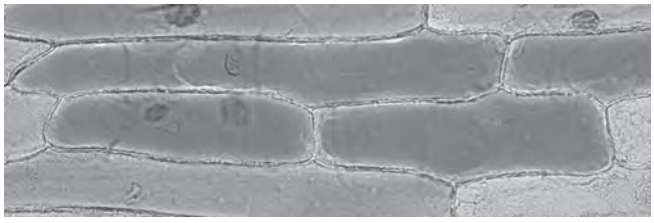
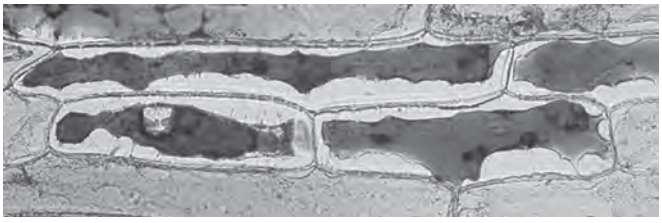
Questions are for both separate science and combined science students unless indicated in the question

1 A student takes two strips from the epidermis of an onion and places one in distilled water and the other in concentrated salt solution.

She then uses a camera to photograph a sample of these cells under a microscope.



cells in distilled water



cells in salt solution

(a) Suggest why a red onion is often used when carrying out this investigation.

(1)

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(b) (i) The differences in the appearance of the plant cells are due to osmosis.

Explain what is meant by the term **osmosis**.

(2)

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(ii) Explain why the cells in distilled water look different when compared to the cells in salt solution.

(4)

(c) If red blood cells are placed in distilled water and examined under a microscope no cells are seen.

Explain why no red blood cells would be seen.

(2)

(Total for Question = 9 marks)

2 Explain how the rate of transpiration is affected by changes in the environment. **(separate only)**

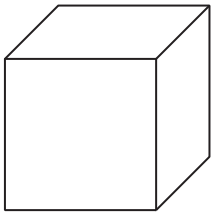
(5)

(Total for Question = 5 marks)

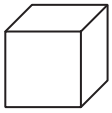
3 A student investigated the effect of size on the movement of molecules.

He cut three different sized cubes from a block of clear agar jelly.

Cube A was 2 × 2 × 2 cm. Cube B was 1 × 1 × 1 cm and cube C was 0.5 × 0.5 × 0.5 cm.



cube A



cube B

cube C

The student wore safety glasses and placed the cubes in a beaker of red dye solution for five minutes.

He then poured the solution into another beaker, washed the surface of the cubes and dried them with blotting paper.

He then cut each cube in half and examined the newly cut surfaces.

Diagram 1 shows what the cubes looked like.

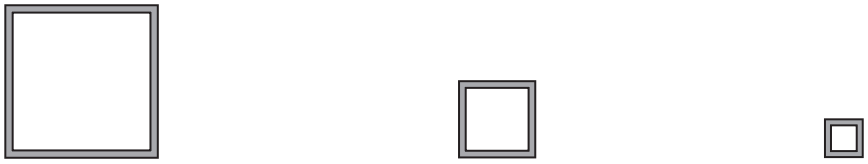


Diagram 1

(a) Why did he wear safety glasses?

(1)

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(b) Explain how the red dye molecules entered the jelly.

(2)

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(c) Use a ruler to measure the distance the red dye has entered each cube in diagram 1.

(1)

..... mm

(d) (i) Calculate the surface area of cube A.

(2)

surface area = ... unit .....

(ii) Calculate the volume of cube A.

(2)

volume = ... unit .....

(e) The student was told by his teacher that the cubes have different surface area to volume ratios.

Complete the table by putting one tick (✓) in each row to show whether the statement applies to cube A, B or C.

(3)

	Cube A	**Cube B**	**Cube C**
largest surface area			
largest surface area to volume ratio			
greatest proportion of cube coloured red			

(f) Explain how this experiment can be used to understand the need for transport systems in larger organisms such as humans.

(3)

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(Total for Question = 14 marks)

4 John wanted to investigate the effect of the size of potato tissue on the rate of osmosis.

He cut three different sized cubes of potato, one 0.5 × 0.5 x 0.5 cm, one 1 × 1 × 1 cm and one 2 × 2 × 2 cm.

He weighed the potato cubes and recorded their masses.

He then placed each cube into a beaker of distilled water and left them for 1 hour.

He weighed them again and recorded their new masses.

In each case the mass of the potato cubes increased.

The table shows his results.

Potato cube size in cm	Original mass in g	Final mass in g	Percentage change in mass (%)
0.5 × 0.5 x 0.5	0.06	0.07	16.67
1 × 1 × 1	0.51	0.56	
2 × 2 × 2	4.04	4.10	1.49

His teacher told him to calculate the percentage change in mass of each cube.

(a) (i) Calculate the percentage change in mass for the 1 × 1 × 1 cm cube.
Show your working.

(2)

Answer .....

(ii) Explain why John converted change in mass to percentage change in mass.

(1)

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(b) Use your knowledge of osmosis to explain why the mass of each cube increased.

(3)

(c) John's teacher suggested that the different sized cubes have a different surface area and volume.

Use the formulae below to calculate the surface area (SA) of each cube, the volume (Vol) of each cube and their SA:Vol ratios.

$SA = 6 \times (\text{cube side in cm})^2$

$Vol = (\text{cube side in cm})^3$

Write your answers in the table below. One cube has been done for you.

(3)

Cube side in cm	Surface area in cm^2	Volume in cm^3	SA:Vol ratio
0.5	1.5	0.125	12
1.0			
2.0			

(d) Explain the effect of the different SA:Vol ratios on the rate of osmosis into the potato.

(2)

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(e) Potato tissue is made from plant cells.

Draw and label a plant cell in the space below.

(3)

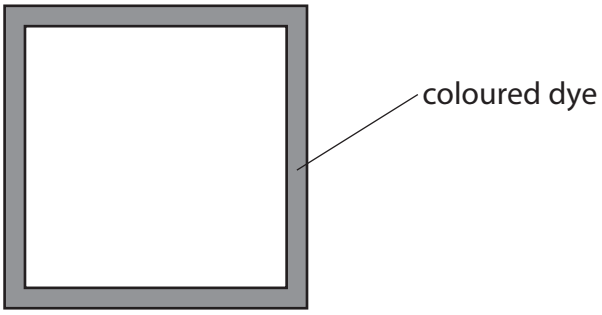
(Total for Question = 14 marks)

5 A student carries out an experiment to investigate the factors affecting the rate of diffusion.

(a) In her first experiment

- she makes three agar jelly cubes, one with sides of 4.0 cm, one with sides of 2.0 cm and one with sides of 1.0 cm
- she covers each cube in a solution of a coloured dye for three minutes
- she then cuts the cubes to see how far the dye has diffused

The diagram shows a cross-section through the largest cube after three minutes.



(i) Describe what is meant by the term **diffusion**.

(1)

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(ii) Measure the distance that the dye has diffused into the large cube.

(1)

distance = ... mm

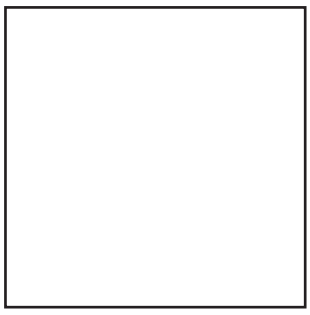
(iii) Complete the diagram below to show how far the dye will have diffused in the smallest cube after three minutes.

(1)

(b) The student then carries out a second experiment but this time she leaves the cubes in the dye for six minutes.

Draw the results you would expect to see when the largest cube is cut open after six minutes.

(1)



(c) Other factors may affect the rate of diffusion of the dye.

Explain two factors that the student should keep constant in her investigation.

(4)

1 .....

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2 .....

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(d) Explain how the results of the student's investigation support the idea that large organisms need a circulation system.

(3)

(Total for Question = 11 marks)