

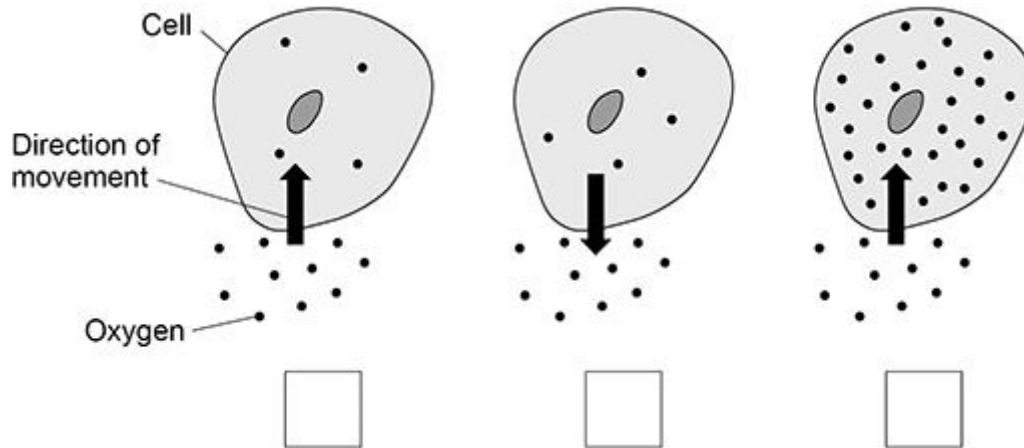
Questions are for both separate science and combined science students unless indicated in the question

Q1.

This question is about cells.

(a) Which diagram shows oxygen moving by diffusion?

Tick (✓) **one** box.



(1)

(b) Complete the sentences.

Choose answers from the box.

carbon dioxide	chlorophyll	energy
light	mineral ions	water

Plant cells absorb substances from the soil.

Plant cells use osmosis to absorb _____.

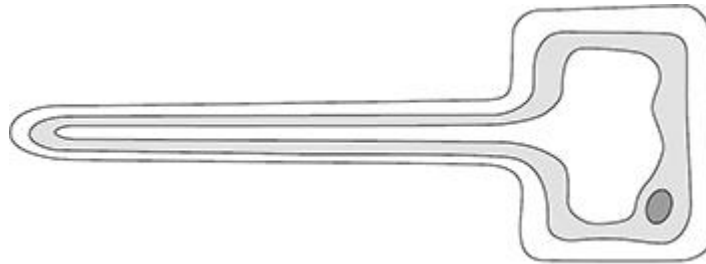
Plant cells use active transport to absorb _____.

Active transport moves substances against the concentration gradient and needs _____.

(3)

Figure 1 shows a specialised cell that absorbs substances from the soil.

Figure 1



(c) Name the type of specialised cell in **Figure 1**.

(1)

(d) Describe how the cell in **Figure 1** is adapted to increase the absorption of substances from the soil.

(1)

A sperm cell is another specialised cell.

Figure 2 shows a sperm cell.

Figure 2



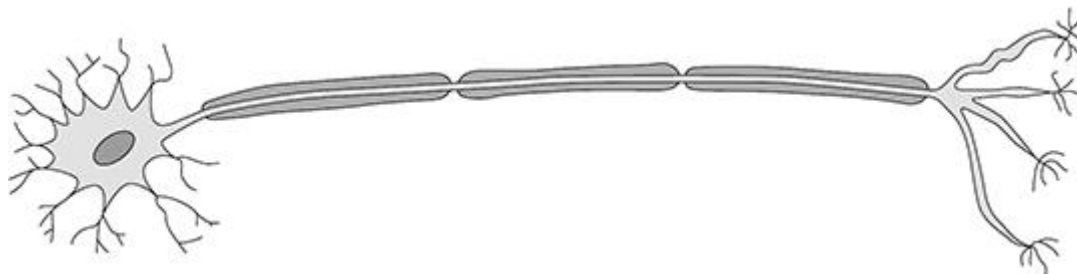
- (e) Draw **one** line from each feature to how the feature helps the sperm cell carry out its function.

Feature of sperm cell	How the feature helps
Contains a nucleus	To break the outer layer of the egg
	To help the cell to swim to the egg
	To provide the chromosomes for fertilisation
Has a long tail	To release energy

(2)

Figure 3 shows another specialised cell.

Figure 3



- (f) Name the type of cell in **Figure 3**.

Describe **one** feature of the cell that helps it to carry out its function.

Name of the cell _____

Feature of the cell _____

(2)

(Total 10 marks)

Q2.

A student prepared some animal cells to view using a microscope.

Figure 1 shows the student preparing the cells.

Figure 1



- (a) Name **two** pieces of laboratory equipment the student could have used to **prepare** cells to view using a microscope.

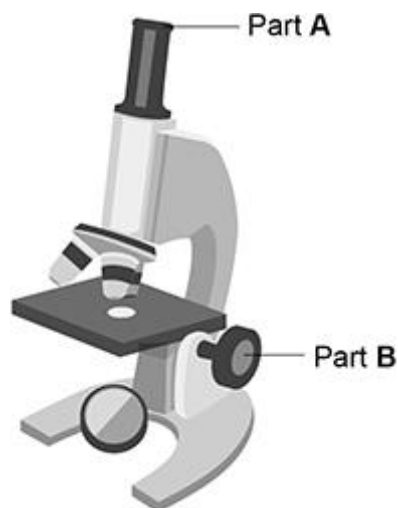
1 _____

2 _____

(2)

Figure 2 shows the student's light microscope.

Figure 2



- (b) Name part **A**.

(1)

- (c) What is the function of part **B**?

(1)

(d) The student tried to look at the cells using the microscope.

Suggest **one** reason why the student could **not** see any cells when looking through part **A**.

(1)

(e) Red blood cells are specialised animal cells.

Compare the structure of a red blood cell with the structure of a plant cell.

(6)

(f) When placed into a beaker of water:

- a red blood cell bursts
- a plant cell does **not** burst.

Explain why the red blood cell bursts but the plant cell does **not** burst.

(2)

(Total 13 marks)

Q3.

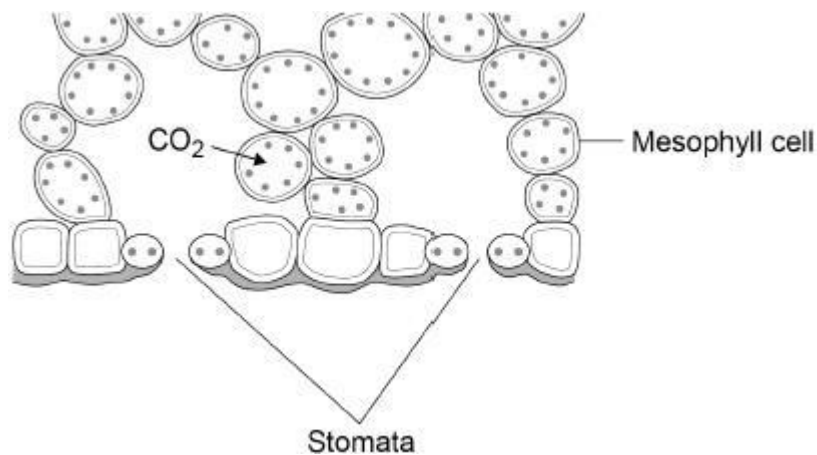
Diffusion is an important process in animals and plants.

(a) What is meant by the term diffusion?

(2)

(b) **Figure 1** shows part of a leaf.

Figure 1



Molecules of carbon dioxide diffuse from the air into the mesophyll cells.

Which **two** changes will increase the rate at which carbon dioxide diffuses into the mesophyll cells?

Tick (✓) **two** boxes.

Decreased number of chloroplasts in the cells

Decreased surface area of cells in contact with the air

Increased carbon dioxide concentration in the air

Increased number of stomata that are open

Increased oxygen concentration in the air

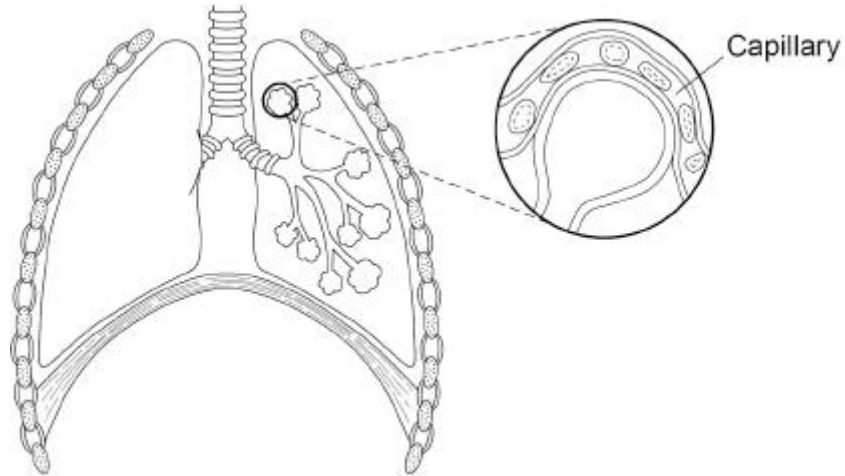


(2)

(c) Diffusion also happens in the human lungs.

Figure 2 shows the human breathing system.

Figure 2

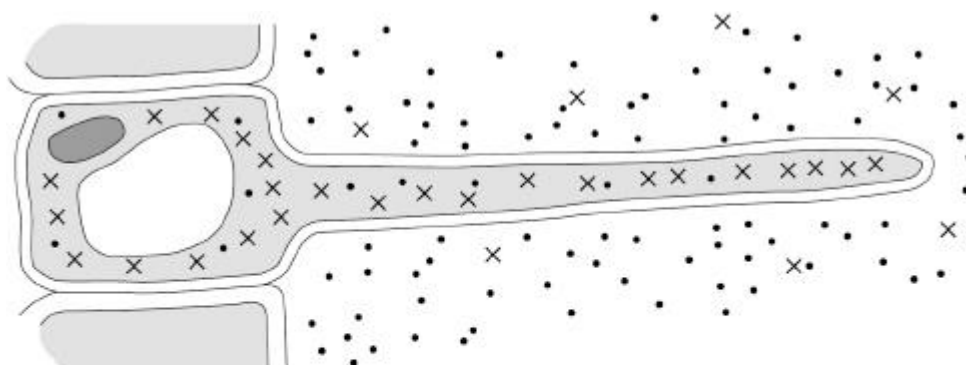


Explain how the human lungs are adapted for efficient exchange of gases by diffusion.

(6)

Figure 3 shows a root hair cell.

Figure 3



Key

•• Water molecules

×× Nitrate ions

(d) Name the process by which water molecules enter the root hair cell.

(1)

(e) Nitrate ions need a different method of transport into the root hair cell.

Explain how the nitrate ions in **Figure 3** are transported into the root hair cell.

Use information from **Figure 3** in your answer.

Name of process _____

Explanation _____

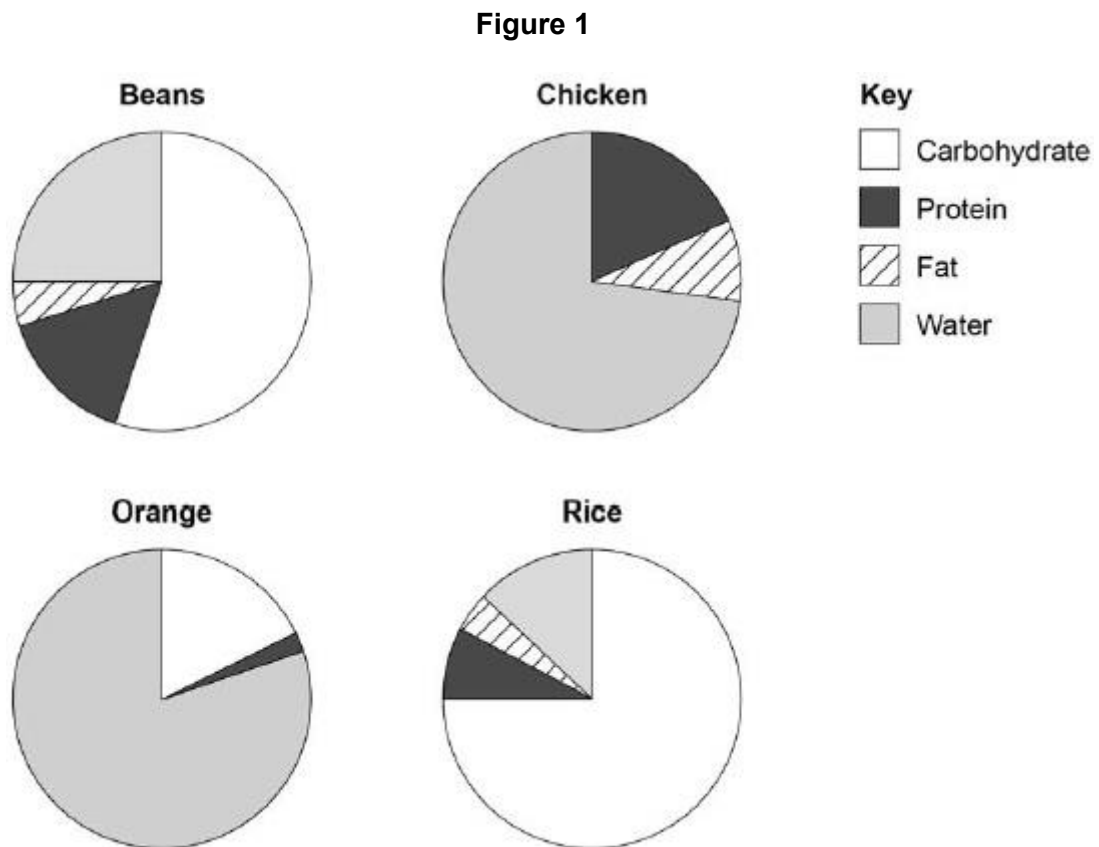
(3)

(Total 14 marks)

Q4.

Many foods contain carbohydrates.

Figure 1 shows information about four different foods.



(a) Which food contains the highest percentage of carbohydrate?

Tick (✓) **one** box.

Beans	<input type="checkbox"/>
Chicken	<input type="checkbox"/>
Orange	<input type="checkbox"/>
Rice	<input type="checkbox"/>

(1)

- (b) Estimate the percentage of water found in beans.

Percentage = _____ %

(1)

- (c) Look at **Figure 1**.

Why would eating only beans provide a more balanced diet than eating only chicken?

(1)

- (d) Sugars are produced when enzymes break down starch.

What is the name of the enzyme which breaks down starch to produce sugars?

Tick (✓) **one** box.

Amylase

Bile

Lipase

Protease

(1)

- (e) Which chemical could be used to test for glucose?

Tick (✓) **one** box.

Benedict's reagent

Biuret reagent

Iodine solution

Sulfuric acid

(1)

- (f) What colour change would be seen in a positive test for glucose?

From blue to _____ .

(1)

- (g) People with diabetes have difficulty controlling the concentration of glucose in their blood.

The blood of four people was tested.

Table 1 shows the results.

Table 1

Person	Concentration of glucose in blood in arbitrary units
A	4.2
B	6.9
C	7.1
D	5.1

Table 2 shows the information used to help decide if a person has diabetes.

Table 2

Concentration of glucose in blood in arbitrary units	Conclusion
<5.6	No diabetes
5.6 to 7.0	Mild diabetes
>7.0	Severe diabetes

Which person has severe diabetes?

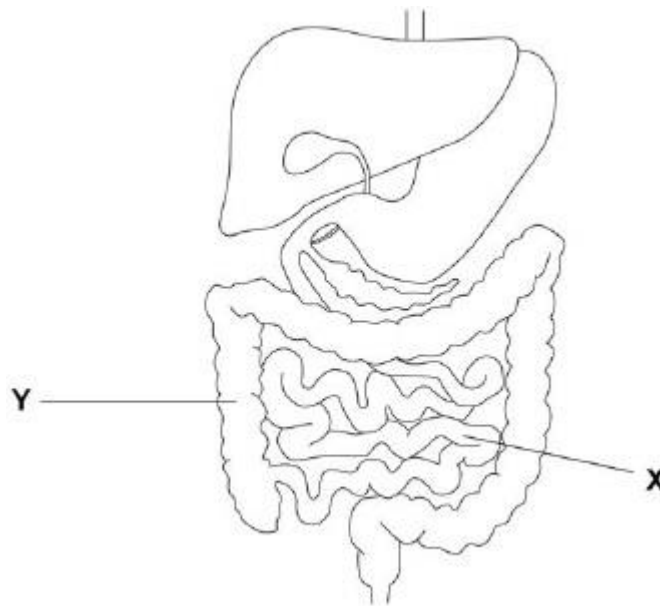
Tick (✓) **one** box.

A B C D

(1)

Figure 2 shows part of the human digestive system.

Figure 2



(h) Glucose is absorbed into the bloodstream in part X.

Name part X.

(1)

(i) Complete the sentences.

Choose answers from the box.

active transport	digestion	excretion
osmosis	respiration	

Some glucose is absorbed into the bloodstream against the concentration gradient

by the process of _____.

Water moves out of part Y and into the bloodstream by

the process of _____.

(2)

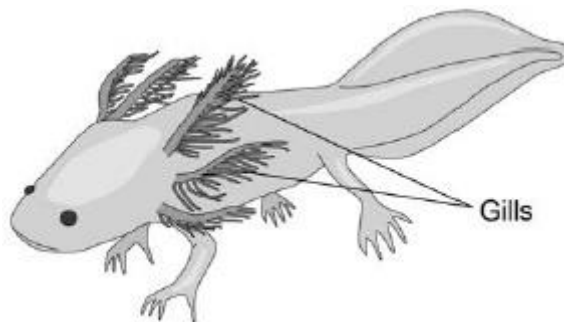
(Total 10 marks)

Q5.

An animal called an axolotl lives in water.

Figure 1 shows an axolotl.

Figure 1



Oxygen enters the axolotl's bloodstream through the gills by diffusion.

(a) What is diffusion?

Tick (✓) **one** box.

The movement of particles from a high concentration to a low concentration

The movement of particles from a low concentration to a high concentration

The movement of water from a concentrated solution to a more dilute solution

(1)

(b) Describe how **one** feature of the axolotl's gills increases the rate of diffusion of oxygen.

Use information from **Figure 1**.

Feature _____

Description _____

(2)

If a gill of an axolotl is removed, stem cells in the damaged area will divide and a new gill will grow.

- (c) Complete the sentence.

Choose the answer from the box.

adaptation	differentiation	evolution	variation
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When stem cells specialise to produce gill cells, this process is known as _____.

(1)

- (d) Complete the sentence.

Choose the answer from the box.

binary fission	mitosis	mutation
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To grow a new gill the stem cells divide by _____.

(1)

- (e) Which **one** of the following does **not** contain stem cells?

Tick (✓) **one** box.

Bone marrow

Embryos

Hair

Meristem tissue

(1)

- (f) Axolotls are small animals. Axolotls are used in stem cell research.

What are **two** advantages of using axolotls in stem cell research?

Tick (✓) **two** boxes.

Axolotls are cheap to feed.

Axolotls are easy to breed.

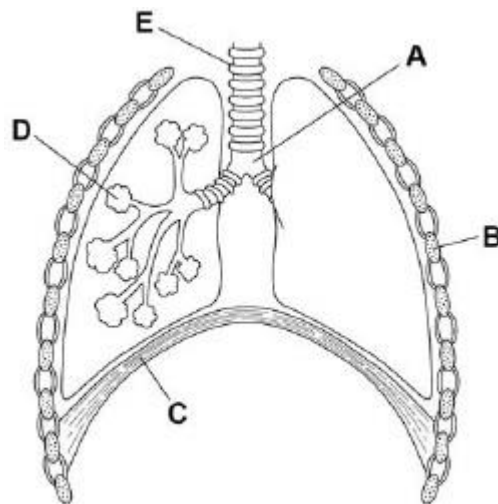
- Axolotls are endangered.
- Axolotls live in water.
- Axolotl research is cruel.

(2)

Oxygen uptake in humans takes place in the lungs.

Figure 2 shows the human breathing system.

Figure 2



(g) Where does oxygen enter the bloodstream?

Tick (✓) **one** box.

- A B C D

(1)

(h) Name part **E** on **Figure 4**.

(1)

(i) Which blood vessel carries blood to the lungs?

Tick (✓) **one** box.

- Aorta

Pulmonary artery

Vena cava

(1)

(Total 11 marks)

Q6.

Two of the substances the body excretes are urea and carbon dioxide.

(a) Complete the sentence.

Choose the answer from the box. **(separate only)**

carbohydrate	lipid	protein	salt
---------------------	--------------	----------------	-------------

A person makes a lot of urea if the person's diet contains

a lot of _____

(1)

(b) Why must urea be excreted from the body? **(separate only)**

(1)

(c) A person produces more carbon dioxide during exercise than when resting.

Complete the sentences.

Choose answers from the box.

breathing	digestion	egestion
osmosis	respiration	

The process that makes carbon dioxide is

During exercise, extra carbon dioxide can be removed from the body by increasing

the rate of _____.

(2)

(d) Excess water must also be removed from the body.

If a person sweats a lot, less water will be excreted in the urine.

A healthy person did the same amount of exercise on each of 3 days.

The following table shows information for the 3 days.

Day	Air temperature in °C	Volume of water consumed in cm ³	Relative amount of urine produced by the kidneys
1	30	1500	
2	20	1500	
3	15	2000	

Complete the table.

Choose answers from the box. **(separate only)**

least	medium	most
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(2)

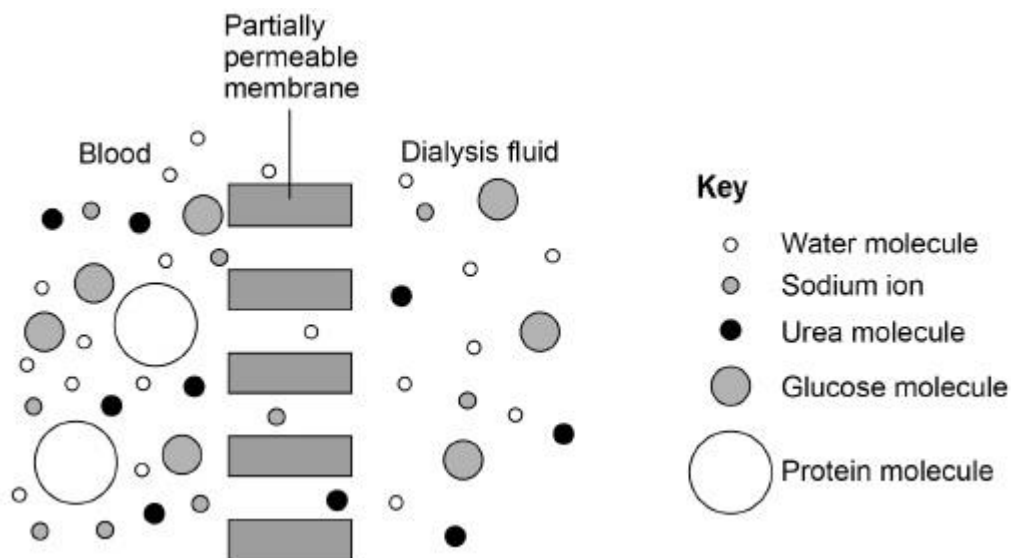
Some people have kidney disease.

Kidney disease may be treated by dialysis or by having a kidney transplant operation.

- During dialysis, a person is connected to a machine that filters the blood.
- Each dialysis session lasts about 6 hours.
- The person has several dialysis sessions each week.

Figure 1 shows how dialysis works.

Figure 1



(e) How does urea move out of the blood during dialysis?

Tick (✓) **one** box. (separate only)

- | | |
|-------------|--------------------------|
| Diffusion | <input type="checkbox"/> |
| Digestion | <input type="checkbox"/> |
| Osmosis | <input type="checkbox"/> |
| Respiration | <input type="checkbox"/> |

(1)

(f) Which substance in **Figure 1** does **not** pass from the blood into the dialysis fluid?

Give the reason for your answer. (separate only)

Substance

Reason

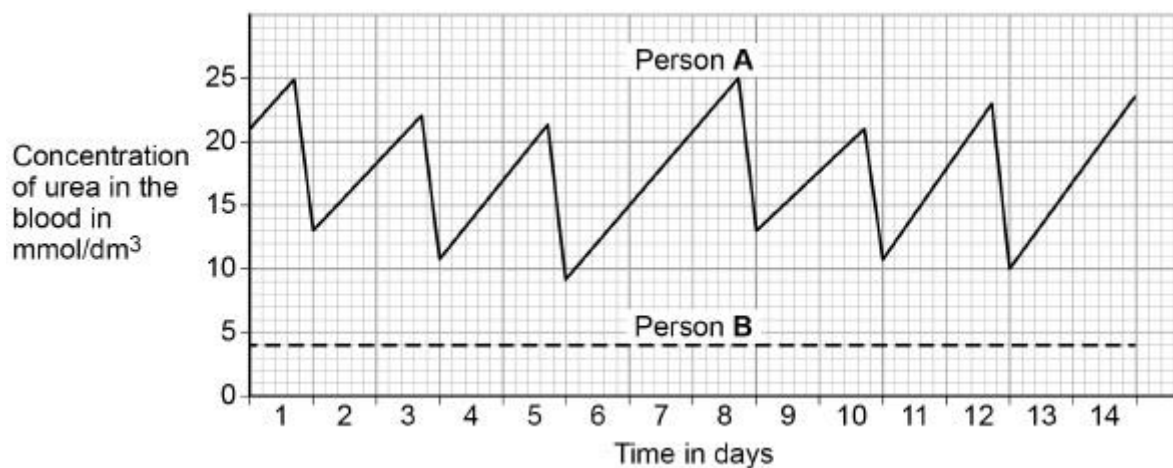
(2)

Two people have kidney disease.

- Person **A** is treated by dialysis.
- Person **B** has had a kidney transplant.

Figure 2 shows changes in the urea concentration in the blood of each person over 2 weeks.

Figure 2



(g) How many dialysis sessions did person **A** have **each week**? **(separate only)**

(1)

(h) What happens to the concentration of urea in the blood between dialysis sessions? **(separate only)**

(1)

(i) Give **two** reasons why a kidney transplant is a better method for treating kidney disease than dialysis. **(separate only)**

1 _____

2 _____

(2)

(Total 13 marks)

Q7.

Earthworms are small animals that live in soil. Earthworms have no specialised gas exchange system and absorb oxygen through their skin.

- (a) What is the name of the process in which oxygen enters the skin cells?

Tick **one** box.

- Active transport
- Diffusion
- Osmosis
- Respiration

(1)

The table below shows information about four skin cells of an earthworm.

Cell	Percentage of oxygen	
	Outside cell	Inside cell
A	9	8
B	12	8
C	12	10
D	8	12

- (b) Which cell has the smallest difference in percentage of oxygen between the outside and the inside of the cell?

Tick **one** box.

A		B		C		D	
----------	--	----------	--	----------	--	----------	--

(1)

- (c) Which cell will oxygen move **into** the fastest?

Tick **one** box.

A		B		C		D	
----------	--	----------	--	----------	--	----------	--

(1)

- (d) Earthworms have a large surface area to volume ratio.

Suggest why a large surface area to volume ratio is an advantage to an earthworm.

(1)

- (e) The earthworm uses enzymes to digest dead plants.

Many plants contain fats or oils.

Which type of enzyme would digest fats?

(1)

- (f) Earthworms move through the soil.

This movement brings air into the soil.

Dead plants decay faster in soil containing earthworms compared with soil containing **no** earthworms.

Explain why.

(3)

- (g) When earthworms reproduce, a sperm cell from one earthworm fuses with an egg cell from a different earthworm.

Name the process when an egg cell and a sperm cell fuse.

(1)

- (h) Some types of worm reproduce by a process called fragmentation.

In fragmentation, the worm separates into two or more parts. Each part grows into a new worm.

What type of reproduction is fragmentation?

(1)

(Total 10 marks)

Q8.

A student carried out an investigation using chicken eggs.

This is the method used.

1. Place 5 eggs in acid for 24 hours to dissolve the egg shell.
2. Measure and record the mass of each egg.
3. Place each egg into a separate beaker containing 200 cm³ of distilled water.
4. After 20 minutes, remove the eggs from the beakers and dry them gently with a paper towel.
5. Measure and record the mass of each egg.

Table 1 shows the results.

Table 1

Egg	Mass of egg without shell in grams	Mass of egg after 20 minutes in grams
1	73.5	77.0
2	70.3	73.9
3	72.4	75.7
4	71.6	73.1
5	70.5	73.8

- (a) Another student suggested that the result for egg 4 was anomalous.

Do you agree with the student?

Give a reason for your answer.

(1)

- (b) Calculate the percentage change in mass of egg 3.

Percentage change in mass = _____

(2)

- (c) Explain why the masses of the eggs increased.

(3)

- (d) Explain how the student could modify the investigation to determine the concentration of the solution inside each egg.

(3)

Chicken egg shells contain calcium. Calcium ions are moved from the shell into the cytoplasm of the egg.

Table 2 shows information about the concentration of calcium ions.

Table 2

Location	Concentration of calcium ions in arbitrary units
Egg shell	0.6
Egg cytoplasm	2.1

- (e) Explain how calcium ions are moved from the shell into the cytoplasm of the egg.

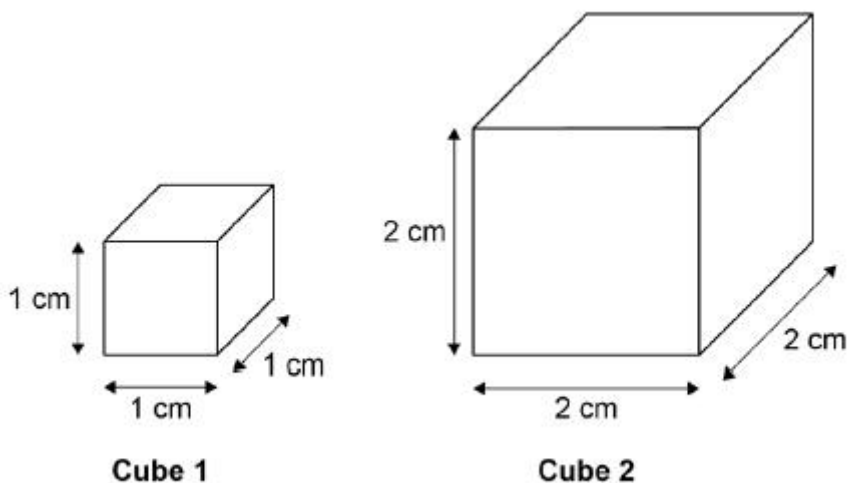
(3)

(Total 12 marks)

Q9.

A student used cubes of potato to investigate the effect of surface area and volume on the rate of osmosis.

The diagram shows two of the cubes of potato the student used.



The surface area to volume ratio of **cube 1** is 6:1.

- (a) Calculate the total surface area of **cube 2**.

Total surface area of **cube 2** = _____ cm²

(1)

- (b) Calculate the volume of **cube 2**.

Volume of **cube 2** = _____ cm³

(1)

- (c) Calculate the surface area to volume ratio of **cube 2**.

Use the equation:

$$\text{surface area to volume ratio} = \frac{\text{surface area}}{\text{volume}}$$

Surface area to volume ratio of **cube 2** = _____ : 1

(1)

This is the method used.

1. Cut two cubes of potato of size 2 cm × 2 cm × 2 cm
 - Cut one of these cubes into 8 cubes of potato of size 1 cm × 1 cm × 1 cm (sample **A**).
 - Do not cut the other cube (sample **B**).
 2. Measure the mass of each sample **A** and the mass of sample **B**.
 3. Place all the cubes into a beaker of distilled water.
 4. Leave for 30 minutes.
 5. Remove the cubes from the beaker and dry the surfaces with a paper towel.
 6. Measure the mass of each sample of cubes.
- (d) Why were 8 cubes of size 1 cm × 1 cm × 1 cm but only one cube of size 2 cm × 2 cm × 2 cm cube used?

(1)

- (e) Why did the student dry the surface of each potato cube in step **5** of the method?

(1)

The table below shows the student's results.

	Mass at start in g	Mass at end in g	Mass change in g
Sample A Eight cubes, each measuring 1 cm × 1 cm × 1 cm	10.4	12.2	1.8
Sample B One cube, measuring 2 cm × 2 cm × 2 cm	9.9	10.7	X

- (f) Calculate mass change **X** in the table above.

Mass change **X** = _____ g

(1)

- (g) Explain why the masses of both samples of cubes increased.

(2)

- (h) It would be better to calculate percentage change in mass rather than change in mass.

Why is this a more valid method?

Tick **one** box.

Because it makes it a fair test.

Because it makes the investigation of the samples of cubes more accurate.

Because the samples of cubes were different masses at the start of the investigation.

(1)

- (i) Explain why the mass of the cubes in sample **A** increased more than the mass of the cube in sample **B**.

(2)

(Total 11 marks)

Q10.

Gases enter and leave the blood by diffusion.

- (a) Define the term diffusion.

(1)

- (b) Name the main gases that diffuse into and out of the blood **in the lungs**.

Into the blood _____

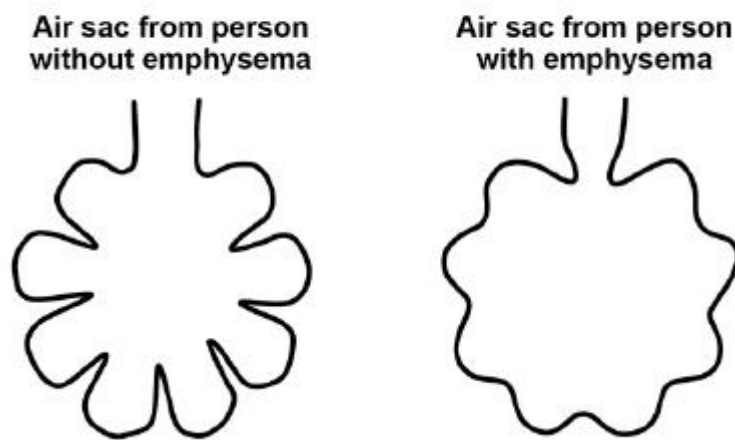
Out of the blood _____

(1)

- (c) Smoking can cause emphysema.

Look at **Figure 1** below.

Figure 1



Emphysema causes the walls of the air sacs in the lungs to break down
 Explain how this will affect the diffusion of gases into and out of the blood.

(2)

Smoking during pregnancy can cause low birth mass in babies.

Table 1 shows the World Health Organisation categories for birth mass.

Table 1

Category	Birth mass in g
Above normal birth mass	> 4500
Normal birth mass	2500–4500
Low birth mass	1500–2499
Very low birth mass	1000–1499
Extremely low birth mass	< 1000

(d) Complete **Table 2**.

Use information in **Table 1**.

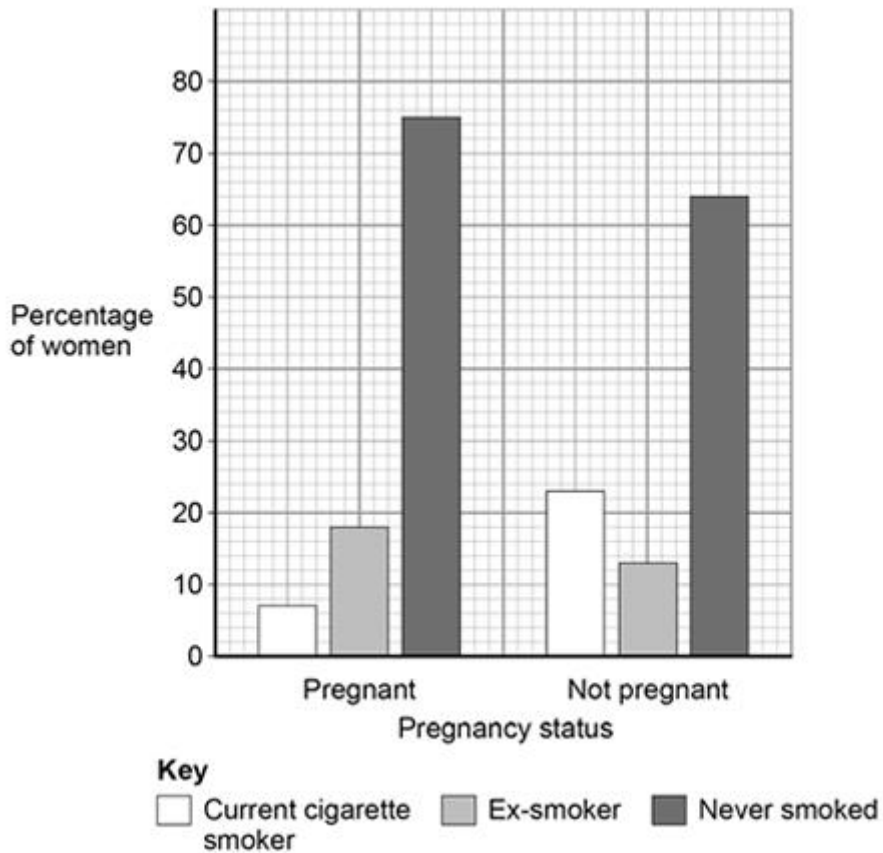
Table 2

Baby	Birth mass in g	Category
A	2678	Normal birth mass
B	1345	
C	991	

(2)

Figure 2 shows data from a study about pregnancy and smoking in women in the UK.

Figure 2



- (e) Sampling from the whole UK population would **not** be appropriate for this study.

Give **one** reason why.

(1)

- (f) Give **three** conclusions that can be made about smoking in pregnant women compared with non-pregnant women.

Use information from **Figure 2**.

1. _____

2. _____

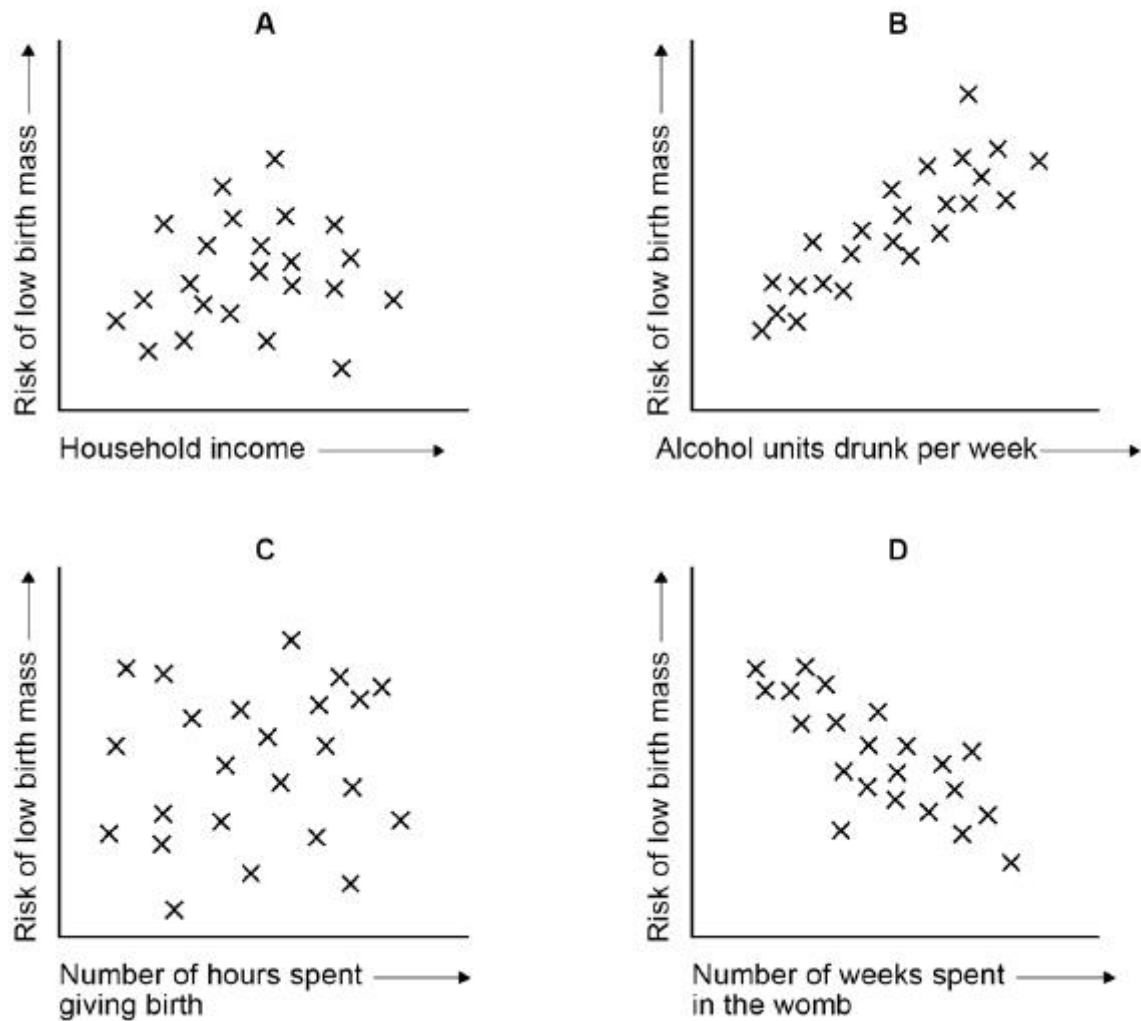
3. _____

(3)

Other factors can also be linked to low birth mass.

Figure 3 shows the relationship between four of these factors and the risk of low birth mass.

Figure 3



(g) What type of graph is shown in **Figure 3**?

Tick **one** box.

Bar graph

Histogram

Line graph

Scatter graph

(1)

(h) Which of the graphs in **Figure 3** shows a positive correlation?

Tick **one** box.

A **B** **C** **D**

(1)

(i) A student concluded that the longer a woman spends giving birth, the greater the risk of low birth mass.

Give **one** reason why the student's conclusion is **not** correct.

Use evidence from **Figure 3**.

(1)

(Total 13 marks)

Q11.

Plants transport water and mineral ions from the roots to the leaves.

(a) Plants move mineral ions:

- from a low concentration in the soil
- to a high concentration in the root cells.

What process do plants use to move these minerals ions into root cells?

Tick **one** box.

Active transport

Diffusion

Evaporation

Osmosis



(1)

(b) Describe how water moves from roots to the leaves.

(2)

(c) Plants lose water through the stomata in the leaves.

The epidermis can be peeled from a leaf.

The stomata can be seen using a light microscope.

The table below shows the data a student collected from five areas on one leaf.

Leaf area	Number of stomata	
	Upper surface	Lower surface
1	3	44
2	0	41
3	1	40
4	5	42
5	1	39
Mean	2	X

Describe how the student might have collected the data.

-
-
- (3)
- (d) What is the median number of stomata on the upper surface of the leaf?
-
- (1)
- (e) Calculate the value of **X** in the table.
Give your answer to 2 significant figures.
-
-
- Mean number of stomata on lower surface of leaf = _____
- (2)
- (f) The plant used in this investigation has very few stomata on the upper surface of the leaf.
Explain why this is an **advantage** to the plant.
-
-
-
-
- (2)
- (Total 11 marks)

Q12.

A student investigated the effect of different sugar solutions on potato tissue.

This is the method used.

1. Add 30 cm³ of 0.8 mol dm⁻³ sugar solution to a boiling tube.
2. Repeat step 1 with equal volumes of 0.6, 0.4 and 0.2 mol dm⁻³ sugar solutions.
3. Use water to give a concentration of 0.0 mol dm⁻³.
4. Cut five cylinders of potato of equal size using a cork borer.
5. Weigh each potato cylinder and place one in each tube.
6. Remove the potato cylinders from the solutions after 24 hours.

7. Dry each potato cylinder with a paper towel.
8. Reweigh the potato cylinders.

The table below shows the results.

Concentration of sugar solution in mol dm ⁻³	Starting mass in g	Final mass in g	Change of mass in g	Percentage (%) change
0.0	1.30	1.51	0.21	16.2
0.2	1.35	1.50	0.15	X
0.4	1.30	1.35	0.05	3.8
0.6	1.34	1.28	-0.06	-4.5
0.8	1.22	1.11	-0.11	-9.0

- (a) Calculate the value of **X** in the table above.

Percentage change in mass = _____ %

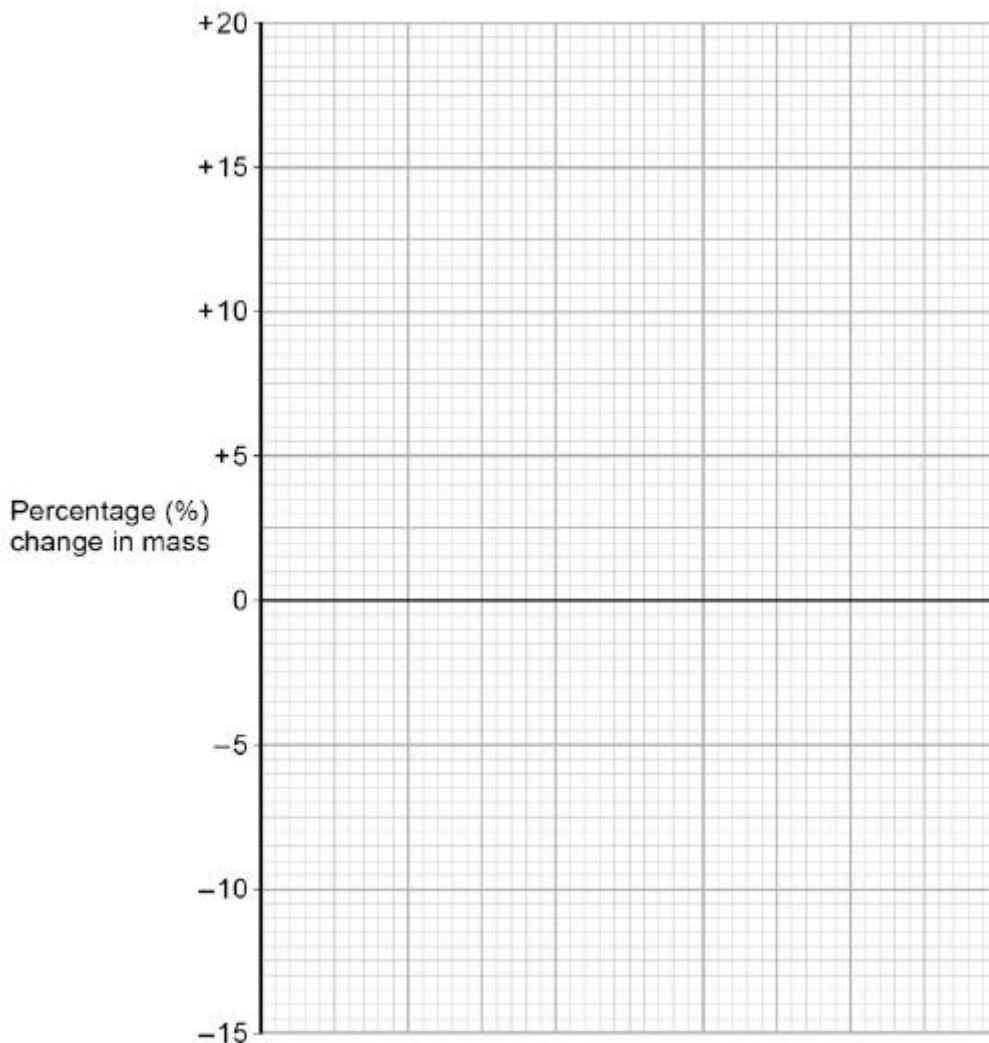
(2)

- (b) Why did the student calculate the percentage change in mass as well as the change in grams?

(1)

- (c) Complete the graph using data from the table above.

- Choose a suitable scale and label for the x-axis.
- Plot the percentage (%) change in mass.
- Draw a line of best fit.



(4)

- (d) Use your graph to estimate the concentration of the solution inside the potato cells.

Concentration = _____ mol dm⁻³

(1)

- (e) The results in the table above show the percentage change in mass of the potato cylinders.

Explain why the percentage change results are positive **and** negative.

(3)

(f) Suggest **two** possible sources of error in the method given above.

1. _____

2. _____

(2)

(Total 13 marks)

Q13.

Explain how the human circulatory system is adapted to:

- supply oxygen to the tissues
- remove waste products from tissues.

(Total 6 marks)

Q14.

Cells, tissues and organs are adapted to take in different substances and get rid of different substances.

The table shows the concentration of four ions outside cells and inside cells.

Ion	Concentration outside cells in mmol per dm ³	Concentration inside cells in mmol per dm ³
Sodium	140	9
Potassium	7	138
Calcium	2	27
Chloride	118	3

- (a) Use information from the table above to complete the following sentences.

Sodium ions will move into cells by the process
of _____ .

Potassium ions will move into cells by the process
of _____ .

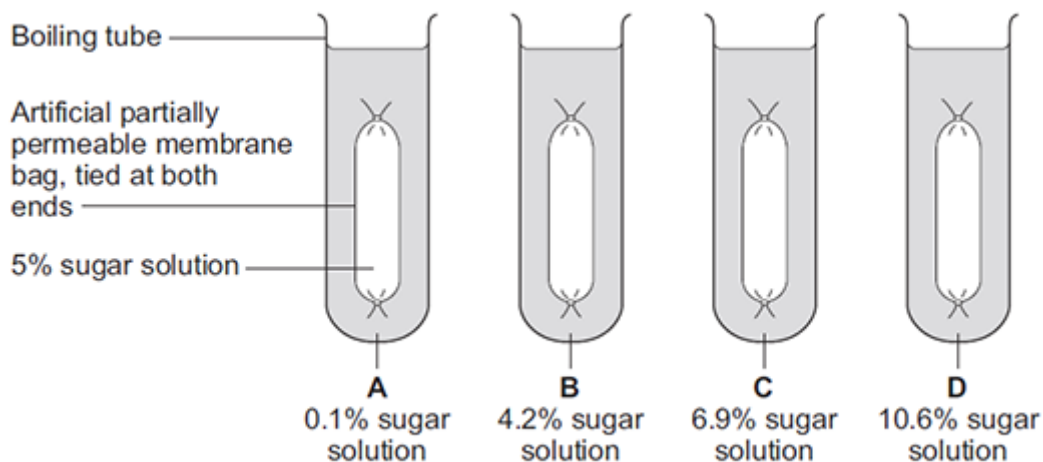
(2)

- (b) Some students investigated the effect of the different concentrations of sugar in four drinks, **A**, **B**, **C** and **D**, on the movement of water across a partially permeable membrane.

The students:

- made four bags from artificial partially permeable membrane
- put equal volumes of 5% sugar solution in each bag
- weighed each bag containing the sugar solution
- placed one bag in each of the drinks, **A**, **B**, **C** and **D**
- after 20 minutes removed the bags containing the sugar solution and weighed them again.

The diagram below shows how they set up the investigation.



- (i) The bag in drink **A** got heavier after 20 minutes.

Explain why.

(3)

- (ii) In which drink, **A**, **B**, **C** or **D**, would you expect the bag to show the smallest change in mass?

Tick (✓) **one** box.

A **B** **C** **D**

(1)

- (iii) Explain why you think the bag you chose in part (b)(ii) would show the smallest change.

(2)

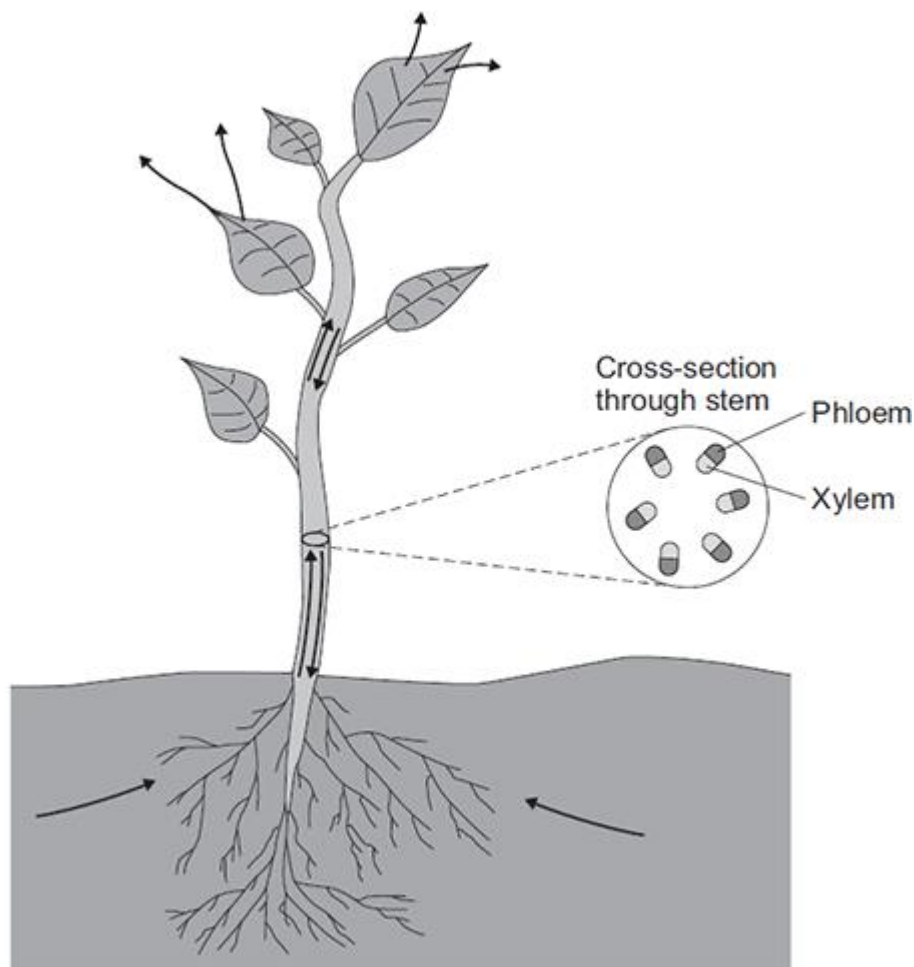
(Total 8 marks)

Q15.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Plants transport many substances between their leaves and roots.

The diagram below shows the direction of movement of substances through a plant.



Describe how **ions**, **water** and **sugar** are obtained and transported through plants.

In your answer you should refer to materials moving upwards in a plant and to materials moving downwards in a plant.

(Total 6 marks)