Q1.
This question is about cells.

(a) Which diagram shows oxygen moving by diffusion?

Tick (✓) one box.
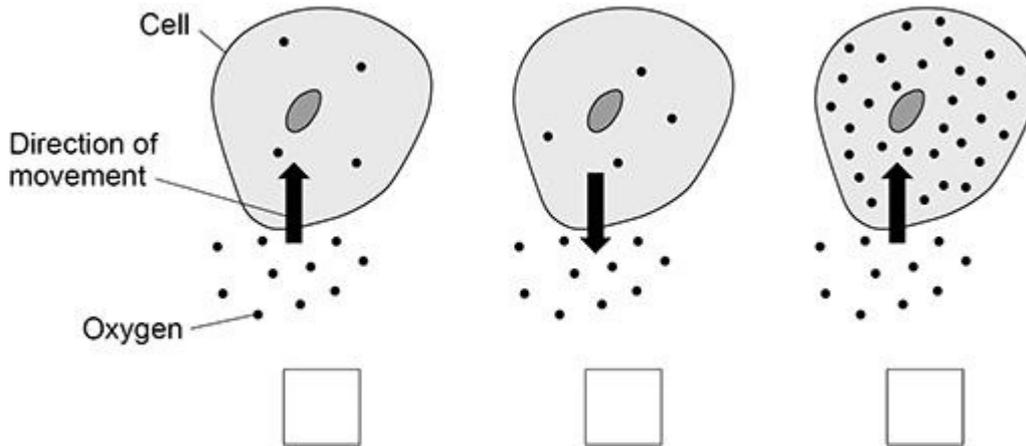
(1)

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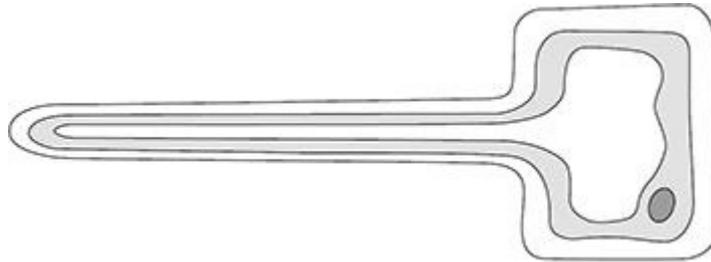
(c)   Name the type of specialised cell in Figure 1.

_____

(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

Nucleus

Long tail

(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

| To break the outer layer of the egg |

| Contains a nucleus |

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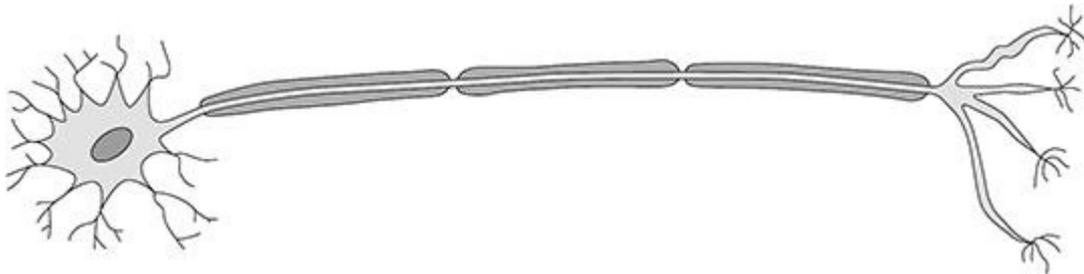
(f) Name the type of cell in Figure 3.

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
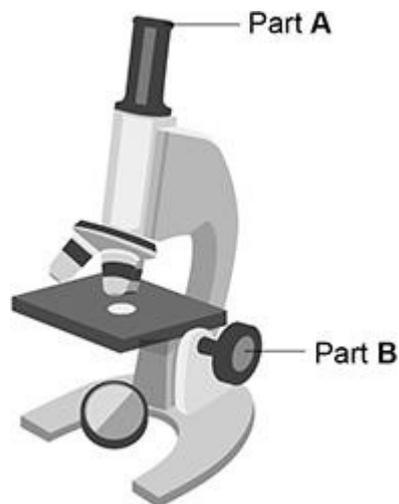
Part A

Part B

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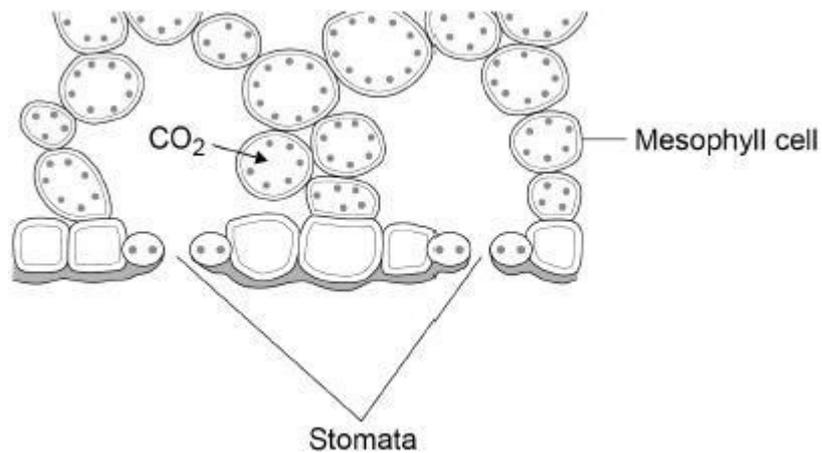
Molecules of carbon dioxide diffuse from the air into the mesophyll cells.

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
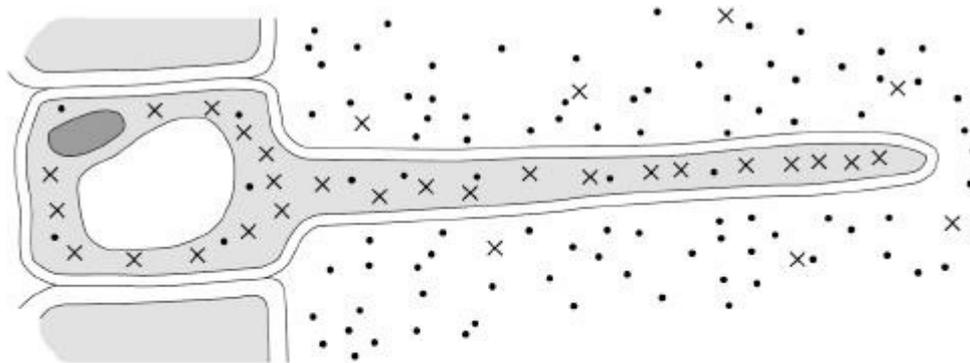
Key

∴• Water molecules

×ˣ 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.
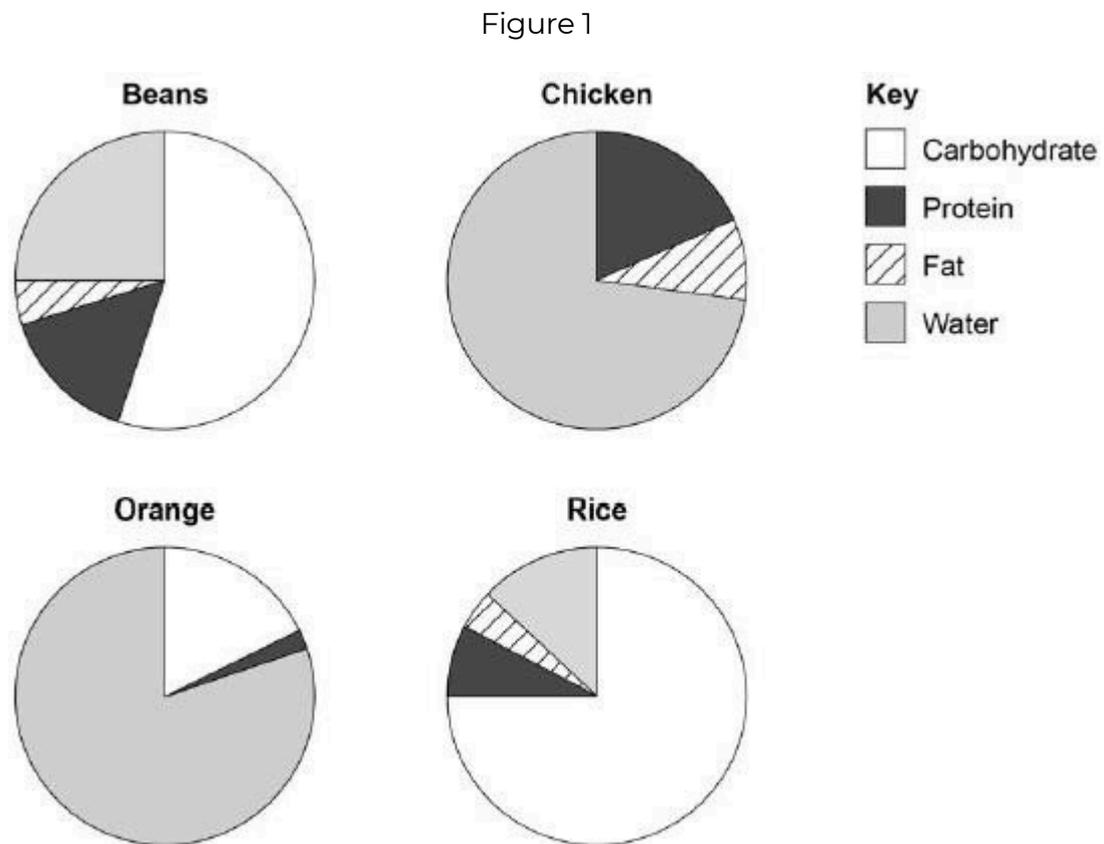
Figure 1

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

Tick (✓) one box.

Beans ☐

Chicken ☐

Orange ☐

Rice ☐

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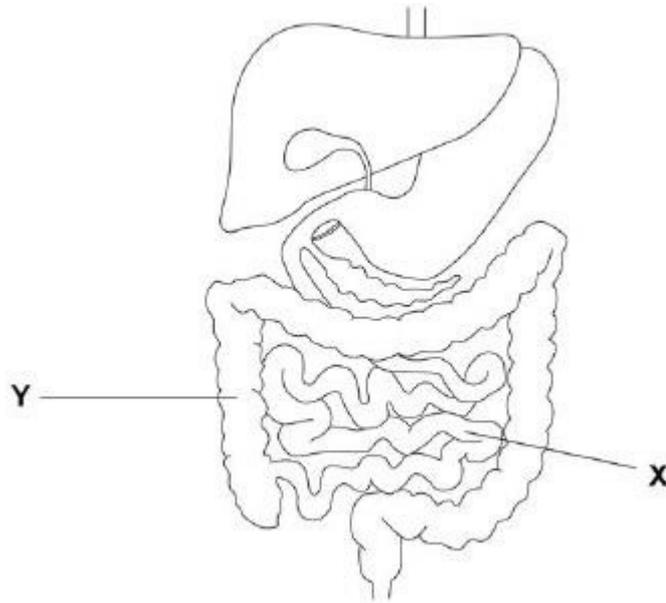
(h)   Glucose is absorbed into the bloodstream in part X.

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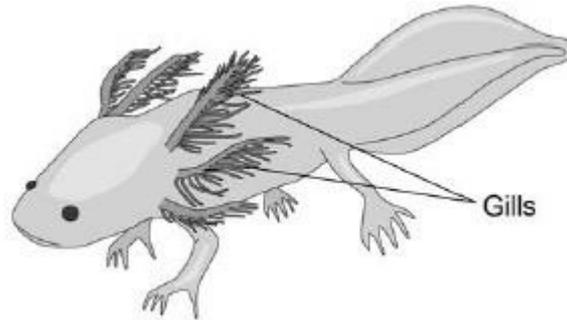
Oxygen enters the axolotl's bloodstream through the gills by diffusion.

(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

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

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.
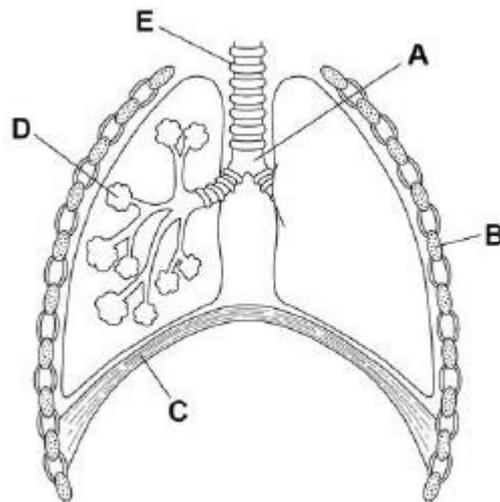
Figure 2

(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.

| 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?

_____

_____

(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 cm3	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.

| least	medium	most

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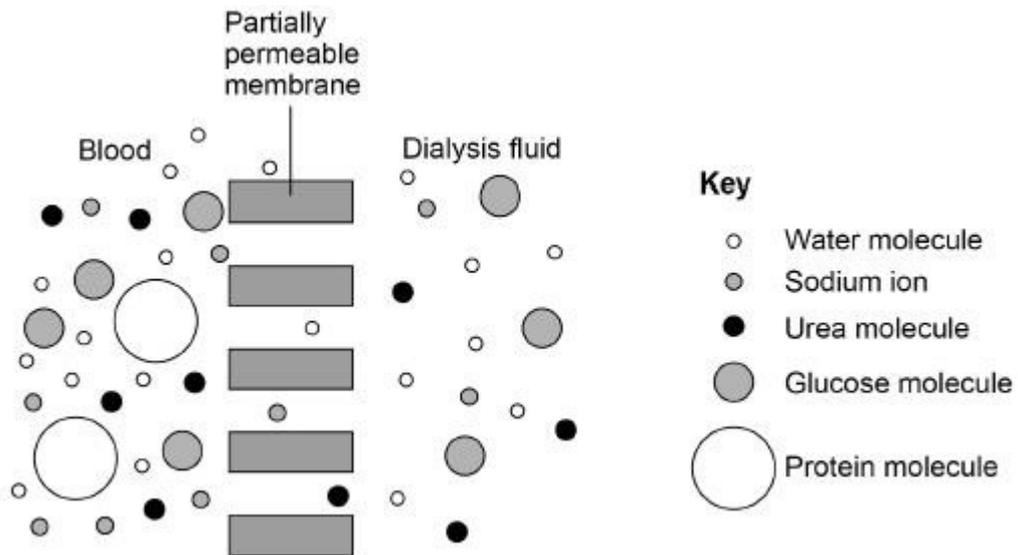
(e) How does urea move out of the blood during dialysis?

Tick (✓) one box.

Diffusion ☐

Digestion ☐

Osmosis ☐

Respiration ☐

(1)

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

Give the reason for your answer.

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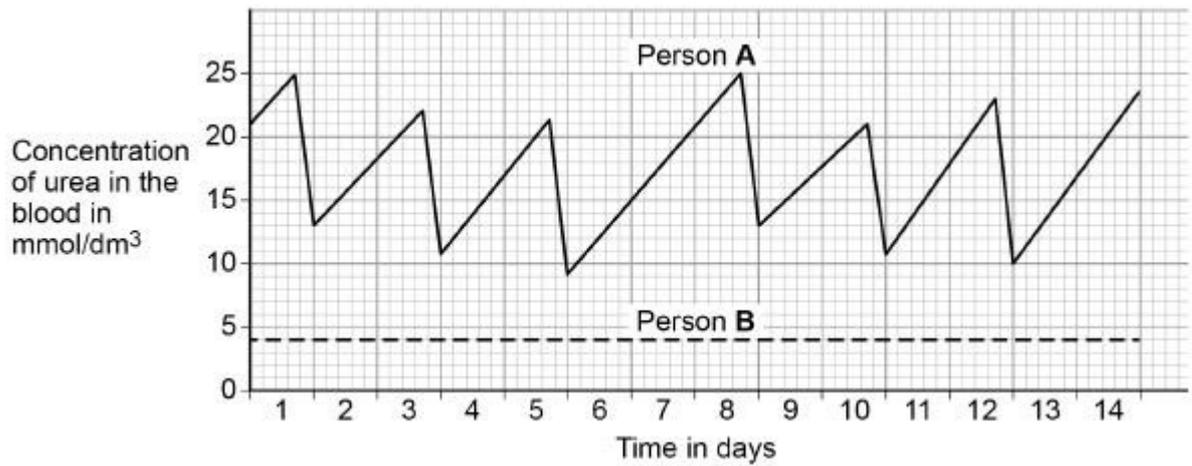
(g)   How many dialysis sessions did person A have   each week?

_____

(1)

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

_____

(1)

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

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.

1 cm

1 cm

1 cm

Cube 1

2 cm

2 cm

2 cm
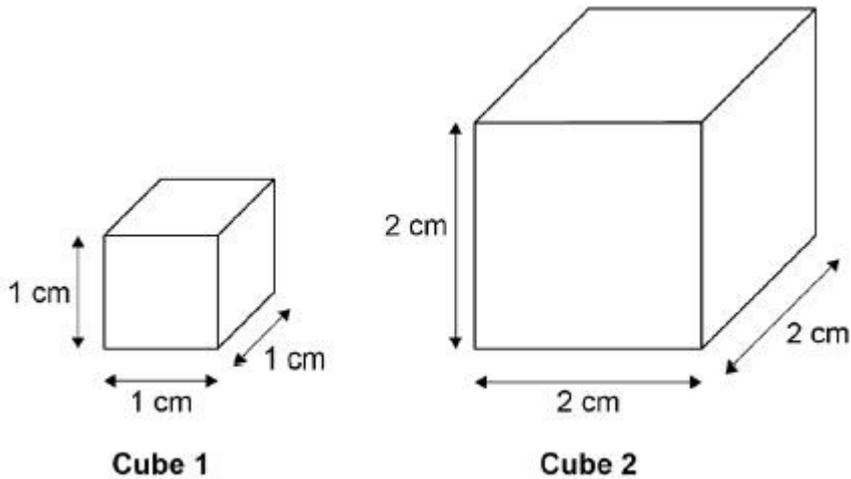
Cube 2

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 1cm × 1cm × 1cm	10.4	12.2	1.8
Sample B One cube, measuring 2cm × 2cm × 2cm	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

Air sac from person
without emphysema

Air sac from person
with emphysema
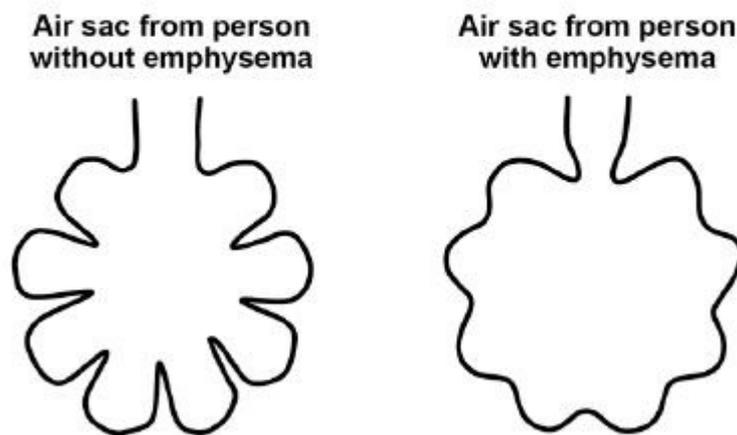
Emphysema causes the walls of the air sacs in the lungs to break down

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 B C	2678	Normal birth mass
	1345	
	991	

(2)

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

Figure 2
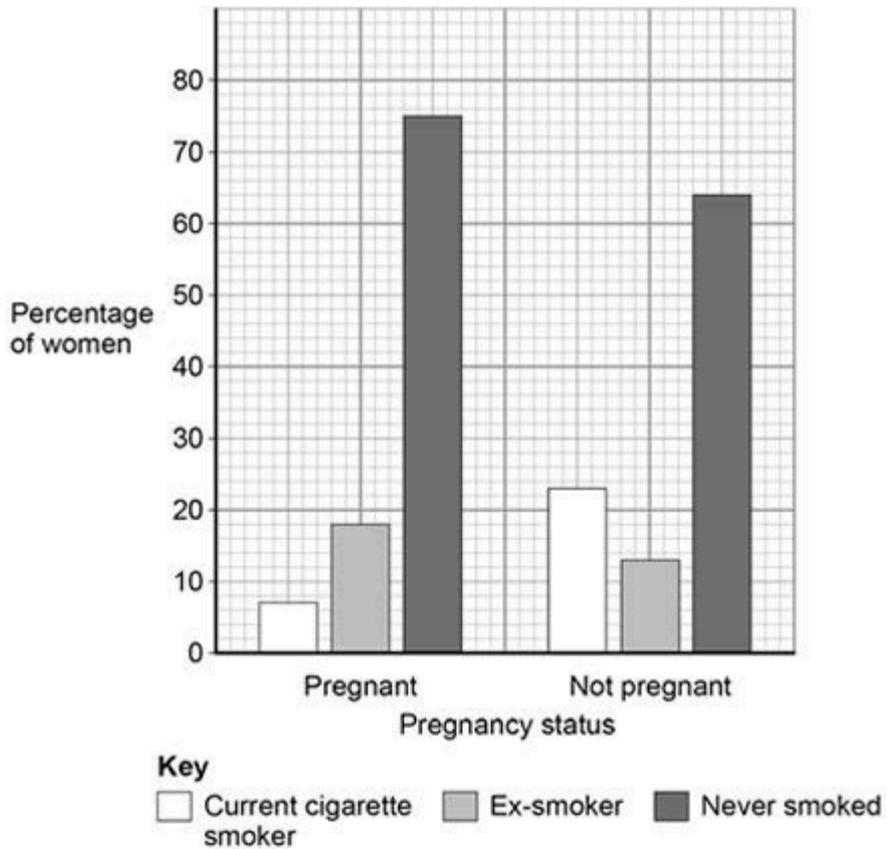
(e) Sampling from the whole UK population would not be appropriate for this study.
Give one reason why.

_____

_____

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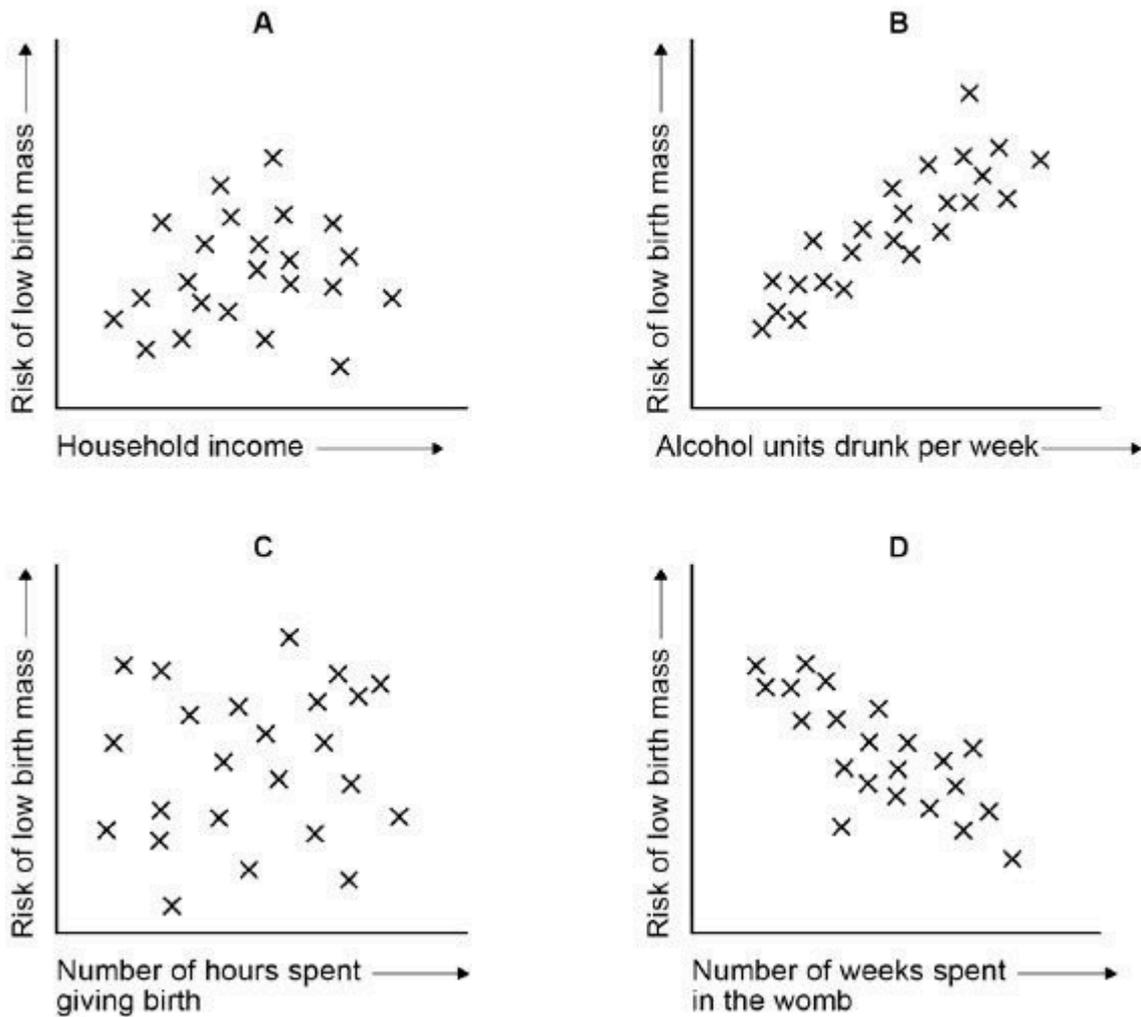
(g)   What type of graph is shown in Figure 3?

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.
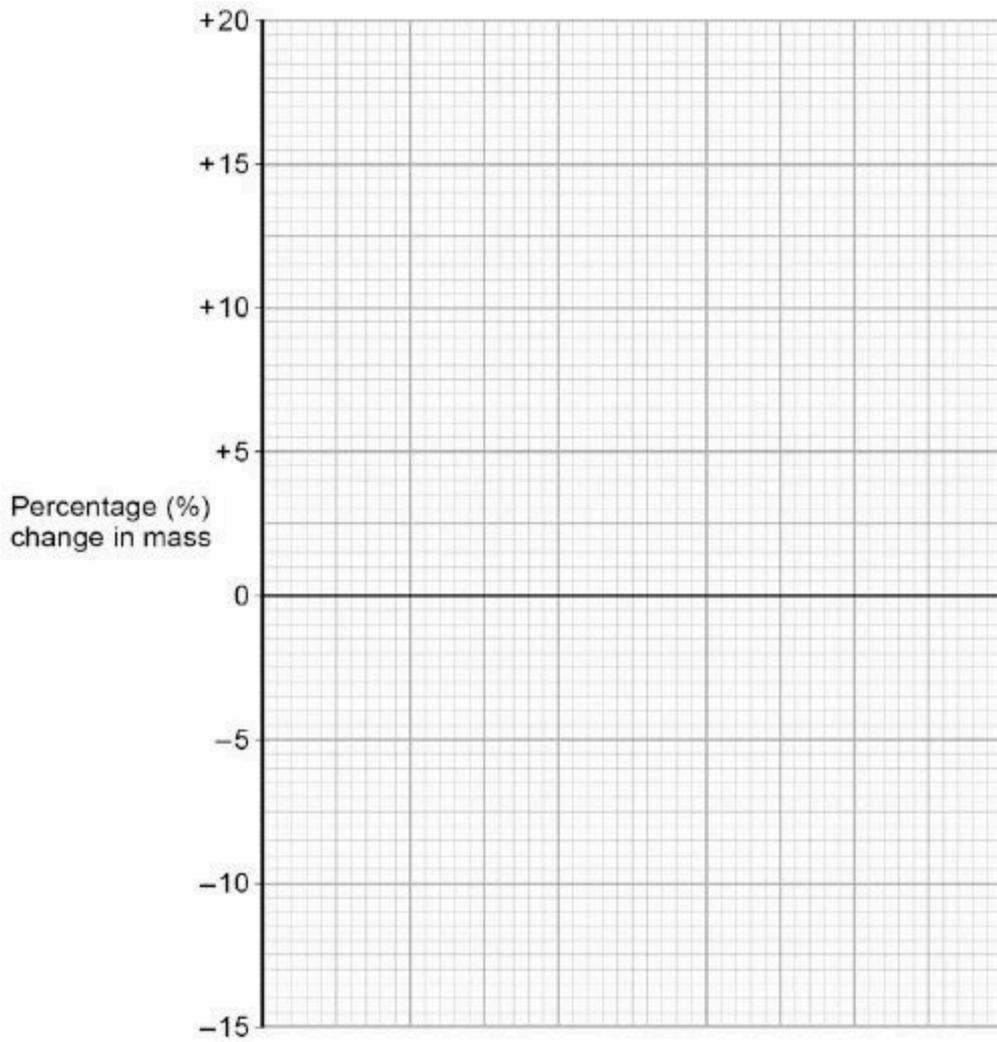
(4)

(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.

_____

_____

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(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 dm3	Concentration inside cells in mmol per dm3
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.

Boiling tube

Artificial partially permeable membrane bag, tied at both ends

5% sugar solution

A	B	C	D
0.1% sugar solution	4.2% sugar solution	6.9% sugar solution	10.6% sugar solution
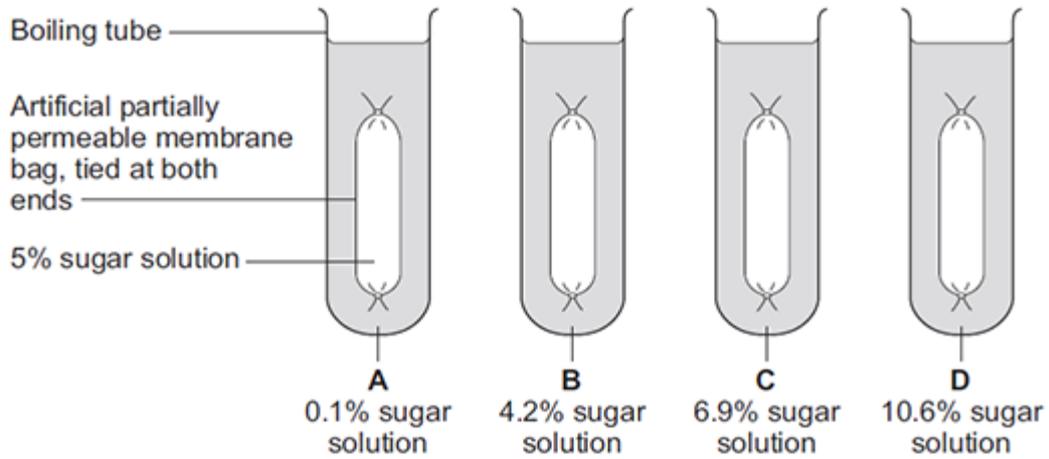
(i)   The bag in drink A got heavier after 20 minutes. Explain why.

    _____

    _____

    _____

    _____

(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.
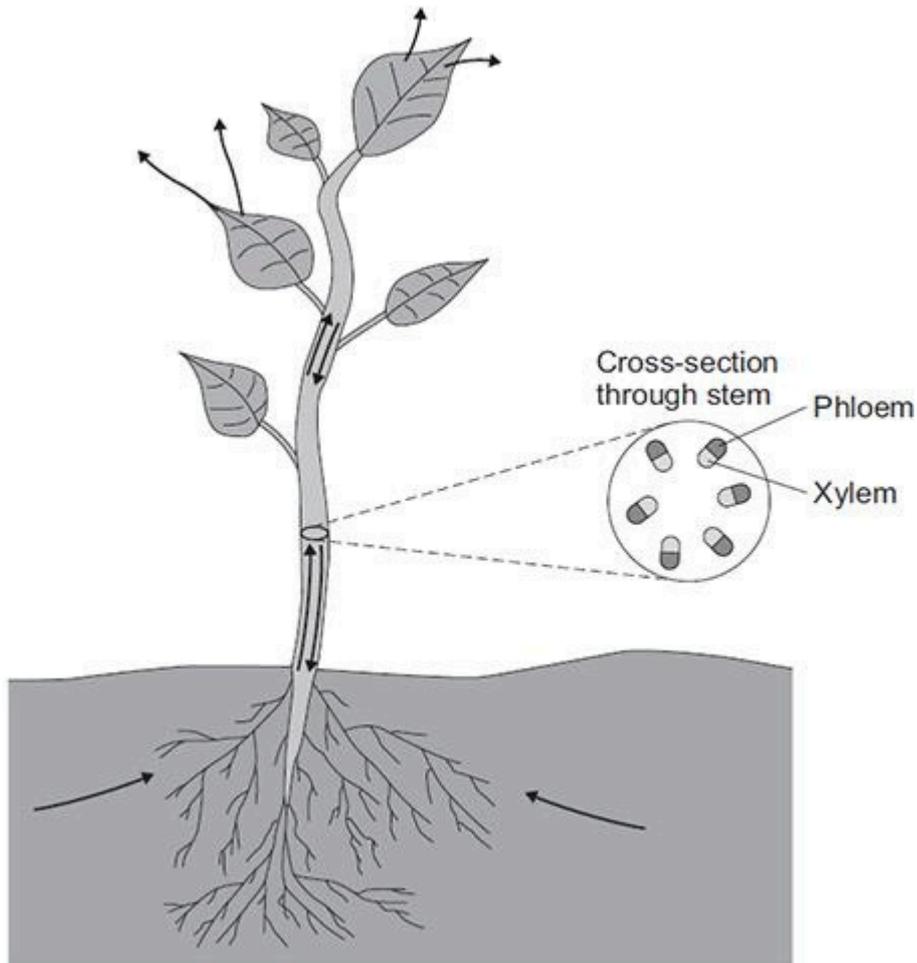
Describe how ions, water and sugar are obtained and transported through plants.
In your answer you should refer to materials moving upwards in a plant and to materials moving downwards in a plant.

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(Total 6 marks)