EXAM PAPERS PRACTICE

Transport across cell membranes 1

Level: Edexcel A Level 9BN0
Subject: Biology
Exam Board: Suitable for all boards
Topic: Transport across cell membranes 1
Type: Questionnaire

To be used by all students preparing for Edexcel Biology A Level 9BN0 foundation or higher tier but also suitable for students of other boards.

1 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)

2 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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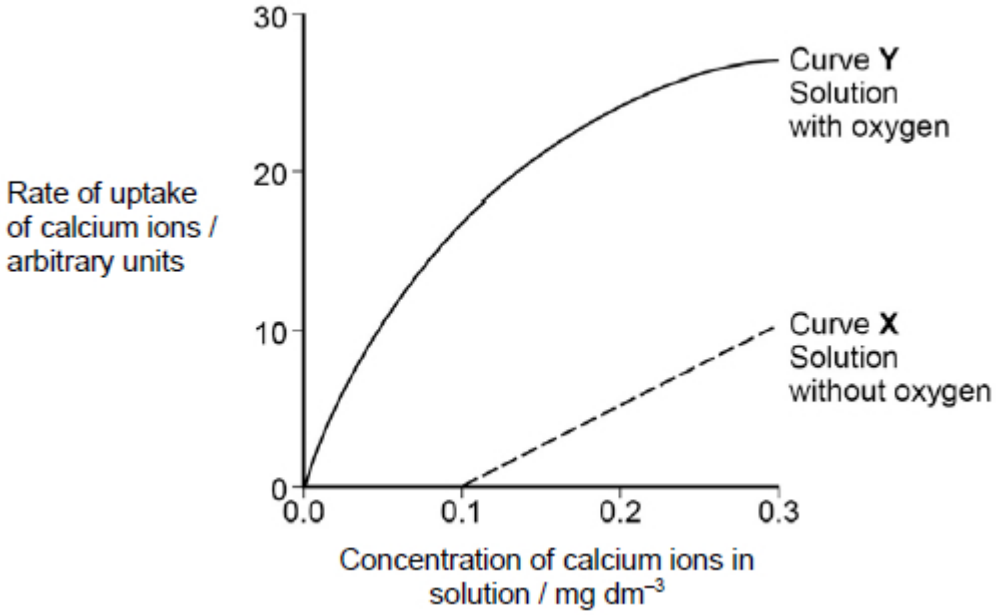
_____

_____

(3)

(Total 9 marks)

3 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.

(5)

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

(1)

(Total 6 marks)

4 (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.

(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*?

_____

_____

_____

_____

_____

_____

(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.

_____

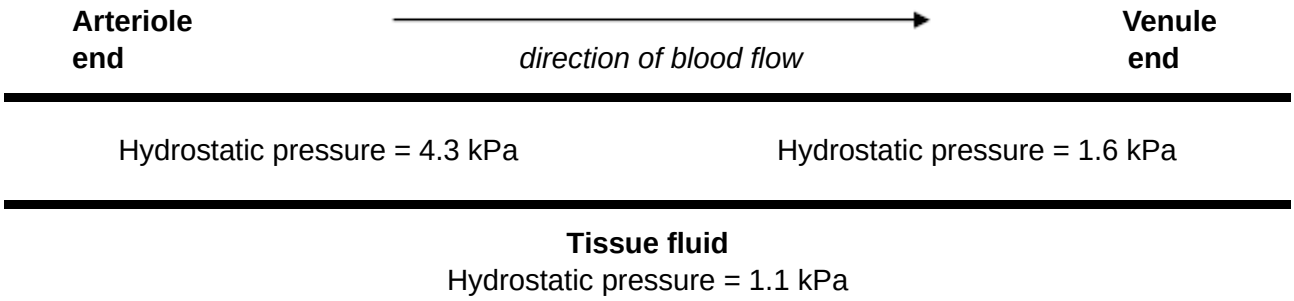
_____

_____

(1)

(Total 10 marks)

5 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.

(Extra space)

(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.

(Extra space)

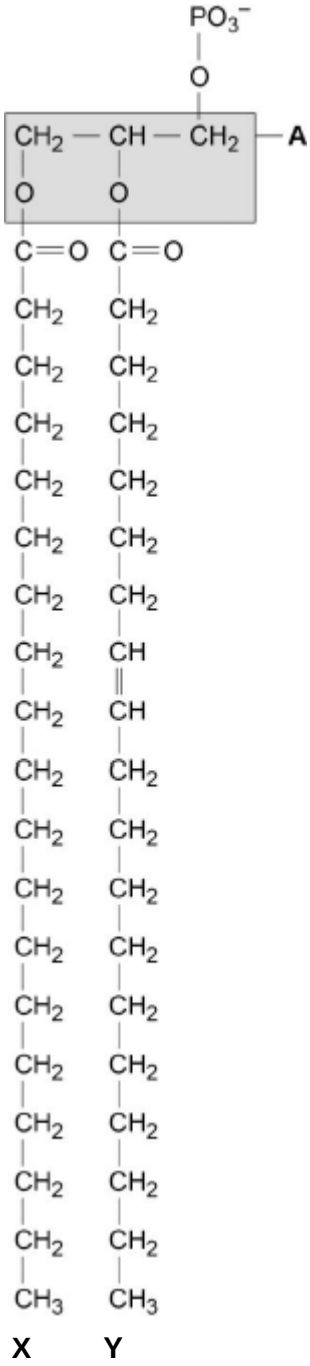
(3)

(Total 9 marks)

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

(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.

(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)

7 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.

(Extra space)

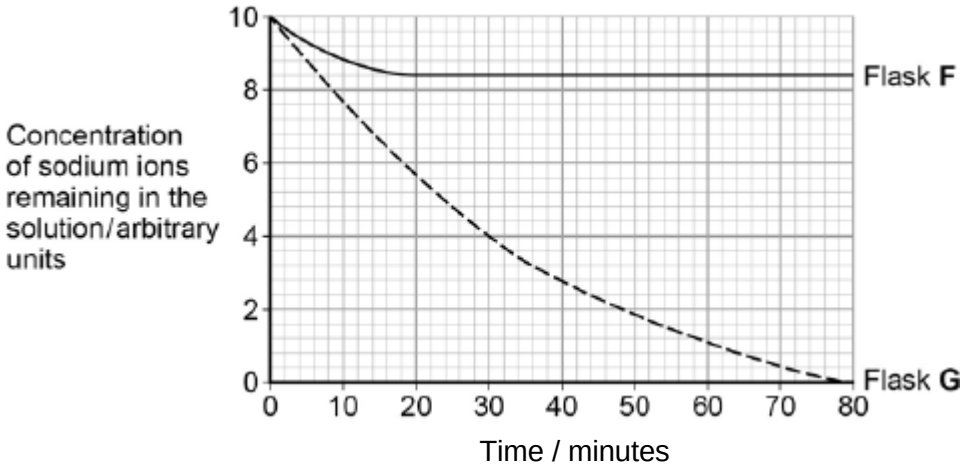
(3)

(Total 8 marks)

8 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.

(Extra space) _____

(4)

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

(2)

(Total 7 marks)

9 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.

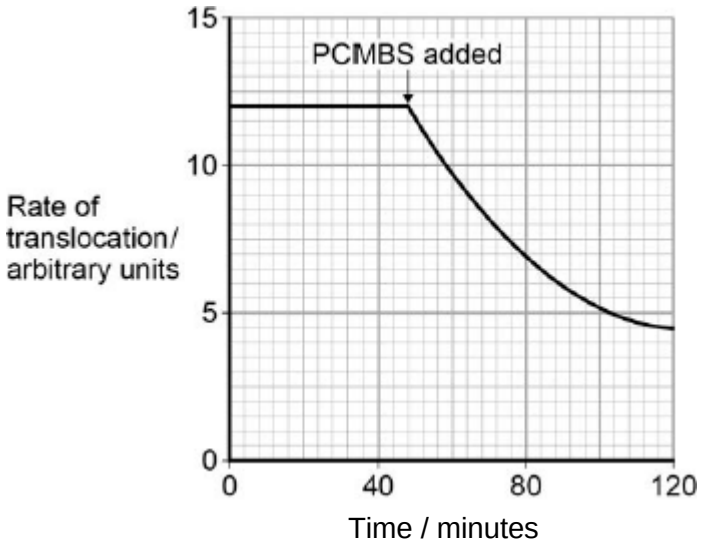
Describe how a high pressure is produced in the leaves.

(Extra space) _____

(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)

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

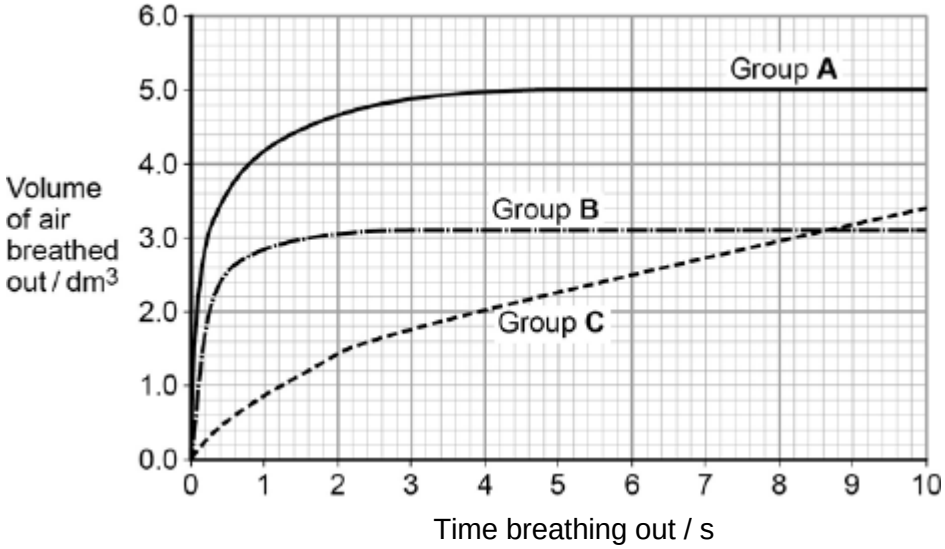
(Extra space)

(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.

(Extra space) _____

(3)

(Total 8 marks)

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

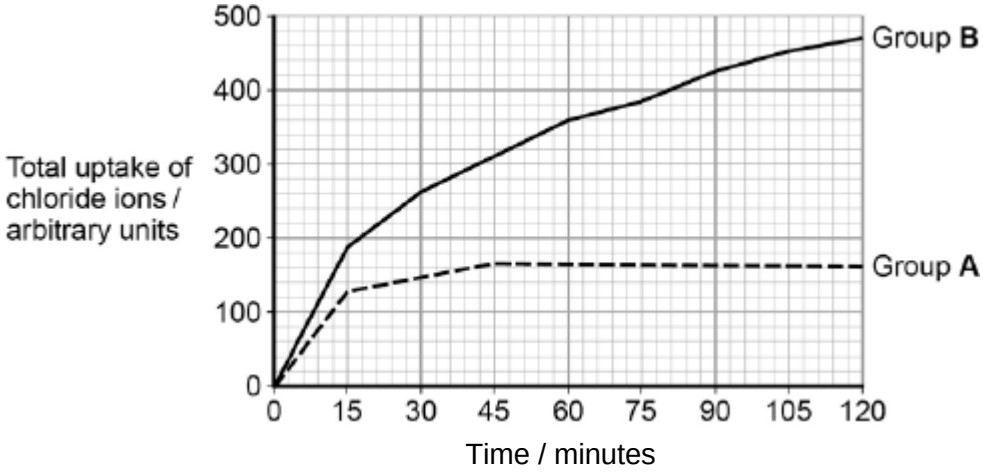
(Extra space) _____

(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.

(Extra space)

(4)

(Total 9 marks)

12 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?

[Extra Space]

(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)

13 (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.

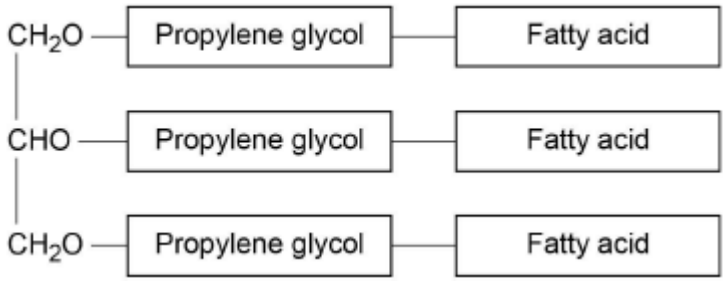
_____

_____

_____

(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)

14 (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.

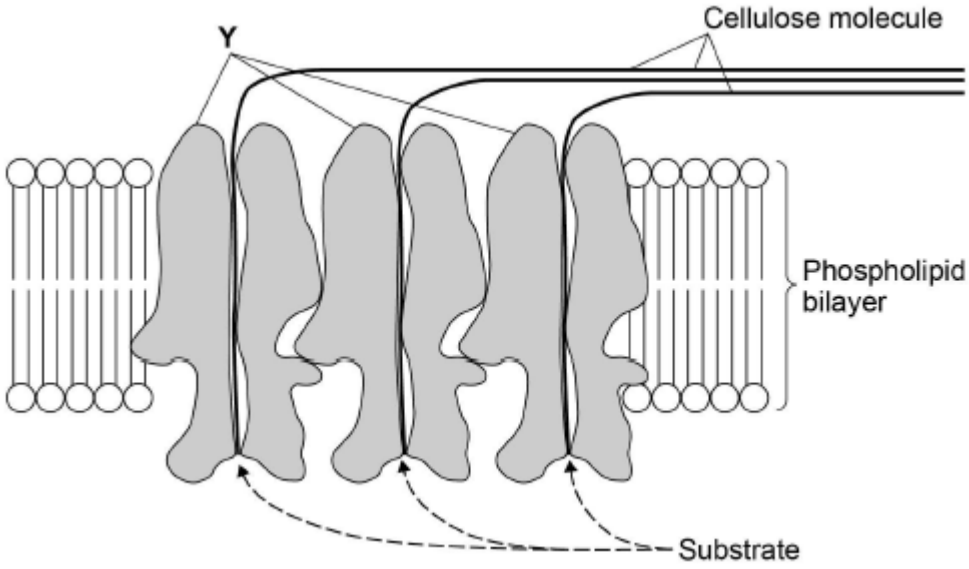
Transport through a channel protein ☐

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)

15 (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.

_____

_____

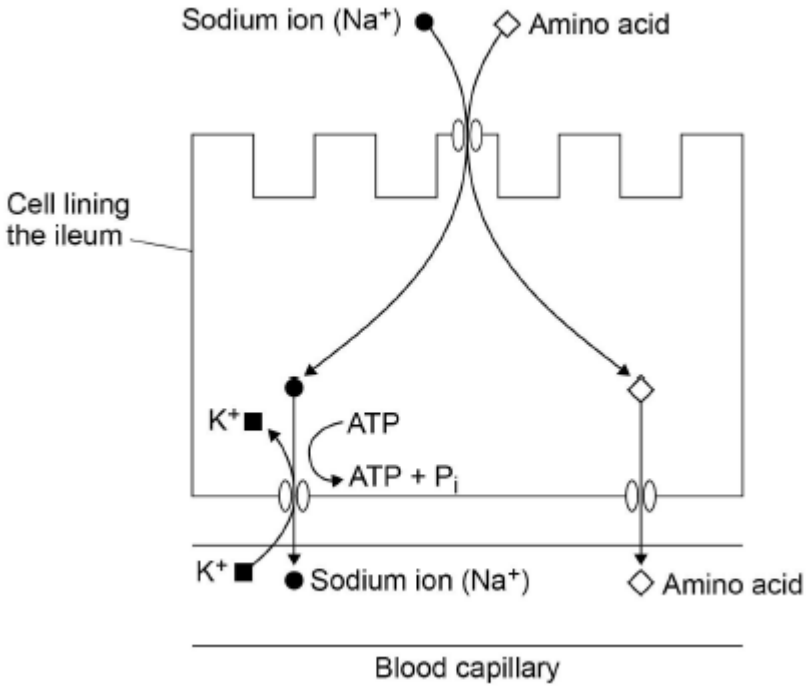
_____

_____

_____

(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.

(3)

(Total 6 marks)

16 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. _____

_____

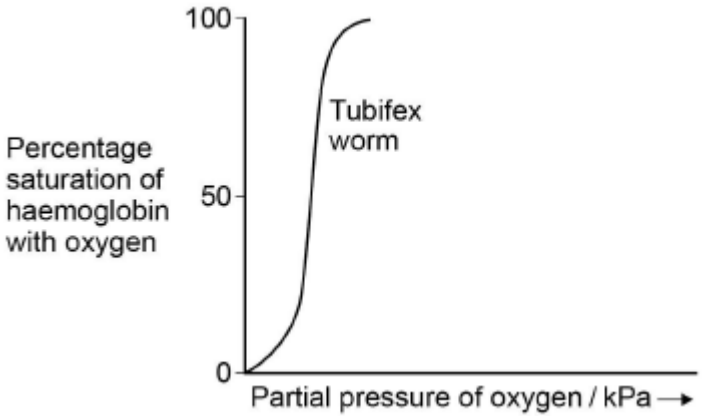
2. _____

_____

(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)

17 (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.

(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.

(5)

(Total 10 marks)

18 (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.

_____

_____

_____

_____

_____

_____

_____

[Extra space] _____

_____

_____

(3)

(Total 5 marks)

19 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)

20 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:

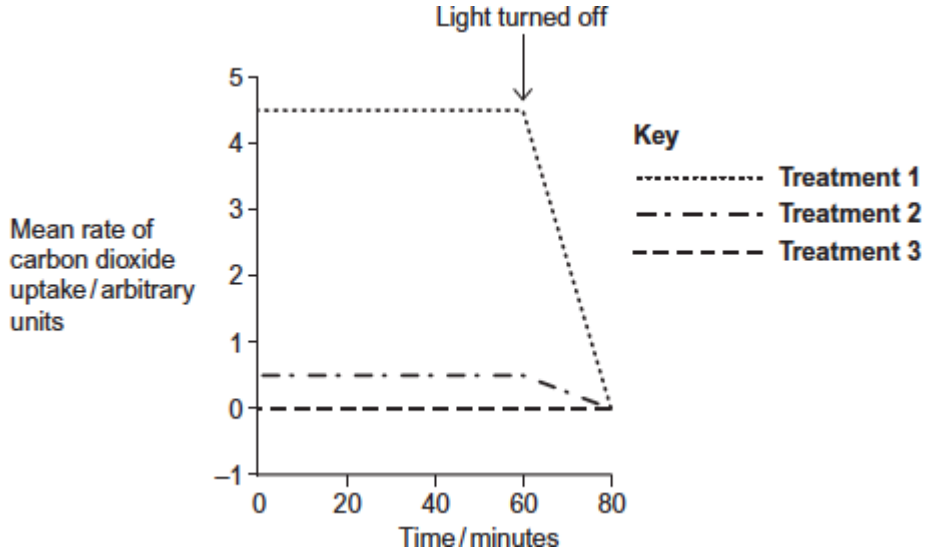
Treatment 1 − No air-sealing grease was applied to either surface of the leaf.

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)

21 (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)

22 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?

_____

_____

_____

_____

_____

_____

(Extra space) _____

_____

_____

(3)

(Total 9 marks)

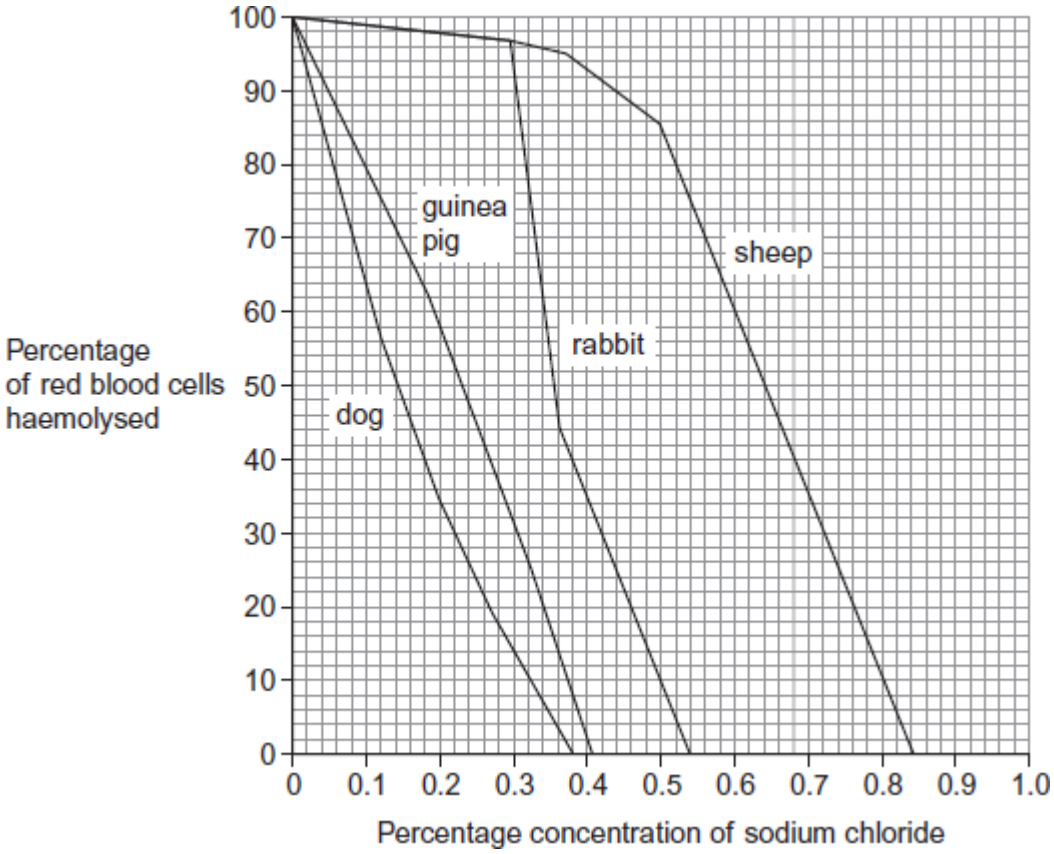
23 If red blood cells are placed in pure water, water enters the cells by osmosis and they burst. This is called haemolysis. As red blood cells burst they release pigment.

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.

(Extra space)

(2)

(Total 7 marks)

24 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.

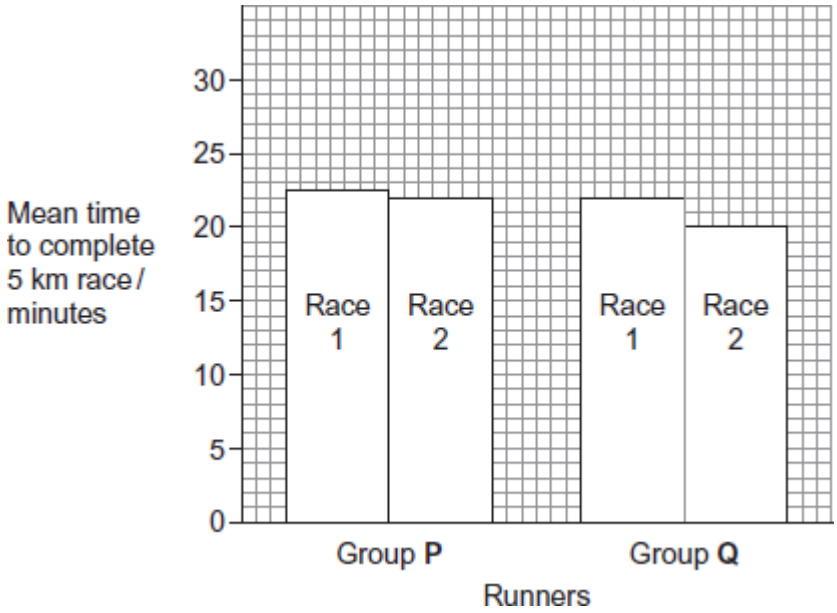
Scientists investigated the effect of a sports drink on the performance of runners in 5 km races. They recruited 100 runners who had previously run a 5 km race in similar times. During this race, Race 1, they had water they could drink.

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)

25 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.

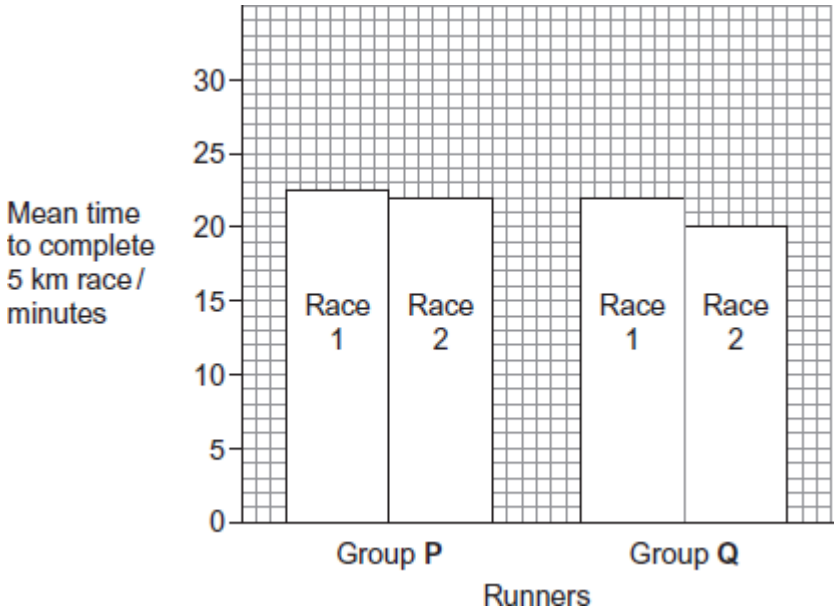
The scientists divided the runners into two equal groups, **P** and **Q**. Both groups ran a second 5 km race, Race 2. During this race:

- 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

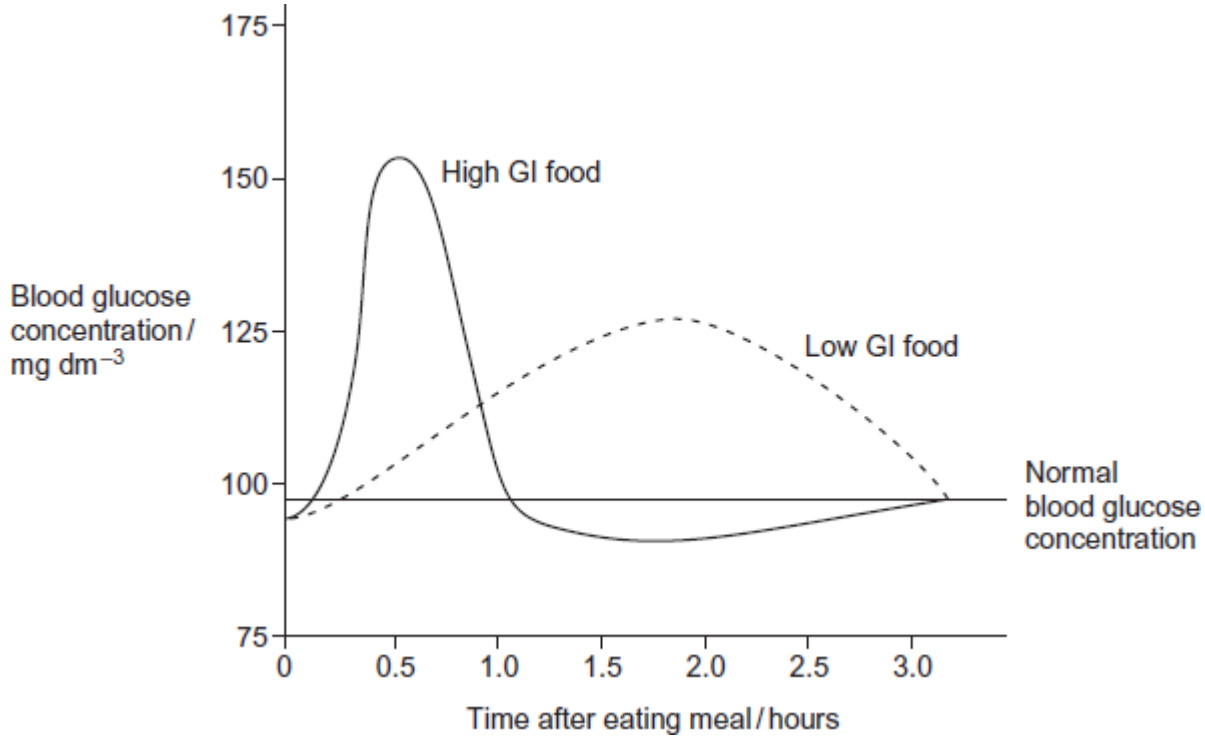


The glycaemic index (GI) is a measure of the increase in blood glucose concentration after eating a given mass of a food compared with eating the same mass of pure glucose. The GI of pure glucose has a value of 100.

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



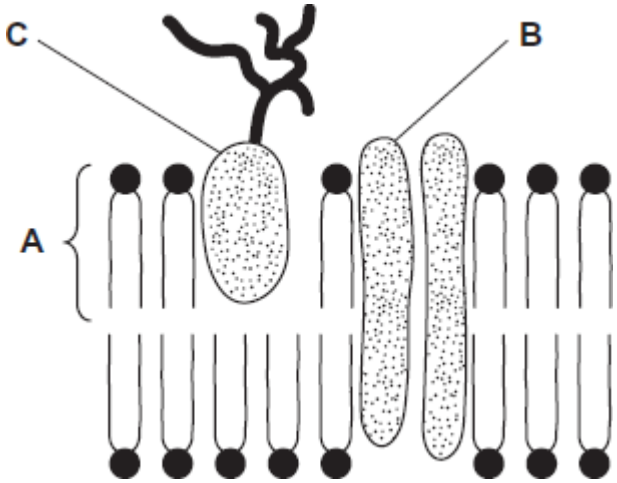
Explain how a sports drink could provide an energy boost when running.

(Extra space)

(3)

(Total 3 marks)

26 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)

27 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)

28 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.

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

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)

29 **Essay**

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy. It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is

Scientific	16
Breadth of knowledge	3
Relevance	3
Quality of written communication	3

Write an essay on the following topic:

The membranes of different types of cells are involved in many different functions.

(Total 25 marks)

30 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.

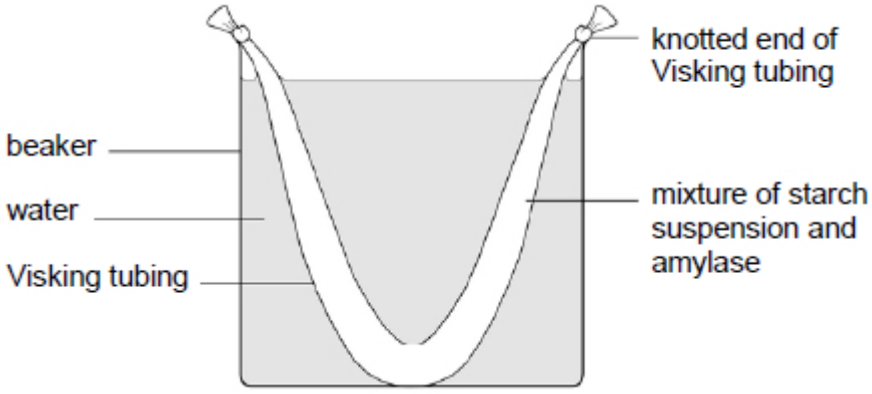
(Extra space) _____

(Total 4 marks)

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

(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)**.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)