AQA A-LEVEL · 7402

BIOLOGY



EXAM QUESTION PACK

3.2.3 TRANSPORT ACROSS CELL MEMBRANES

SCORE	PERCENTAGE
/826	%

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Q1.

(a) What is a monomer?

_____

_____

_____

_____

_____

(1)

(b) Lactulose is a disaccharide formed from one molecule of galactose and one molecule of fructose.

Other than both being disaccharides, give one similarity and one difference between the structures of lactulose and lactose.

Similarity _____

_____

_____

_____

_____

Difference _____

_____

_____

_____

_____

(2)

(c) Following digestion and absorption of food, the undigested remains are processed to form faeces in the parts of the intestine below the ileum.

The faeces of people with constipation are dry and hard. Constipation can be treated by drinking lactulose. Lactulose is soluble, but is not digested or absorbed in the human intestine.

Use your knowledge of water potential to suggest why lactulose can be used to help people suffering from constipation.

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(2)

(d) Lactulose can also be used to treat people who have too high a concentration of hydrogen ions (H^+) in their blood.

The normal range for blood H^+ concentration is 3.55×10^{-8} to 4.47×10^{-8} mol dm^{-3}

A patient was found to have a blood H^+ concentration of 2.82×10^{-7} mol dm^{-3}

Calculate the minimum percentage decrease required to bring the patient's blood H^+ concentration into the normal range.

Answer = _____

(2)

(Total 7 marks)

Q2.

(a) Give **two** similarities in the movement of substances by diffusion and by osmosis.

1. _____

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2. _____

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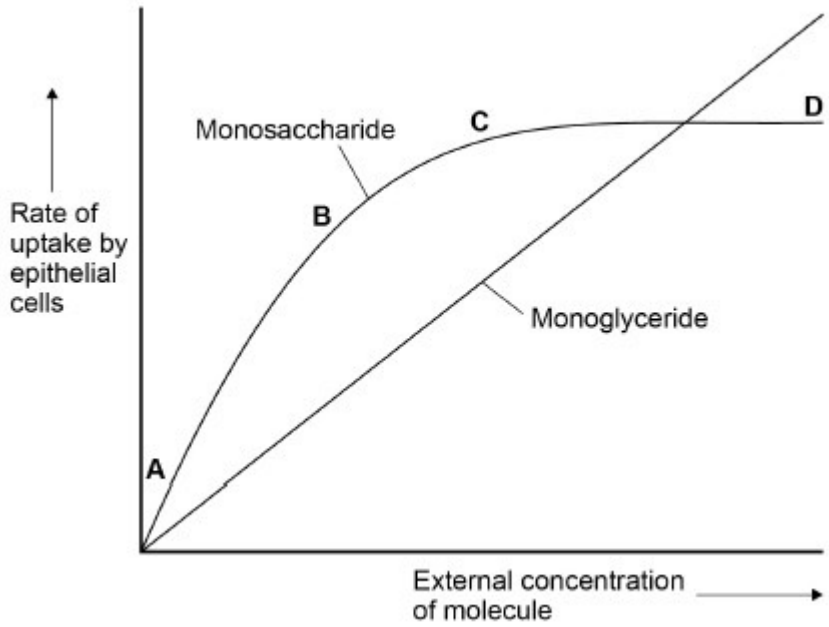
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(2)

A scientist measured the rate of uptake of a monoglyceride and a monosaccharide by epithelial cells of the small intestine of mice. A monoglyceride is a molecule of glycerol with one fatty acid attached. She did this for different concentrations of monoglyceride and monosaccharide.

Her results are shown in the graph.



(b) Use your knowledge of transport across membranes to explain the shape of the curve in the graph for uptake of monosaccharides between concentrations:

A and **B** _____

_____

_____

_____

_____

_____

C and **D** _____

_____

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_____

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(3)

(c) The graph is evidence for monoglycerides being lipid-soluble molecules.

Suggest how.

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(2)

(Total 7 marks)

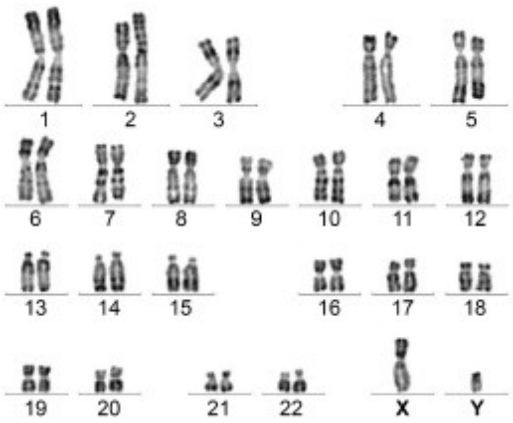
Q3.

Figure 1 shows all the chromosomes present in one human cell during mitosis. A scientist stained and photographed the chromosomes. In **Figure 2**, the scientist has arranged the images of these chromosomes in homologous pairs.

Figure 1



Figure 2



(a) Give **two** pieces of evidence from **Figure 1** that this cell was undergoing mitosis. Explain your answers.

1. _____

_____

_____

_____

_____

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2. _____

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(2)

(b) Tick (✓) **one** box that gives the name of the stage of mitosis shown in **Figure 1**.

A Anaphase ☐

B Interphase ☐

C Prophase ☐

D Telophase ☐

(1)

(c) When preparing the cells for observation the scientist placed them in a solution that had a slightly higher (less negative) water potential than the cytoplasm. This did not cause the cells to burst but moved the chromosomes further apart in order to reduce the overlapping of the chromosomes when observed with an optical microscope.

Suggest how this procedure moved the chromosomes apart.

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(2)

(d) The dark stain used on the chromosomes binds more to some areas of the chromosomes than others, giving the chromosomes a striped appearance.

Suggest **one** way the structure of the chromosome could differ along its length to result in the stain binding more in some areas.

_____

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_____

_____

(1)

(e) In **Figure 2** the chromosomes are arranged in homologous pairs.
What is a homologous pair of chromosomes?

_____

_____

_____

_____

_____

(1)

(f) Give **two** ways in which the arrangement of prokaryotic DNA is different from the arrangement of the human DNA in **Figure 1**.

1. _____

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2. _____

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(2)

(Total 9 marks)

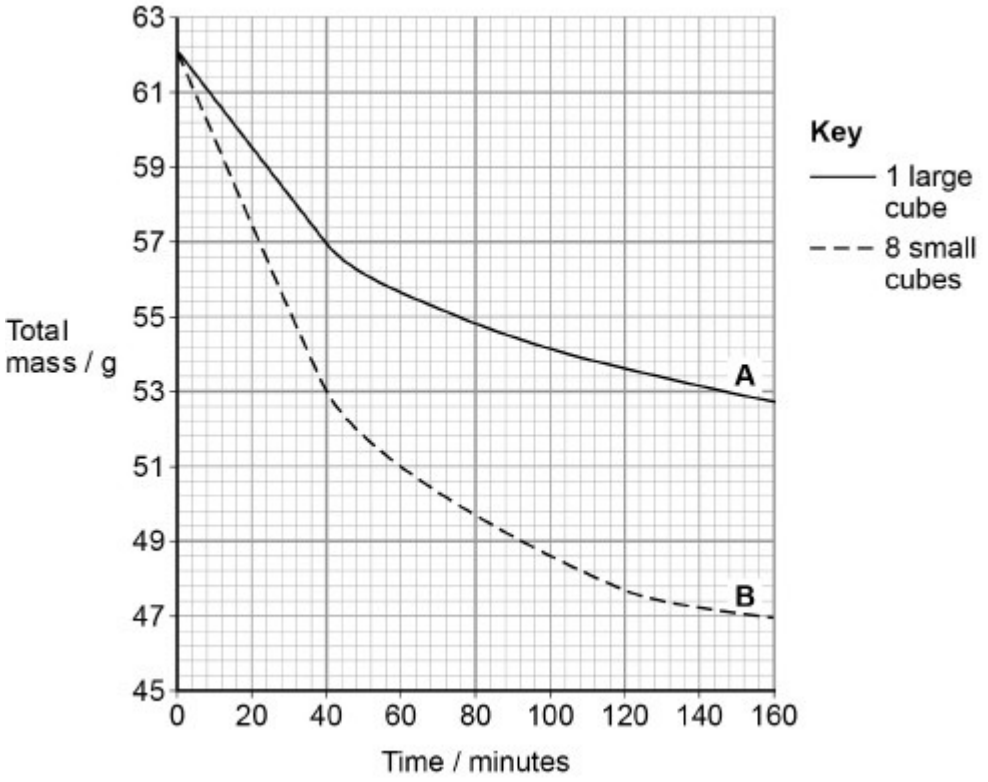
Q4.

A student investigated the effect of surface area on osmosis in cubes of potato.

- He cut two cubes of potato tissue, each with sides of 35 mm in length.

- He put one cube into a concentrated sucrose solution.
- He cut the other cube into eight equal-sized smaller cubes and put them into a sucrose solution of the same concentration as the solution used for the large cube.
- He recorded the masses of the cubes at intervals.

His results are shown in the graph.



(a) Describe the method the student would have used to obtain the results in the graph. Start after all of the cubes of potato have been cut. Also consider variables he should have controlled.

_____

_____

_____

_____

(3)

(b) The loss in mass shown in the graph is due to osmosis. The rate of osmosis between 0 and 40 minutes is faster in **B** (the eight small cubes) than in **A** (single large cube).

Is the rate of osmosis per mm^2 per minute different between **A** and **B** during this time?
Use appropriate calculations to support your answer.

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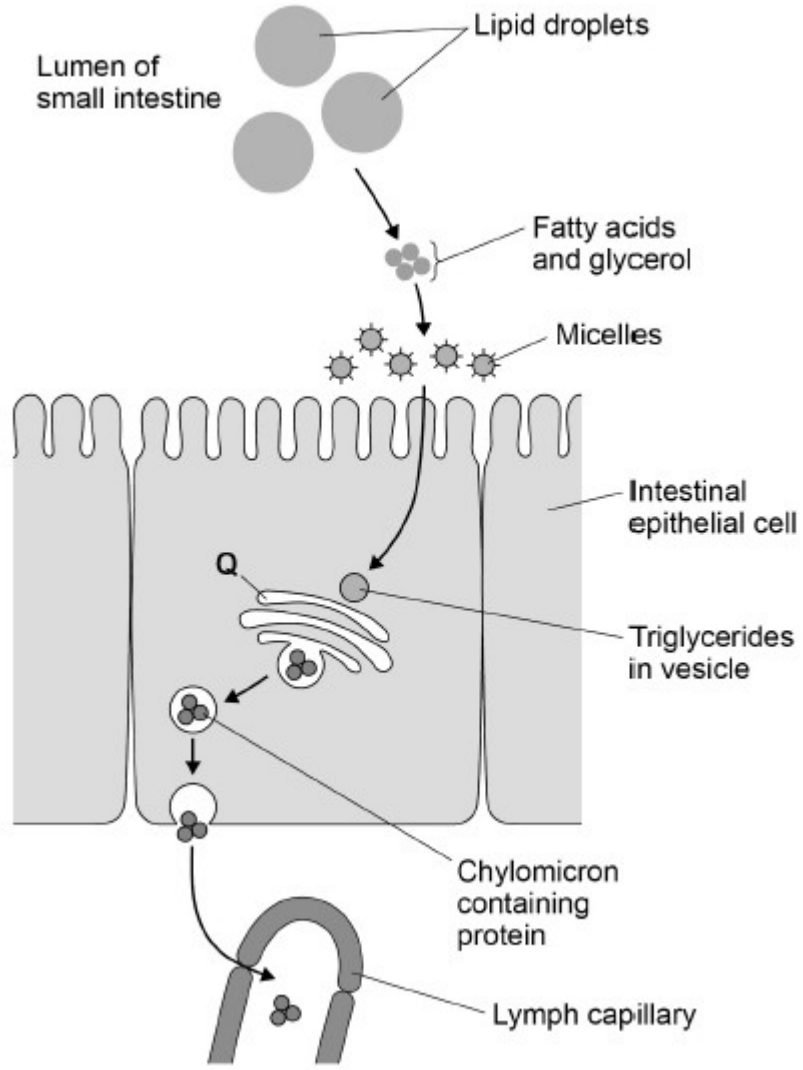
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(3)

(Total 6 marks)

Q5.

The diagram outlines the digestion and absorption of lipids.



(a) Tick (✔) the box by the name of the process by which fatty acids and glycerol enter the intestinal epithelial cell.

Active transport	☐
Diffusion	☐
Endocytosis	☐
Osmosis	☐

(1)

(b) Explain the advantages of lipid droplet and micelle formation.

_____

_____

_____

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(3)

(c) Name structure **Q** in the diagram above and suggest how it is involved in the absorption of lipids.

Name _____

How it is involved _____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q6.

(a) Give **three** properties of water that are important in biology.

1. _____

_____

2. _____

_____

3. _____

(3)

A student investigated the effect of different concentrations of sucrose solution on “chips” cut from a potato. Each chip had the same dimensions.

The student:

- weighed each chip at the start
- placed each chip in a separate test tube, each containing 10 cm^3 of sucrose solution at a different concentration
- left the chips in the sucrose solution for 24 hours
- dried the surface of the chips and then weighed them again.

The table shows the student's results.

Concentration of sucrose solution / mol dm^{-3}	Initial mass of chip / g	Final mass of chip / g	Ratio of final mass to initial mass of chips
0.0	2.79	3.82	
0.2	2.75	2.97	
0.4	2.78	2.67	
0.6	2.69	2.31	
0.8	2.72	2.20	
1.0	2.77	1.99	

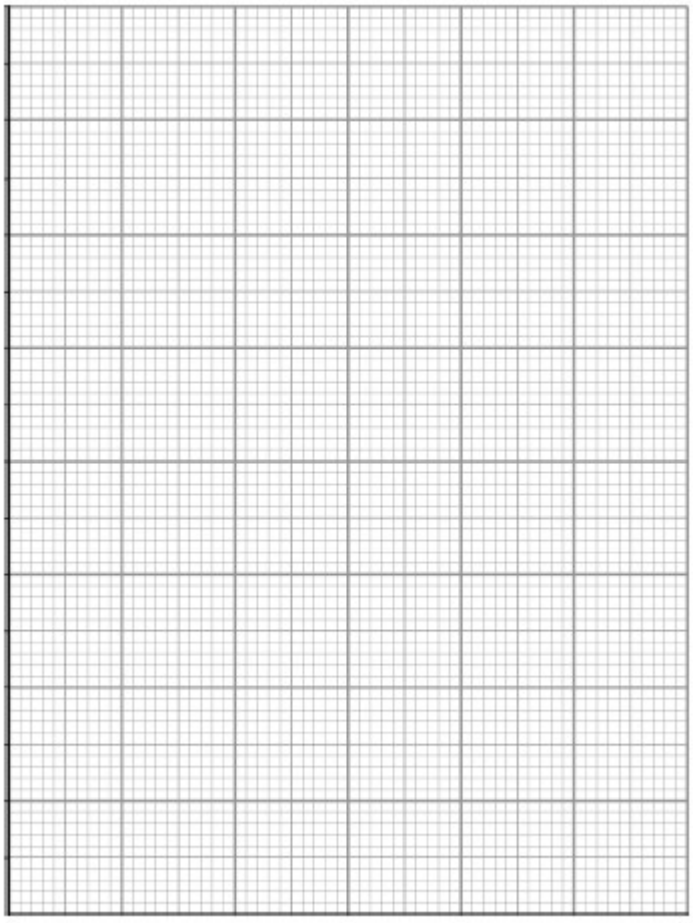
(b) The student produced the sucrose solutions with different concentrations from a concentrated sucrose solution.

Name the method she would have used to produce these sucrose solutions.

Name of method _____

(1)

(c) Calculate the ratio of final mass to initial mass of potato chips and plot a suitable graph of your processed data. Express the ratios in the table in part (a) as a single number (for example 5.26:1 would be expressed as 5.26).



(3)

(d) Explain the result for the chip in 0.8 mol dm^{-3} sucrose solution.

_____

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

Q7.

The cells of beetroot contain a red pigment. A student investigated the effect of temperature on the loss of red pigment from beetroot. He put discs cut from beetroot into tubes containing water. He maintained each tube at a different temperature. After 25 minutes, he measured the percentage of light passing through the water in each tube.

(a) The student put the same volume of water in each tube.

Explain why it was important that he controlled this experimental variable.

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(2)

(b) Describe a method the student could have used to monitor the temperature of the water in each tube.

_____

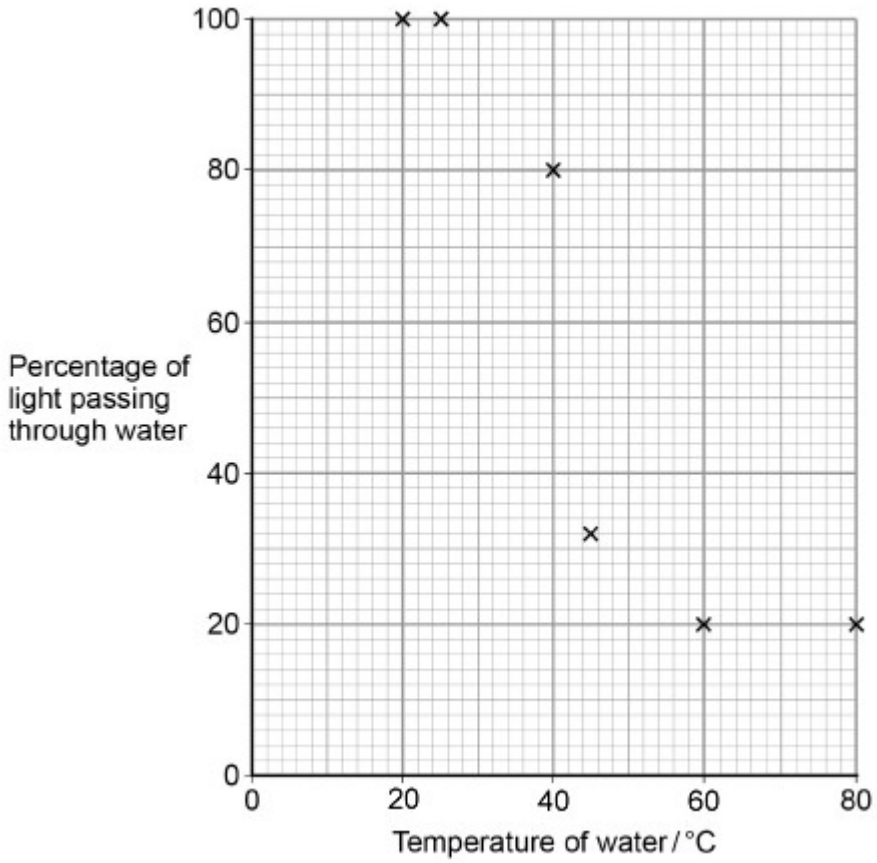
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(1)

The graph shows the student's results.



(c) Draw a suitable curve on the graph above.

(1)

(d) The decrease in the percentage of light passing through the water between 25 °C and 60 °C is caused by the release of the red pigment from cells of the beetroot.

Suggest how the increase in temperature of the water caused the release of the red pigment.

_____

_____

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(2)

(Total 6 marks)

Q8.

In mammals, in the early stages of pregnancy, a developing embryo exchanges substances with its mother via cells in the lining of the uterus. At this stage, there is a high concentration of glycogen in cells lining the uterus.

(a) Describe the structure of glycogen.

_____

_____

_____

_____

_____

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(2)

(b) During early pregnancy, the glycogen in the cells lining the uterus is an important energy source for the embryo.

Suggest how glycogen acts as a source of energy.

Do **not** include transport across membranes in your answer.

_____

_____

_____

_____

_____

(2)

(c) Suggest and explain **two** ways the cell-surface membranes of the cells lining the uterus may be adapted to allow rapid transport of nutrients.

1. _____

_____

_____

2. _____

_____

_____

(2)

(d) In humans, after the gametes join at fertilisation, every cell of the developing embryo undergoes mitotic divisions before the embryo attaches to the uterus lining.

- The first cell division takes 24 hours.
- The subsequent divisions each take 8 hours.

After 3 days, the embryo has a total volume of $4.2 \times 10^{-3}\,mm^3$.

What is the mean volume of each cell after 3 days? Express your answer in standard form.

Show your working.

Answer = _____ mm^3

(2)

(Total 8 marks)

Q9.

(a) Sodium ions from salt (sodium chloride) are absorbed by cells lining the gut. Some of these cells have membranes with a carrier protein called NHE3.

NHE3 actively transports one sodium ion into the cell in exchange for one proton (hydrogen ion) out of the cell.

Use your knowledge of transport across cell membranes to suggest how NHE3 does this.

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(3)

(b) Scientists investigated the use of a drug called Tenapanor to reduce salt absorption in the gut. Tenapanor inhibits the carrier protein, NHE3.

The scientists fed a diet containing a high concentration of salt to two groups of rats, **A** and **B**.

- The rats in Group **A** were **not** given Tenapanor (0 mg kg^{-1}).
- The rats in Group **B** were given 3 mg kg^{-1} Tenapanor.

One hour after treatment, the scientists removed the gut contents of the rats and

immediately weighed them.

Their results are shown in the table.

Concentration of Tenapanor / mg kg^{-1}	Mean mass of contents of the gut / g
0	2.0
3	4.1

The scientists carried out a statistical test to see whether the difference in the means was significant. They calculated a P value of less than 0.05.

They concluded that Tenapanor did reduce salt absorption in the gut.

Use all the information provided and your knowledge of water potential to explain how they reached this conclusion.

(4)

(c) High absorption of salt from the diet can result in a higher than normal concentration of salt in the blood plasma entering capillaries. This can lead to a build-up of tissue fluid.

Explain how.

(2)

(Total 9 marks)

Q10.

2,4-D is a selective herbicide that kills some species of plants but not others. 2,4-D disrupts cell-surface membranes but the extent of disruption differs in different species.

Scientists investigated the effect of 2,4-D on wheat plants (a crop) and on wild oat plants (a weed).

They grew plants of both species in glasshouses. They put plants of each species into one of two groups, **W** and **H**, which were treated as follows:

- Group **W** – leaves sprayed with water
- Group **H** – leaves sprayed with a solution of 2,4-D.

After spraying, they cut 40 discs from the leaves of plants in each group and placed them in flasks containing 10 cm^3 de-ionised water. After 5 minutes, they calculated the disruption to cell-surface membranes by measuring the concentration of ions released into the water from the leaf discs.

Their results are shown in the table below.

The lowest significant difference (LSD), is the smallest difference between two means that would be significant at P≤0.05

Group	**Treatment**	**Mean concentration of ions in water / arbitrary units**	
		Wheat	**Wild oats**
W	Water	26	45
H	2,4-D	27	70
Lowest significant difference (LSD)		7	10

(a) Give **three** environmental variables that should be controlled when growing the plants before treatment with the different sprays.

1. _____

_____

2. _____

_____

3. _____

_____

(2)

(b) Evaluate the use of 2,4-D as a herbicide on a wheat crop that contains wild oats as a weed. Use all the information provided.

_____

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_____

(4)

(c) The scientists incubated the flasks containing the leaf discs at 26 °C and gently shook the flasks.

Suggest **one** reason why the scientists ensured the temperature remained constant and **one** reason why the leaf discs were shaken.

Temperature _____

_____

_____

Shaken _____

_____

_____

(2)

(Total 8 marks)

Q11.

(a) When a nerve impulse arrives at a synapse, it causes the release of neurotransmitter from vesicles in the presynaptic knob.

Describe how.

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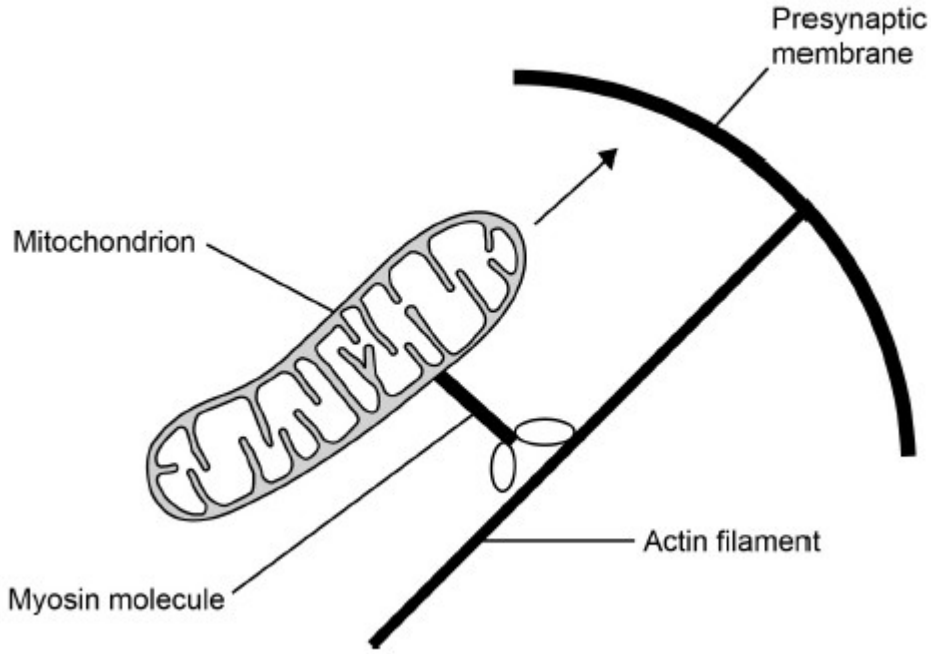
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(3)

(b) The presynaptic knob contains actin filaments and myosin molecules.

The myosin molecules can attach to mitochondria and move them towards the presynaptic membrane, as shown in the diagram.



Use your knowledge of how myosin and actin interact to suggest how the myosin molecule moves the mitochondrion towards the presynaptic membrane.

Do **not** include the roles of calcium ions and tropomyosin in your answer.

_____

_____

_____

_____

_____

_____

(2)

(c) This movement of mitochondria happens when nerve impulses arrive at the synapse.

Suggest and explain **one** advantage of the movement of mitochondria towards the presynaptic membrane when nerve impulses arrive at the synapse.

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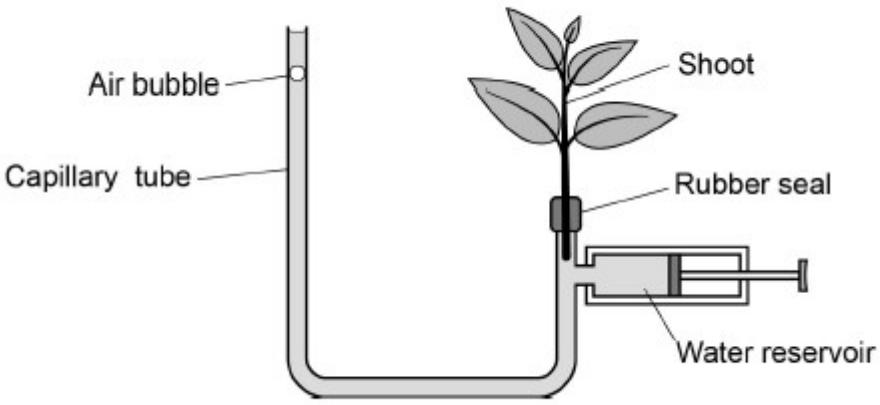
(2)

(Total 7 marks)

Q12.

A student used a potometer to measure the movement of water through the shoot of a plant. The potometer is shown in **Figure 1**. As water is lost from the shoot, it is replaced by water from the capillary tube.

Figure 1



(a) In one experiment, the air bubble moved 7.5 mm in 15 minutes. The diameter of the capillary tube was 1.0 mm.

Calculate the rate of water uptake by the shoot in this experiment.

Give your answer in mm^3 per hour. Show your working. (The area of a circle is found using the formula, area = πr^2)

_____ $mm^3\,hour^{-1}$

(2)

(b) The student wanted to determine the rate of water loss per mm^2 of surface area of the leaves of the shoot in **Figure 1**.

Outline a method she could have used to find this rate. You should assume that all water loss from the shoot is from the leaves.

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(3)

(c) The rate of water movement through a shoot in a potometer may not be the same as the rate of water movement through the shoot of a whole plant.

Suggest **one** reason why.

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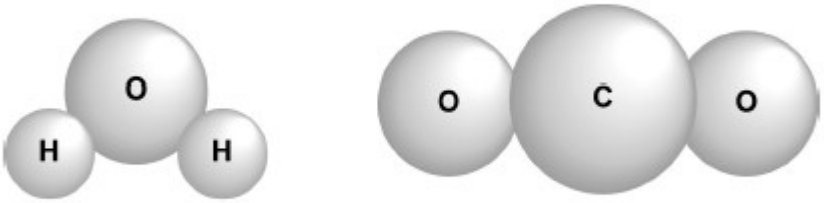
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(1)

(d) Aquaporins are channel proteins that allow the diffusion of water across membranes. One type of aquaporin, called PIP1, can also transport carbon dioxide molecules across membranes.

Figure 2 shows the structure of a water molecule and of a carbon dioxide molecule. They are drawn to the same scale.

Figure 2



Water molecule (H_2O)

Carbon dioxide molecule (CO_2)

Suggest **two** reasons why water molecules **and** carbon dioxide molecules can both pass through PIP1.

1. _____

_____

_____

_____

2. _____

_____

_____

_____

(2)

(e) The scientists first produced transgenic poplar trees. These trees all had a length of foreign DNA inserted into them. This DNA led to the production of single-stranded RNA that specifically inhibited expression of the gene for PIP1.

The scientists then measured the difference in the amount of PIP1 in leaves of transgenic poplars and in leaves of wild type poplars without the foreign DNA. The amount of PIP1 in the transgenic poplars was approximately 15% of that in the wild type poplars.

Using this information, what can you conclude about the effect of the foreign DNA in the transgenic poplar trees?

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(3)

(f) The transgenic poplars still produced some PIP1.

Suggest why.

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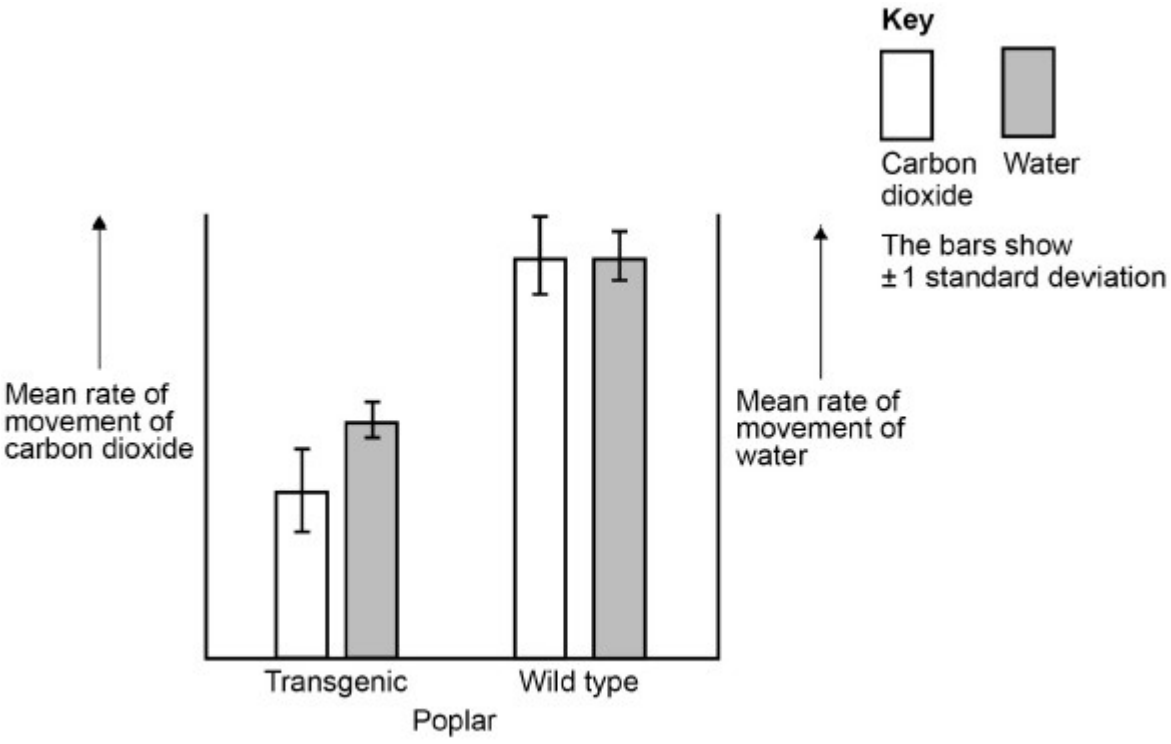
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(1)

(g) The scientists investigated the importance of PIP1 in the movement of water and carbon dioxide through the tissues of leaves of poplar trees.

They measured the mean rates of movement of carbon dioxide and water through the tissues of leaves of transgenic poplars and through the tissues of leaves of wild type poplars.

Their results are shown in the graph below.



Using only the graph above, evaluate the importance of PIP1 in the movement of carbon dioxide and water through leaves of poplar trees.

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(3)

(Total 15 marks)

Q13.

(a) Cells lining the ileum of mammals absorb the monosaccharide glucose by co-transport with sodium ions. Explain how.

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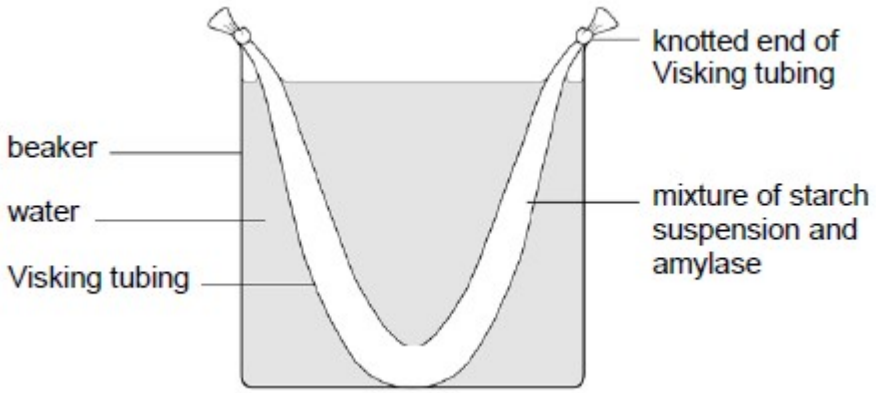
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(3)

A student set up the experiment shown in the diagram below.



The material from which Visking tubing is made is partially permeable.

After 15 minutes, the student removed samples from the liquid in the beaker and from the liquid inside the Visking tubing. She carried out biochemical tests on these samples. She drew the table below to record her results.

(b) Complete the table by placing a tick (✔) in each box that you expect to have shown a positive result.

Biochemical test	Liquid from beaker	Liquid inside Visking tubing
Biuret reagent		
Iodine in potassium iodide		
Benedict's solution		

(3)

(c) Justify your answers to part **(b)**.

_____

_____

_____

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(3)

(Total 9 marks)

Q14.

Water and inorganic ions have important biological functions within cells.

(a) Give **two** properties of water that are important in the cytoplasm of cells.
For each property of water, explain its importance in the cytoplasm.

Property 1_____

Biological importance within cells_____

_____

_____

Property 2_____

Biological importance within cells_____

_____

_____

(4)

(b) Other than sodium, name **one** inorganic ion and give **one** example of its biological importance in a cell.

Name of inorganic ion_____

Biological importance_____

_____

_____

(2)

(c) Compare and contrast the processes by which water and inorganic ions enter cells.

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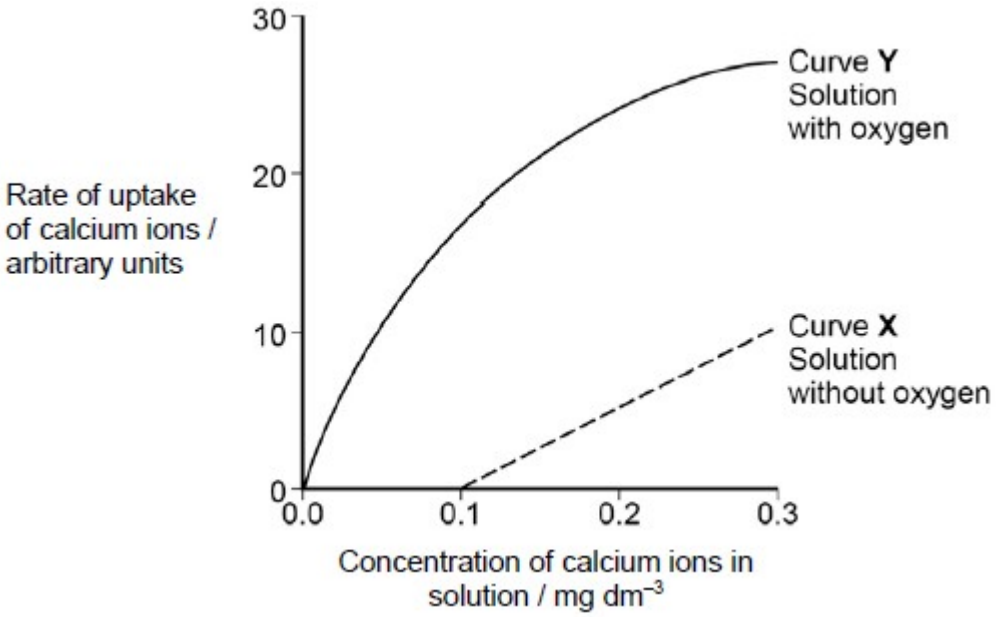
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(3)

(Total 9 marks)

Q15.

A scientist placed plant cells in solutions containing different concentrations of calcium ions. She measured the rate of uptake of calcium ions by plant cells.
The graph below shows her results.



(a) What can you conclude from the graph about the processes involved in the uptake of calcium ions by these plant cells?

Use evidence from the graph to support your answer.

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(5)

(b) Suggest **one** way in which the scientist could have ensured the solutions she used for curve **X** contained **no** oxygen.

_____

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(1)

(Total 6 marks)

Q16.

(a) Name the process by which bacterial cells divide.

_____

(1)

A microbiologist investigated the ability of different plant oils to kill the bacterium *Listeria monocytogenes*. She cultured the bacteria on agar plates. She obtained the bacteria from a broth culture.

(b) Describe **two** aseptic techniques she would have used when transferring a sample of broth culture on to an agar plate.
Explain why each was important.

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(4)

The microbiologist tested five different plant oils at two different temperatures and determined the minimum concentration of plant oil that killed the *L. monocytogenes*.

The table below shows her results.

Plant oil	**Minimum concentration of plant oil that killed *Listeria monocytogenes* / percentage**	
	4 °C	**35 °C**
Bay	0.10	0.04
Cinnamon	0.08	0.08
Clove	0.05	0.05
Nutmeg	>1.00	0.05
Thyme	0.02	0.03

(c) Which plant oil is least effective at killing *L. monocytogenes* at 35 °C?

_____

(1)

L. monocytogenes is a pathogen of great concern to the food industry, especially in foods stored in refrigeration conditions (4 °C) where, unlike most food-borne pathogens, it is able to multiply. It has been suggested that plant oils, together with refrigeration may help to reduce the growth of *L. monocytogenes*.

(d) What conclusions can be drawn about the effectiveness of using plant oils with refrigeration to reduce food-borne infections caused by *L. monocytogenes*?

_____

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(3)

(e) Plant oils are hydrophobic and can cross the cell-surface membrane of the bacterium. The low temperature of 4 °C can slow the rate of entry of plant oils into the cells.

Suggest how the low temperature slows the rate of entry.

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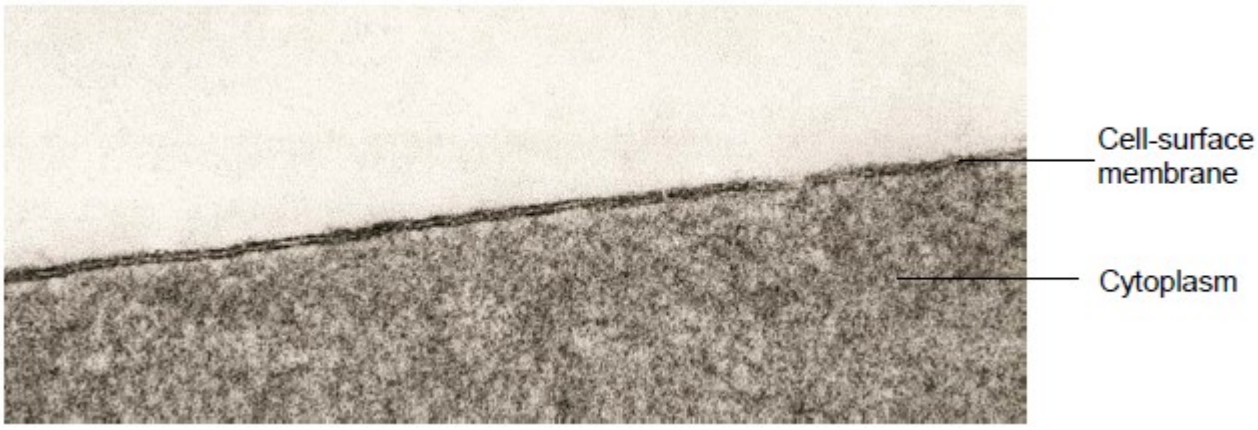
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(1)

(Total 10 marks)

Q17.

The image below shows the cell-surface membrane of a red blood cell seen with a transmission electron microscope.



(a) The cell-surface membrane can be seen with a transmission electron microscope but **not** with an optical microscope.

Explain why.

_____

_____

_____

(1)

(b) No organelles are visible in the cytoplasm of this red blood cell.

Suggest why.

_____

_____

_____

(1)

(c) Before the cell was examined using the electron microscope, it was stained. This stain caused parts of the structure of the cell-surface membrane to appear as two dark lines.

Suggest an explanation for the appearance of the cell-surface membrane as two dark lines.

_____

_____

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_____

(3)

(d) Describe how substances move across cell-surface membranes by facilitated diffusion.

_____

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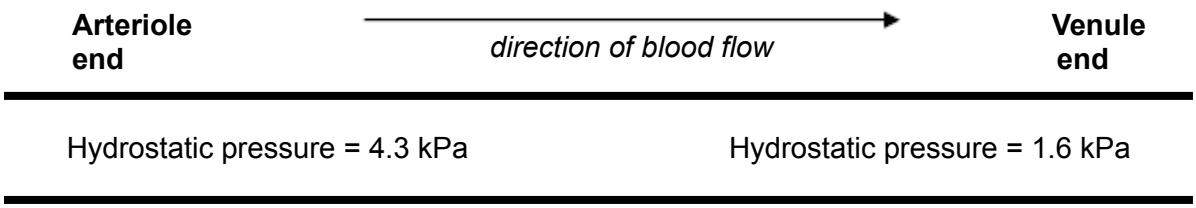
_____

(3)

(Total 8 marks)

Q18.

The figure below represents a capillary surrounded by tissue fluid.
The values of the hydrostatic pressure are shown.



(a) Use the information in the figure above to explain how tissue fluid is formed.

_____

_____

_____

_____

(2)

(b) The hydrostatic pressure falls from the arteriole end of the capillary to the venule end of the capillary. Explain why.

_____

_____

(1)

(c) High blood pressure leads to an accumulation of tissue fluid. Explain how.

_____

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(3)

(d) The water potential of the blood plasma is more negative at the venule end of the capillary than at the arteriole end of the capillary. Explain why.

_____

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(3)

(Total 9 marks)

Q19.

(a) Describe how you would test a piece of food for the presence of lipid.

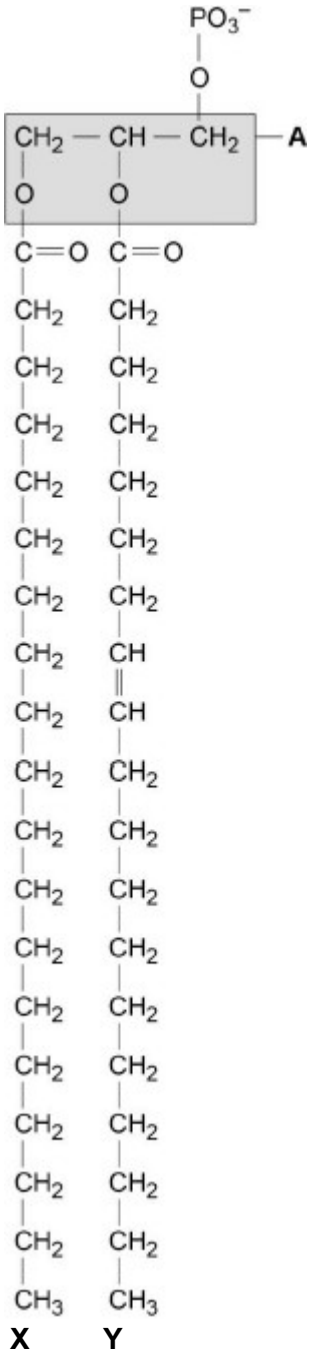
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(2)

The figure below shows a phospholipid.



(b) The part of the phospholipid labelled **A** is formed from a particular molecule. Name this molecule.

_____

(1)

(c) Name the type of bond between **A** and fatty acid **X**.

_____

(1)

(d) Which of the fatty acids, **X** or **Y**, in the figure above is unsaturated? Explain your answer.

_____

_____

_____

_____

(1)

Scientists investigated the percentages of different types of lipid in plasma membranes from different types of cell. The table shows some of their results.

Type of lipid	**Percentage of lipid in plasma membrane by mass**		
	Cell lining ileum of mammal	**Red blood cell of mammal**	**The bacterium *Escherichia coli***
Cholesterol	17	23	0
Glycolipid	7	3	0
Phospholipid	54	60	70
Others	22	14	30

(e) The scientists expressed their results as **Percentage of lipid in plasma membrane by mass**. Explain how they would find these values.

_____

_____

_____

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(2)

Cholesterol increases the stability of plasma membranes. Cholesterol does this by making membranes less flexible.

(f) Suggest **one** advantage of the different percentage of cholesterol in red blood cells compared with cells lining the ileum.

_____

_____

_____

(1)

(g) *E. coli* has no cholesterol in its cell-surface membrane. Despite this, the cell maintains a constant shape. Explain why.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q20.

A group of students carried out an investigation to find the water potential of potato tissue.

The students were each given a potato and 50 cm^3 of a 1.0 mol dm^{-3} solution of sucrose.

- They used the 1.0 mol dm^{-3} solution of sucrose to make a series of different concentrations.
- They cut and weighed discs of potato tissue and left them in the sucrose solutions for a set time.
- They then removed the discs of potato tissue and reweighed them.

The table below shows how one student presented his processed results.

Concentration of sucrose solution / mol dm^{-3}	Percentage change in mass of potato tissue
0.15	+4.7
0.20	+4.1
0.25	+3.0
0.30	+1.9
0.35	−0.9
0.40	−3.8

(a) Explain why the data in the table above are described as **processed** results.

_____

_____

(1)

(b) Describe how you would use a 1.0 mol dm^{-3} solution of sucrose to produce 30 cm^3 of a 0.15 mol dm^{-3} solution of sucrose.

_____

_____

_____

_____

(2)

(c) Explain the change in mass of potato tissue in the 0.40 mol dm^{-3} solution of sucrose.

_____

_____

_____

_____

(2)

(d) Describe how you would use the student's results in the table above to find the water potential of the potato tissue.

_____

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(3)

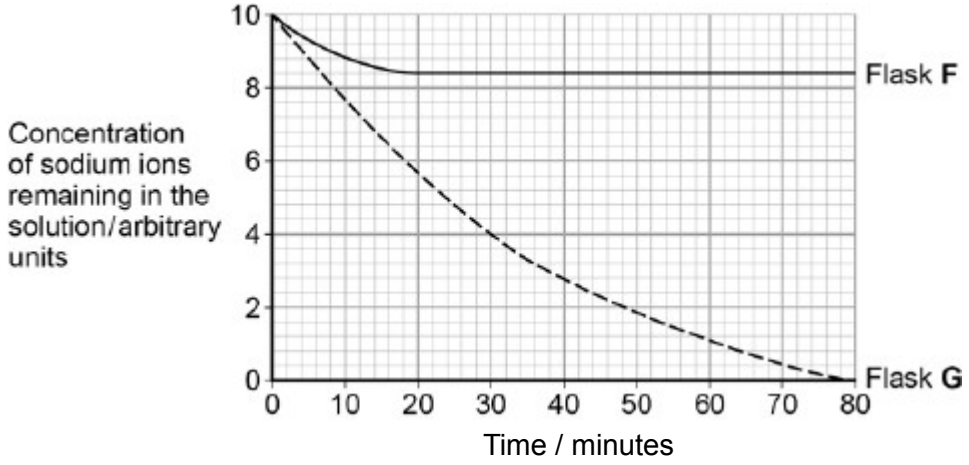
(Total 8 marks)

Q21.

A scientist investigated the uptake of sodium ions by animal tissue.
To do this, he:

- used two flasks, **F** and **G**
- put equal masses of animal tissue into each flask
- added equal volumes of a solution containing sodium ions to each flask
- added to flask **F** a solution of a substance that prevents the formation of ATP by cells
- measured the concentration of sodium ions **remaining** in the solution in each flask.

The graph below shows his results.



(a) Calculate the rate of uptake of sodium ions by the tissue in flask **G** during the first 20 minutes of this investigation.

Answer = _____ arbitrary units per minute

(1)

(b) The scientist concluded that the cells in flask **G** took up sodium ions by active transport. Explain how the information given supports this conclusion.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) The curve for flask **F** levelled off after 20 minutes. Explain why.

_____

_____

_____

_____

_____

(2)
(Total 7 marks)

Q22.

Organic compounds synthesised in the leaves of a plant can be transported to the plant's roots.
This transport is called translocation and occurs in the phloem tissue of the plant.

(a) One theory of translocation states that organic substances are pushed from a high pressure in the leaves to a lower pressure in the roots.

Describe how a high pressure is produced in the leaves.

_____

_____

_____

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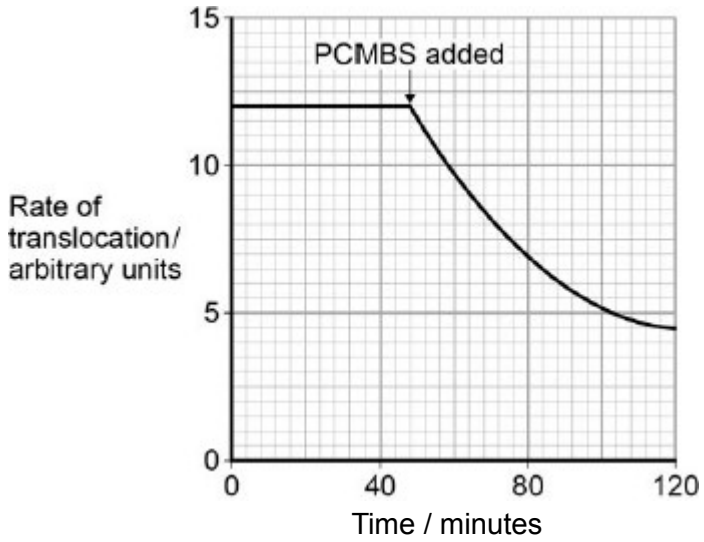
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(3)

PCMBS is a substance that inhibits the uptake of sucrose by plant cells.

Scientists investigated the effect of PCMBS on the rate of translocation in sugar beet.
The figure below shows their results.



(b) During their experiment, the scientists ensured that the rate of photosynthesis of their plants remained constant.
Explain why this was important.

_____

_____

_____

_____

(2)

(c) The scientists concluded that some translocation must occur in the spaces in the cell walls.
Explain how the information in the figure above supports this conclusion.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

Q23.

(a) Describe how oxygen in the air reaches capillaries surrounding alveoli in the lungs.
Details of breathing are **not** required.

_____

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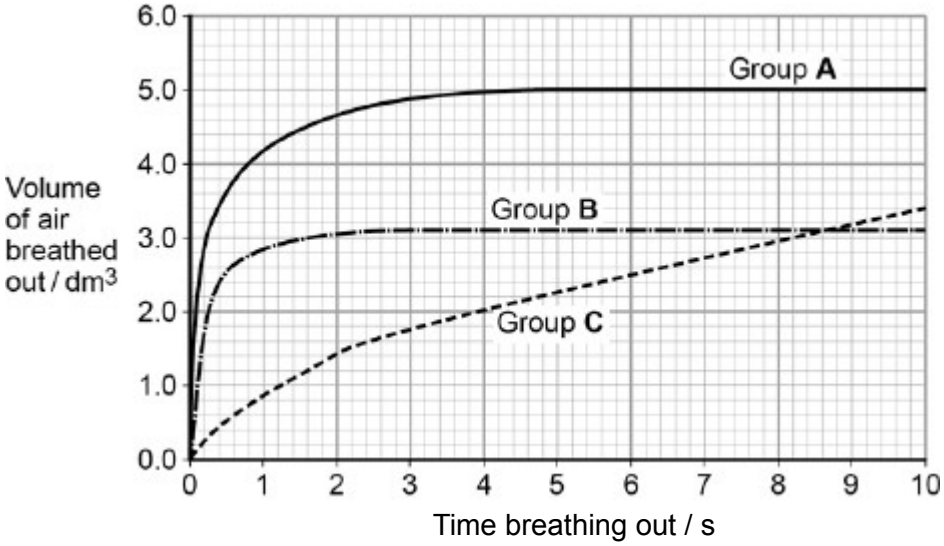
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(4)

Forced expiratory volume (FEV) is the greatest volume of air a person can breathe out in 1 second.

Forced vital capacity (FVC) is the greatest volume of air a person can breathe out in a single breath.

The figure below shows results for the volume of air breathed out by three groups of people, **A**, **B** and **C**. Group **A** had healthy lungs. Groups **B** and **C** had different lung conditions that affect breathing.



(b) Calculate the percentage drop in FEV for group **C** compared with the healthy people.

Answer = _____

(1)

(c) Asthma affects bronchioles and reduces flow of air in and out of the lungs. Fibrosis does not affect bronchioles; it reduces the volume of the lungs.

Which group, **B** or **C**, was the one containing people with fibrosis of their lungs? Use the information provided and evidence from the figure above to explain your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q24.

(a) Contrast the processes of facilitated diffusion and active transport.

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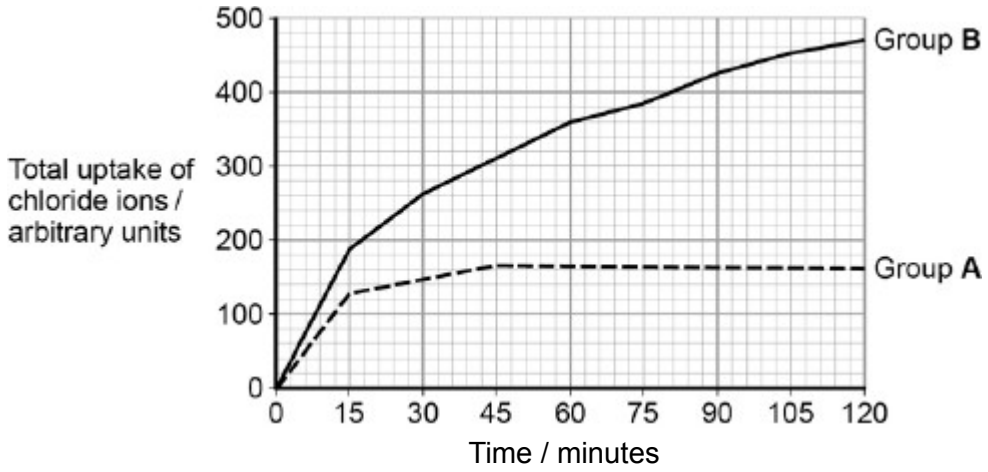
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(3)

Students investigated the uptake of chloride ions in barley plants. They divided the plants into two groups and placed their roots in solutions containing radioactive chloride ions.

- Group **A** plants had a substance that inhibited respiration added to the solution.
- Group **B** plants did not have the substance added to the solution.

The students calculated the total amount of chloride ions absorbed by the plants every 15 minutes. Their results are shown in the figure below.



(b) Calculate the ratio of the mean **rate** of uptake of chloride ions in the first hour to the **rate** of uptake of chloride ions in the second hour for group **B** plants.

Ratio = _____ :1

(2)

(c) Explain the results shown in the figure above.

_____

_____

_____

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_____

_____

(4)

(Total 9 marks)

Q25.

The artery leaving the left ventricle is the aorta. One form of heart disease is aortic valve disease (AVD). In this disease, the valve (the aortic valve) between the left ventricle and the aorta opens normally but only partly closes. This means that when the ventricle relaxes some blood flows back into the ventricle from the aorta.

Severe AVD can be treated by replacing the aortic valve.

A surgeon investigated the effect of this treatment,

- He replaced the aortic valves of 19 patients with valves removed from donors who had recently died.
- The valves from donors were stored in an isotonic antibiotic solution before use.
- He recorded the maximum pressure reached in an artery (as the ventricles contract) and minimum pressure in the artery (as the ventricles relax) in each patient before and after valve replacement surgery.

His results are shown in **Table 1**.

Table 1

	Mean maximum pressure reached in the artery / kPa (± standard deviation)	**Mean minimum pressure reached in the artery / kPa (± standard deviation)**
Before surgery	21.7 (±3.5)	4.8 (±2.5)
After surgery	18.2 (±2.2)	11.0 (±1.1)

This investigation involved 19 patients.

- The mean age was 36 years (standard deviation ±17 years).
- The mean time after surgery that pressure readings were taken was 7 months (standard deviation ±5 months).

Table 2 shows the normal range of values of pressure in this artery in the UK.

Table 2

Pressure	**Range of pressures / kPa**
Maximum	12.0 to 18.5
Minimum	8.0 to 11.9

Aortic valves removed from donors were stored in isotonic solution containing an antibiotic before being used in valve replacement surgery.

(a) Explain why the valves were stored in an **isotonic** solution.

_____

_____

_____

_____

_____

(2)

(b) Explain why the valves were stored in a solution containing an antibiotic.

_____

_____

_____

(1)

(c) There was a significant increase in the minimum blood pressure in the artery after valve replacement surgery.
Explain why the valve replacement surgery had this effect.

_____

_____

_____

(1)

(d) The surgeon concluded that there was sufficient evidence for him to continue using this treatment.

How does the information above support his conclusion?

_____

_____

_____

_____

_____

_____

_____

(3)

(e) How does the information above **not** support his conclusion?

_____

_____

_____

_____

_____

(2)

(f) From the data in **Table 1** it is **not** possible to determine the highest pressure measured. Explain why.

_____

_____

_____

(1)

(Total 10 marks)

Q26.

(a) Describe the difference between the structure of a triglyceride molecule and the structure of a phospholipid molecule.

_____

_____

_____

(1)

(b) Describe how you would test for the presence of a lipid in a sample of food.

_____

_____

_____

_____

(2)

(c) Animal fats contain triglycerides with a high proportion of saturated fatty acids. If people have too much fat in their diet, absorption of the products of fat digestion can increase the risk of obesity. To help people lose weight, fat substitutes can be used to replace triglycerides in food.

Describe how a saturated fatty acid is different from an unsaturated fatty acid.

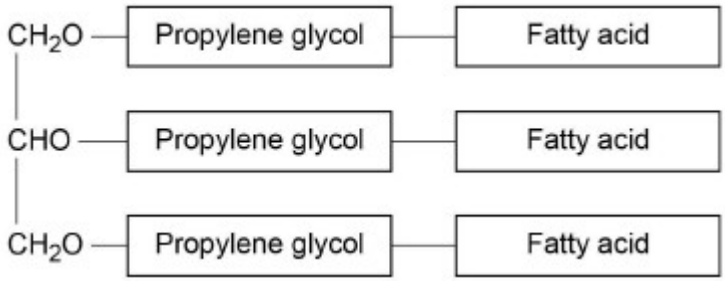
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(1)

The diagram shows the structure of a fat substitute.



(d) This fat substitute **cannot** be digested in the gut by lipase.

Suggest why.

_____

_____

_____

_____

_____

(2)

(e) This fat substitute is a lipid. Despite being a lipid, it cannot cross the cell-surface membranes of cells lining the gut.

Suggest why it **cannot** cross cell-surface membranes.

_____

_____

_____

(1)

(Total 7 marks)

Q27.

(a) The letters **P**, **Q**, **R**, **S** and **T** represent ways substances can move across membranes.

- **P** – diffusion through the phospholipid bilayer
- **Q** – facilitated diffusion
- **R** – active transport
- **S** – co-transport
- **T** – osmosis

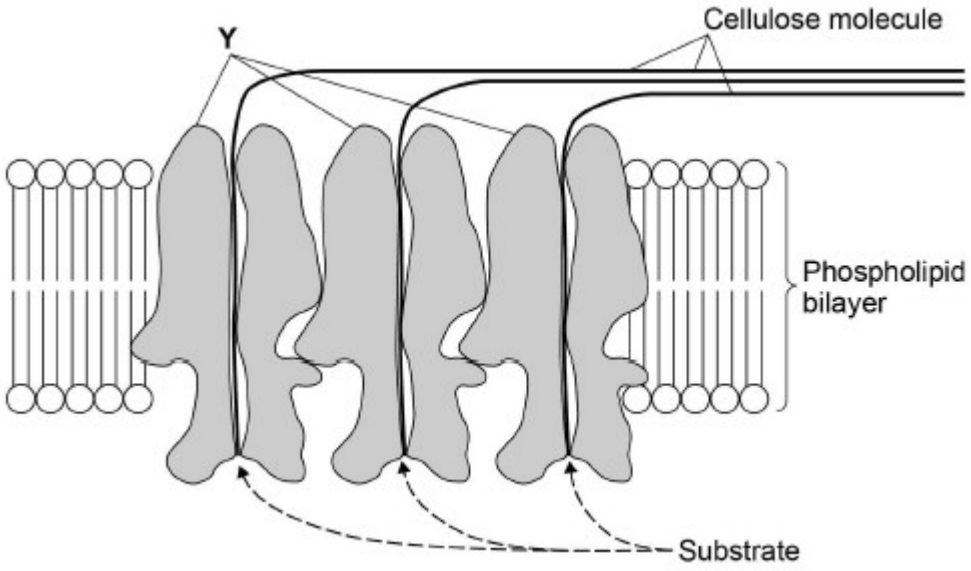
For each of the following examples of transport across membranes, select the letter that represents the way in which the substance moves across the membrane.

Write the appropriate letter in each box provided.

Transport through a channel protein	
Transport of small, non-polar molecules	
Transport of glucose with sodium ions	

(3)

The diagram shows how a plant cell produces its cell wall.



(b) **Y** is a protein. One function of **Y** is to transport cellulose molecules across the phospholipid bilayer.

Using information from the diagram, describe the other function of **Y**.

_____

_____

_____

_____

_____

(2)

(c) What is the evidence in the diagram that the phospholipid bilayer shown is part of the cell-surface membrane?

_____

_____

(1)

(d) In the cell wall, bonds hold the cellulose molecules together side by side.

Tick (✔) **one** box that describes the type of bond that holds the cellulose molecules together side by side.

Ester	☐
Hydrogen	☐
Ionic	☐
Peptide	☐

(1)

(Total 7 marks)

Q28.

(a) Endopeptidases and exopeptidases are involved in the hydrolysis of proteins.

Name the other type of enzyme required for the complete hydrolysis of proteins to amino acids.

_____

(1)

(b) Suggest and explain why the combined actions of endopeptidases and exopeptidases are more efficient than exopeptidases on their own.

_____

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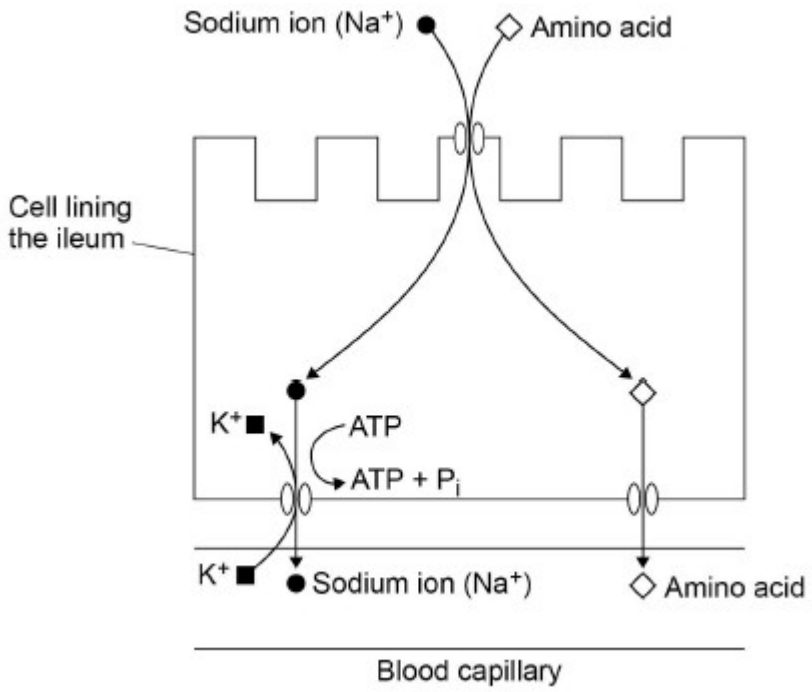
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(2)

(c) The diagram shows the co-transport mechanism for the absorption of amino acids into the blood by a cell lining the ileum.



The addition of a respiratory inhibitor stops the absorption of amino acids.

Use the diagram to expain why.

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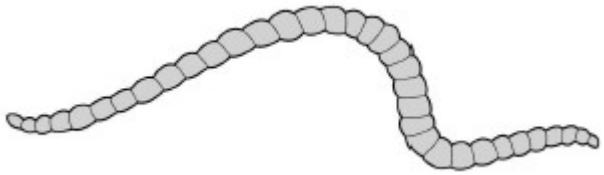
(3)

(Total 6 marks)

Q29.

Tubifex worms are small, thin animals that live in water. They have no specialised gas exchange or circulatory system.

The figure below shows a tubifex worm.



(a) Name the process by which oxygen reaches the cells inside the body of a tubifex worm.

_____

(1)

(b) Using the information provided, explain how **two** features of the body of the tubifex worm allow efficient gas exchange.

1. _____

_____

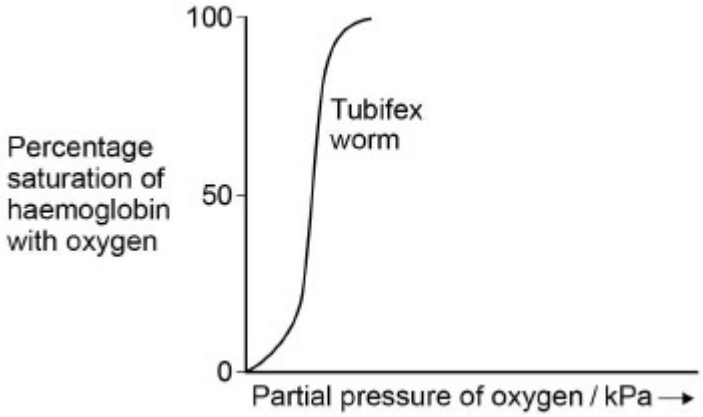
2. _____

_____

(2)

(c) Most species of tubifex worms live at the bottom of ponds, lakes and rivers where the partial pressure of oxygen is low. Pollution of water by sewage can cause the partial pressure of oxygen to fall below 0.2 kPa.

The graph shows the oxyhaemoglobin dissociation curve for a species of tubifex worm found in a river polluted with sewage.



The species of tubifex worm in the graph has 50% saturation of their haemoglobin with oxygen at 0.08 kPa.

Explain how this enables this species to survive in water polluted with sewage.

_____

_____

_____

_____

_____

(2)

(d) Species of tubifex worm that live in ponds, lakes and rivers **cannot** survive in seawater.

Use your knowledge of water potential to explain why they cannot survive in seawater.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q30.

(a) Glucose is absorbed from the lumen of the small intestine into epithelial cells. Explain how the transport of sodium ions is involved in the absorption of glucose by epithelial cells.

_____

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_____

_____

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_____

_____

(5)

(b) Oxygen and chloride ions can diffuse across cell-surface membranes. The diffusion of chloride ions involves a membrane protein. The diffusion of oxygen does not involve a membrane protein.

Explain why the diffusion of chloride ions involves a membrane protein and the diffusion of oxygen does not.

_____

_____

_____

_____

_____

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_____

_____

(5)

(Total 10 marks)

Q31.

(a) Give **two** ways in which pathogens can cause disease.

1. _____

_____

2. _____

_____

(2)

(b) Putting bee honey on a cut kills bacteria. Honey contains a high concentration of sugar.

Use your knowledge of water potential to suggest how putting honey on a cut kills bacteria.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 5 marks)

Q32.

Read the following passage.

Low-density lipoprotein (LDL) is a substance found in blood. A high concentration of LDL in a person's blood can increase the risk of atheroma formation. Liver cells have a receptor on their cell-surface membranes that LDL binds to. This leads to LDL entering the cell. A regulator protein, also found in blood, can bind to the same receptor as LDL. This prevents LDL entering the liver cell. People who have a high concentration of this regulator protein in their blood will have a high concentration of LDL in their blood. Scientists have made a monoclonal antibody that prevents this regulator protein working. They have suggested that these antibodies could be used to reduce the risk of coronary heart disease.

A trial was carried out on a small number of healthy volunteers, divided into two groups. The scientists injected one group with the monoclonal antibody in salt solution. The other group was a control group. They measured the concentration of LDL in the blood of each volunteer at the start and after 3 months. They found that the mean LDL concentration in the volunteers injected with the antibody was 64% lower than in the control group.

Use the information in the passage and your own knowledge to answer the following questions.

(a) The scientists gave an injection to a mouse to make it produce the monoclonal antibody used in this investigation (line 7).

What should this injection have contained?

_____

(1)

(b) LDL enters the liver cells (lines 3−4).

Using your knowledge of the structure of the cell-surface membrane, suggest how LDL enters the cell.

_____

_____

_____

_____

_____

(2)

(c) Explain how the monoclonal antibody would prevent the regulator protein from working (lines 7−8).

_____

_____

_____

_____

_____

(2)

(d) Describe how the control group should have been treated.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

Q33.

Scientists studied the rate of carbon dioxide uptake by grape plant leaves. Grape leaves have stomata on the lower surface but no stomata on the upper surface.

The scientists recorded the carbon dioxide uptake by grape leaves with three different treatments:

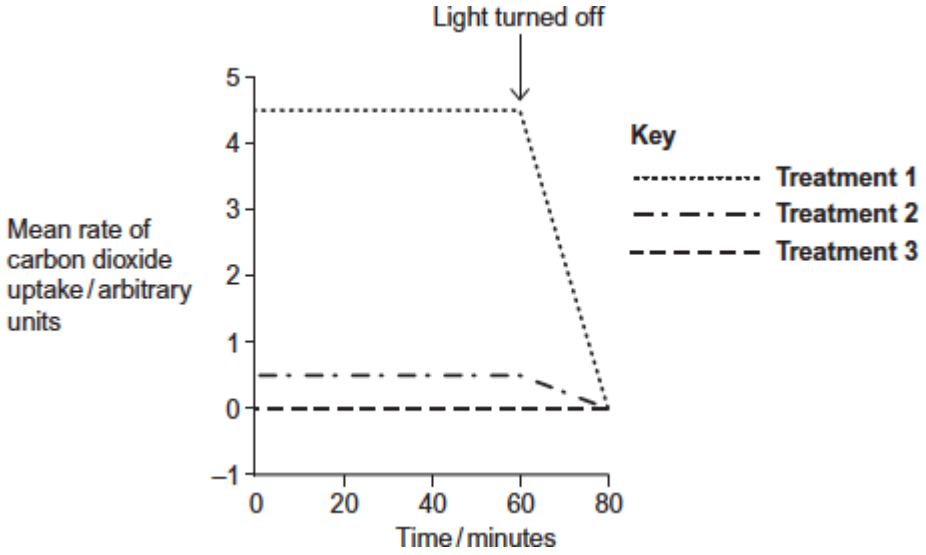
Treatment 1 − No air-sealing grease was applied to either surface of the leaf.

Treatment 2 − The lower surface of the leaf was covered in air-sealing grease that prevents gas exchange.

Treatment 3 − Both the lower surface and the upper surface of the leaf were covered in air–sealing grease that prevents gas exchange.

The scientists measured the rate of carbon dioxide uptake by each leaf for 60 minutes in light and then for 20 minutes in the dark.

The scientists' results are shown in the diagram below.



(a) Suggest the purpose of each of the three leaf treatments.

Treatment 1

_____

_____

_____

Treatment 2

_____

_____

_____

Treatment 3

_____

_____

_____

(3)

(b) (i) Describe the results shown for **Treatment 1**.

_____

_____

_____

_____

_____

(2)

(ii) The stomata close when the light is turned off.

Explain the advantage of this to the plant.

_____

_____

_____

_____

_____

(2)

(c) (i) **Treatment 2** shows that even when the lower surface of the leaf is sealed there is still some uptake of carbon dioxide.

Suggest how this uptake of carbon dioxide continues.

_____

_____

_____

(1)

(ii) In both **Treatment 1** and **Treatment 2**, the uptake of carbon dioxide falls to zero when the light is turned off.

Explain why.

_____

_____

_____

_____

_____

(2)

(Total 10 marks)

Q34.

(a) Describe how phospholipids are arranged in a plasma membrane.

_____

_____

_____

_____

(2)

(b) Cells that secrete enzymes contain a lot of rough endoplasmic reticulum (RER) and a large Golgi apparatus.

(i) Describe how the RER is involved in the production of enzymes.

_____

_____

_____

_____

(2)

(ii) Describe how the Golgi apparatus is involved in the secretion of enzymes.

_____

_____

_____

(1)

(Total 5 marks)

Q35.

In many parts of the world, crops have to be watered to grow enough food but fresh water is often in short supply.

Barley is a plant that grows a leafy shoot and then produces seed that is harvested for food.

Scientists investigated whether barley could be grown successfully using fresh water mixed with seawater. This would reduce the use of fresh water. However, seawater contains dissolved sodium chloride (salt).

The scientists grew barley in plots of equal size in the same large field. Each plot received one of four treatments.

A No watering.
B Watering with fresh water during growth and seed production.
C Watering with a 1:1 mix of fresh water and seawater during growth and seed production.
D Watering with fresh water during growth and with a 1:1 mix of fresh water and seawater during seed production.

At the end of the investigation, the scientists measured the concentration of salt in the soil in each plot and the yield of barley seed harvested from each plot.

The scientists' results are shown in the table below.

Watering treatment	Mean concentration of salt in soil / arbitrary units	Mean yield of barley seed / g
A	10.1	346
B	9.7	804
C	13.5	538
D	11.6	695

(a) Watering treatment was the independent variable in this investigation.
Explain what is meant by the **independent** variable.

_____

_____

_____

(1)

(b) The same variety of barley was used in all the plots. Why was this important?

_____

_____

_____

_____

_____

(2)

(c) When barley plants are growing, the number of cells increases.
Name the process that increases the number of cells.

_____

(1)

(d) What do the data in the table above show about the effect of watering barley with a mixture of fresh water and seawater?

_____

_____

_____

_____

_____

(2)

(e) The scientists suggested that watering barley with diluted seawater might not be sustainable if repeated every year.
Do these data support this suggestion?

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q36.

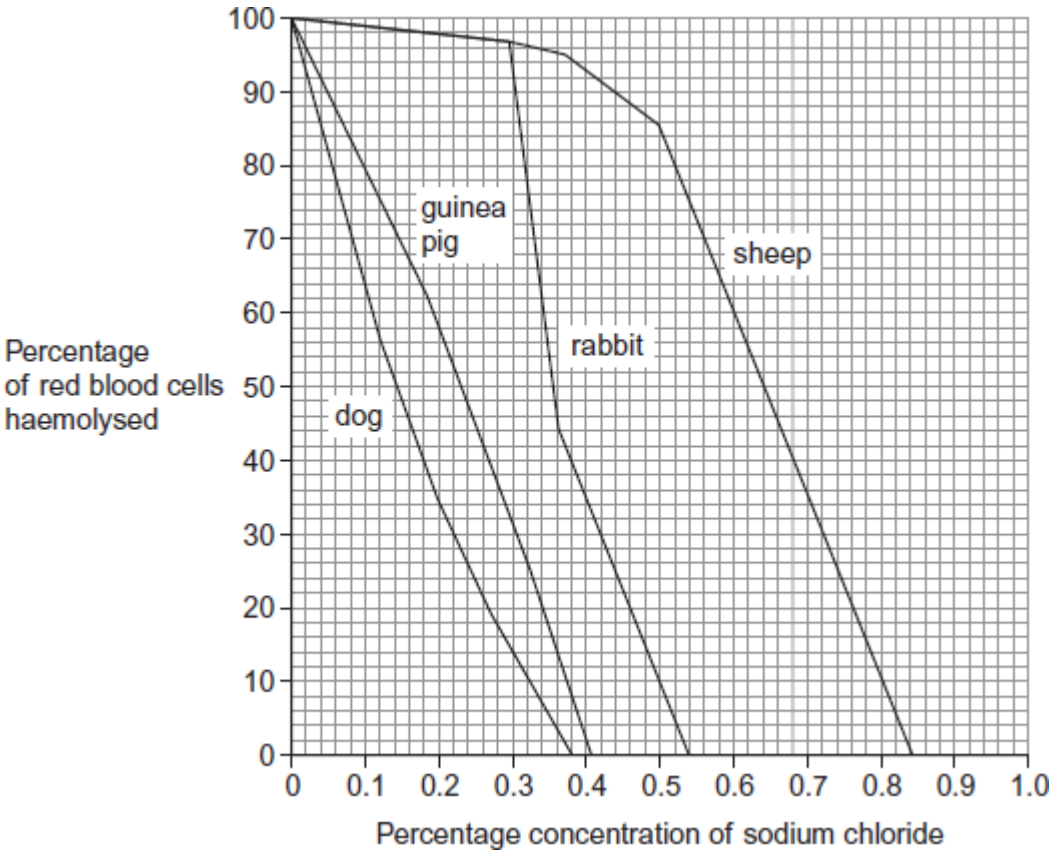
If red blood cells are placed in pure water, water enters the cells by osmosis and they burst. This is called haemolysis. As red blood cells burst they release pigment.

Scientists placed samples of red blood cells in different concentrations of sodium chloride solution for the same period of time. They used red blood cells from four different mammals: dog, guinea pig, rabbit and sheep.

If haemolysis had taken place, the solution turned red. The scientists measured the intensity of the red colour using a colorimeter. The more intense the red colour, the greater the amount of haemolysis.

The scientists calculated the percentage of red blood cells that were haemolysed in each sodium chloride solution.

The following figure shows the scientists' results.



(a) Use the figure to give **two** differences between the results for dog and sheep.

Difference 1 _____

_____

Difference 2 _____

_____

(2)

(b) Calculate the difference in the percentage of haemolysed cells between sheep and rabbit at a sodium chloride concentration of 0.5%.

_____

(1)

(c) Explain the relationship between the depth of the red colour of the solution and how much haemolysis has taken place.

_____

_____

_____

_____

_____

(2)

(d) During treatment in a veterinary surgery, any of the mammals in the figure above may be given an infusion of sodium chloride solution directly into a vein. The concentration of sodium chloride solution used is 0.9%, rather than 0.5%, regardless of the species of mammal.

Explain the advantage to the vet of using this concentration.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q37.

Many sports drinks contain water, sodium chloride and carbohydrates. The manufacturers of the sports drinks claim that carbohydrates provide an energy boost. The sodium chloride is used to increase absorption of glucose in the small intestine.

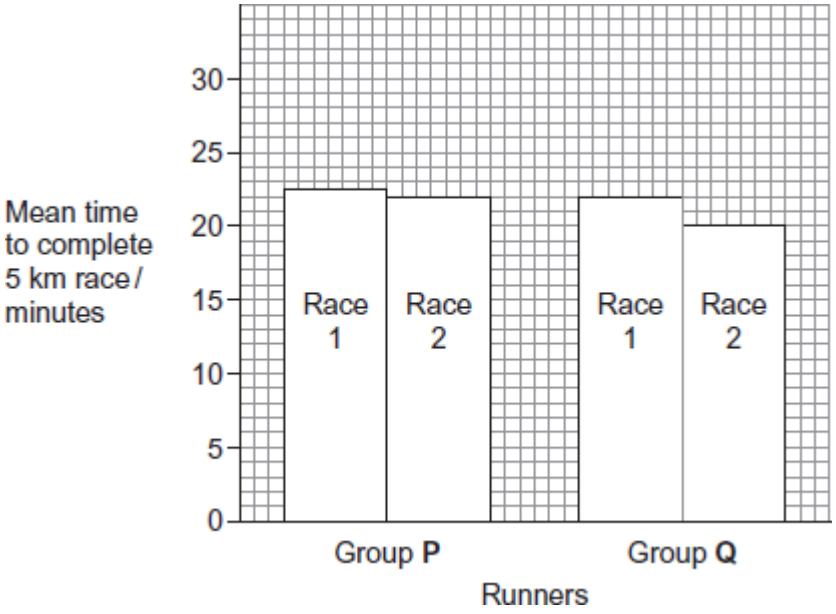
Scientists investigated the effect of a sports drink on the performance of runners in 5 km races.
They recruited 100 runners who had previously run a 5 km race in similar times. During this race, Race 1, they had water they could drink.

The scientists divided the runners into two equal groups, **P** and **Q**. Both groups ran a second 5 km race, Race 2. During this race:

- group **P** had water available
- group **Q** had the sports drink available.

The scientists recorded the mean time for each group to complete this race.

The following figure shows their results.



(a) Use the figure to calculate the percentage decrease in the mean time taken for group **Q** to complete Race 2 compared with Race 1.

Show your working.

_____ %

(2)

(b) One of the runners concluded that the sports drink improved performance.

Do these data support his conclusion?

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) The runners were matched for the time taken to run the first race.

Give **three** other factors for which they should have been matched.

Factor 1 _____

_____

Factor 2 _____

_____

Factor 3 _____

_____

(3)

(d) The sports drink contains sodium chloride. Sodium chloride increases uptake of glucose in the small intestine.

Explain how.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 12 marks)

Q38.

Many sports drinks contain water, sodium chloride and carbohydrates. The manufacturers of the sports drinks claim that carbohydrates provide an energy boost. The sodium chloride is used to increase absorption of glucose in the small intestine.

Scientists investigated the effect of a sports drink on the performance of runners in 5 km races.
They recruited 100 runners who had previously run a 5 km race in similar times. During this race, Race 1, they had water they could drink.

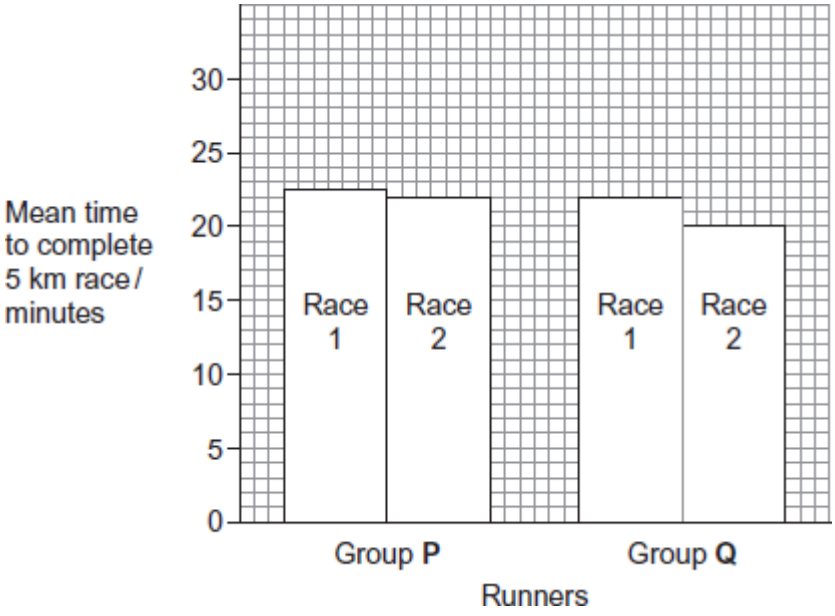
The scientists divided the runners into two equal groups, **P** and **Q**. Both groups ran a second 5 km race, Race 2. During this race:

- group **P** had water available
- group **Q** had the sports drink available.

The scientists recorded the mean time for each group to complete this race.

Figure 1 shows their results.

Figure 1

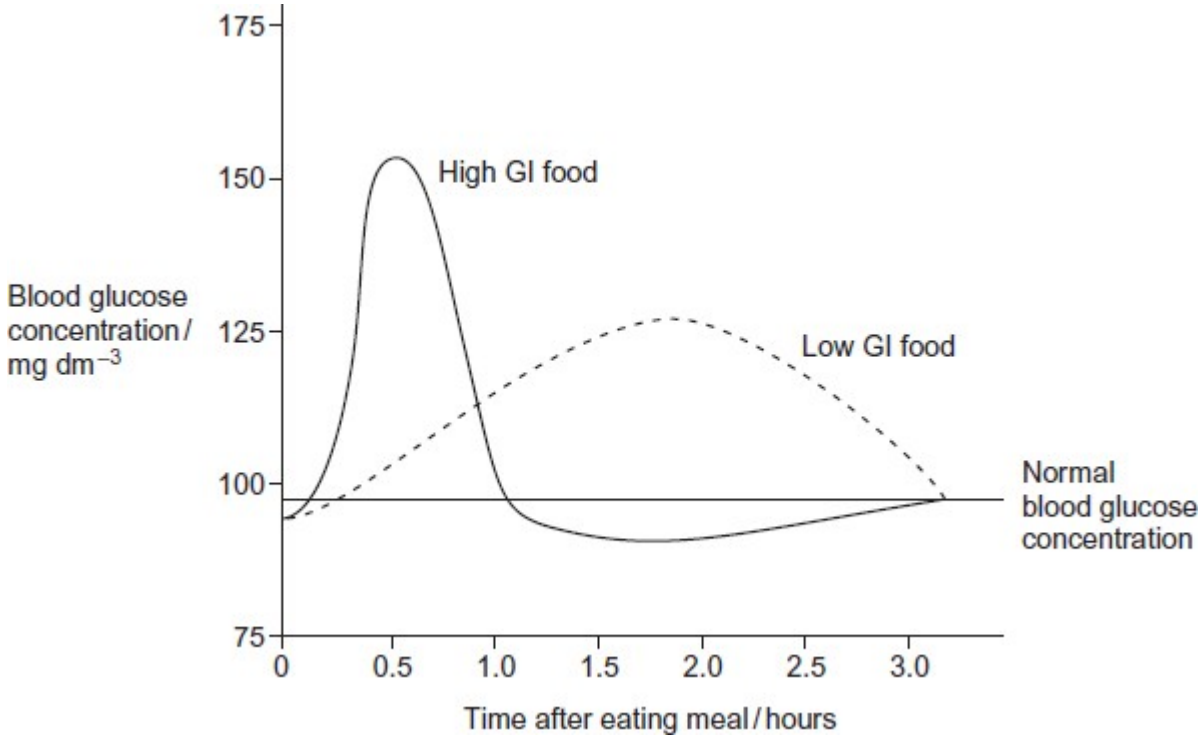


The glycaemic index (GI) is a measure of the increase in blood glucose concentration after eating a given mass of a food compared with eating the same mass of pure glucose. The GI of pure glucose has a value of 100.

The GI of a food depends on several factors such as how much starch and sugars it contains. High GI foods include those containing lots of simple sugars or white flour. The carbohydrates in these foods are rapidly digested and absorbed. Low GI foods include wholegrain bread and breakfast cereals that contain a lot of fibre. The carbohydrates in these foods are digested and absorbed more slowly.

Figure 2 shows changes in blood glucose concentration after eating meals of high GI food and meals of low GI food.

Figure 2



Explain how a sports drink could provide an energy boost when running.

_____

_____

_____

_____

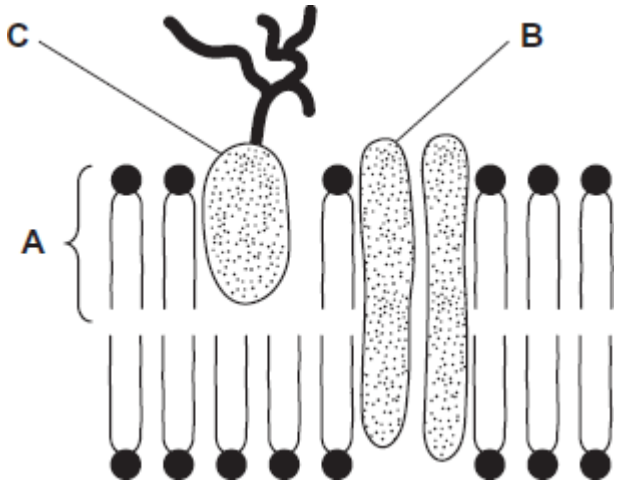
_____

_____

(Total 3 marks)

Q39.

The diagram shows the structure of the cell-surface membrane of a cell.



(a) Name **A** and **B.**

A _____

B _____

(2)

(b) (i) **C** is a protein with a carbohydrate attached to it. This carbohydrate is formed by joining monosaccharides together. Name the type of reaction that joins monosaccharides together.

Name the type of reaction that joins monosaccharides together.

_____

(1)

(ii) Some cells lining the bronchi of the lungs secrete large amounts of mucus. Mucus contains protein.

Name **one** organelle that you would expect to find in large numbers in a mucus-secreting cell and describe its role in the production of mucus.

Organelle_____

Description of role _____

_____

_____

_____

(2)

(Total 5 marks)

Q40.

Imatinib is a drug used to treat a type of cancer that affects white blood cells. Scientists investigated the rate of uptake of imatinib by white blood cells. They measured the rate of uptake at 4°C and at 37°C.
Their results are shown in the table.

	Mean rate of uptake of imatinib into cells / µg per million cells per hour	
Concentration of imatinib outside cells / µmol dm^{-3}	**4°C**	**37°C**
0.5	4.0	10.5
1.0	10.7	32.5
5.0	40.4	420.5
10.0	51.9	794.6

50.0	249.9	3156.1
100.0	606.9	3173.0

(a) The scientists measured the rate of uptake of imatinib in μg per million cells per hour. Explain the advantage of using this unit of rate in this investigation.

_____

_____

_____

_____

_____

(2)

(b) Calculate the percentage increase in the mean rate of uptake of imatinib when the temperature is increased from 4°C to 37°C at a concentration of imatinib outside the cells of 1.0 μmol dm^{-3}.

Give your answer to one decimal place.

Answer _____

(2)

(c) Imatinib is taken up by blood cells by active transport.

(i) Explain how the data for the two different temperatures support this statement.

_____

_____

_____

_____

_____

(2)

(ii) Explain how the data for concentrations of imatinib outside the blood cells at 50 and 100 μmol dm^{-3} at 37°C support the statement that imatinib is taken up by active transport.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

Q41.

Read the following passage.

Microfold cells are found in the epithelium of the small intestine. Unlike other epithelial cells in the small intestine, microfold cells do not have adaptations for the absorption of food.

Microfold cells help to protect against pathogens that enter the intestine. They have receptor proteins on their cell-surface membranes that bind to antigens on the surface of pathogens. The microfold cells take up the antigens and transport them to cells of the immune system. Antibodies are then produced which give protection against the pathogen. 5

Scientists believe that it may be possible to develop vaccines that make use of microfold cells. These vaccines could be swallowed in tablet form. 10

Use information from the passage and your own knowledge to answer the following questions.

(a) (i) Microfold cells have receptor proteins on their cell-surface membranes that bind to antigens (line 5). What is an antigen?

_____

_____

_____

(1)

(ii) Microfold cells take up the antigens and transport them to cells of the immune system (lines 6-7). Antigens are not able to pass through the cell-surface membranes of other epithelial cells. Suggest **two** reasons why.

_____

_____

_____

_____

_____

(2)

(b) Scientists believe that it may be possible to develop vaccines that make use of

microfold cells (lines 9-10). Explain how this sort of vaccine would lead to a person developing immunity to a pathogen.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 8 marks)

Q42.

Write an essay on the membranes of different types of cells and how they are involved in many different functions.

(Total 25 marks)

Q43.

Doctors investigated the effect of the smoking habits of men on their non-smoking wives.

The doctors recruited 540 non-smoking women aged 40 or older. They divided these women into groups according to the smoking habits of their husbands.
After 14 years, the doctors recorded how many of the wives had died and their cause of death.

They used these data to determine the relative risk of a wife dying from a particular disease according to her husband's smoking habit.

In this comparison, they gave the relative risk to the wife of a non-smoker as 1.00. A value greater than 1.00 shows an increased risk compared to the wife of a non-smoker.

The results are shown in the table below.

Cause of death	**Relative risk of wife dying**		
	Husband non-smoker	**Husband smokes 1 to 19 cigarettes /day**	**Husband smokes more than 19 cigarettes /**

			day
Lung cancer	1.00	1.61	2.08
Emphysema	1.00	1.29	1.49
Cervical cancer	1.00	1.15	1.14
Stomach cancer	1.00	1.02	0.99
Heart disease	1.00	0.97	1.03

A journalist concluded from these data that if a husband smoked, it greatly increased the risk of his wife dying of certain diseases. Evaluate this statement.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q44.

Some substances can cross the cell-surface membrane of a cell by simple diffusion through the phospholipid bilayer. Describe other ways by which substances cross this membrane.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 5 marks)

Q45.

(a) (i) An arteriole is described as an organ. Explain why.

_____

_____

_____

(1)

(ii) An arteriole contains muscle fibres. Explain how these muscle fibres reduce blood flow to capillaries.

_____

_____

_____

_____

_____

(2)

(b) (i) A capillary has a thin wall. This leads to rapid exchange of substances between the blood and tissue fluid. Explain why.

_____

_____

_____

(1)

(ii) Blood flow in capillaries is slow. Give the advantage of this.

_____

_____

_____

(1)

(c) Kwashiorkor is a disease caused by a lack of protein in the blood. This leads to a swollen abdomen due to a build up of tissue fluid.

Explain why a lack of protein in the blood causes a build up of tissue fluid.

_____

_____

_____

_____

_____

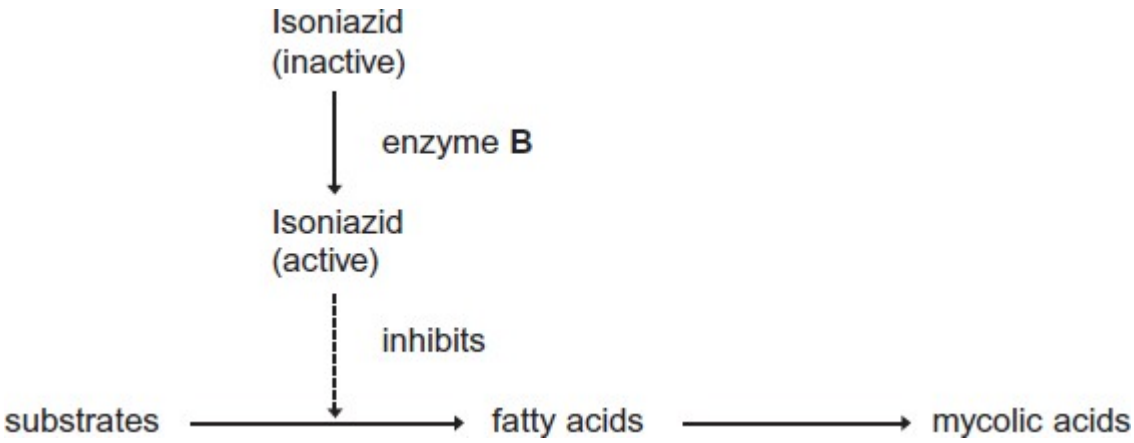
_____

(3)

(Total 8 marks)

Q46.

Mycolic acids are substances that form part of the cell wall of the bacterium that causes tuberculosis. Mycolic acids are made from fatty acids. Isoniazid is an antibioticthat is used to treat tuberculosis. The diagram shows how this antibiotic inhibits the production of mycolic acids in this bacterium.



(a) Treatment with isoniazid leads to the osmotic lysis of this bacterium. Use information in the diagram to suggest how.

_____

_____

_____

_____

_____

(2)

(b) Human cells also produce fatty acids. Isoniazid does not affect the production of these fatty acids.

Use information in the diagram to suggest **one** reason why isoniazid does **not** affect the production of fatty acids in human cells.

_____

_____

_____

(1)

(c) A mutation in the gene coding for enzyme **B** could lead to the production of a non-functional enzyme. Explain how.

_____

_____

_____

_____

_____

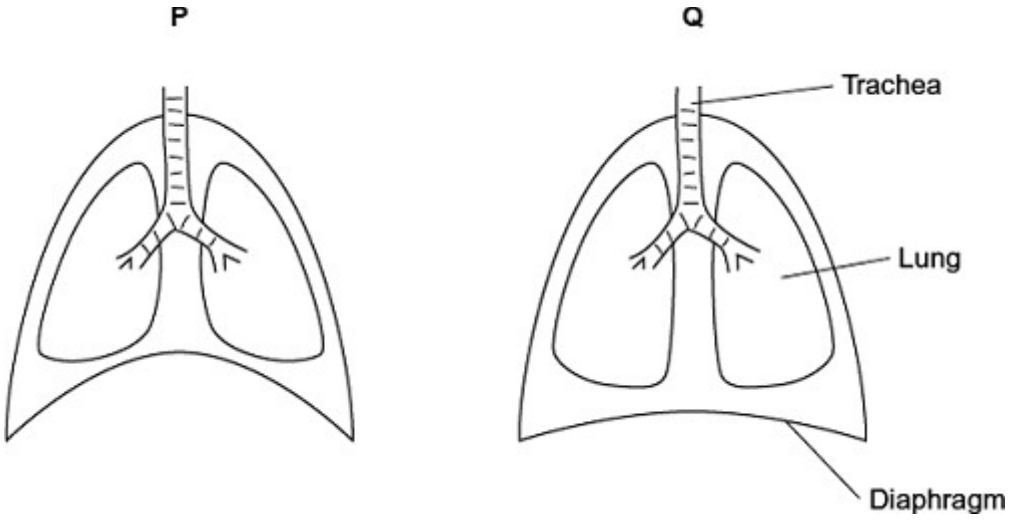
_____

(3)

(Total 6 marks)

Q47.

The diagram shows the position of the diaphragm at times **P** and **Q**.



(a) Describe what happens to the diaphragm between times **P** and **Q** to bring about the change in its shape.

_____

_____

_____

_____

_____

(2)

(b) Air moves into the lungs between times **P** and **Q**. Explain how the diaphragm causes this.

_____

_____

_____

_____

_____

(3)

(c) Describe how oxygen in air in the alveoli enters the blood in capillaries.

_____

_____

_____

_____

(2)

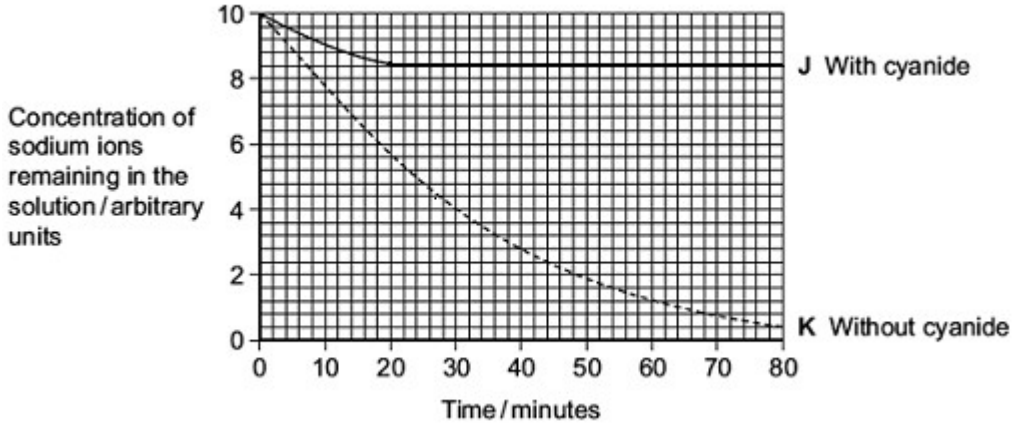
(Total 7 marks)

Q48.

A scientist investigated the effect of cyanide on the uptake of sodium ions by animal tissue.
He set up two beakers, **J** and **K**.
He put equal volumes of a solution containing sodium ions and equal masses of an animal tissue in each beaker.

- He added cyanide to beaker **J**.
- He did not add cyanide to beaker **K**.

He measured the concentration of sodium ions remaining in the solution in each beaker, for 80 minutes. The graph shows his results.



(a) Calculate the rate of uptake of sodium ions by the tissue in beaker **K** for the first 30 minutes. Show your working.

Answer _____ arbitrary units per minute

(2)

(b) Adding cyanide affects the uptake of sodium ions by the tissue. Use the graph to describe how.

_____

_____

_____

_____

_____

(2)

(c) Cyanide is a substance which affects respiration.
Use information in the question to explain the effect of cyanide on the uptake of sodium ions by the tissue.

_____

_____

_____

_____

_____

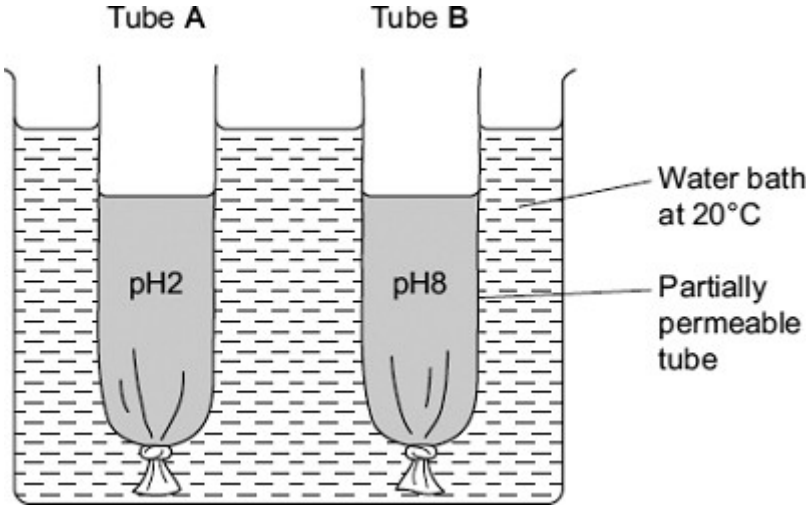
_____

(3)

(Total 7 marks)

Q49.

(a) A student investigated the effect of pH on the activity of the enzyme amylase.
She set up the apparatus shown in the diagram.



The tubes were made from Visking tubing. Visking tubing is partially permeable.
She added an equal volume of amylase solution and starch to each tube.

- She added a buffer solution at pH2 to tube **A**.
- She added an equal volume of buffer solution at pH8 to tube **B**.

After 30 minutes, she measured the height of the solutions in both tubes.
She then tested the solutions in tubes **A** and **B** for the presence of reducing sugars.

Describe how the student would show that reducing sugars were present in a solution.

_____

_____

_____

_____

_____

_____

(3)

(b) After 30 minutes, the solution in tube **B** was higher than the solution in tube **A**.

(i) Explain why the solution in tube **B** was higher.

_____

_____

_____

_____

_____

_____

(3)

(ii) The student concluded from her investigation that the optimum pH of amylase was pH8. Is this conclusion valid? Explain your answer.

_____

_____

_____

(1)

(Total 7 marks)

Q50.

Read the following passage.

Gluten is a protein found in wheat. When gluten is digested in the small intestine, the products include peptides. Peptides are short chains of amino acids. These

peptides cannot be absorbed by facilitated diffusion and leave the gut in faeces

Some people have coeliac disease. The epithelial cells of people with coeliac disease do not absorb the products of digestion very well. In these people, some of the

peptides from gluten can pass between the epithelial cells lining the small intestine and enter the intestine wall. Here, the peptides cause an immune response that leads to the destruction of microvilli on the epithelial cells.

Scientists have identified a drug which might help people with coeliac disease. It reduces the movement of peptides between epithelial cells. They have carried out trials of the drug with patients with coeliac disease.

Use the information in the passage and your own knowledge to answer the following questions.

(a) Name the type of chemical reaction which produces amino acids from proteins.

_____

(1)

(b) The peptides released when gluten is digested cannot be absorbed by facilitated diffusion (lines 2 – 3). Suggest why.

_____

_____

_____

_____

_____

_____

(3)

(c) Explain why the peptides cause an immune response (lines 7 – 8).

_____

_____

_____

(1)

(d) Scientists have carried out trials of a drug to treat coeliac disease (lines 10 – 11). Suggest **two** factors that should be considered before the drug can be used on patients with the disease.

1. _____

_____

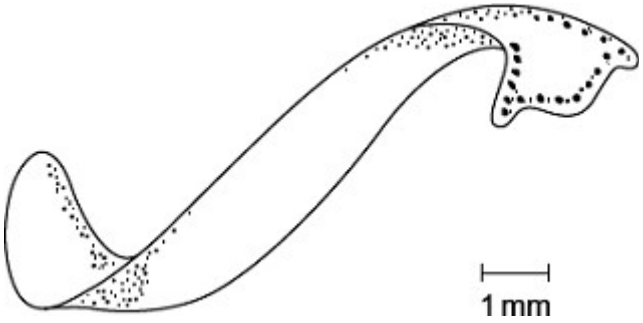
2. _____

_____

(2)
(Total 7 marks)

Q51.

(a) Flatworms are small animals that live in water. They have no specialised gas exchange or circulatory systems.
The drawing shows one type of flatworm.



(i) Name the process by which oxygen reaches the cells inside the body of this flatworm.

_____

(1)

(ii) The body of a flatworm is adapted for efficient gas exchange between the water and the cells inside the body.
Using the diagram, explain how **two** features of the flatworm's body allow efficient gas exchange.

1. _____

_____

2. _____

_____

(2)

(b) (i) A leaf is an organ. What is an organ?

_____

_____

_____

(1)

(ii) Describe how carbon dioxide in the air outside a leaf reaches mesophyll cells inside the leaf.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q52.

Strawberries may be dehydrated by removing most of the water they contain. Dehydrated strawberries have many different uses in the food industry.

Food scientists investigated the effect of using osmosis to dehydrate strawberries.

1. The scientists weighed a sample of strawberries and then cut them into 10 mm thick slices.
2. They put the strawberry slices into a 1.2 mol dm^{-3} solution of sucrose at a temperature of 25 °C.
3. After 1 hour, they removed the slices from the sucrose solution and washed them in water. They dried the slices by blotting them and then weighed them.
4. They also measured the texture of the strawberry slices.
5. The scientists repeated steps 1 to 4, but they left the strawberry slices in the sucrose solution for different amounts of time.

The results of the investigation are shown in the table.

Length of time in sucrose solution / hours	Percentage loss in mass	Texture / arbitrary units
0	Not applicable	1.2
1	15.96	0.9
2	22.88	0.7
4	32.36	0.7
6	38.78	0.7

(a) (i) In this investigation, the scientists cut the strawberries into slices (step 1). Explain the advantage of this.

_____

_____

_____

_____

_____

(2)

(ii) The scientists blotted the strawberry slices dry before weighing them (step 3). Explain why.

_____

_____

_____

_____

_____

(2)

(b) In the second column of the table, the percentage loss in mass for one of the values has been recorded as not applicable. Explain why.

_____

_____

_____

(1)

(c) Use the table to describe how the length of time in the sucrose solution affected the strawberries.

_____

_____

_____

_____

_____

_____

(3)

(d) You could use the data in the table to predict the time that strawberries should be left in sucrose solution to dehydrate them fully. Describe how you could use a graph to do this.

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

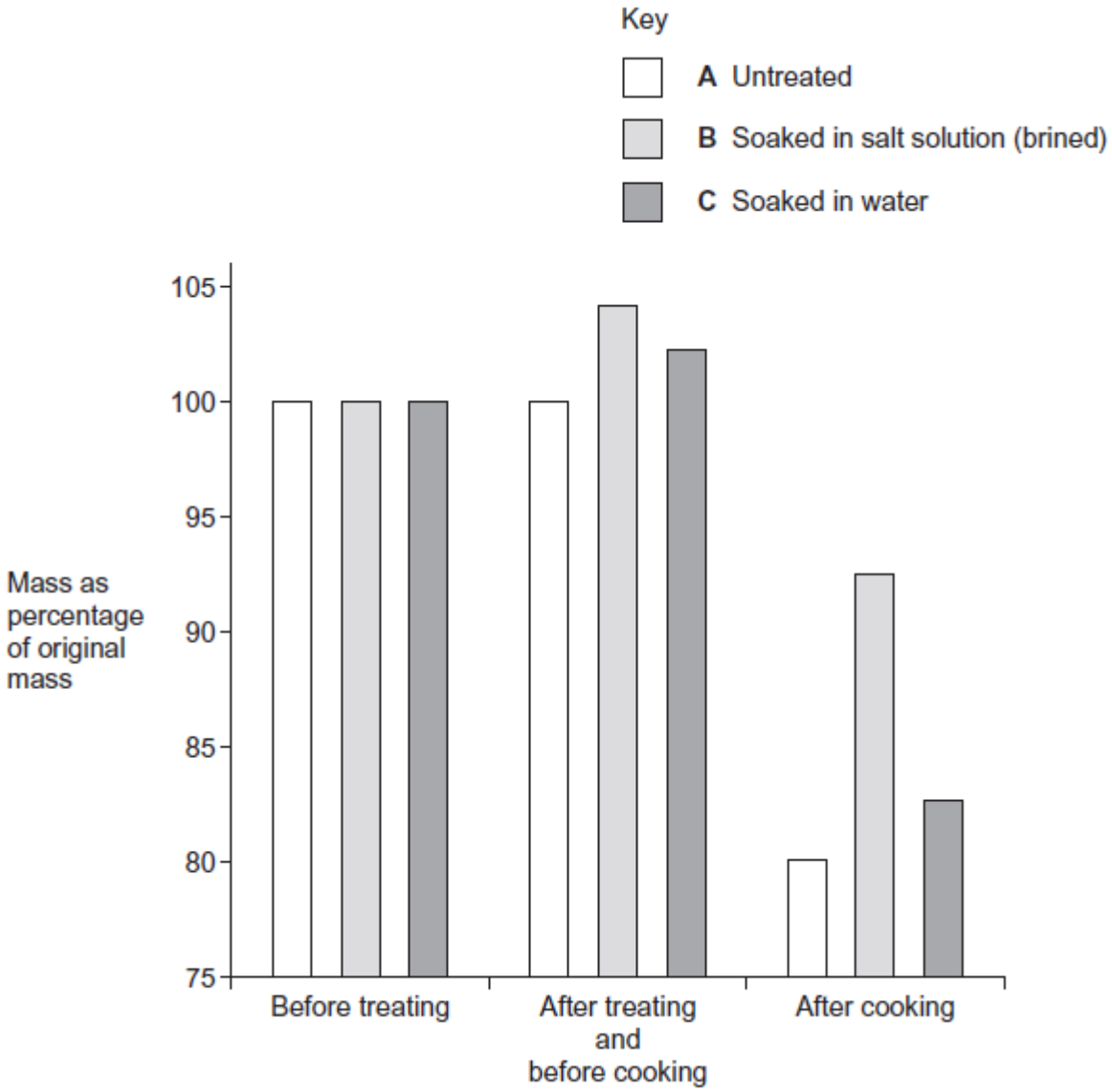
Q53.

Turkey meat can dry out when it is cooked in an oven. One way to overcome this is to soak the meat in a salt solution before cooking it. This is called brining.

A food writer organised a demonstration. He treated three similar pieces of turkey in different ways.

- Piece **A** was untreated.
- Piece **B** was soaked overnight in a 6% solution of salt. A 6% solution of salt has a greater solute concentration than the cells in turkey meat.
- Piece **C** was soaked overnight in water.

He put all three pieces in an oven at 150 °C. He left each piece until it was cooked and the temperature in its centre was 65 °C. The writer weighed each piece at different stages in the demonstration. The graph shows his results.



(a) (i) Explain the advantage of using percentage change in mass in this investigation.

_____

_____

_____

_____

_____

(2)

(ii) The pieces of turkey meat were cooked. Explain the advantage of leaving them in the oven until the temperature in the centre of each piece was 65 °C.

_____

_____

_____

_____

_____

(2)

(iii) Recording mass is a valid way to measure the dependent variable in this investigation.
Evaluate this statement.

_____

_____

_____

_____

_____

(2)

(b) Students suggested that osmosis resulted in cooked brined turkey meat containing more water than cooked untreated meat.

Use your knowledge of water potential and the data in the graph to explain why this suggestion could not be correct.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

Q54.

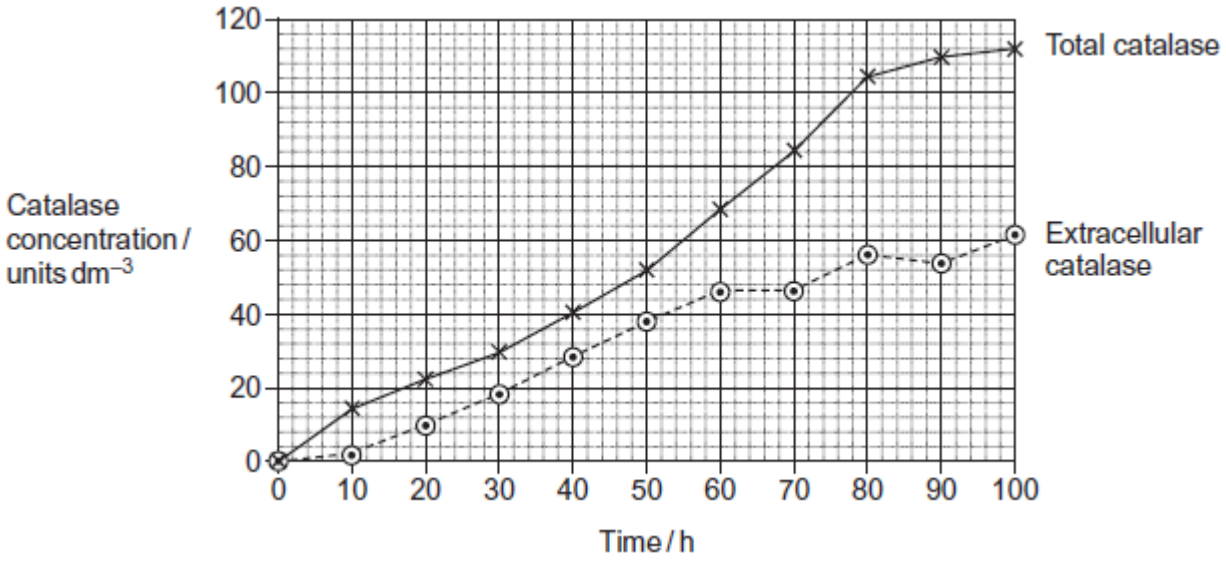
Some of the catalase produced by *Aspergillus niger* is intracellular and some is extracellular.
Intracellular enzymes stay inside the cells that produce them. Extracellular enzymes are

secreted from the cells that produce them.

Another group of scientists grew a different strain of *A. niger*.

- *A. niger* grows from tiny structures called spores. The scientists kept the spores in an isotonic medium at a low temperature until they needed them.
- They put spores of *A. niger* into a 500 cm^3 flask containing a sterile medium. The medium contained starch.
- They measured the total amount of catalase and the amount of extracellular catalase produced by the fungus over a period of 100 hours.

The graph shows their results.



(a) (i) The scientists kept the spores in an isotonic medium until they were needed. Suggest why it was important that the medium was isotonic.

_____

_____

_____

_____

_____

(2)

(ii) The scientists kept the spores at a low temperature until they were needed. Suggest why.

_____

_____

_____

(1)

(b) Starch is a source of carbon, hydrogen and oxygen for the fungus. Name one other

chemical element that must be in the culture medium before *A. niger* can synthesise catalase. Give the reason for your answer.

Chemical element _____

Reason _____

_____

_____

_____

(2)

(c) To get reliable results in this investigation, the medium must be sterile. Explain why.

_____

_____

_____

_____

_____

(2)

(d) (i) At what time was the concentration of intracellular catalase highest?

_____

(1)

(ii) Between what times was the rate of total catalase production highest?

_____

(1)

(e) Technologists prefer to manufacture extracellular enzymes rather than intracellular enzymes. This is because intracellular enzymes are more expensive to purify than extracellular enzymes. Suggest why intracellular enzymes are more expensive to purify.

_____

_____

_____

_____

_____

(2)

(Total 11 marks)

Q55.

Vaccines protect people against disease. Explain how.

_____

_____

_____

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_____

(Total 5 marks)

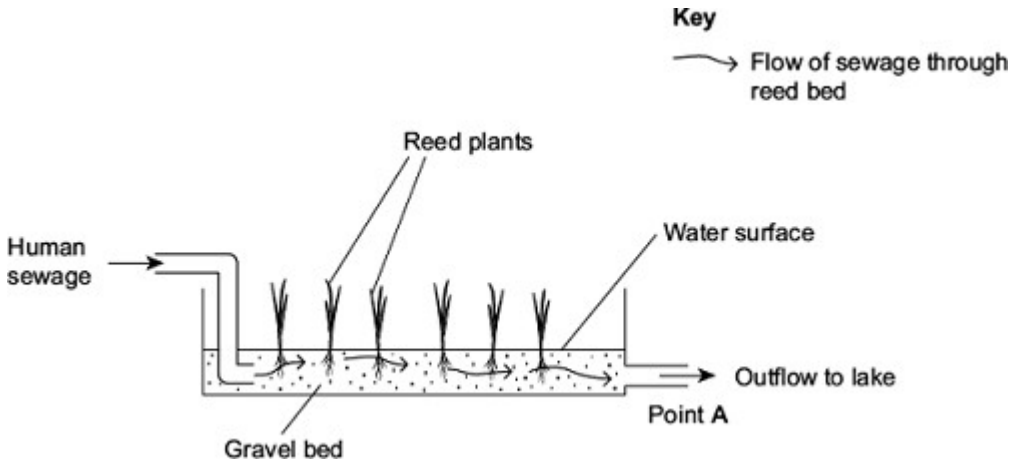
Q56.

(a) Name the process by which some bacteria oxidise ammonia to nitrate.

_____

(1)

Reeds are plants that grow with their roots under water. A reed bed contains a large number of growing reeds. Reed beds may be used to absorb nitrates produced when bacteria break down human sewage. The diagram shows a reed bed.



(b) Reeds have hollow, air-filled tissue in their stems which supplies oxygen to their roots.
Explain how this enables the roots to take up nitrogen-containing substances.

_____

_____

_____

_____

_____

(2)

(c) (i) There is an optimum rate at which human sewage should flow through the reed bed. If the flow of human sewage is too fast, the nitrate concentration at point **A** falls.
Explain why.

_____

_____

_____

_____

_____

(2)

(ii) An increase in nitrate concentration in the water entering the lake could affect algae and fish in the lake. Explain how.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q57.

The equation shows the breakdown of lactose by the enzyme lactase.



(a) (i) Name the type of reaction catalysed by the enzyme lactase.

_____

(1)

(ii) Name monosaccharide **X**.

_____

(1)

(b) (i) Describe how you would use a biochemical test to show that a reducing sugar is present.

_____

_____

_____

_____

_____

(2)

(ii) Lactose, galactose and monosaccharide **X** are all reducing sugars. After the lactose has been broken down there is a higher concentration of reducing sugar. Explain why.

_____

(1)

(c) A high concentration of galactose slows down the breakdown of lactose by lactase. Use your knowledge of competitive inhibition to suggest why.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

Q58.

(a) Give **two** ways in which active transport is different from facilitated diffusion.

1. _____

_____

2. _____

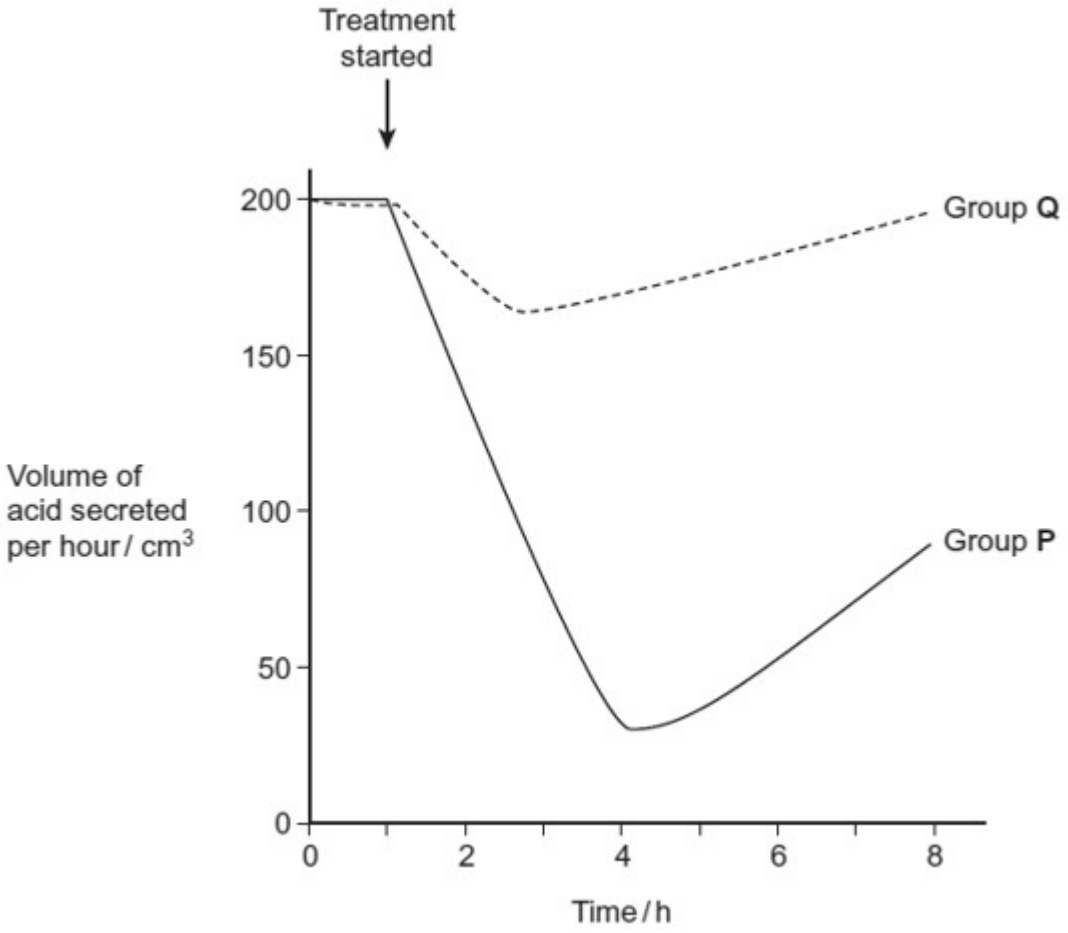
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(2)

Scientists investigated the effect of a drug called a proton pump inhibitor. The drug is given as a tablet to people who produce too much acid in their stomach. It binds to a carrier protein in the surface membrane of cells lining the stomach. This carrier protein usually moves hydrogen ions into the stomach by active transport.

The scientists used two groups of people in their investigation. All the people produced too much acid in their stomach. People in group **P** were given the drug. Group **Q** was the control group.

The graph shows the results.



(b) (i) The scientists used a control group in this trial. Explain why.

_____

_____

(1)

(ii) Suggest how the control group would have been treated.

_____

_____

_____

_____

(2)

(c) Describe the effect of taking the drug on acid secretion.

_____

_____

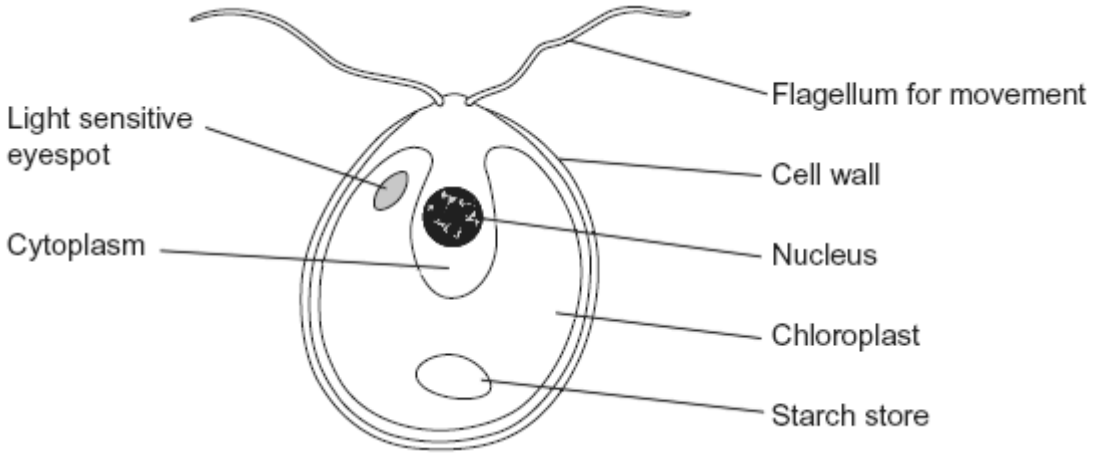
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(1)

(Total 6 marks)

Q59.

The diagram shows an organism called *Chlamydomonas*.



(a) Name **two** structures shown in the diagram that are present in plant cells but are **not** present in animal cells.

1. _____

_____

2. _____

_____

(2)

(b) *Chlamydomonas* lives in fresh water ponds. Use your knowledge of osmosis to suggest an advantage of using starch as a carbohydrate store.

_____

_____

_____

_____

_____

(2)

(c) *Chlamydomonas* has adaptations that help it to maintain a high rate of photosynthesis.

Use information in the diagram to explain what these adaptations are.

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q60.

A student investigated the effect of putting cylinders cut from a potato into sodium chloride solutions of different concentration. He cut cylinders from a potato and weighed each cylinder. He then placed each cylinder in a test tube. Each test tube contained a different concentration of sodium chloride solution. The tubes were left overnight. He then removed the cylinders from the solutions and reweighed them.

(a) Before reweighing, the student blotted dry the outside of each cylinder. Explain why.

_____

_____

_____

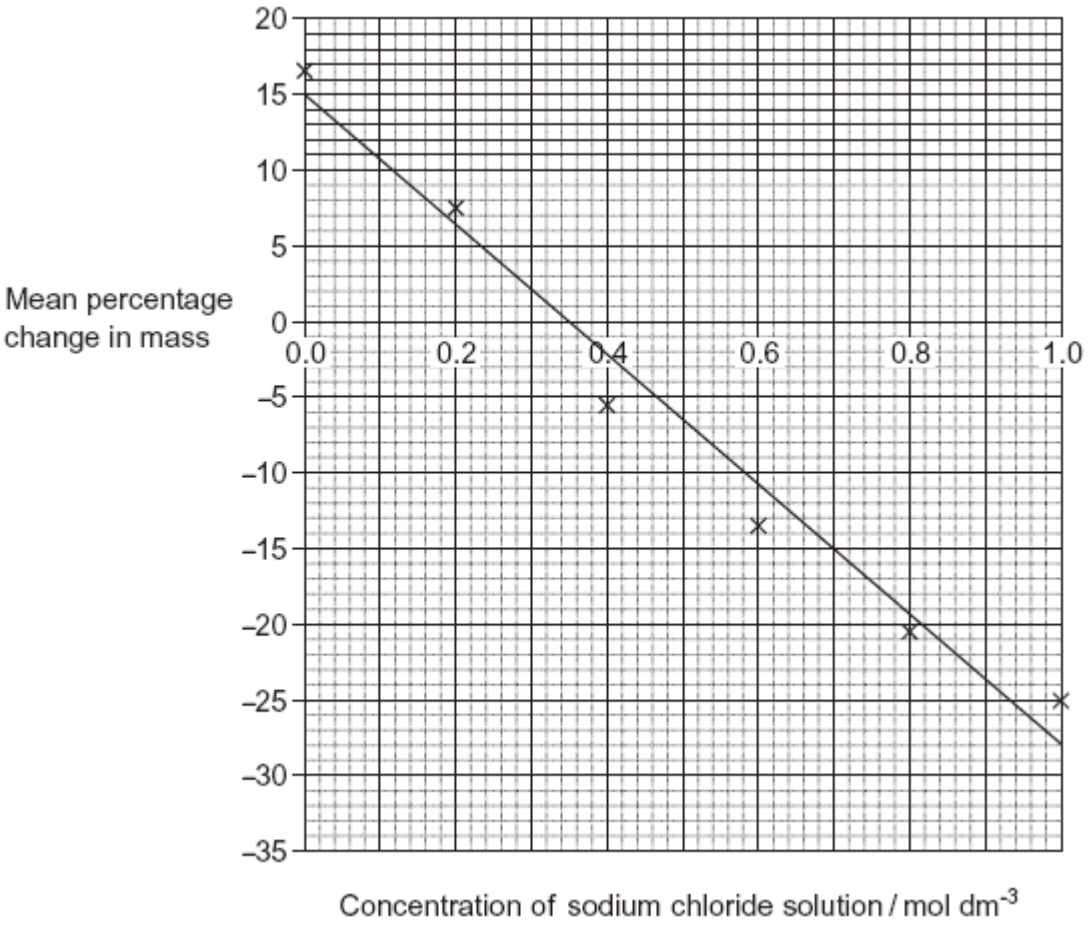
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(2)

The student repeated the experiment several times at each concentration of sodium chloride solution. His results are shown in the graph.



(b) The student made up all the sodium chloride solutions using a 1.0 mol dm^{-3} sodium chloride solution and distilled water.

Complete the table to show how he made 20 cm^3 of a 0.2 mol dm^{-3} sodium chloride solution.

Volume of 1.0 mol dm^{-3} sodium chloride solution	**Volume of distilled water**

(1)

(c) The student calculated the *percentage* change in mass rather than the change in mass. Explain the advantage of this.

_____

_____

_____

_____

_____

(2)

(d) The student carried out several repeats at each concentration of sodium chloride

solution. Explain why the repeats were important.

_____

_____

_____

_____

_____

(2)

(e) Use the graph to find the concentration of sodium chloride solution that has the same water potential as the potato cylinders.

_____ mol dm^{-3}

(1)

(Total 8 marks)

Q61.

(a) Many different substances enter and leave a cell by crossing its cell surface membrane. Describe how substances can cross a cell surface membrane.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(b) Describe and explain how the lungs are adapted to allow rapid exchange of oxygen between air in the alveoli and blood in the capillaries around them.

_____

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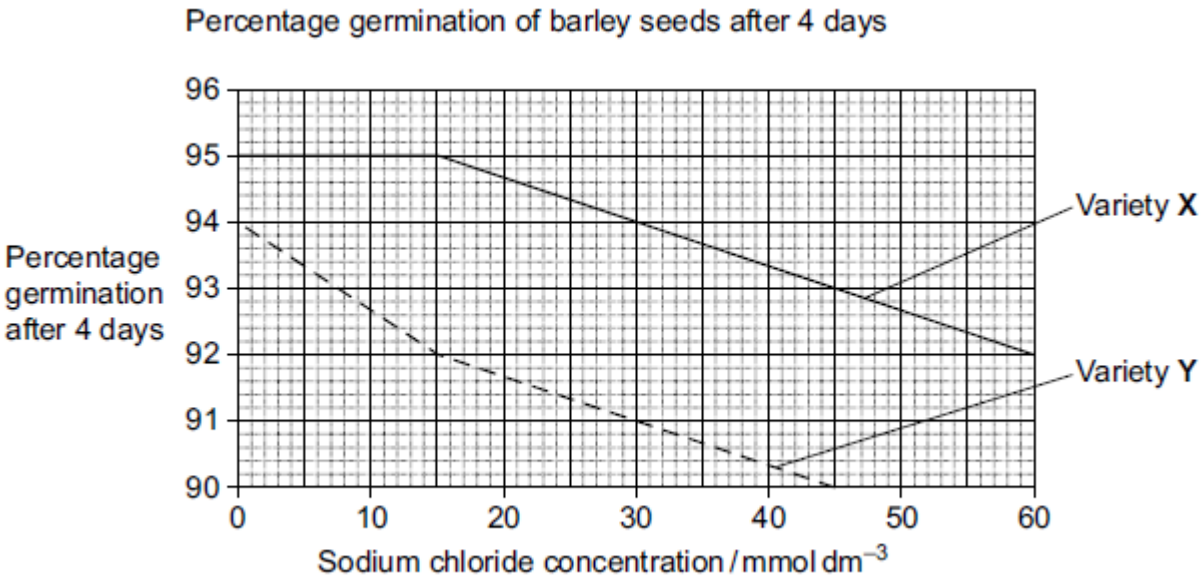
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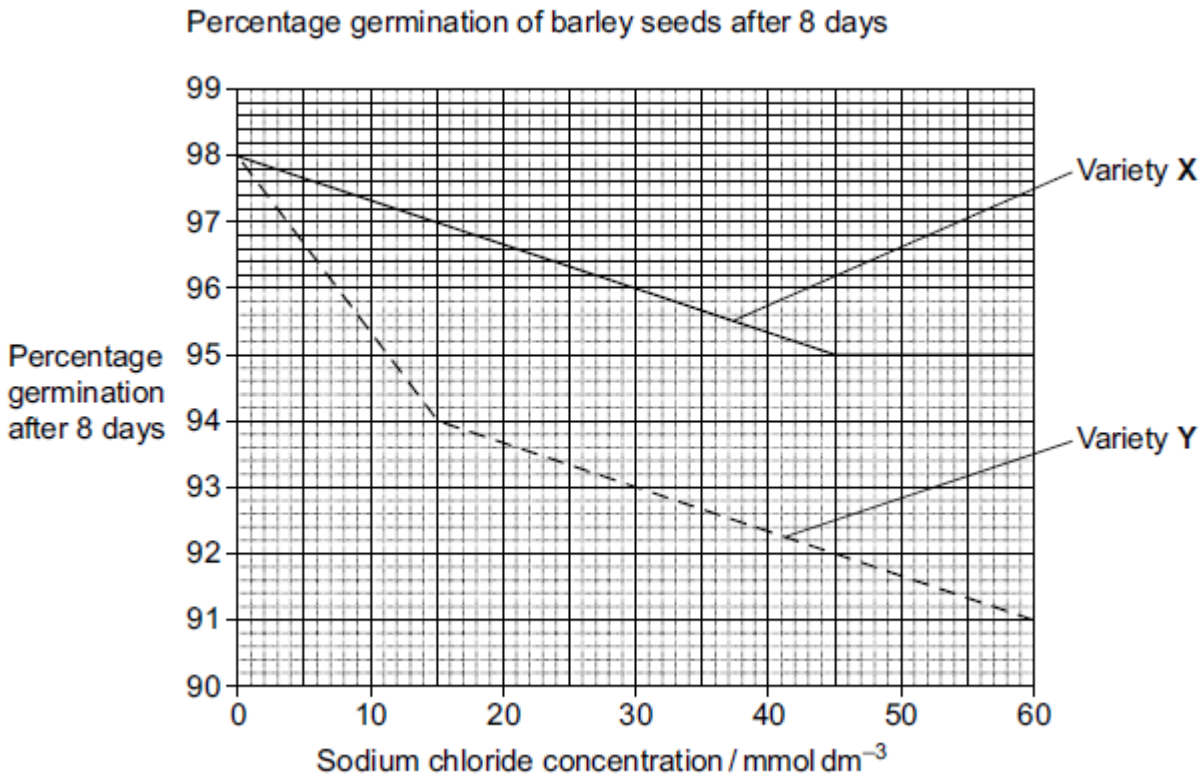
(5)

(Total 10 marks)

Q62.

Scientists investigated the effects of different concentrations of sodium chloride on the germination of the seeds of two varieties of barley. The seeds were soaked for one hour in different concentrations of sodium chloride solutions and then germinated in distilled water at 25°C. The scientists found the percentage of germinated seeds after 4 days and again after 8 days.





Describe what the data in above shows about the effect of sodium chloride concentration on germination in these two varieties of barley.

_____

_____

_____

_____

_____

_____

(Total 3 marks)

Q63.

(a) (i) The equation shows the reaction catalysed by the enzyme lactase. Complete this equation.

Lactose + _____ ⟶ Glucose + _____

(2)

(ii) Name the type of chemical reaction shown in this equation.

_____

(1)

(b) Lactase is an enzyme. Lactose is a reducing sugar.

(i) Describe how you could use the biuret test to distinguish a solution of the enzyme, lactase from a solution of lactose.

_____

_____

(1)

(ii) Explain the result you would expect with the enzyme.

_____

_____

(1)

(Total 5 marks)

Q64.

Students investigated the effect of different concentrations of sodium chloride solution on discs cut from an apple. They weighed each disc and then put one disc into each of a range of sodium chloride solutions of different concentrations. They left the discs in the solutions for 24 hours and then weighed them again. Their results are shown in the table.

Concentration of sodium chloride solution / mol dm^{-3}	Mass of disc at start / g	Mass of disc at end / g	Ratio of mass at start to mass at end
0.00	16.1	17.2	0.94
0.15	19.1	20.2	0.95
0.30	24.3	23.2	1.05
0.45	20.2	18.7	1.08
0.60	23.7	21.9	
0.75	14.9	13.7	1.09

(a) (i) Calculate the ratio of the mass at the start to the mass at the end for the disc placed in the 0.60 mol dm^{-3} sodium chloride solution.

Answer _____

(1)

(ii) The students gave their results as a ratio. What is the advantage of giving the results as a ratio?

_____

_____

_____

_____

_____

(2)

(iii) The students were advised that they could improve the reliability of their results by taking additional readings at the same concentrations of sodium chloride.

Explain how.

_____

_____

_____

_____

_____

(2)

(b) (i) The students used a graph of their results to find the sodium chloride solution with the same water potential as the apple tissue. Describe how they did this.

_____

_____

_____

_____

_____

(2)

(ii) The students were advised that they could improve their graph by taking additional readings. Explain how.

_____

_____

_____

_____

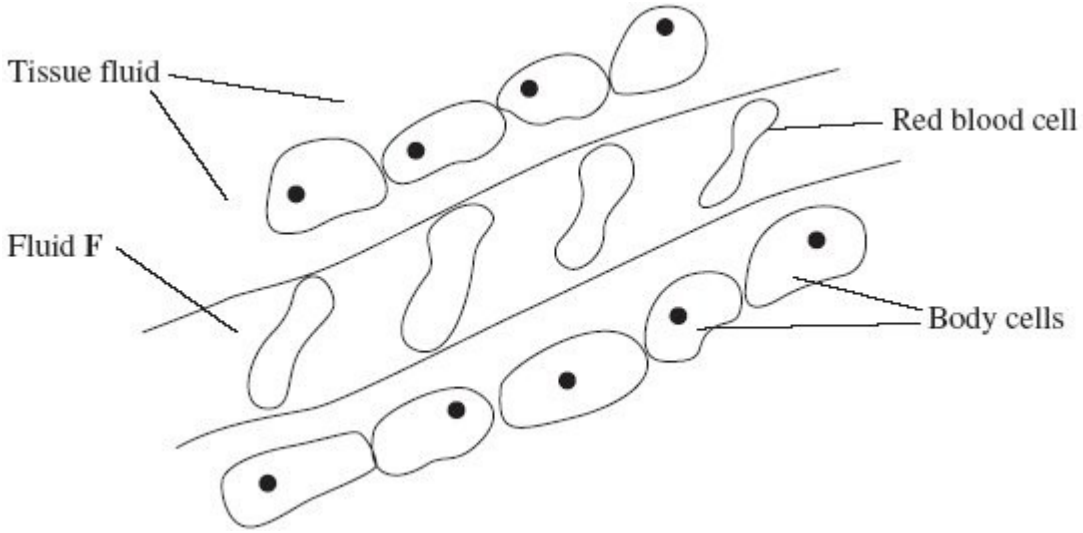
_____

(2)

(Total 9 marks)

Q65.

The diagram shows tissue fluid and cells surrounding a capillary.



(a) Name fluid **F**.

_____

(1)

(b) Give **one** way in which fluid **F** is different from tissue fluid.

_____

(1)

(c) (i) The blood pressure is high at the start of the capillary. Explain how the left ventricle causes the blood to be at high pressure.

_____

_____

(1)

(ii) The blood pressure decreases along the length of the capillary. What causes this decrease in pressure?

_____

_____

(1)

(d) In children, some diets may result in a low concentration of protein in fluid **F**. This can cause the accumulation of tissue fluid. Explain the link between a low concentration of protein in fluid **F** and the accumulation of tissue fluid.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q66.

The effect of watering tomato plants with sodium chloride solution on the mass of tomatoes

Type of tomato plant	Watered with	Mean mass of tomatoes / g	
		fresh mass	dry mass
Normal	Distilled water	115.9	6.5
Normal	Sodium chloride solution	87.8	6.6
GM	Distilled water	101.3	6.4
GM	Sodium chloride solution	57.4	6.5

(a) What conclusions can you draw about the effects of watering plants with sodium chloride solution on the mass of tomatoes?

_____

_____

_____

_____

(2)

(b) Use your knowledge of water potential to suggest how watering plants with sodium chloride solution affects the fresh mass of the tomatoes.

_____

_____

_____

_____

_____

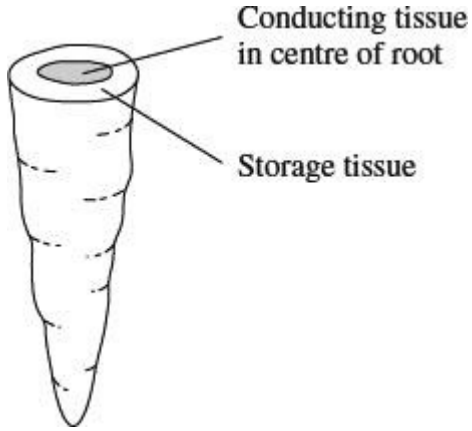
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(3)

(Total 5 marks)

Q67.

The diagram shows a carrot.



A group of students investigated the effect of sucrose concentration on the length of cylinders cut from a carrot.

(a) The students used a cork borer to cut cylinders from the carrot. Describe how the students should cut these cylinders to make sure that this was a fair test and would produce reliable results.

_____

_____

_____

_____

(2)

(b) They measured the initial length of each cylinder then placed the cylinders into test tubes containing different concentrations of sucrose solution. Bungs were placed in the tubes and the tubes were left overnight. Explain why the bungs were placed in the tubes.

_____

_____

_____

_____

(2)

(c) The students then measured the final lengths of the carrot cylinders. Their results are shown in the table.

Concentration of sucrose / mol dm^{-3}	$\frac{\text{Final length}}{\text{Initial length}}$
0.0	1.4
0.2	1.4

0.4	1.2
0.6	1.1
0.8	0.9

(i) The students used these results to find the concentration of sucrose that has the same water potential as the carrot cylinders. Describe how they could have done this.

_____

_____

_____

_____

(2)

(ii) Was it important in this investigation that the carrot cylinders had the same initial length? Explain your answer.

_____

_____

_____

(1)

(Total 7 marks)

Q68.

Read the following passage.

Campylobacter jejuni is a bacterium. It is one of the commonest causes of diarrhoea in humans. The illness that it causes does not usually last very long and many sufferers do not even go to the doctor. The only treatment required is the use of oral rehydration solutions to replace the water lost by diarrhoea. In 1998, laboratory tests confirmed 60 000 cases of diarrhoea caused by this bacterium in the UK. The bacterium was more frequently found in males than in females with a ratio of 1.5 : 1.

In rare cases, the nervous system may be affected. Scientists are now beginning to understand the cause of this. Sugars in the antigens on the surface of the bacteria are identical to some of the sugars on the surface of nerve cells. Antibodies produced against the bacteria may therefore attack the body's nerve cells. There can be serious problems if this leads to paralysis of the diaphragm. Breathing difficulties result and the patient may die.

Use information in the passage and your own knowledge to answer the following questions.

(a) (i) The number of cases of diarrhoea confirmed as being caused by *Campylobacter jejuni* in the UK in 1998 was 60 000 (lines 4–5). Explain why the true number of cases is thought to be more than this.

_____

_____

_____

(1)

(ii) Calculate the number of cases of diarrhoea confirmed as being caused by *Campylobacter jejuni* in men in 1998.

Answer _____

(1)

(b) Explain why antibodies produced against *Campylobacter jejuni* also attack nerve cells (lines 9 –10).

_____

_____

_____

_____

_____

_____

(3)

(c) Explain how paralysis of the diaphragm leads to breathing difficulties (line 11).

_____

_____

_____

_____

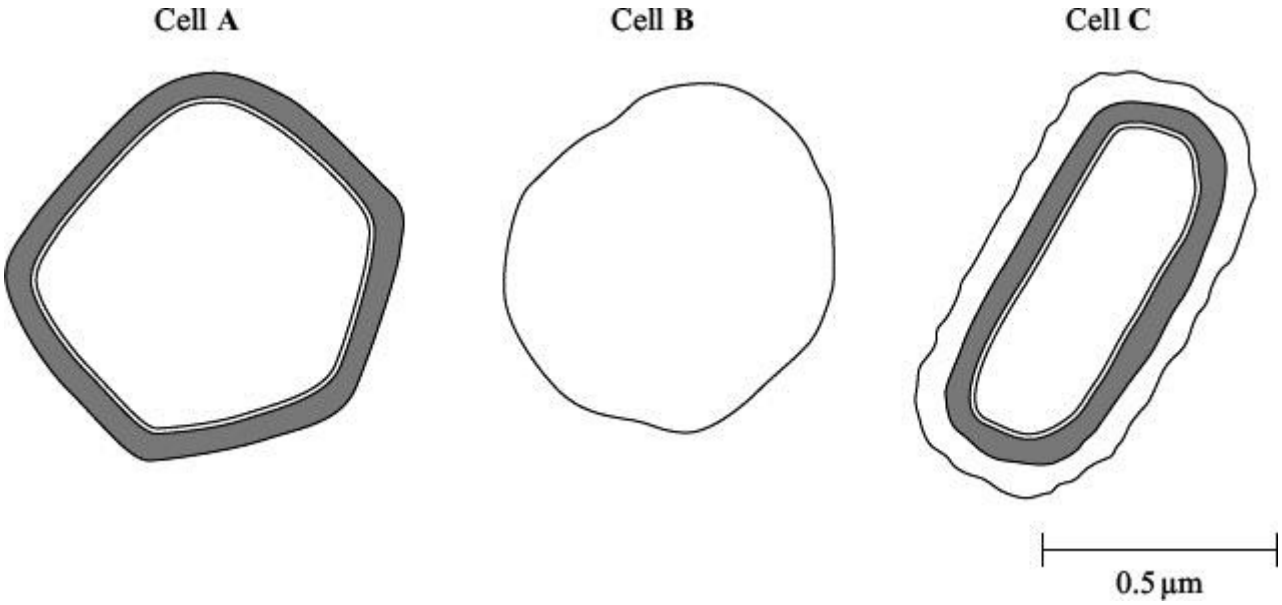
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(2)

(Total 7 marks)

Q69.

The diagram shows the outer layers of three different cells, **A**, **B** and **C**.



(a) What is the evidence from the diagram that

(i) cell **B** is an animal cell,

_____

_____

(1)

(ii) cell **C** is a prokaryotic cell?

_____

_____

(1)

(b) Explain how you would calculate the magnification of cell **C**.

_____

_____

(1)

(c) Cell **A** is a plant cell. Name a polysaccharide which may be found in cell **A** but would not be found in the animal cell.

_____

(1)

(d) Penicillin is an antibiotic. It prevents the formation of bacterial cell walls. As a result, bacterial cells that have been treated with penicillin swell and burst as water enters.

(i) Explain how water enters a bacterial cell.

_____

_____

_____

_____

(2)

(ii) Suggest why penicillin has no effect on plant cells.

_____

_____

(1)

(Total 7 marks)

Q70.

Tradescantia is a house plant. There are small hairs on its flowers. These hairs are made of cells. **Figure 1** shows the appearance of cells from one of these hairs after 20 minutes in distilled water. **Figure 2** shows cells from another hair after 20 minutes in a solution of potassium nitrate.

Figure 1 (in distilled water)

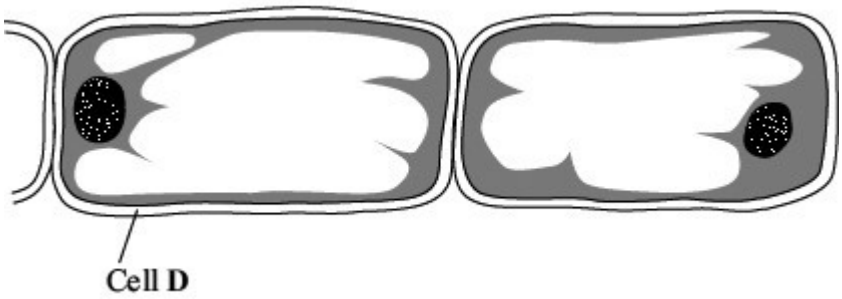
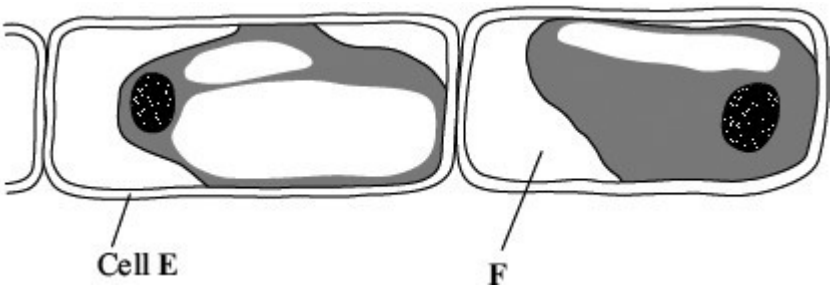


Figure 2 (in potassium nitrate solution)



(a) What does **Figure 2** suggest about the permeability of the plasma membranes surrounding these cells?

_____

_____

(1)

(b) What is present in the space labelled **F**? Explain your answer.

_____

_____

_____

_____

(2)

(c) How would the water potential of the sap in the vacuole of cell **E** differ from the water potential of the sap in the vacuole of cell **D**? Explain your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q71.

(a) A plant cell was observed with an optical microscope. Describe how the length of the cell could be estimated.

_____

_____

_____

_____

(2)

(b) The water potential of a plant cell is –400 kPa. The cell is put in a solution with a water potential of –650 kPa. Describe and explain what will happen to the cell.

_____

_____

_____

_____

_____

_____

(3)

(c) A group of students investigated the effect of sucrose concentration on the change in length of cylinders of tissue cut from a young carrot. They measured the initial lengths of the carrot cylinders, then placed one in each of a number of sucrose solutions. After 18 hours, they removed the carrot cylinders and measured their final lengths. Some of the results are shown in the table.

Concentration of sucrose / mol dm^{-3}	Percentage decrease in length of carrot cylinder
0.4	4.2
0.5	8.7
0.6	13.0
0.7	16.8
0.8	18.1
0.9	18.1
1.0	18.1

(i) The carrot cylinders were left for 18 hours in the sucrose solutions. Explain why they were left for a long time.

_____

_____

(1)

(ii) Explain how you would use a graph to predict the concentration of sucrose that would result in no change in length of the carrot cylinders.

_____

_____

_____

_____

(2)

(iii) Young carrots store sugars in their tissues but, in older carrots, some of this is converted to starch. How would using cylinders of tissue from older carrots affect the results obtained for a sucrose solution of 0.6 mol dm^{-3}? Give a reason for your answer.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q72.

Read the following passage.

During the course of a day, we come into contact with many poisonous substances. These include industrial and household chemicals. The skin acts as a barrier and prevents many of these substances entering and harming the body.

The skin is one of the largest organs in the body. It is composed of several layers of tissue. The outer layer consists of dead cells packed with keratins. Keratins are a group of proteins that differ from each other in their primary structure. Each keratin molecule consists of several polypeptide chains, each individual chain wound into a spiral or helix. The polypeptide chains include many sulphur-containing amino acids and these help to give the keratin molecules their characteristic strength.

Use information from the passage and your own knowledge to answer the questions.

(a) What is the evidence from the passage that keratin molecules have a quaternary structure?

_____

_____

(1)

(b) Explain how sulphur-containing amino acids help to give keratin molecules their characteristic strength (lines 8–9).

_____

_____

_____

_____

(2)

(c) Explain why differences in primary structure result in keratins with different properties
(line 6).

_____

_____

_____

_____

(2)

(d) The skin prevents poisonous substances entering and harming the body (line 3). Explain why these substances are unable to pass through the outer layer of skin cells by active transport.

_____

_____

_____

_____

_____

_____

(3)

(e) Skin cells may be studied with a transmission electron microscope or an optical microscope. Explain the advantages and limitations of using a transmission electron microscope to study cells.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 14 marks)

Q73.

(a) Discs of carrot were placed in a solution containing potassium ions (K^+). The concentration of oxygen in air bubbled through the solution was changed and the rates of respiration and uptake of potassium ions were measured. The results are shown in the table.

Concentration of oxygen / %	Rate of respiration / arbitrary units	Rate of uptake of potassium ions / arbitrary units
2.7	31	29
12.2	69	72
20.8	90	80

Describe and explain the link between oxygen concentration, rate of respiration and rate of uptake of potassium ions.

_____

_____

_____

_____

_____

_____

_____

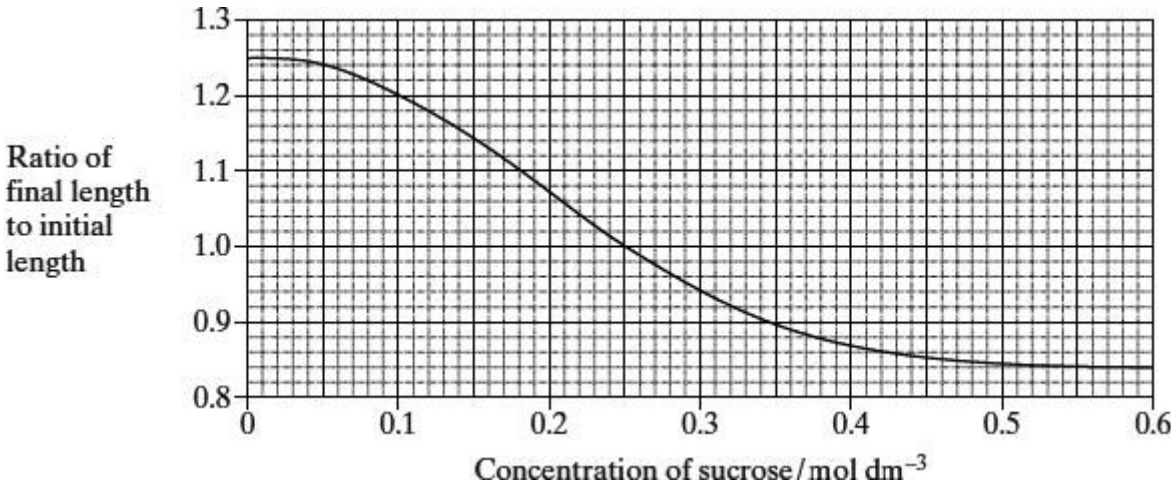
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_____

(4)

(b) Cylinders of potato were cut using a cork borer. Their initial lengths were measured. Each cylinder was then put in a different concentration of sucrose solution for 12 hours. The graph shows the changes in length of the potato cylinders in the different sugar solutions.



(i) In what concentration of sucrose did the length of the potato cylinder remain the same?

_____

(1)

(ii) The initial length of the potato cylinder in the solution of concentration 0.1 mol dm^{-3} was 90 mm. Calculate its final length. Show your working.

Final length = _____ mm

(2)

(iii) Explain the change in length which occurs in a sucrose solution of concentration 0.5 mol dm^{-3}.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q74.

In a hospital laboratory, a sterile Petri dish of nutrient agar was inoculated with bacteria from a patient with a throat infection. Four discs, each of which had been soaked in a different antibiotic, were placed on top of the bacteria. The dish was incubated at 37 °C. **Figure 1** shows the appearance of the dish after incubation.

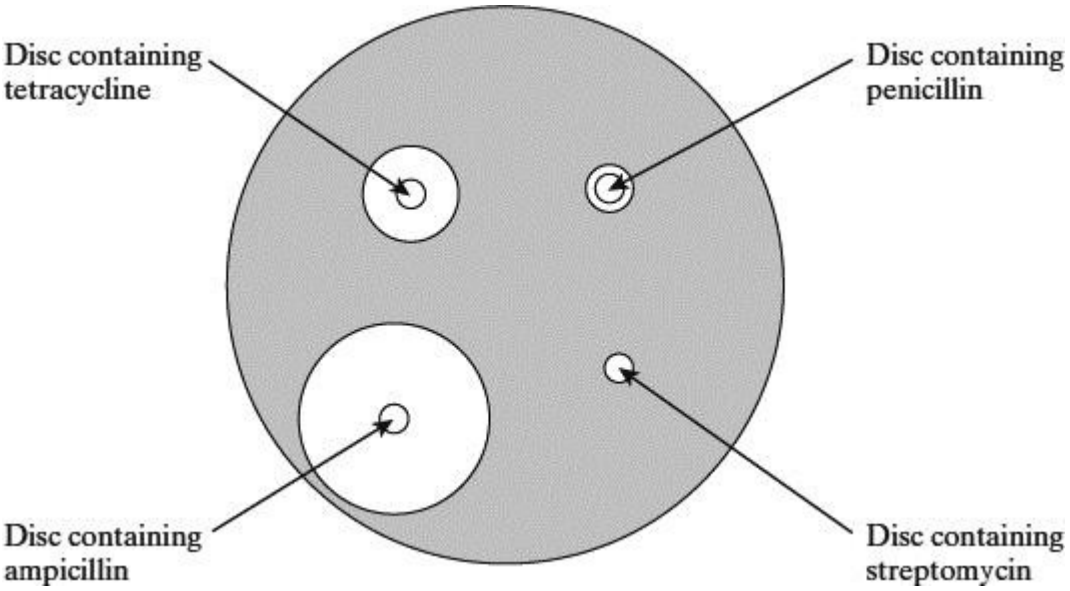


Figure 1

(a) Explain why there are clear zones around some of the discs containing antibiotic.

_____

_____

_____

_____

(2)

(b) It was suggested that ampicillin might be the best antibiotic to treat the patient's throat infection. Give the evidence from the laboratory test to support this suggestion.

_____

_____

(1)

(c) Tetracycline binds to bacterial ribosomes. This is shown in **Figure 2**.

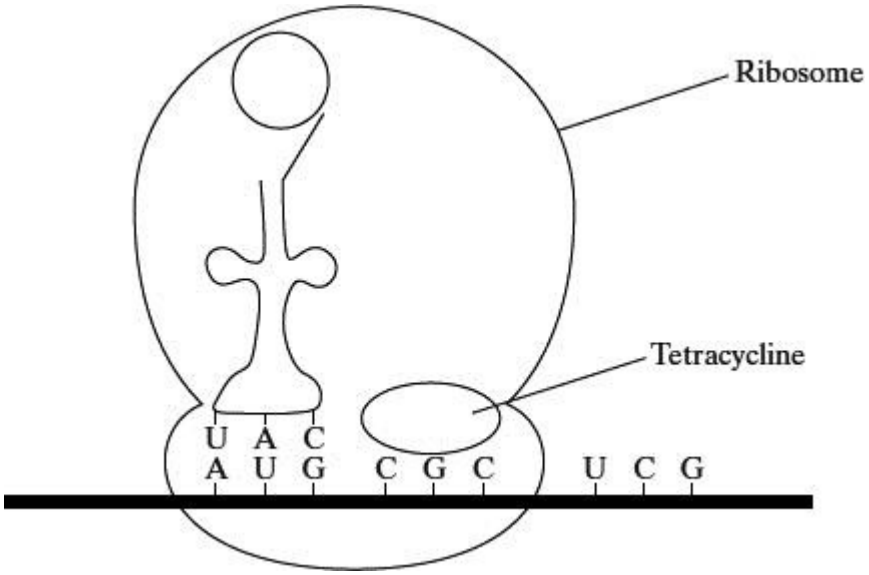


Figure 2

Tetracycline prevents bacterial growth by preventing protein synthesis. Give **two** other ways in which antibiotics can prevent bacterial growth.

1. _____

_____

2. _____

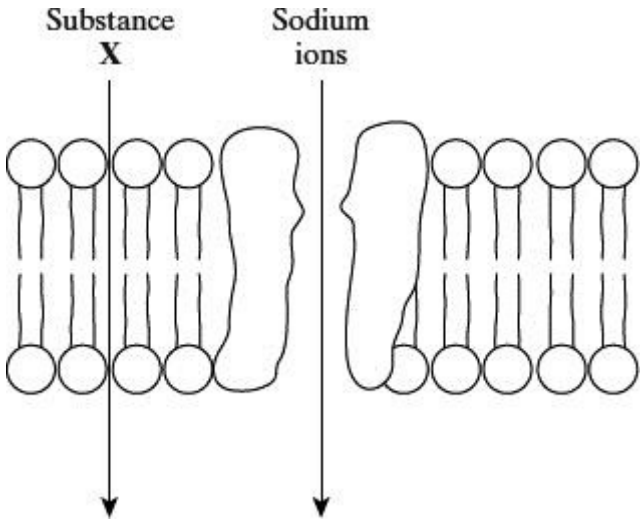
_____

(2)

(Total 5 marks)

Q75.

The diagram shows part of a plasma membrane. The arrows show the path taken by sodium ions and by substance **X** when they diffuse through the membrane into a cell.



(a) An optical microscope cannot be used to see a plasma membrane. Explain why.

_____

_____

_____

_____

(2)

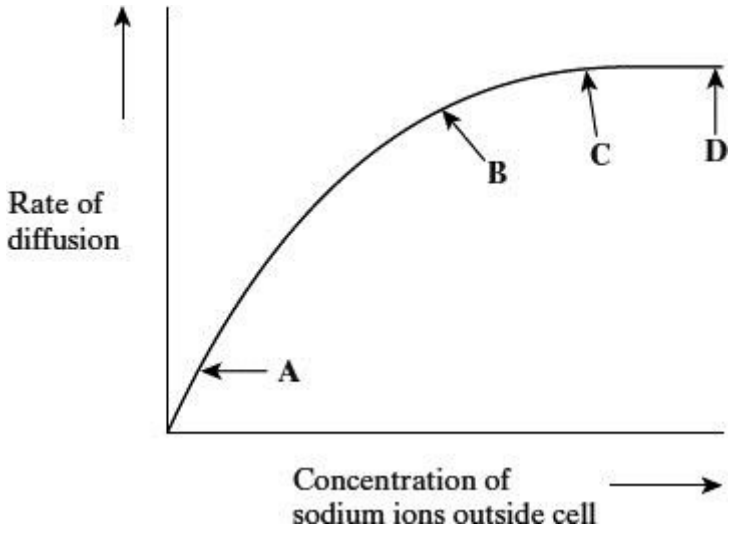
(b) Give **one** property of the molecules of substance **X** which allows them to diffuse through the membrane at the position shown.

_____

_____

(1)

(c) The effect of the concentration of sodium ions in the surrounding solution on their rate of diffusion across the membrane was investigated. The graph shows the results.



(i) What limits the diffusion of sodium ions across the membrane between

A and **B** on the graph? Give the evidence for your answer.

Limiting factor _____

Evidence _____

_____

(2)

(ii) Explain the shape of the curve between **C** and **D**.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q76.

Some strains of the bacterium that causes gonorrhoea are resistant to antibiotics. This makes the disease difficult to treat. One way of testing the effectiveness of antibiotics is to use discs of paper soaked in antibiotic. These are placed in the centre of an agar plate covered by bacteria. A clear zone forms around the disc if the antibiotic is effective.

The table shows some results of an investigation into the effect of four different antibiotics on gonorrhoea bacteria.

Antibiotic	Diameter of clear zone / mm	Minimum diameter of clear zone if antibiotic is effective / mm
A	47	52
B	30	28
C	22	40
D	33	34

(a) Give **two** reasons why it would be important to use sterile techniques during this investigation.

1. _____

_____

2. _____

_____

(2)

(b) (i) The antibiotic reached the bacteria by diffusion. Suggest why an effective antibiotic may produce only a small clear zone.

_____

_____

(1)

(ii) Which antibiotic used in the investigation would be most useful for treating gonorrhoea? Explain your answer.

Antibiotic _____

Explanation _____

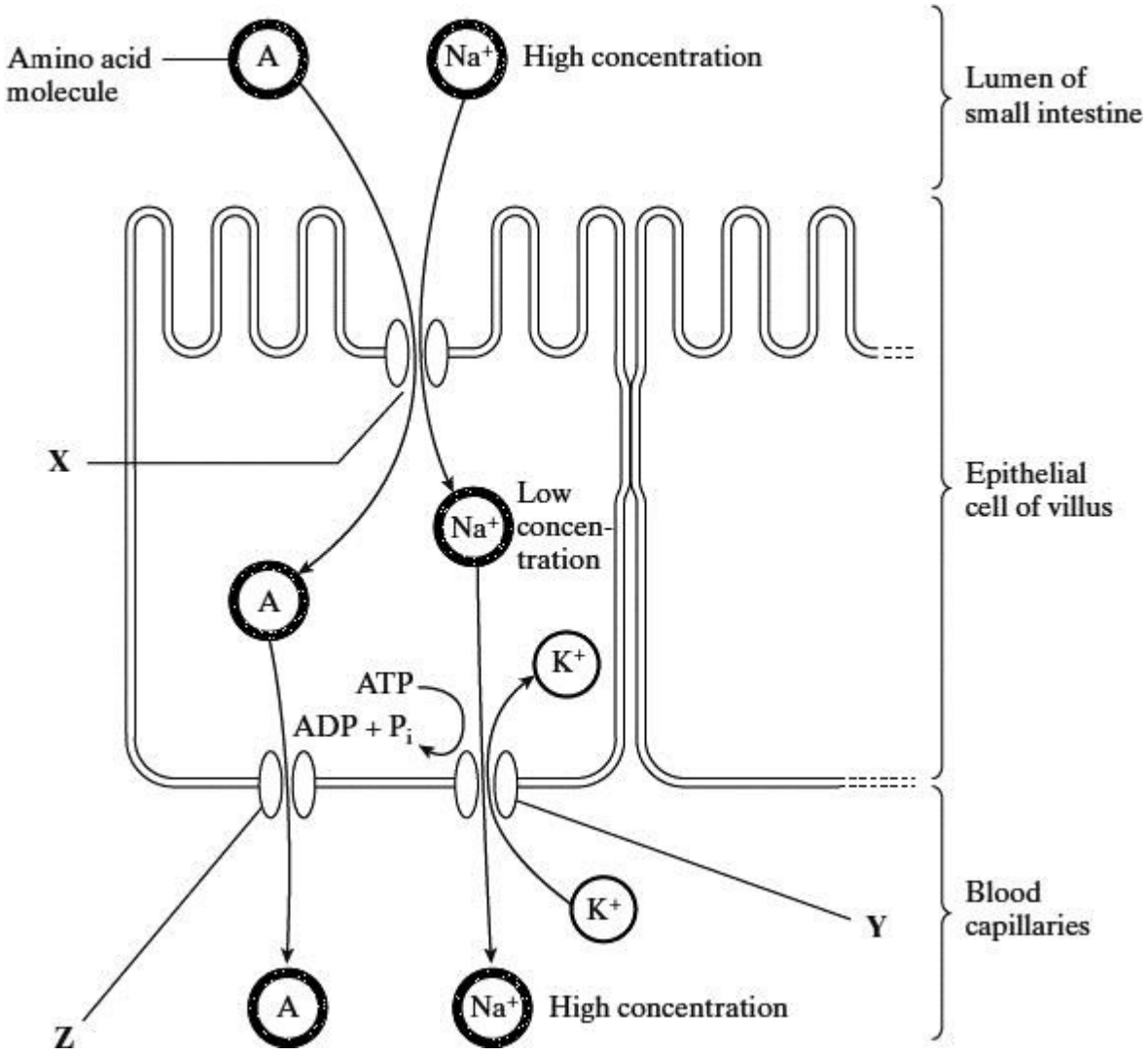
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(2)

(Total 5 marks)

Q77.

The diagram shows one method by which amino acids are absorbed from the small intestine into the blood. They are co-transported into the epithelial cell with sodium ions (Na^+) at point **X** on the diagram. Normally, the concentration of sodium ions inside the epithelial cell is low.



Source: adapted from M. ROWLAND,

Dinitrophenol (DNP) prevents oxidative phosphorylation. When treated with DNP, the sodium-potassium pump at **Y** no longer works. As a result, the concentration of sodium ions in the cell rises and amino acid absorption stops.

(i) Explain why pump **Y** will **not** work in the presence of DNP.

_____

_____

_____

_____

(2)

(ii) Explain why sodium ions and amino acids are **not** absorbed from the lumen of the small intestine in the presence of DNP.

_____

_____

_____

_____

(2)

(iii) By what mechanism would amino acids leave the epithelial cell at point **Z**?

_____

(1)

(Total 5 marks)

Q78.

Read the following passage.

The plasma membrane plays a vital role in microorganisms. It forms a barrier between the cell and its environment, controlling the entry and exit of solutes.
This makes bacteria vulnerable to a range of antiseptics and antibiotics.

When bacteria are treated with antiseptics, the antiseptics bind to the proteins in the membrane and create tiny holes. Bacteria contain potassium ions at a concentration many times that outside the cell. Because of the small size of these ions and their concentration in the cell, the first observable sign of antiseptic damage to the plasma membrane is the leaking of potassium ions from the cell. Some antibiotics damage the plasma membrane in a similar way. One of these is tyrocidin. This is a cyclic polypeptide consisting of a ring of ten amino acids. Tyrocidin and other polypeptide antibiotics are of little use in medicine.

Other antibiotics also increase the rate of potassium movement from cells. It is thought that potassium ions are very important in energy release and protein synthesis, and a loss of potassium ions would lead to cell death.

Gramicidin A coils to form a permanent pore passing through the plasma membrane. This pore enables potassium ions to be conducted from the inside of the cell into the surrounding medium. Vanilomycin also facilitates the passage of potassium ions from the cell.

A molecule of vanilomycin forms a complex with a potassium ion and transports it across the membrane. The potassium ion is released on the outside and the vanilomycin is free to return and pick up another potassium ion. Vanilomycin depends on the fluid nature of the plasma membrane in order to function.

Polyene antibiotics have flattened ring-shaped molecules. The two sides of the ring differ from each other. One side consists of an unsaturated carbon chain. This part is strongly hydrophobic and rigid. The opposite side is a flexible, strongly hydrophilic region. It has been shown that polyene antibiotics bind only to sterols. Sterols are lipids found in the membranes of eukaryotes but not in the membranes of prokaryotic organisms. It is thought that several sterol-polyene complexes come together.

The plasma membranes of eukaryotic cells treated with these polyene antibiotics lose the ability to act as selective barriers and small ions and molecules rapidly leak out.

Use information in the passage and your own knowledge to answer the questions.

(a) By what process do potassium ions normally enter a bacterial cell? Explain the evidence for your answer.

_____

_____

_____

_____

(2)

(b) (i) Draw a peptide bond showing how the COOH group of one amino acid joins to the NH_2 group of another.

(1)

(ii) How many peptide bonds are there in a molecule of tyrocidin (lines 9 - 10)?

_____

(1)

(c) Experiments have shown that vanilomycin is unable to transport potassium ions across a membrane when it is cooled. Gramicidin A continues to facilitate the movement of potassium ions at these low temperatures. Explain these results.

_____

_____

_____

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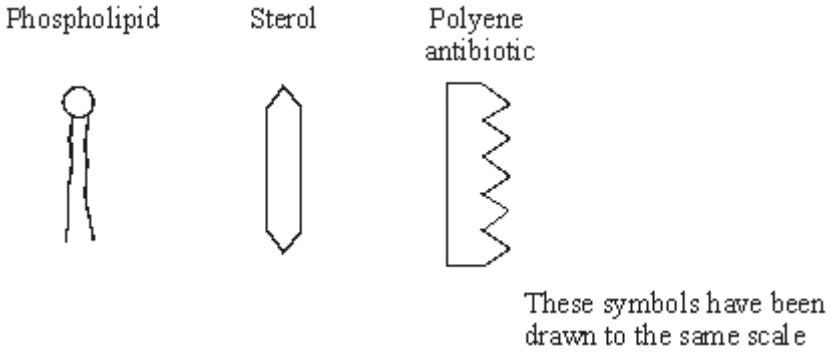
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(3)

(d) Draw a simple diagram of one of the phospholipid layers to show how polyene antibiotics allow small ions and molecules to leak rapidly through a plasma membrane. Use the following symbols to represent the different molecules.

Note that the zigzag line on the symbol for the polyene antibiotic represents its hydrophobic region.



(2)

(Total 9 marks)

Q79.

(a) Explain how the shape of a red blood cell allows it to take up a large amount of oxygen in a short time.

_____

_____

_____

_____

(2)

Samples of blood were mixed with equal volumes of different liquids. A drop of each mixture was put on a slide and examined with an optical microscope. The table shows the appearance of each slide.

Slide	Liquid added	Appearance of slide
A	Distilled water	No cells seen. Slide appears a uniform pale red colour
B	Sucrose solution	Cells are smaller in diameter than in an untreated sample of blood
C	Detergent (dissolves lipids)	No cells seen. Slide appears a uniform pale red colour

(b) (i) What does the appearance of slide **B** tell you about the plasma membrane surrounding a red blood cell?

_____

_____

(1)

(ii) Explain the appearance of slide **C**.

_____

_____

_____

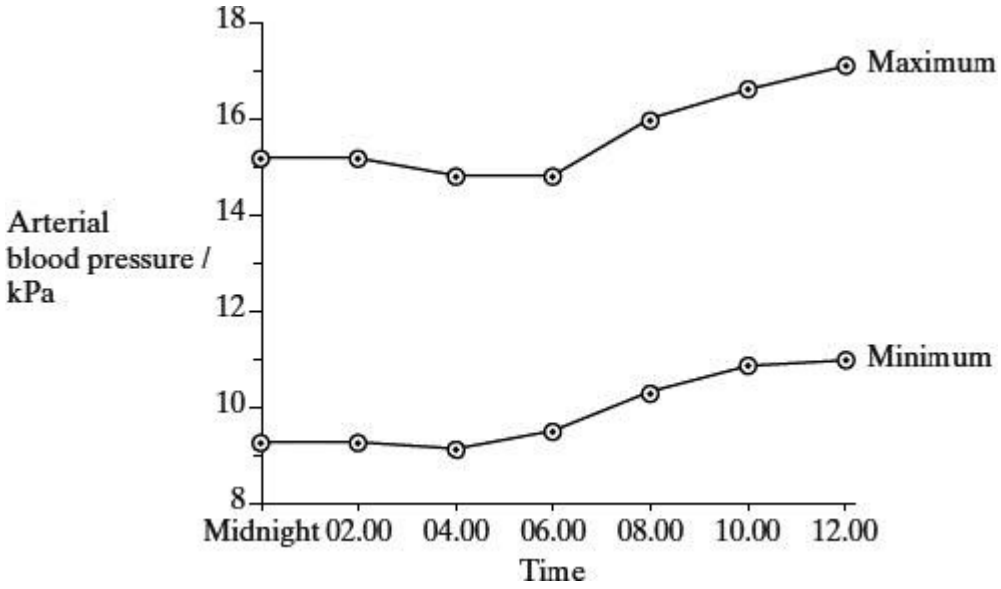
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(2)

(Total 5 marks)

Q80.

(a) The graph shows hourly blood pressure recordings from a group of 65 people.



(i) Describe how the mean maximum arterial blood pressure changes over the period shown in the graph.

_____

_____

(1)

(ii) In each cardiac cycle, the arterial pressure has a maximum value. Explain the link between this maximum value and the events of the cardiac cycle.

_____

_____

(1)

(iii) The recordings shown in this graph were taken from an artery. Describe **two** ways in which you would expect blood pressure in a vein to differ from that in an artery.

1 _____

_____

2 _____

_____

(2)

(b) Molecules of different substances differ in size. The relative molecular mass of a substance gives an indication of the size of its molecules. The table shows the relative permeability of the wall of a capillary to different molecules.

Substance	Relative molecular mass	Relative permeability of capillary wall
Water	18	1.00

Urea	60	0.96
Glucose	180	0.60
Haemoglobin	68 000	0.01
Albumin (plasma protein)	69 000	0
Globulin (plasma protein)	140 000	0

(i) Describe the relationship between molecule size and the permeability of the capillary wall.

_____

_____

_____

_____

(2)

(ii) The water potential of the plasma at the venule end of the capillary is more negative than the water potential at the arteriole end. Use the table to explain why.

_____

_____

_____

_____

(2)

(iii) Although the capillary walls are slightly permeable to haemoglobin molecules, there is no haemoglobin in the tissue fluid. Explain what causes the absence of haemoglobin in tissue fluid.

_____

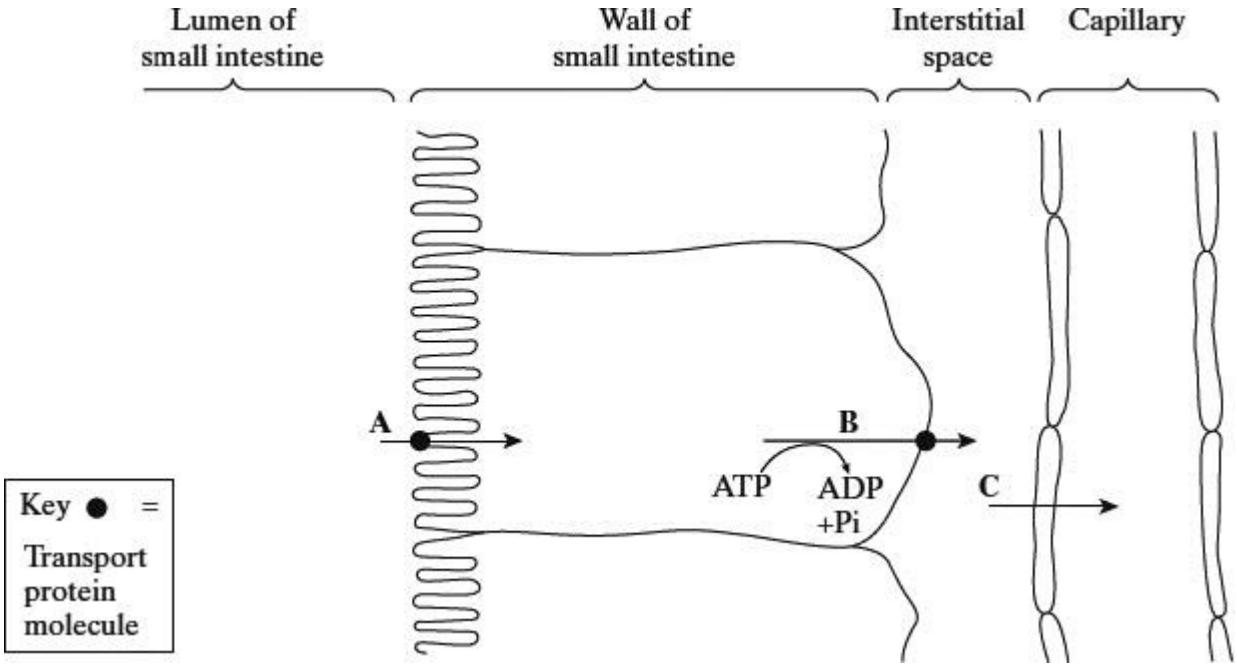
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(1)

(Total 9 marks)

Q81.

The figure below shows the processes involved in absorbing amino acids into a capillary from the small intestine.



(i) Name processes **A**, **B** and **C**. In each case, give the evidence for your answer.

A Process _____

Evidence _____

_____

B Process _____

Evidence _____

_____

C Process _____

Evidence _____

_____

(3)

(ii) Explain how process **B** creates the conditions for process **A** to occur.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q82.

Lactose is a disaccharide found in milk. In the small intestine, it is digested into glucose and galactose by the enzyme lactase. Molecules of lactase are located in the plasma

membranes of cells lining the small intestine.

(a) What evidence in the paragraph suggests that galactose is a monosaccharide?

_____

_____

(1)

(b) (i) Name **one** other digestive enzyme that is located in the plasma membranes of cells lining the small intestine.

_____

(1)

(ii) Give an advantage of lactase and other digestive enzymes being located in the plasma membranes of cells lining the small intestine, rather than being secreted into the lumen of the small intestine.

_____

_____

(1)

(c) The absorption of galactose from the small intestine is reduced if the absorbing cells are treated with a respiratory inhibitor, such as cyanide. Suggest an explanation for this.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q83.

Read the following passage.

Human milk contains all the nutrients a young baby needs in exactly the right proportions. It is formed in the mammary glands by small groups of milk-producing cells. These cells absorb substances from the blood and use them to synthesise the lipids, carbohydrates and proteins found in milk. Milk-producing cells are roughly cube-shaped and have a height to breadth ratio of approximately 1.2 : 1.

The main carbohydrate in milk is lactose. Lactose is a disaccharide formed by the condensation of two monosaccharides, glucose and galactose. (A molecule of galactose has the same formula as a molecule of glucose – the atoms are just arranged in a different way.)

Lactose is synthesised in the Golgi apparatus and transported in vesicles through the cytoplasm. Because lactose is unable to escape from these vesicles, they increase in

diameter as they move towards the plasma membrane. The vesicle membranes fuse with the plasma membrane and the vesicles empty their contents out of the cell.

Use the information from the passage and your own knowledge to answer the following questions.

(a) (i) The breadth of a milk-producing cell is 26 μm. Calculate the height of this cell.

Height = _____ μm

(1)

(ii) Describe and explain how you would expect the height to breadth ratio of an epithelial cell from a lung alveolus to differ from the height to breadth ratio of a milk-producing cell.

_____

_____

_____

_____

(2)

(b) How many oxygen atoms are there in a molecule of

(i) galactose;

_____

(1)

(ii) lactose?

_____

(1)

(c) The lactose-containing vesicles increase in diameter as they move towards the plasma membrane of the milk-producing cell (lines 11-12). Use your knowledge of water potential to explain why.

_____

_____

_____

_____

(2)

(d) Suggest **one** advantage of milk-producing cells containing large numbers of mitochondria.

_____

_____

_____

_____

(2)

(e) Some substances pass through the plasma membrane of a milk-producing cell by diffusion. Describe the structure of a plasma membrane and explain how different substances are able to pass through the membrane by diffusion.

_____

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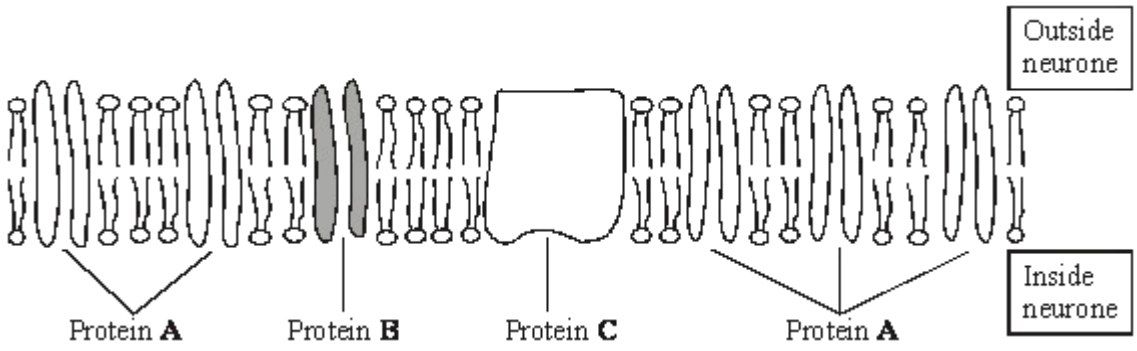
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(6)

(Total 15 marks)

Q84.

The resting potential of a neurone is maintained by the unequal distribution of ions inside and outside the plasma membrane. The diagram shows the plasma membrane of a neurone and the three different proteins that are involved in maintaining the resting potential.



(a) Protein **C** requires ATP to function. Describe the role of protein **C**.

_____

_____

_____

_____

(2)

(b) (i) Proteins **A** and **B** differ from each other. Explain why different proteins are required for the diffusion of different ions through the membrane.

_____

(2)

(ii) The plasma membrane of the neurone is more permeable to potassium ions than to sodium ions. Give the evidence from the diagram that supports this observation.

_____

_____

_____

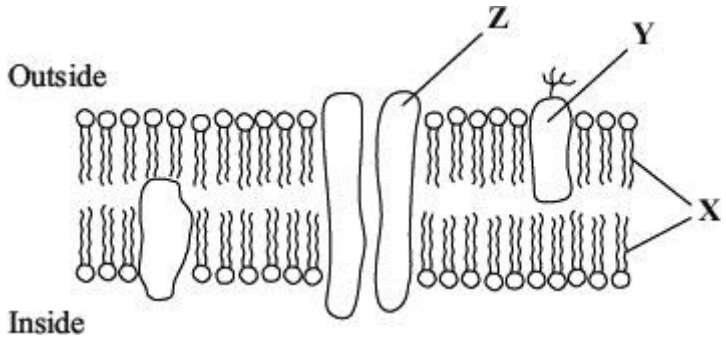
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(1)

(Total 5 marks)

Q85.

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.

_____

_____

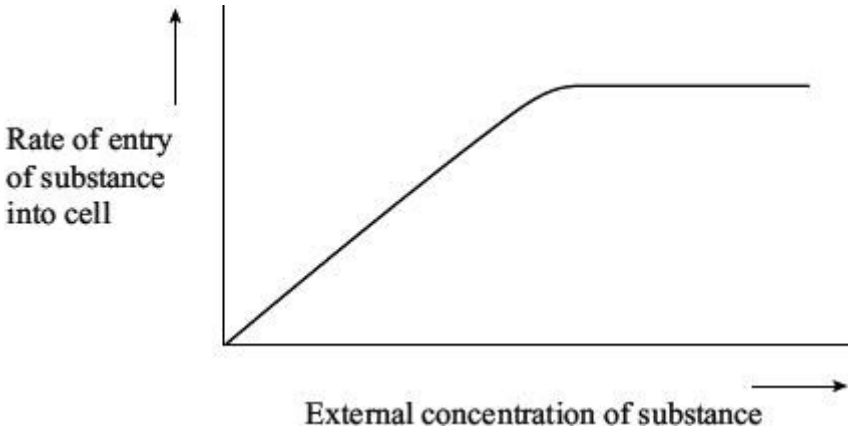
(ii) Give **one** way in which active transport differs from facilitated diffusion.

_____

_____

(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.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q86.

(a) Explain how including leguminous plants in a crop rotation reduces the need to use artificial fertilisers.

_____

_____

_____

_____

(2)

(b) Application of very high concentrations of fertiliser to the soil causes plants to wilt. Explain why.

_____

_____

_____

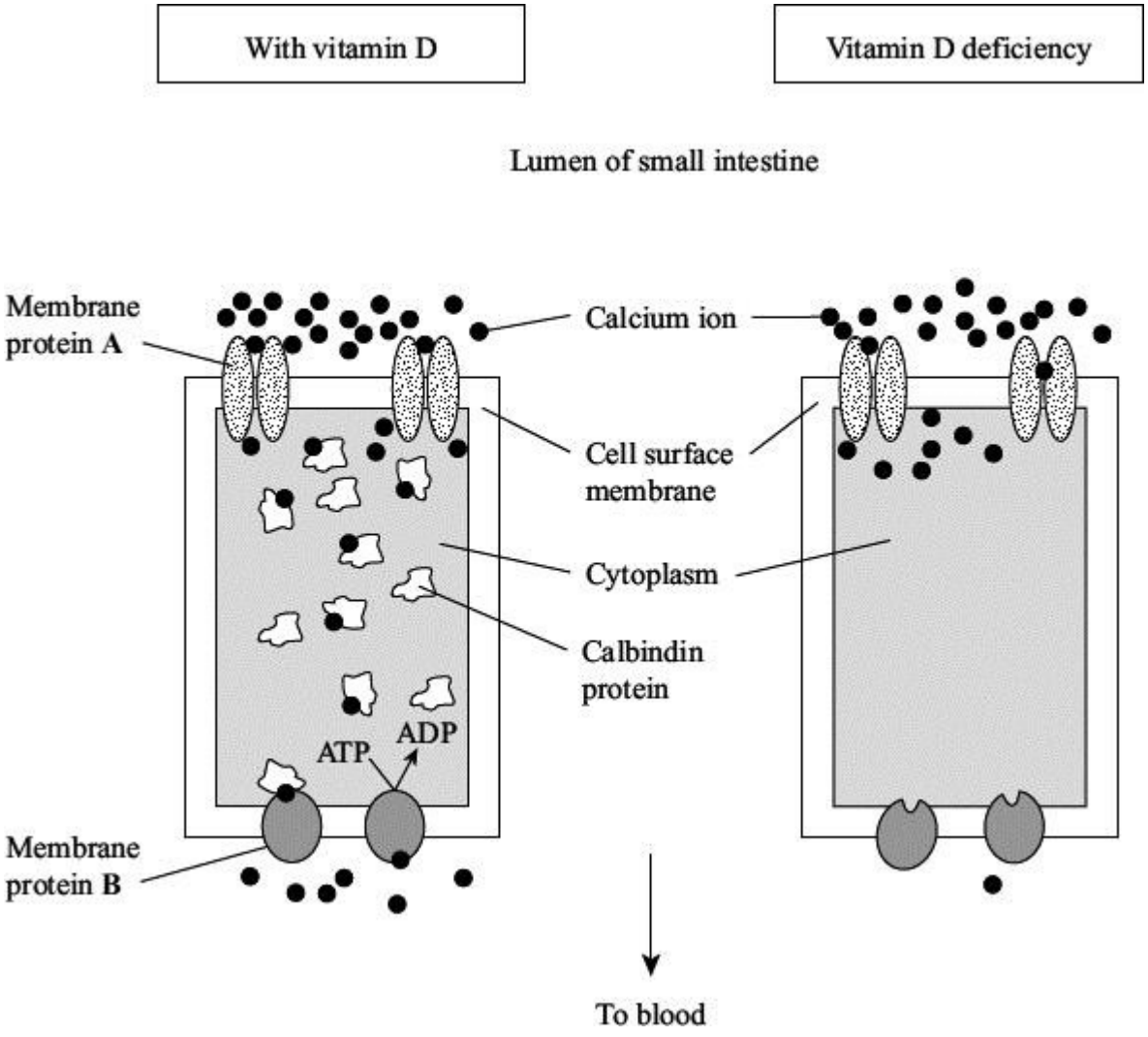
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(2)

(Total 4 marks)

Q87.

Vitamin D deficiency reduces the uptake of calcium ions by epithelial cells lining the small intestine. The diagrams show how calcium ions are transported through normal epithelial cells and those deficient in vitamin D.



(i) Use the information in the diagrams to explain how vitamin D deficiency reduces calcium ion uptake through gut epithelial cells.

_____

_____

_____

_____

(2)

(ii) Membrane proteins **A** and **B** transport calcium ions through cell surface membranes. Explain how each type of membrane protein transports calcium ions.

Protein **A** _____

_____

_____

_____

Protein **B** _____

_____

_____

_____

(4)

(Total 6 marks)

Q88.

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

_____

_____

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_____

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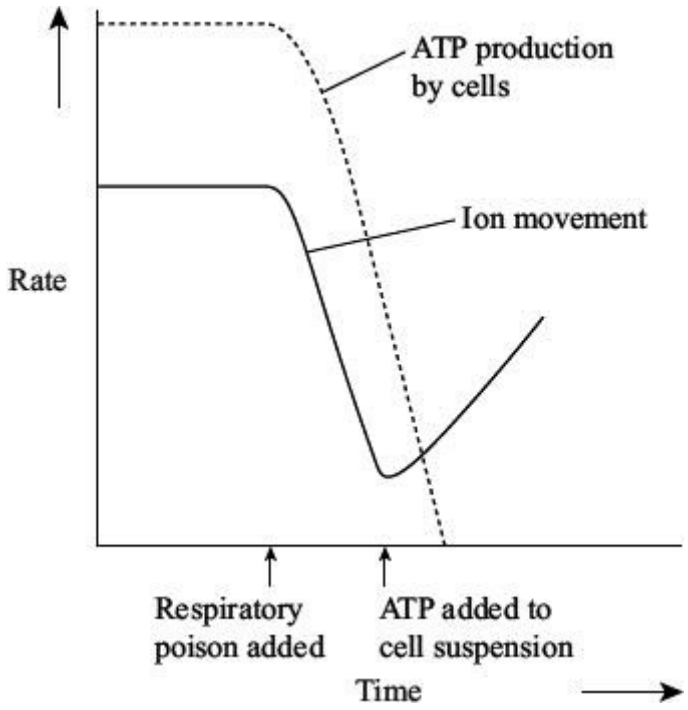
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(6)

(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.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Q89.

The shore crab is common in Britain. It lives both in the sea and in river estuaries, where it feeds on a wide variety of species.

(a) The shore crab has recently spread to, and has established large populations in, the coastal waters of the USA, where it is not a native species. Explain how the shore

crab has been able to establish large populations and why this is causing concern to ecologists in the USA.

_____

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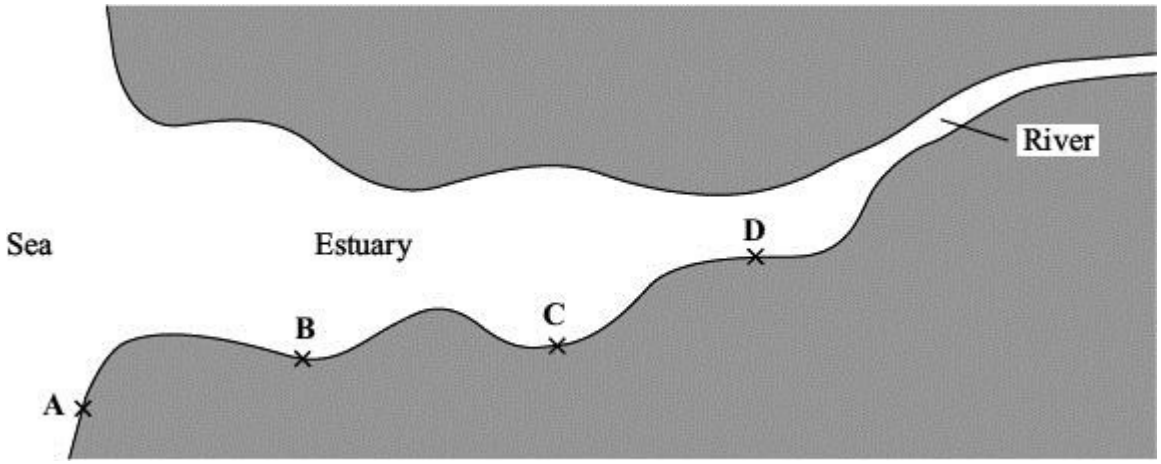
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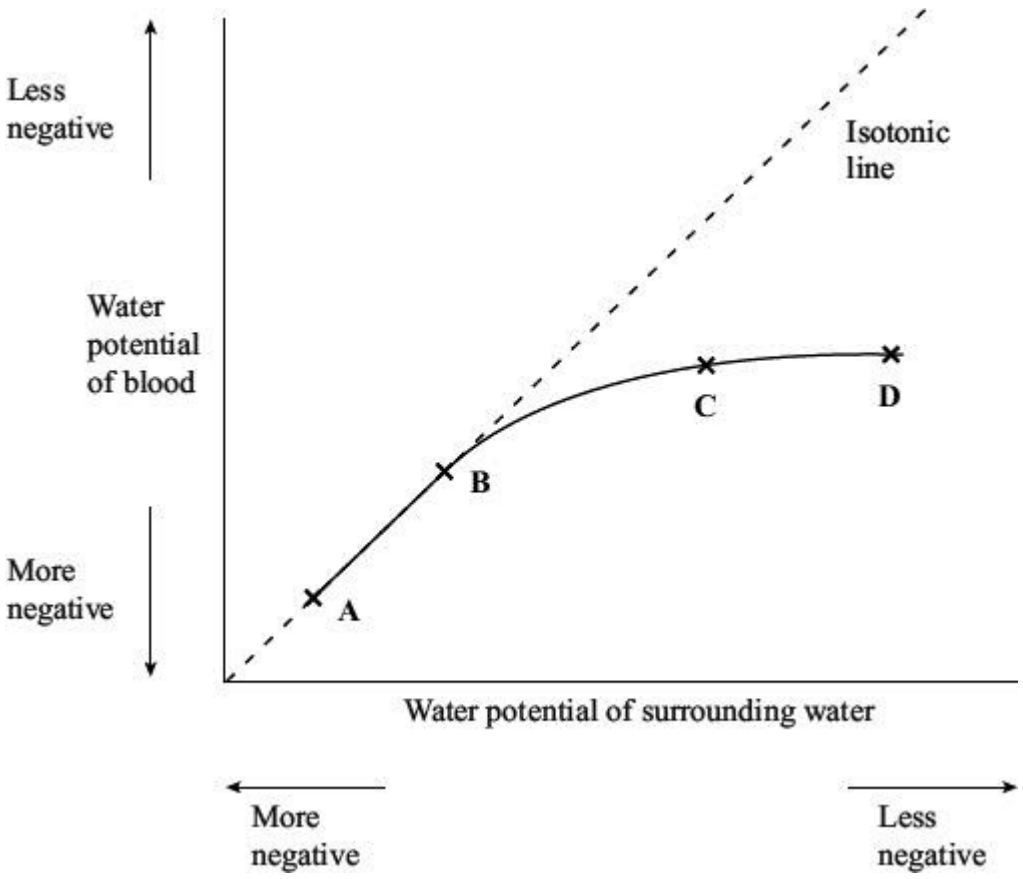
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(5)

In Britain, crabs living in an estuary and along the neighbouring coast were studied. Crabs were collected from four different sites, **A** to **D**, as shown in the map.



The graph shows the mean water potential of the blood of samples of crabs from the four sites in relation to the water potential of the environment at the same sites. The isotonic line shows values at which the water potential of the blood and surrounding water would be the same.



(b) Describe the relationship between the mean water potential of the blood of the crabs and the water potential of the surrounding water.

_____

_____

(1)

(c) Is there any net movement of water in or out of the blood of the crabs at sites **A** and **B**? Explain your answer.

_____

_____

(1)

(d) Crabs living at sites **C** and **D** actively transport salts into their blood through their gills.

(i) Explain how this enables crabs to survive at these sites.

_____

_____

_____

(2)

(ii) Crabs are unable to control their body temperature. In winter, when the water temperature falls, crab populations at sites **C** and **D** migrate towards the sea.

Suggest the advantage of this behaviour.

_____

_____

_____

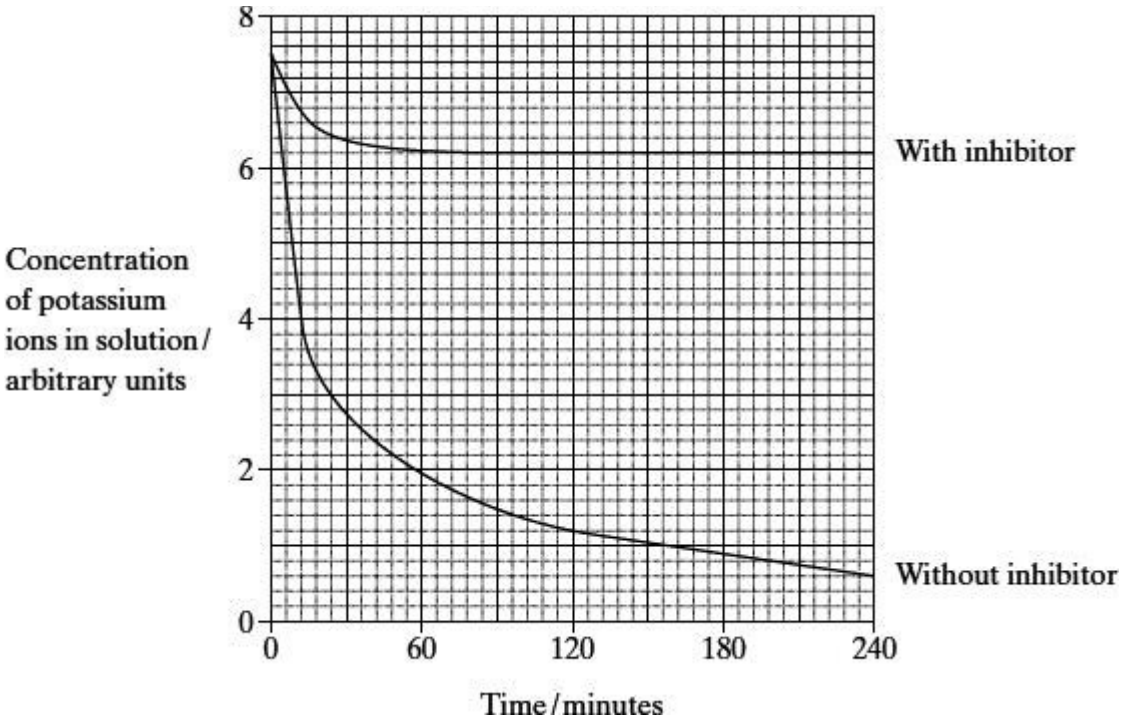
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(3)

(Total 12 marks)

Q90.

Two samples of the roots of pea plants were placed in solutions containing potassium ions. An inhibitor to prevent respiration was added to one solution. The concentrations of potassium ions in the two solutions were measured at regular intervals. The graph shows the results.



(a) Explain the decrease in the concentrations of potassium ions in the two solutions between 0 and 30 minutes.

(i) With inhibitor

_____

_____

_____

_____

(2)

(ii) Without inhibitor

_____

_____

(1)

(b) Explain why there is no further decrease in the concentration of potassium ions in the solution with the inhibitor after 60 minutes.

_____

_____

_____

_____

(2)

(c) The substance malonate is an inhibitor of respiration. It has a structure very similar to the substrate of an enzyme that catalyses one of the reactions of respiration. Explain how malonate inhibits respiration.

_____

_____

_____

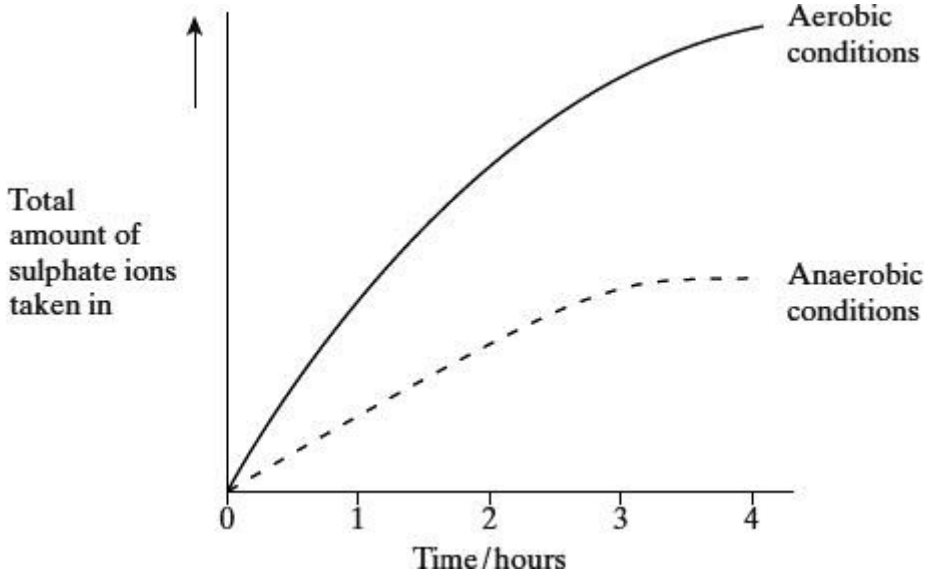
_____

(2)

(Total 7 marks)

Q91.

An investigation was carried out to compare the uptake of sulphate ions by barley roots in aerobic and in anaerobic conditions. The results are shown in the graph.



(i) Explain the evidence from the graph that active transport is involved in the uptake of sulphate ions.

_____

_____

_____

_____

(2)

(ii) Suggest why the uptake of sulphate ions by the roots in anaerobic conditions stopped after 3 hours.

_____

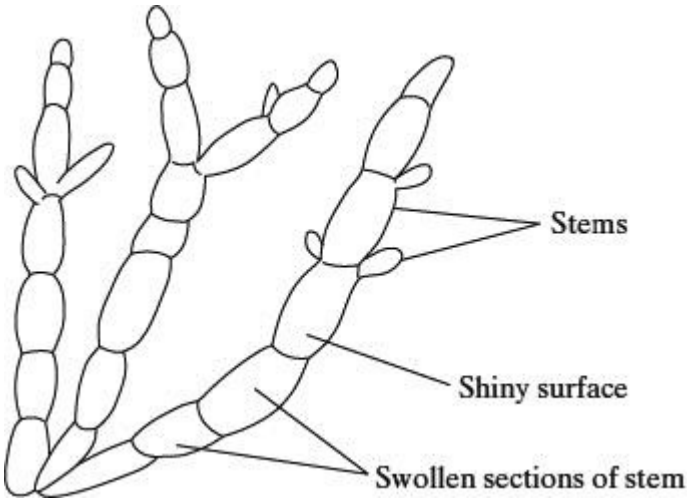
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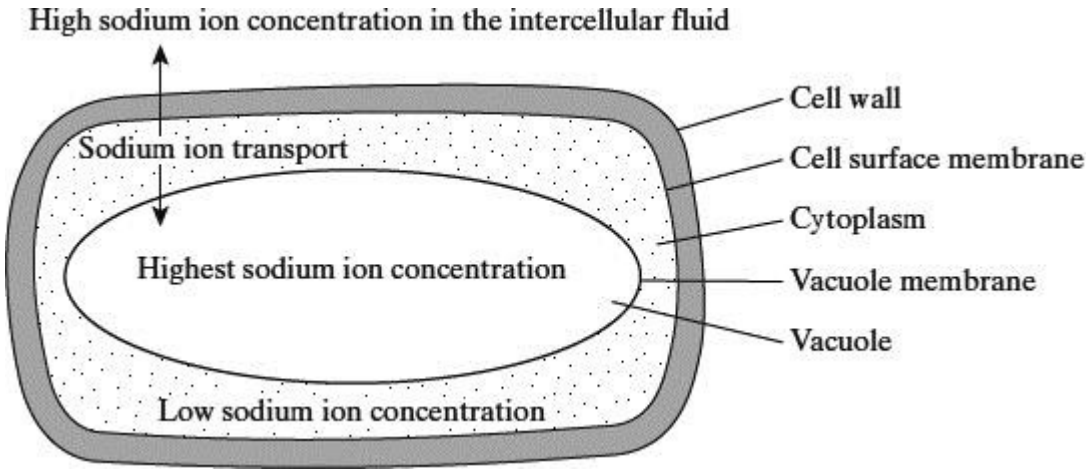
(Total 3 marks)

Q92.

Glasswort is a plant that grows in salt marshes. The plants are covered by seawater at each high tide. The roots grow in mud which contains a high concentration of salt. The drawing shows a shoot of the plant.



In glasswort cells, sodium ions are transported from the cytoplasm outwards across the cell surface membrane and also into the cell vacuole. The concentration of sodium ions is greater inside the vacuole than in the intercellular fluid, which is the fluid between the cells in tissues. High sodium ion concentrations would disrupt metabolic processes in the cytoplasm. This information is summarised in the diagram below.



(a) The total concentration of all ions in the cytoplasm is higher than in the intercellular fluid. Explain how this allows the cell to take up water.

_____

_____

_____

_____

(2)

(b) (i) Explain how sodium ions are transported through the membranes.

_____

_____

_____

_____

(2)

(ii) There is a higher concentration gradient between the cytoplasm and the vacuole than between the cytoplasm and the intercellular fluid. Suggest how the vacuole membrane maintains this higher concentration gradient.

_____

_____

_____

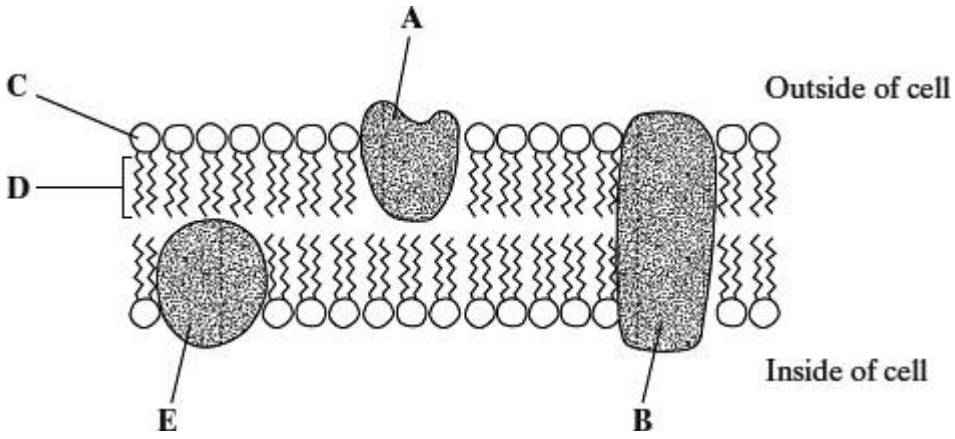
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(2)

(Total 6 marks)

Q93.

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*.

_____

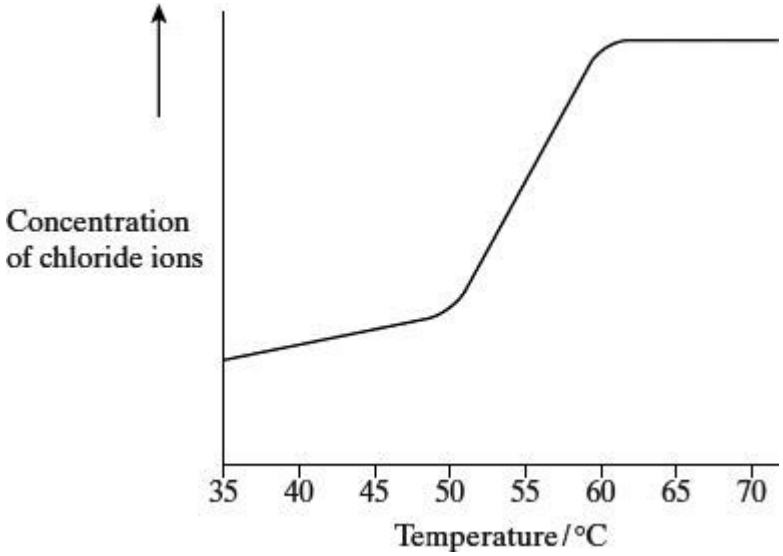
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_____

_____

(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.

_____

_____

_____

_____

_____

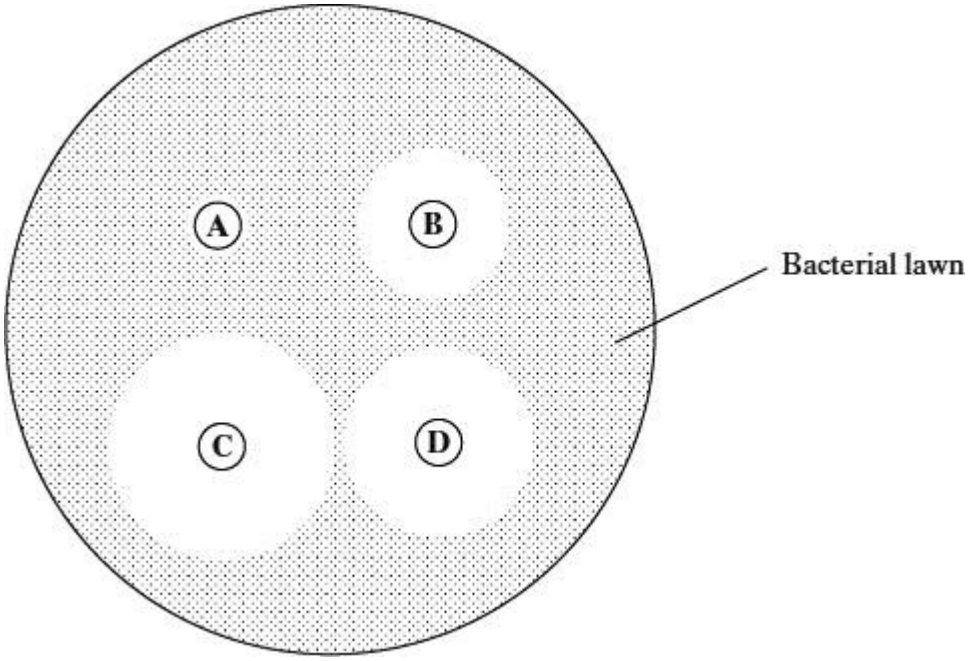
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(3)

(Total 7 marks)

Q94.

An agar plate was flooded with a culture of a species of bacterium usually found in the mouth. Four sterile paper discs, **A**, **B**, **C** and **D**, each containing a different brand of mouthwash, were then placed on the agar plate. The drawing shows the appearance of the plate after it had been incubated at 37°C for three days.



(a) Describe the aseptic techniques that would be used when flooding the agar plate with bacteria.

_____

_____

_____

_____

_____

_____

(3)

(b) The effectiveness of a mouthwash can be measured by calculating the total area of a paper disc and the clear zone around it. The area of a circle is given by πr^2, where r is the radius of the circle. Calculate how many times more effective mouthwash **C** is than mouthwash **B**. Show your working.

Mouthwash **C** is _____ times more effective than mouthwash **B**.

(2)

(c) Several factors affect the rate at which the antiseptic in the mouthwash from each paper disc diffuses through the agar. Describe the effect of **three** named factors on this rate.

1. _____

_____

2. _____

_____

3. _____

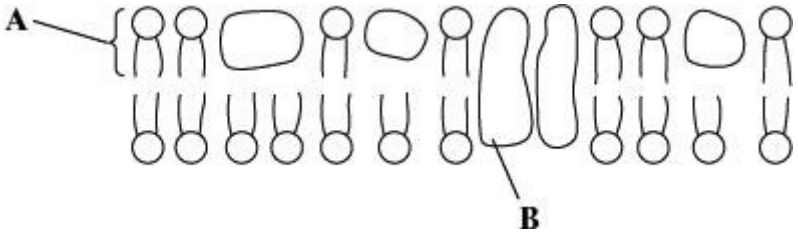
_____

(3)

(Total 8 marks)

Q95.

(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?

_____

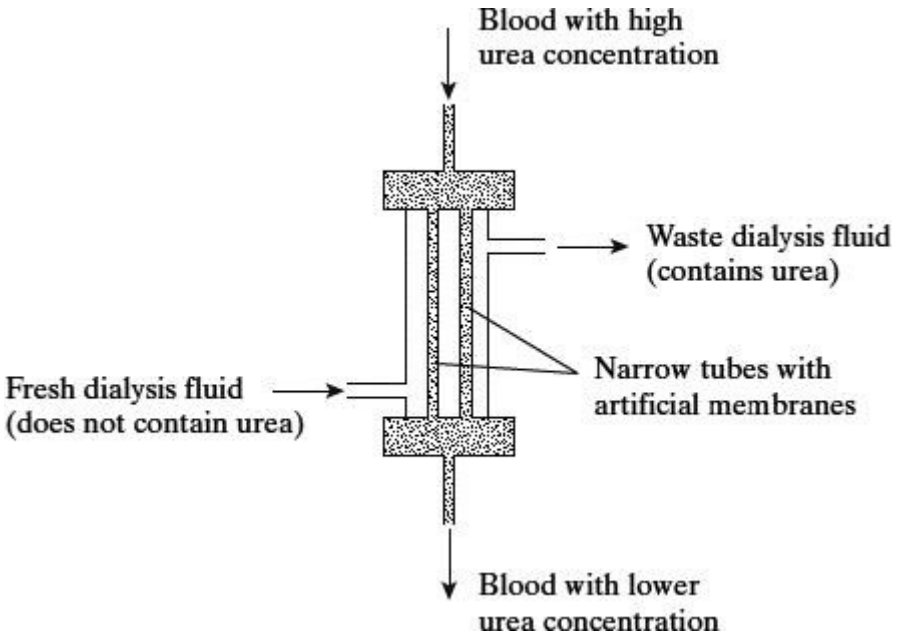
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(2)

(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. _____

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(2)

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

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(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

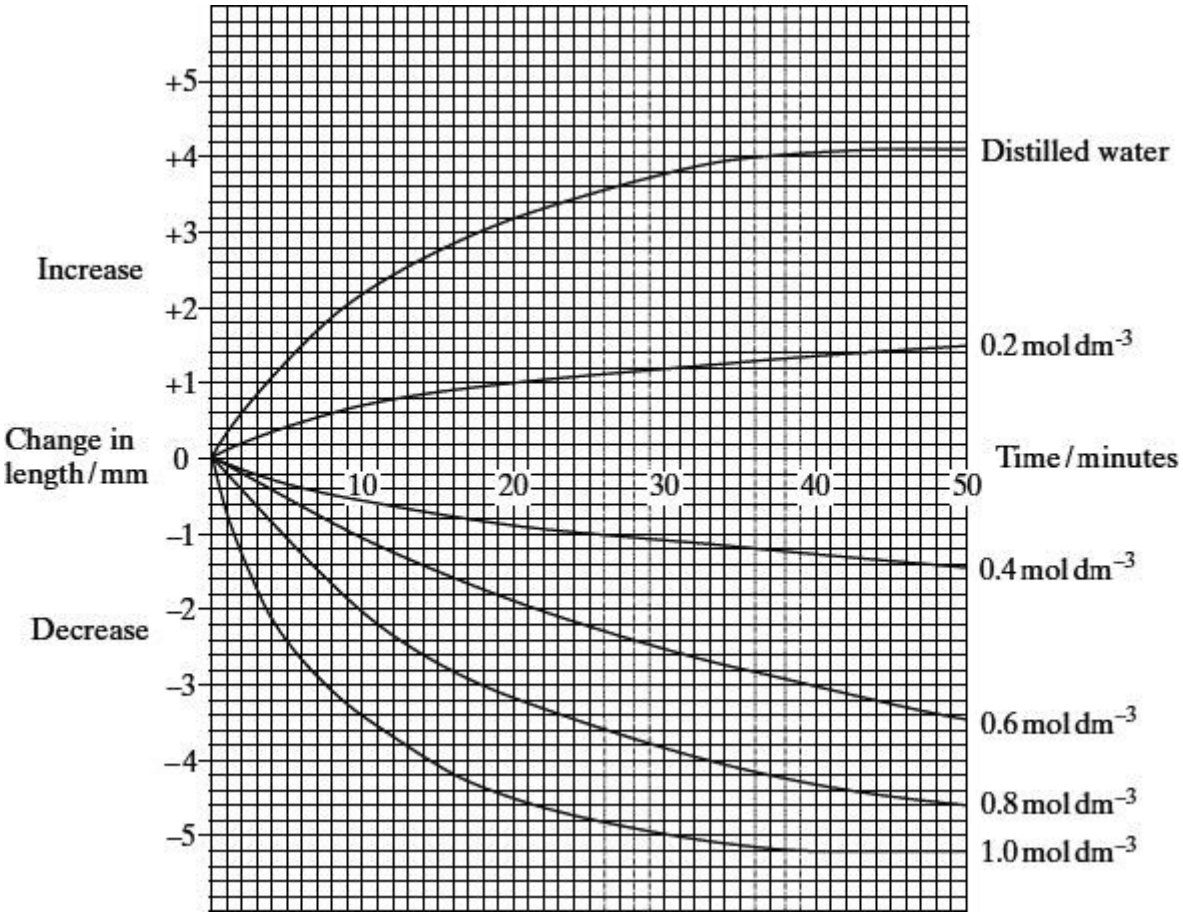
(2)

(Total 10 marks)

Q96.

Six cylinders of a standard size were cut from a single large potato. One cylinder was placed in distilled water and the others were placed in sucrose solutions of different concentrations. The length of each cylinder was measured every 5 minutes for the next 50 minutes.

The graph shows the changes in length at each sucrose concentration.



(a) Explain why

(i) the potato cylinder in distilled water increased in length;

_____

_____

_____

_____

(2)

(ii) the potato cylinder in the 1.0 mol dm^{-3} sucrose solution showed no further decrease in length after 40 minutes.

_____

_____

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(2)

(b) (i) Describe the difference in the rate of decrease in length during the first 10 minutes between the cylinder in the 0.4 mol dm^{-3} and the cylinder in the 0.8 mol dm^{-3} solution.

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_____

(1)

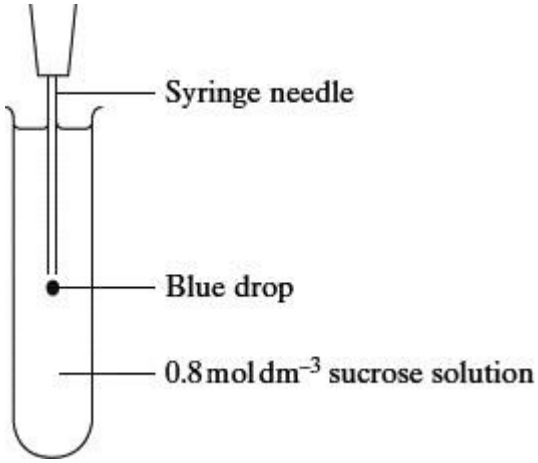
(ii) Use your knowledge of water potential to explain this difference.

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(1)

(c) After 45 minutes the potato cylinder in the 0.8 mol dm^{-3} solution was removed and blue dye added to this solution. Some of this blue-stained solution was drawn into a syringe. A drop was then released, slowly, halfway down a test tube of fresh 0.8 mol dm^{-3} sucrose solution as shown in the diagram. The blue drop quickly moved to the surface of the liquid in the test tube.



(i) The density of a solution depends on its concentration. The more concentrated the solution the greater its density. Explain why the blue drop had a lower density and therefore moved up.

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(2)

(ii) A sucrose solution of concentration 0.3 mol dm^{-3} has a water potential which is equivalent to that of the potato cells. Describe and explain what would happen to the blue drop from this solution.

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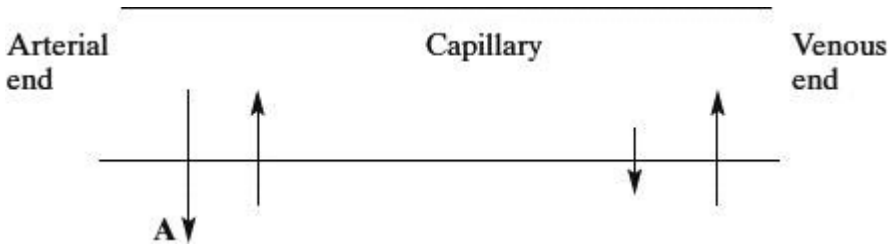
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(2)

(Total 10 marks)

Q97.

Tissue fluid is formed when water and small molecules pass out of capillaries at their arterial end. The diagram shows some pressures involved in tissue fluid formation. The relative lengths of the arrows indicate the size of the pressures.



(a) What causes the pressure represented by the arrow labelled **A**?

_____

_____

(1)

(b) Explain why there is a net loss of water from a capillary at the arterial end.

_____

_____

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(2)

(c) The total volume of fluid that passes from the capillaries to the surrounding tissue fluid is normally greater than the volume that is reabsorbed into them. Describe what happens to this extra fluid.

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(2)

(d) Tissue fluid accumulates in the tissues of people who do not eat enough protein. Explain why.

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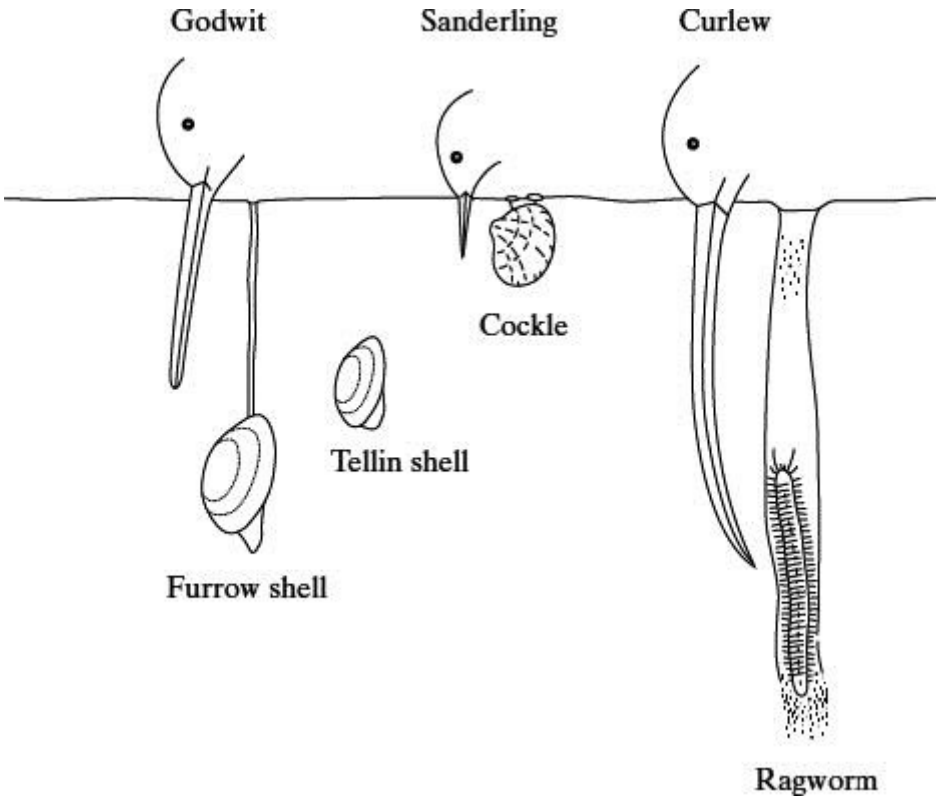
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(2)

(Total 7 marks)

Q98.

Some birds feed on animals found in mud in estuaries. The drawing shows the heads of three species of these birds and their prey.



(a) Use the information in the drawing to explain how interspecific competition between the birds is reduced.

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_____

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(2)

(b) Explain how competition might have played a part in the evolution of the long curved beak of the curlew.

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(4)

(c) Mud higher up the shore receives fresh water draining from the land. Ragworms are able to survive in this mud because they can tolerate the absorption of water into their tissues. Explain what causes a ragworm to absorb water when higher up the shore.

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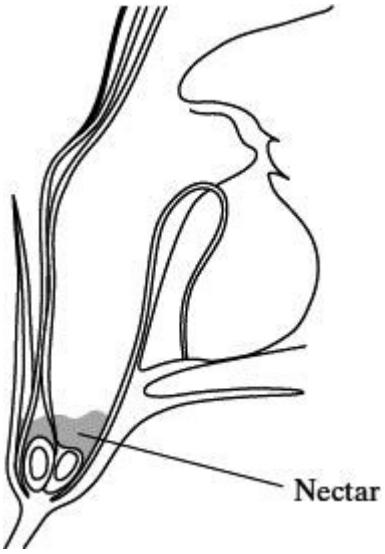
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(2)

(Total 8 marks)

Q99.

Penstemon plants have mechanisms that regulate the amount of nectar produced by their flowers. Nectar is a solution containing sucrose which attracts insect pollinators. The diagram shows a section through a penstemon flower.



To investigate these mechanisms the volume of nectar produced was determined. A thin strip of filter paper was dipped into the nectar until all the nectar was absorbed. The distance the nectar moved up the paper was measured. The actual volume of nectar was found by reading the value from a calibration curve on a graph. A sucrose solution similar to nectar was used to produce this calibration curve.

(a) (i) The solution contained 22% by mass of sucrose. Describe how you would make 50 cm^3 of this solution.

_____

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(1)

(ii) Describe how you would use the solution to produce the calibration curve.

_____

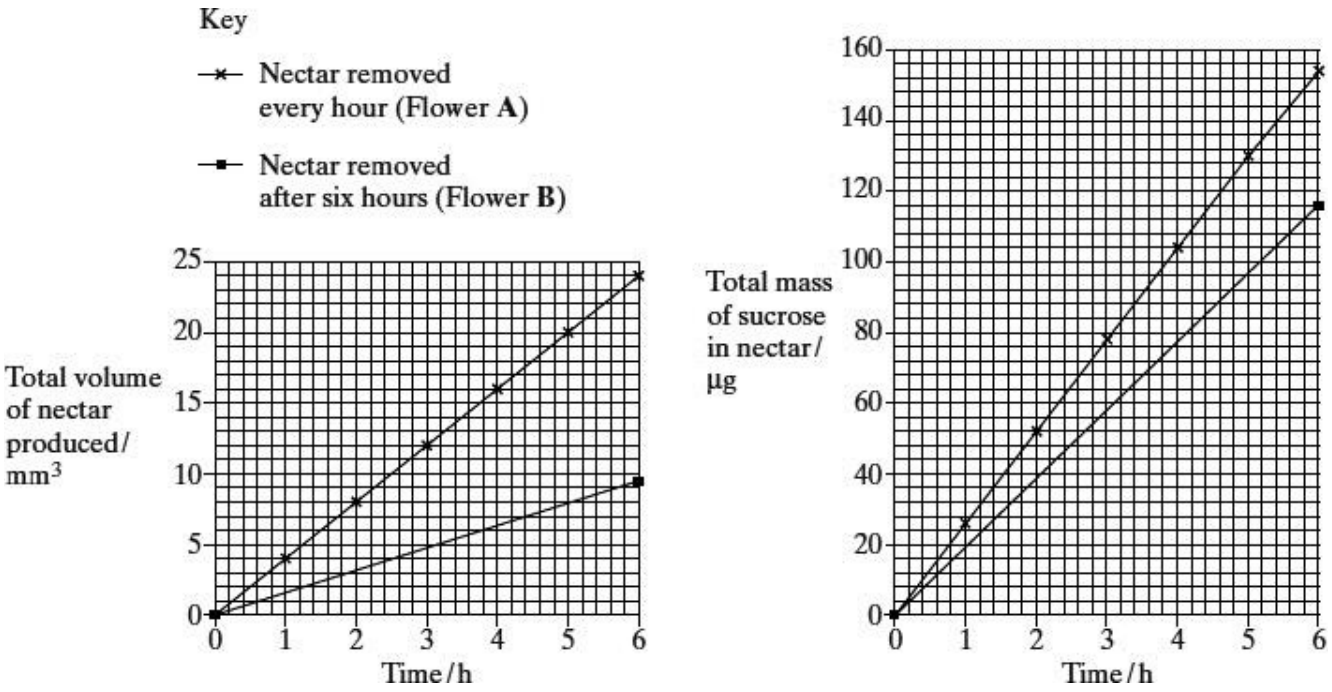
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(2)

In one experiment the effect of removing nectar at regular intervals was investigated. First all the nectar was removed from two penstemon flowers. From one flower (**A**) all the nectar produced was removed each hour for the next six hours. In the second flower (**B**) the nectar was allowed to accumulate for six hours. Each time the nectar was removed, the sugar was extracted from the strip of filter paper and its mass was measured. The graphs show the results.



(b) (i) Describe the effects on nectar production and on sucrose secretion of removing the nectar every hour compared with removing it after 6 hours.

_____

_____

_____

_____

(2)

(ii) How would the nectar collected after 6 hours from plant **B** differ from that collected after 6 hours from plant **A**.

_____

_____

(1)

(iii) Pollinating insects such as bees visit flowers and collect nectar. Suggest **one** advantage for penstemon flowers of the response to regular removal of nectar.

_____

_____

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_____

(1)

(c) In a different experiment the nectar was removed from two penstemon flowers. In one flower the nectar was replaced with 5 mm^3 of a solution containing a total of 120 µg of sucrose. The second flower was left empty as a control. The two flowers were protected from insects. After three hours the nectar solutions in the flowers were

removed. The table shows the results.

	Volume of solution / mm^3		Mass of sucrose in solution / µg	
Time / h	**Experimental**	**Control**	**Experimental**	**Control**
0	5.00	0.00	120	0
3	5.75	1.65	104	20

Describe the effect of the addition of sucrose solution on the volume of nectar produced and on the movement of sucrose.

_____

_____

_____

_____

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_____

(3)

(d) Nectar is formed by specialised cells in the flower which synthesise sucrose. Describe how sucrose is moved against a concentration gradient from these cells into the nectar.

_____

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(2)

(Total 12 marks)

Q100.

Write an essay on the importance of osmosis to living organisms.

(Total 25 marks)

Q101.

(a) Oxygen and water move through plasma membranes into cells. Describe **two** ways in which these movements are similar.

1. _____

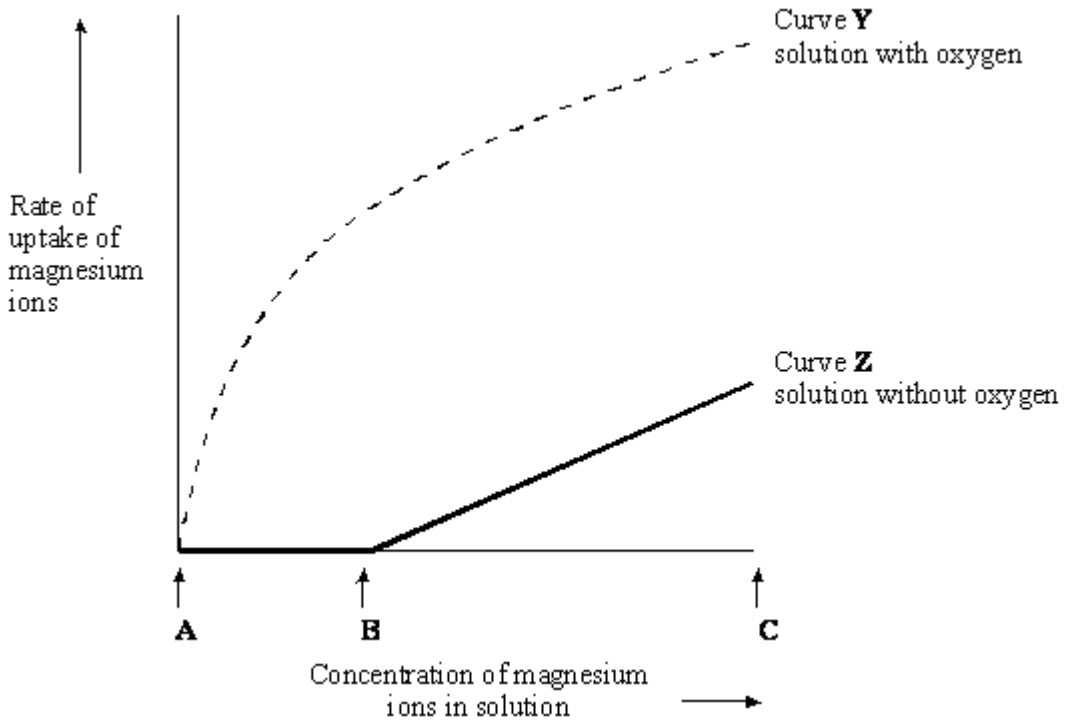
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2. _____

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(2)

The graph shows the effect of concentration on the rate of uptake of magnesium ions by root hair cells.



(b) For curve **Y** name the process the cells are using to absorb magnesium ions between concentrations **A** and **B**. Use information in the graph to explain your answer.

Name of process _____

Explanation _____

_____

_____

(2)

(c) In the solution without oxygen, explain why no magnesium ions are taken up between concentrations **A** and **B**.

_____

_____

(1)

(d) For curve **Z** explain why the rate of uptake increases between **B** and **C**.

_____

_____

(1)

(Total 6 marks)

Q102.

This question should be answered in continuous prose.

Quality of Written Communication will be assessed in these answers.

(a) Describe and explain **four** ways in which the structure of a capillary adapts it for the exchange of substances between blood and the surrounding tissue.

(4)

(b) Explain how tissue fluid is formed and how it may be returned to the circulatory system.

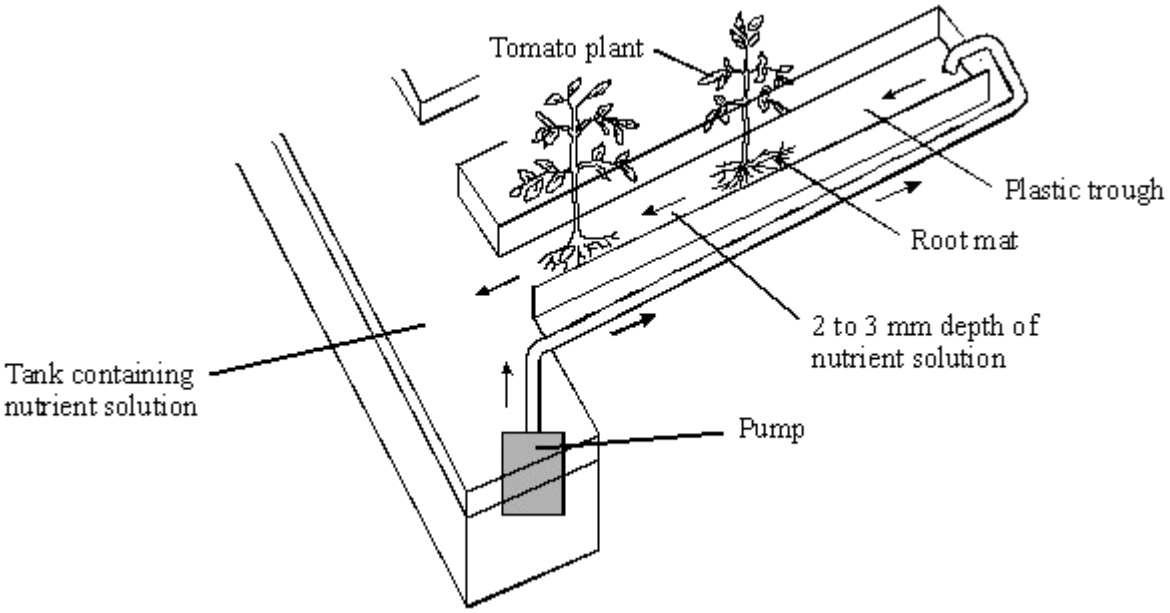
(6)

(Total 10 marks)

Q103.

Tomato growers have increased the yield of fruit from 100 to 400 tonnes per hectare by

growing the tomato plants in automatically heated glasshouses and enhancing the carbon dioxide concentration. To control the nutrient supply to the roots, the plants are grown without soil in plastic troughs, as shown in the diagram.



(a) Explain how enhancing the carbon dioxide concentration helps to increase the yield.

_____

_____

_____

_____

(2)

(b) Maintaining a high temperature in a glasshouse in winter, when the light intensity is low, may reduce the yield. Explain how.

_____

_____

_____

_____

(2)

(c) Tomato fruits have a high percentage of water. When making tomato ketchup, it is more economical to use fruits which have a low percentage of water. Growers can reduce the water content of the fruit by adding sodium chloride to the nutrient solution in the plastic trough.

Explain how adding sodium chloride can reduce the water content of the fruit.

_____

_____

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(2)

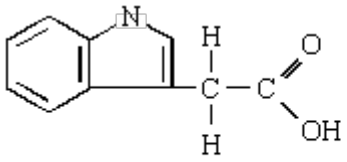
(Total 6 marks)

Q104.

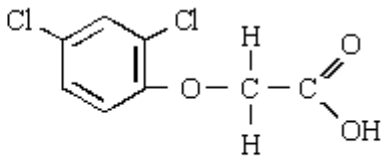
IAA is an auxin which stimulates plant growth. It binds to proteins in cell walls. This changes the arrangement of the cellulose molecules, so the walls are more easily stretched. IAA also lowers the pH around the cells.

2,4-D is a systemic herbicide which has the same effect on cell walls as IAA, but it is less easily broken down in plants.

(a) The diagram shows the molecular structures of IAA and 2,4-D.



IAA



2,4-D

Use evidence from the diagram to suggest

(i) why IAA lowers pH;

_____

_____

(1)

(ii) why IAA and 2,4-D have similar effects on cell walls.

_____

_____

(1)

(b) When 2,4-D is applied to weeds their growth is very rapid but very distorted. After a short time they die. Suggest **one** explanation for the rapid and distorted growth of weeds when 2,4-D is applied.

_____

_____

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_____

(2)

(Total 4 marks)

Q105.

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**.

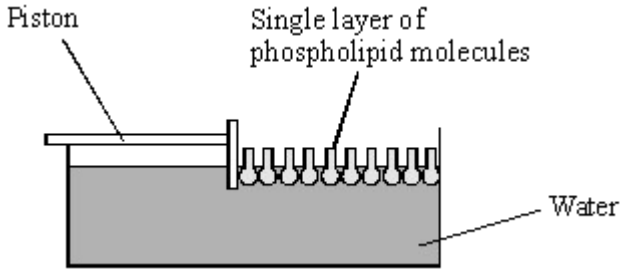


Figure 1

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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_____

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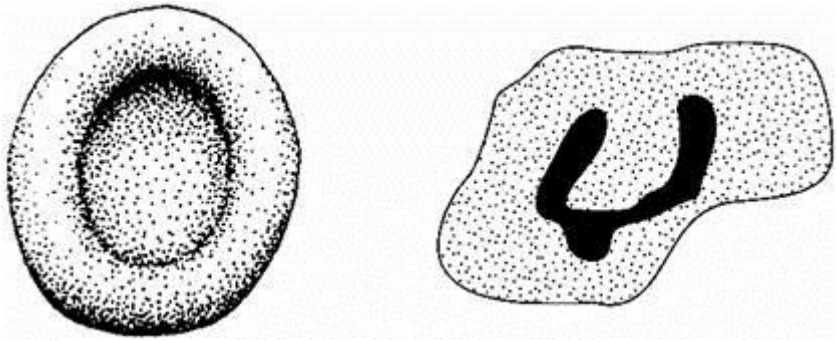
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(3)

(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)