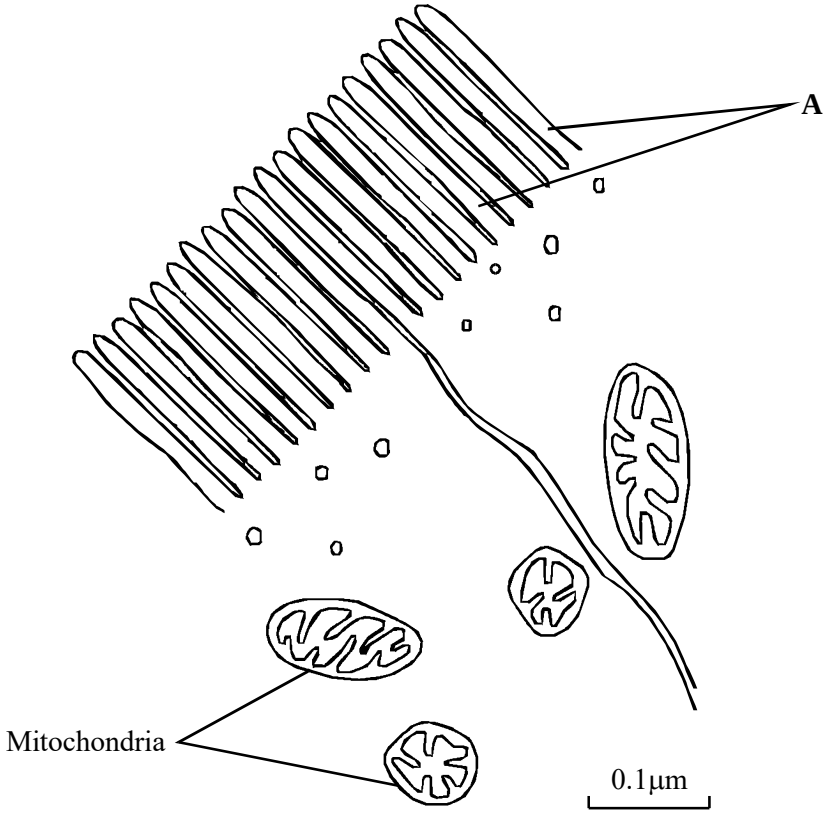
Calculate the magnification of the diagram. Show your working.

Magnification .....

(2)

(Total 7 marks)

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



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

.....

(1)

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

.....

.....

(1)

(b) (i) The scale bar on this drawing represents a length of 0.1 μm. 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.

.....

.....

.....

(2)

(c) The length of mitochondria can vary from 1.5 μm to 10 μm but their width never exceeds 1 μm. Explain the advantage of the width of mitochondria being no more than 1 μm.

.....

.....

(1)

(Total 7 marks)

11. S Gorter and Grendel investigated the structure of the surface membrane of cells. They extracted the phospholipids from the surface membranes of red blood cells in 1 cm^3 of blood and placed them in the apparatus shown in **Figure 1**.

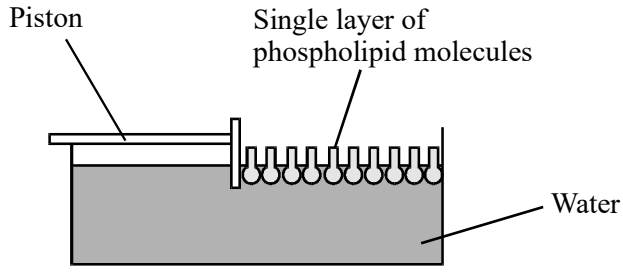


Figure 1

The piston was pushed across the surface of the water until the phospholipid molecules were tightly packed into a single layer. The area covered by the phospholipid molecules was measured. This area was compared with the estimated surface area of the red blood cells from which phospholipids were extracted.

Gorter and Grendel obtained the data shown in the table.

Number of red blood cells per cm^3 of blood	4.74×10^9
Estimated mean surface area of one red blood cell	99.4 μm^2
Surface area of membrane phospholipids extracted from $1cm^3$ of blood	0.92 m^2

(a) Explain what these data suggest about the arrangement of phospholipids in the surface membranes of red blood cells. Support your explanation with suitable calculations. Show your working.

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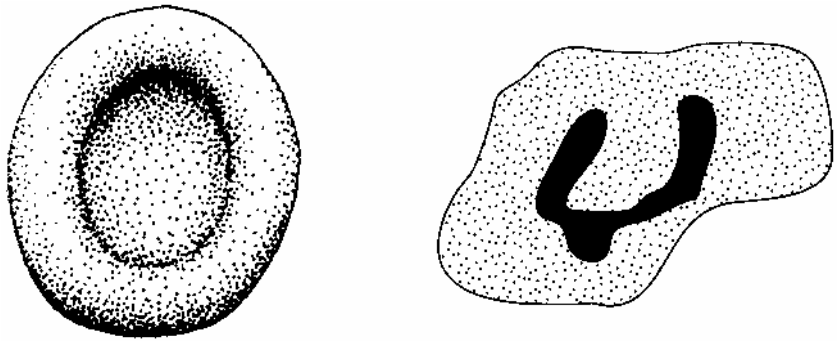
(3)

(b) **Figure 2** shows a red blood cell and a white blood cell.



Red blood cell White blood cell

Figure 2

Explain why red blood cells were used in this investigation rather than white blood cells.

.....

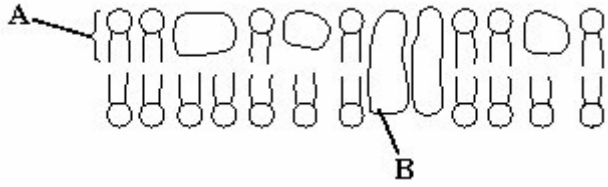
.....

.....

.....

(2)
(Total 5 marks)

12. (a) The diagram shows the fluid-mosaic model of a cell surface membrane.



(i) Name the molecules labelled **A** and **B**.

A .....

B .....

(1)

(ii) How does the bilayer formed by substance **A** affect entry and exit of substances into and out of a cell?

.....

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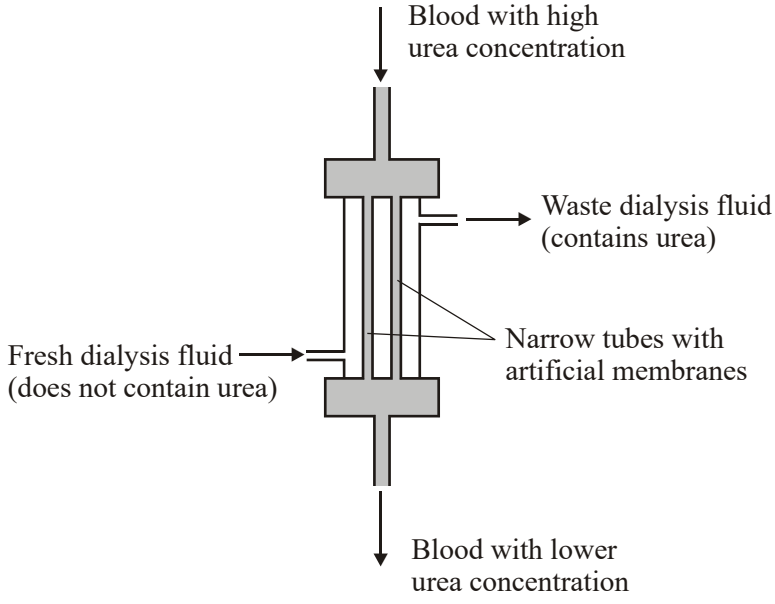
.....

.....

(2)

(b) A dialysis machine contains artificial membranes which enable urea to be removed from the blood of a person with kidney failure. The diagram shows a dialysis machine.



(i) By what process does urea pass from the blood into the dialysis fluid?

.....

(1)

(ii) Suggest **two** reasons for keeping the fluid in the dialysis machine at 40 °C rather than room temperature.

1 .....

.....

2 .....

.....

(2)

(iii) The blood and the dialysis fluid flow in opposite directions in the dialysis machine. Explain the advantage of this.

.....

.....

.....

.....

(2)

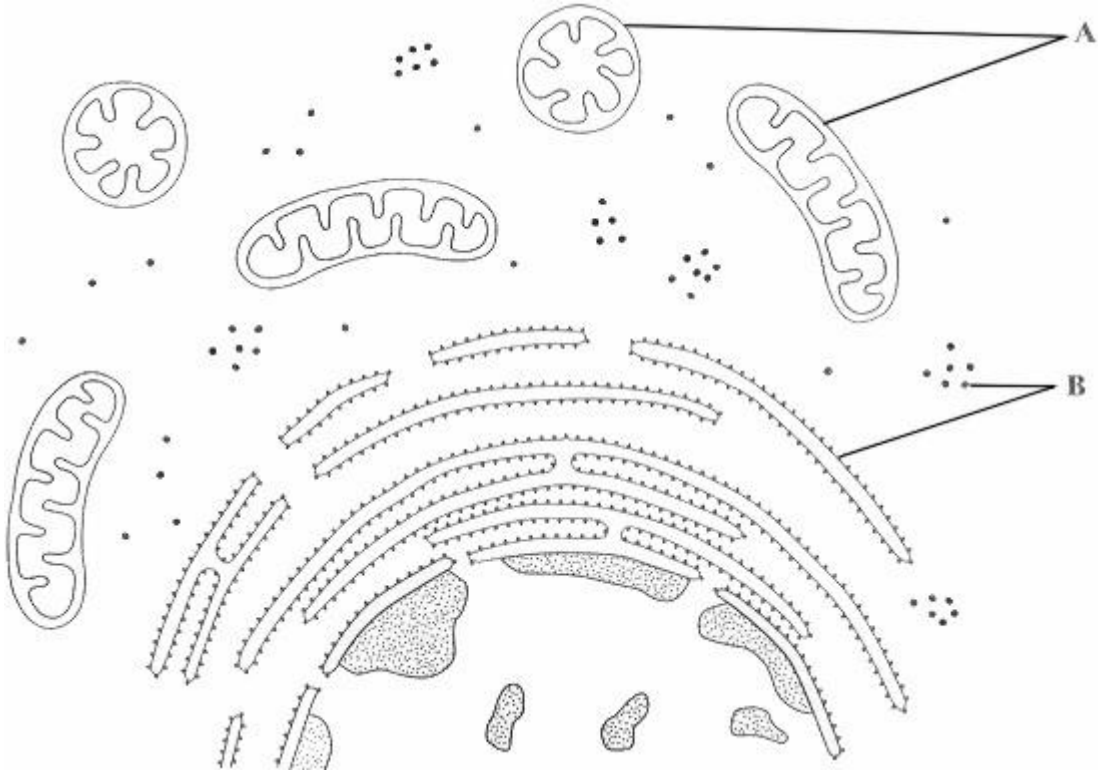
(iv) Blood flows through the dialysis machine at a rate of 200 cm^3 per minute. Calculate the total volume which passes through the machine in 5 hours. Give your answer in dm^3 and show your working.

Answer ..... dm^3

(2)

(Total 10 marks)

13. The diagram shows part of an animal cell as seen through an electron microscope.



(a) Name the organelles labelled **A** and **B**.

A .....

B .....

(2)

(b) Explain why the shapes of the two organelles labelled **A** appear different.

.....

.....

.....

.....

(2)

(c) Give the function of organelle **B**.

.....

.....

(1)

(d) The epithelial cells of the small intestine have large numbers of organelle **A**.
Explain how this is an adaptation for the function of these cells.

.....

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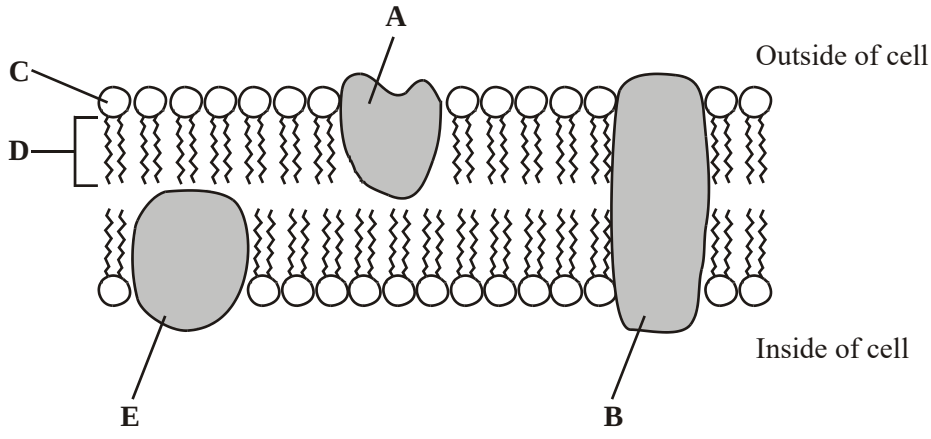
(3)
(Total 8 marks)

14. The diagram shows part of a cell surface membrane.



(a) Complete the table by writing the letter from the diagram which refers to each part of the membrane.

Part of membrane	Letter
Channel protein	
Contains only the elements carbon and hydrogen	

(2)

(b) Explain why the structure of a membrane is described as *fluid-mosaic*.

.....

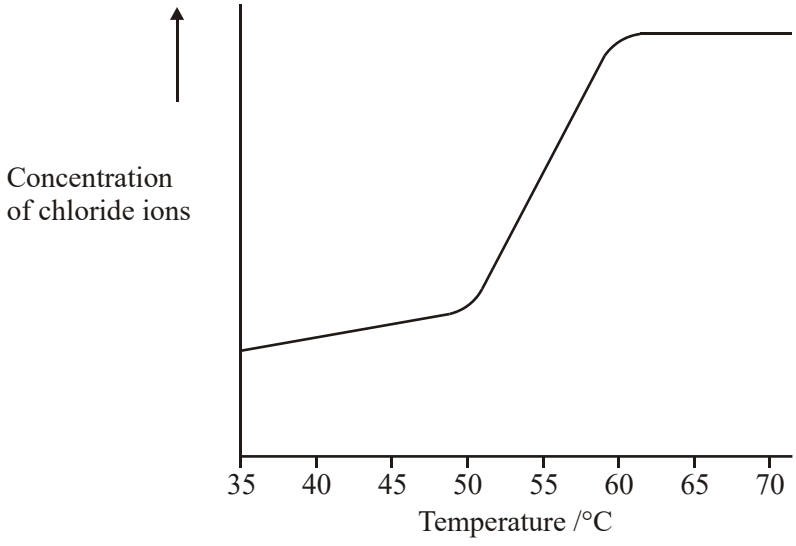
.....

.....

.....

(2)

(c) When pieces of carrot are placed in water, chloride ions are released from the cell vacuoles. Identical pieces of carrot were placed in water at different temperatures. The concentration of chloride ions in the water was measured after a set period of time. The graph shows the results.



Describe and explain the shape of the curve.

.....

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.....

.....

.....

(3)
(Total 7 marks)

15. (a) Small samples of plant tissue were placed in a cold, isotonic solution and then treated to break open the cells to release the organelles. The different organelles were then separated. Describe a technique that could be used to

(i) break open the cells;

.....

.....

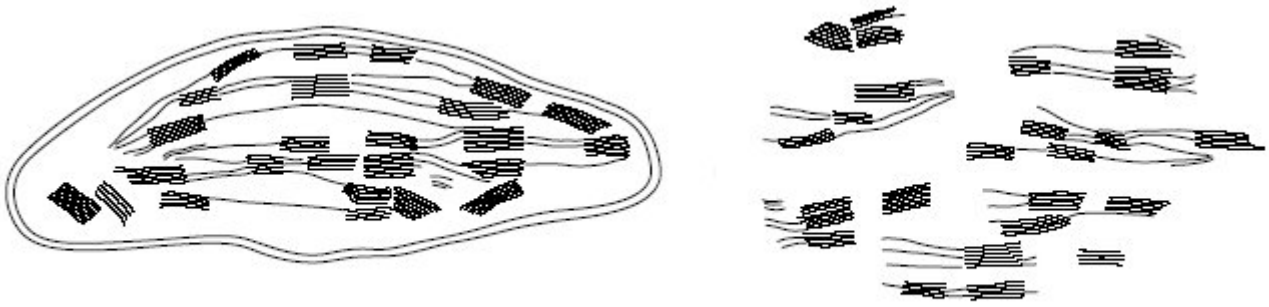
(ii) separate the organelles.

.....

.....

(2)

(b) One group of organelles was placed in a hypotonic solution. The diagram shows one of these organelles seen under an electron microscope before and after it was placed in the hypotonic solution.



Before

After

(i) Name the organelle.

.....

(1)

(ii) Describe and explain the effect on the organelle of placing it in the hypotonic solution.

.....

.....

.....

.....

.....

.....

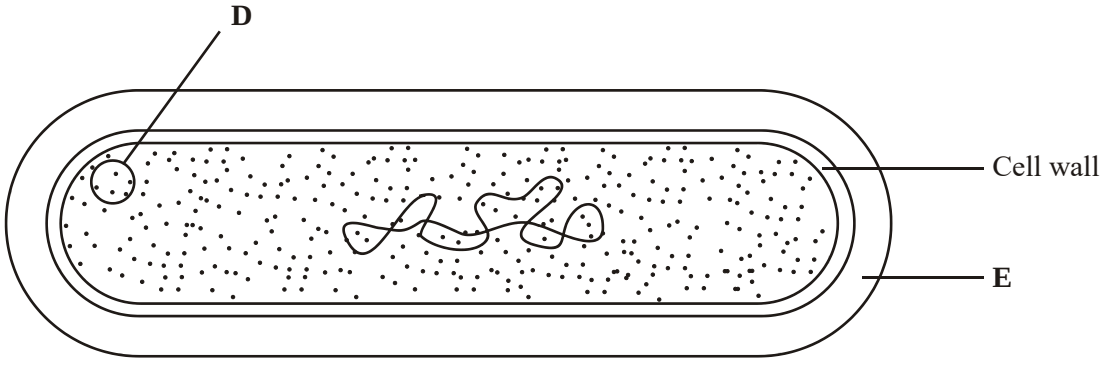
.....

.....

(4)

(Total 7 marks)

16. (a) The diagram shows a bacterial cell.



(i) Name the parts labelled **D** and **E.**

D .....

E .....

(2)

(ii) Give **one** function of the cell wall.

.....

.....

(1)

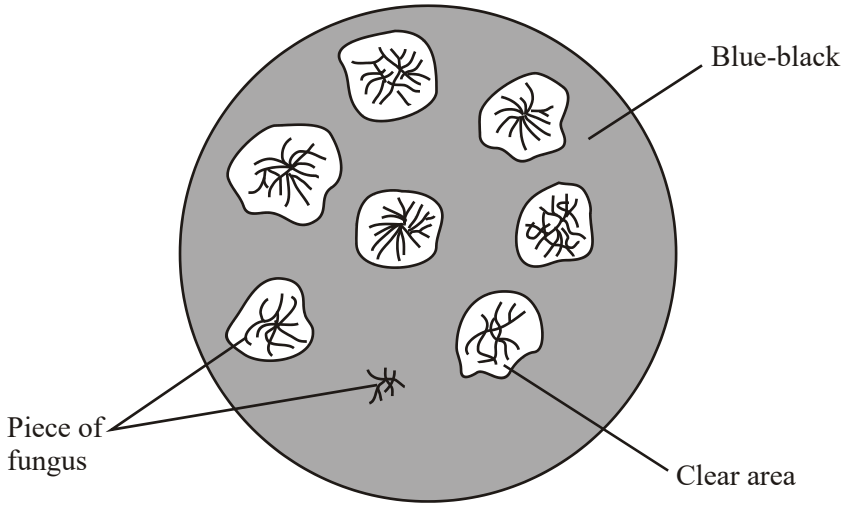
(b) Name **two** structures present in eukaryotic cells that are not present in the cells of prokaryotes.

1 .....

2 .....

(2)

(c) Several small pieces of a saprophytic fungus were placed on a starch agar plate. After 48 hours the iodine solution was poured over the starch agar. The result is shown in the diagram below.



(i) Explain why there is a clear area around most of the pieces of fungus.

.....

.....

.....

.....

(2)

(ii) Suggest why one piece of fungus has no clear area round it.

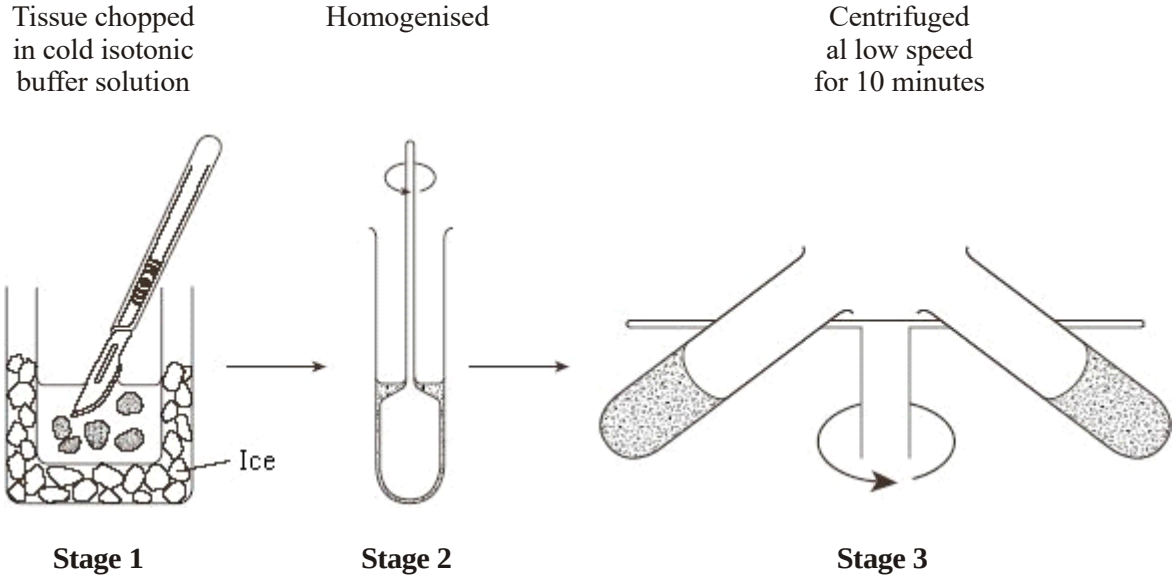
.....

.....

(1)

(Total 8 marks)

17. Mitochondria were isolated from the liver tissue using differential centrifugation. The tissue was chopped in cold, isotonic buffer solution. A buffer solution maintains a constant pH. The first stages in the procedure are shown in the diagram.



(i) The tissue was chopped in cold, isotonic buffer solution. Explain the reason for using

a *cold* solution; .....

.....

an *isotonic* solution; .....

.....

a *buffer* solution. .....

.....

(3)

(ii) Why is the liver tissue homogenised?

.....

.....

(1)

(iii) Describe what should be done after **Stage 3** to obtain a sample containing only mitochondria.

.....

.....

.....

.....

(2)
(Total 6 marks)

18. (a) Explain how **three** features of a plasma membrane adapt it for its functions.

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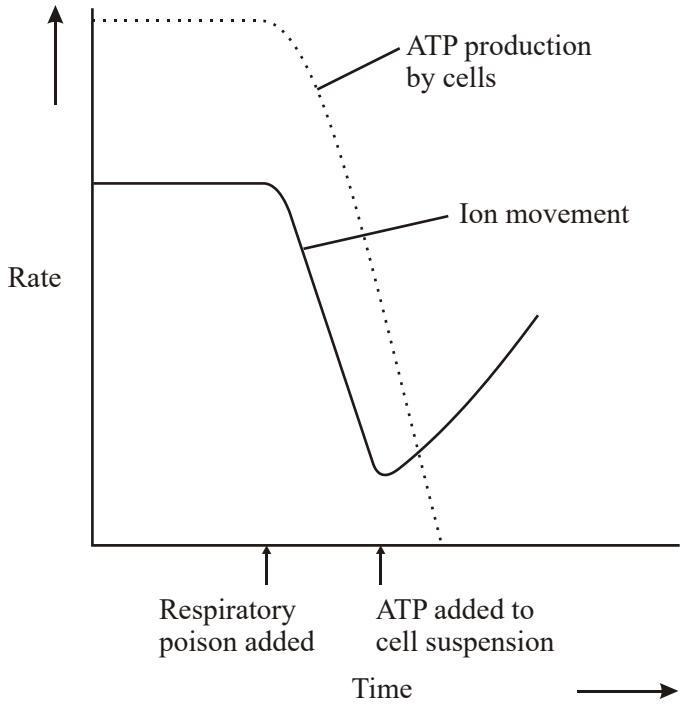
.....

(6)

(b) ATP breaks down to ADP and phosphate releasing energy. The graph shows the rate of ion movement and the rate of ATP production in an investigation carried out on a suspension of cells. At a certain point in the investigation, a respiratory poison was added to the cell suspension. Later, ATP was added to the same cell suspension.



Describe and explain the changes in the rate of ion movement.

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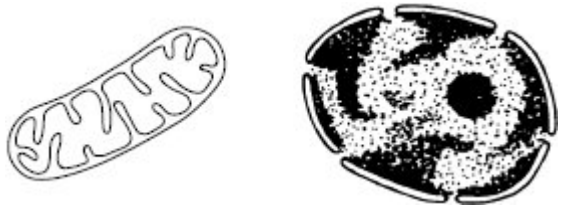
.....

(4)

(Total 10 marks)

19. (a) The diagram shows two organelles found in a eukaryotic cell.



A **B**

(i) Name the organelles.

A .....

B .....

(1)

(ii) Explain how the inner membrane is adapted to its function in organelle **A**.

.....

.....

.....

.....

(2)

(b) Give **one** feature of a prokaryotic cell that is not found in a eukaryotic cell.

.....

(1)

(c) Describe how a sample consisting only of chloroplasts could be obtained from homogenised plant tissue.

.....

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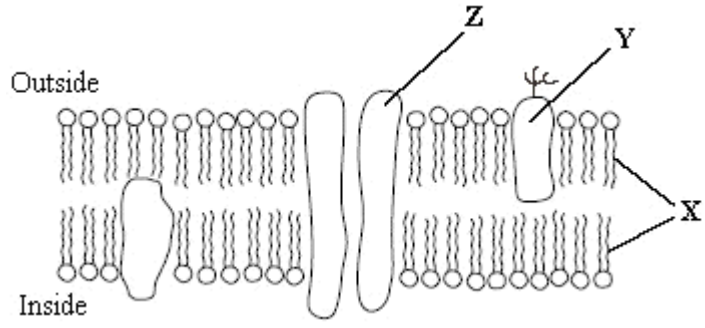
(3)
(Total 7 marks)

20. The diagram shows part of a plasma membrane.



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

1 .....

.....

2 .....

.....

(2)

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

.....

.....

(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.

.....

.....

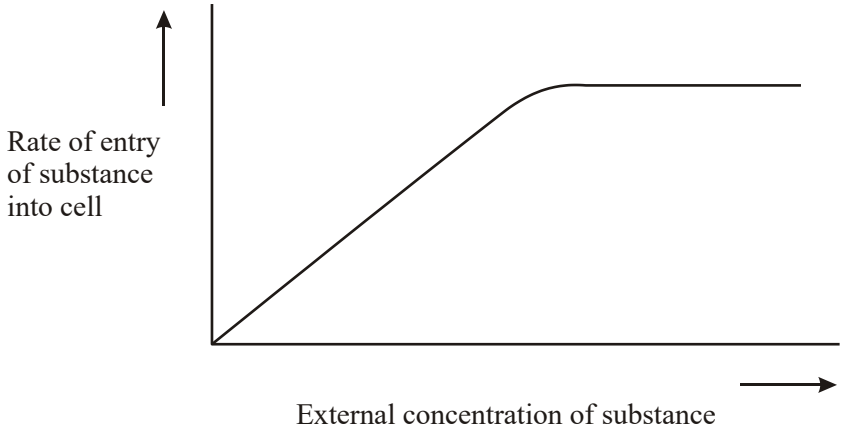
(ii) Give **one** way in which active transport differs from facilitated diffusion.

.....

.....

(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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.....

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(2)

(Total 7 marks)

21. (a) The structure of a cholera bacterium is different from the structure of an epithelial cell from the small intestine. Describe how the structure of a cholera bacterium is different.

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(5)

(b) Scientists use optical microscopes and transmission electron microscopes (TEMs) to investigate cell structure. Explain the advantages and the limitations of using a TEM to investigate cell structure.

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(5)

(Total 10 marks)