Section A

Answer **all** questions.

1 Figure 1 shows two types of tissues that are adapted for their function, one from an animal and the other from a plant.

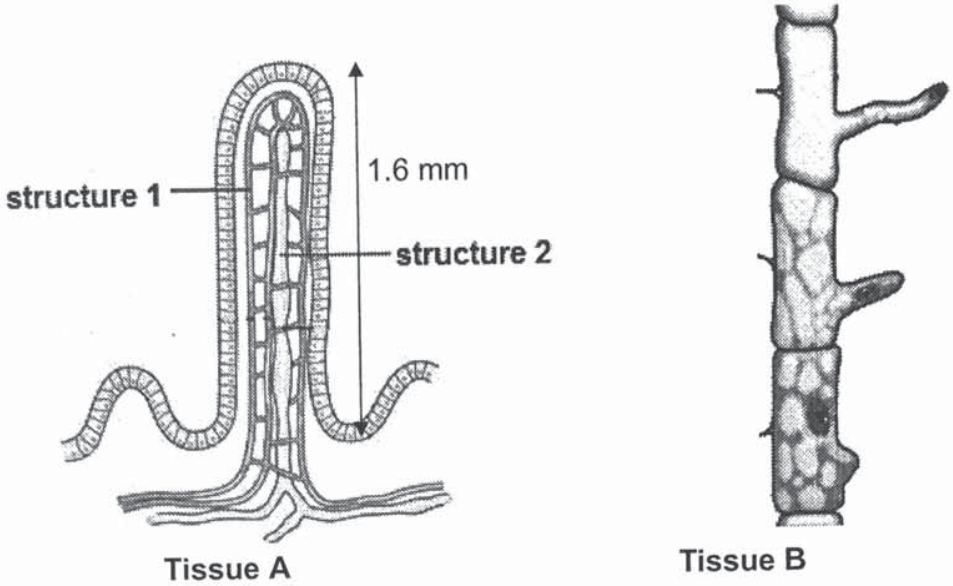

Figure 1

a) State one feature that these two tissues have in common and explain how it helps them to carry out their function. [1]

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b) Calculate the magnification of tissue A. Show your working. [1]

X .....

c) A student just consumed a serving of fried chicken burger. State the process(es) by which the following substances are transported in structures 1 and 2 in the table below. (Put N.A. if the structure does not transport the substance.) [2]

	structure 1	structure 2
glucose		
amino acids		
fatty acids		

[Total: 4 marks]

2

2 In an experiment to measure the rate of diffusion, a student placed cubes of agar jelly containing an indicator into dilute hydrochloric acid. The indicator changes from pink to colourless in acidic conditions.

The student used cubes of different sizes and recorded the time taken for the pink colour of each cube to disappear completely. The student's results are recorded in Table 2.1.

Table 2.1

length of side of cube (mm)	surface area of cube (mm^2)	volume of cube (mm^3)	surface area to volume ratio	time taken for pink colour to disappear (s)	rate of diffusion (mm/s)
2	24	8	3.0:1	50	0.020
5	150	125	1.2:1	120	0.021
10	600	1 000		300	0.017
20	2 400	8 000	0.3:1	700	0.014
30	5 400	27 000	0.2:1	1 200	0.013

a) **(i)** Complete Table 2.1 to show the surface area to volume ratio of the cube with 10 mm sides. [1]

(ii) With reference to Table 2.1, explain the significance of the relationship between the rate of diffusion and the surface area to volume ratio for large plants. [2]

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b) Another student used the same raw data obtained in the experiment but calculated a different rate of diffusion for each cube. This student's results are shown in Table 2.2.

length of side of cube (mm)	time taken for pink colour to disappear (s)	rate of diffusion (mm/s)
2	50	0.040
5	120	0.042
10	300	0.033
20	700	0.029
30	1 200	0.025

Table 2.2

Which method is more accurate? Explain why. [2]

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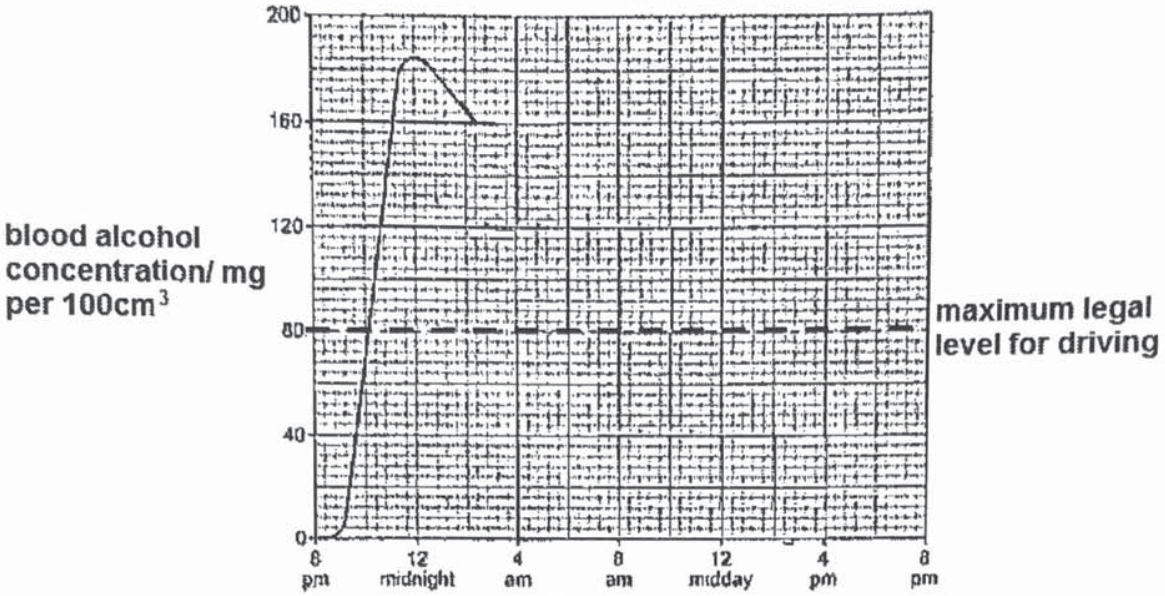
[Total: 5 marks]

3 It is illegal for a person to drive a vehicle with more than 80 mg of alcohol per 100 cm^3 of blood.

Graph 3 shows the concentration of alcohol in the blood of a person over a number of hours. During this time, the person had several alcoholic drinks while eating a meal.



Graph 3

a) Suggest why it is illegal for the person to drive when the person's blood alcohol concentration is above the advisory limit. [1]

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b) Use the graph to determine the highest concentration of alcohol in the person's blood. [1]

..... mg per 100 cm^3

c) Describe the role of liver in the breaking down of alcohol. [2]

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d) Complete Graph 3 by extending the line to predict when the person would be able to legally drive a vehicle again. [1]

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[Total: 5 marks]

4 Figure 4.1 is a simplified plan of the mammalian circulatory system.

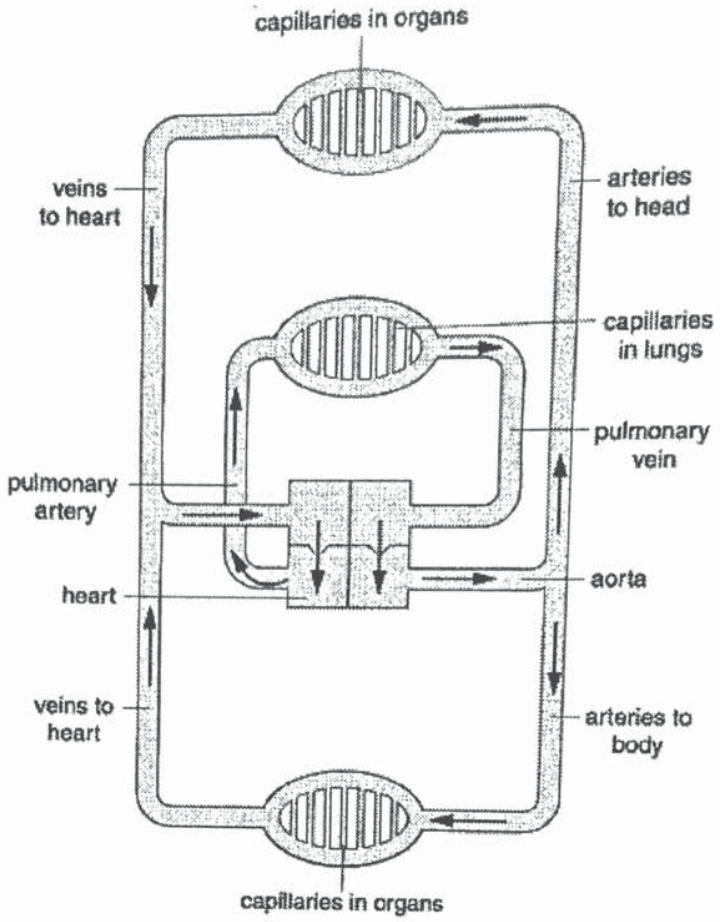

Figure 4.1

a) With reference to Figure 4.1, describe what is meant by the term *double circulation*. [2]

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b) Describe **and** explain how a molecule of oxygen is forced out of the heart and eventually reaches the liver cells. [4]

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c) Figure 4.2 shows the formation of tissue fluid in a mammal.

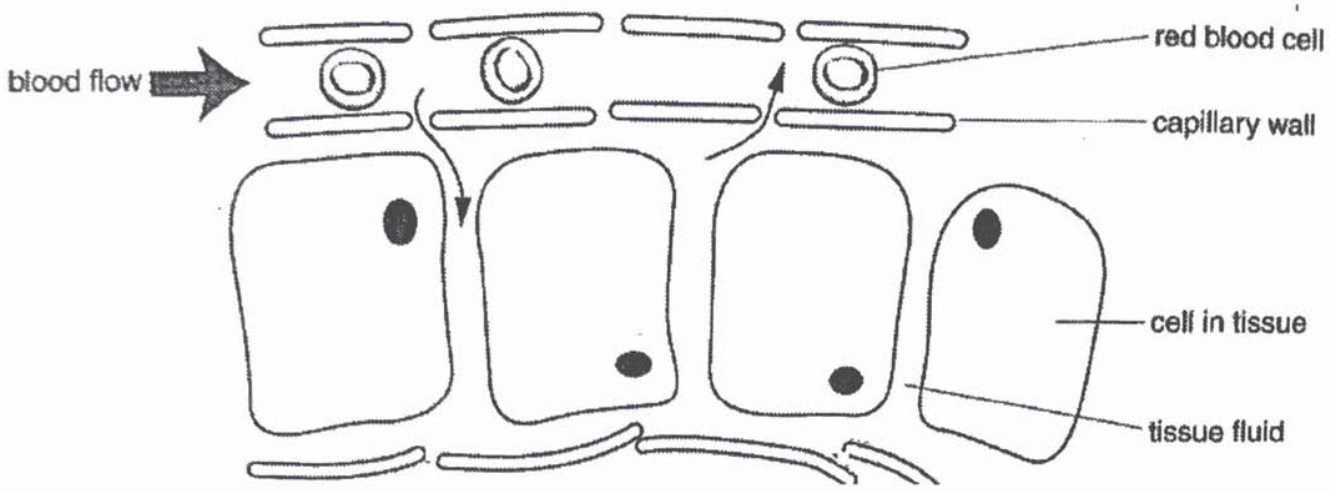

Figure 4.2

(i) State two differences between the composition of tissue fluid and blood. [2]

1. .....

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2. .....

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(ii) Describe the formation of tissue fluid. [1]

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[Total: 9 marks]

5 Figure 5.1 shows the mammalian respiratory system and Figure 5.2 shows the cross-section taken through line XY.

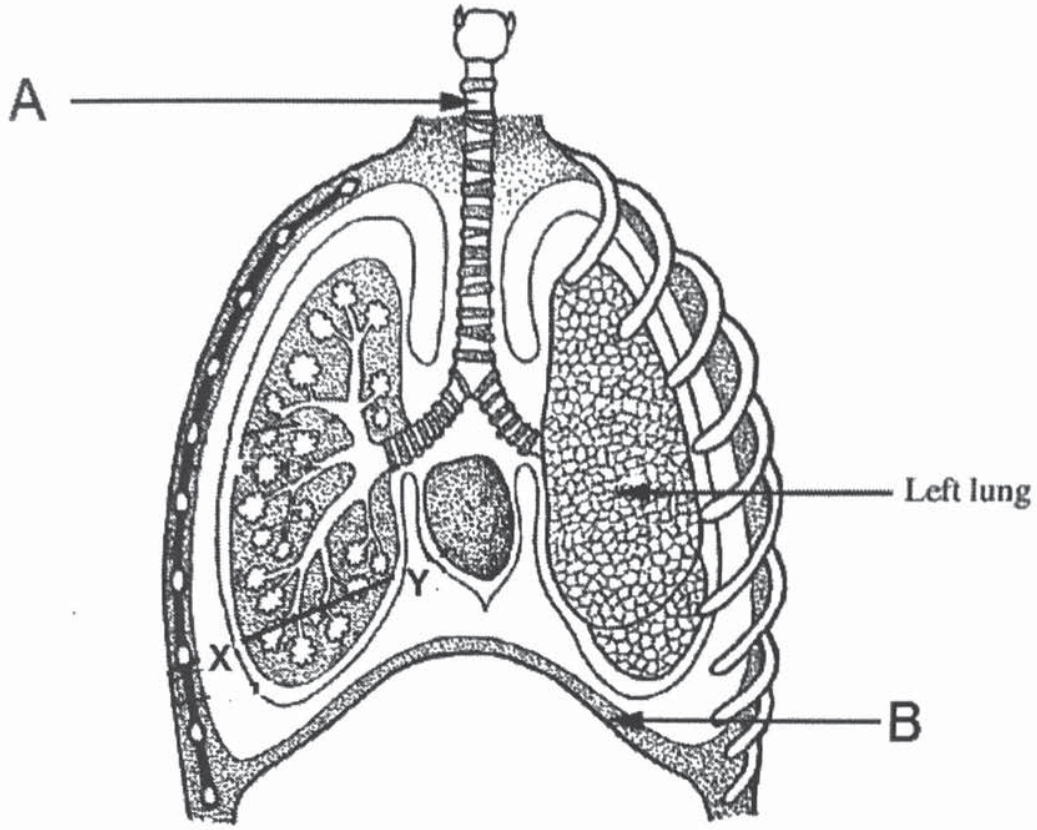

Figure 5.1

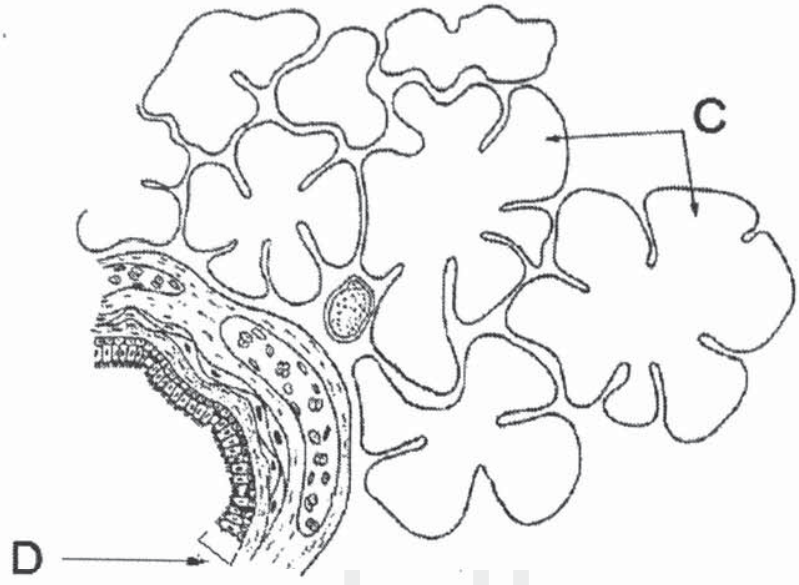

Figure 5.2

a) Name structures **A** and **B**. [1]

A: .....

B: .....

b) **(i)** Describe how structure **C** will appear in a person suffering from emphysema and explain how this will affect the breathing of the person. [2]

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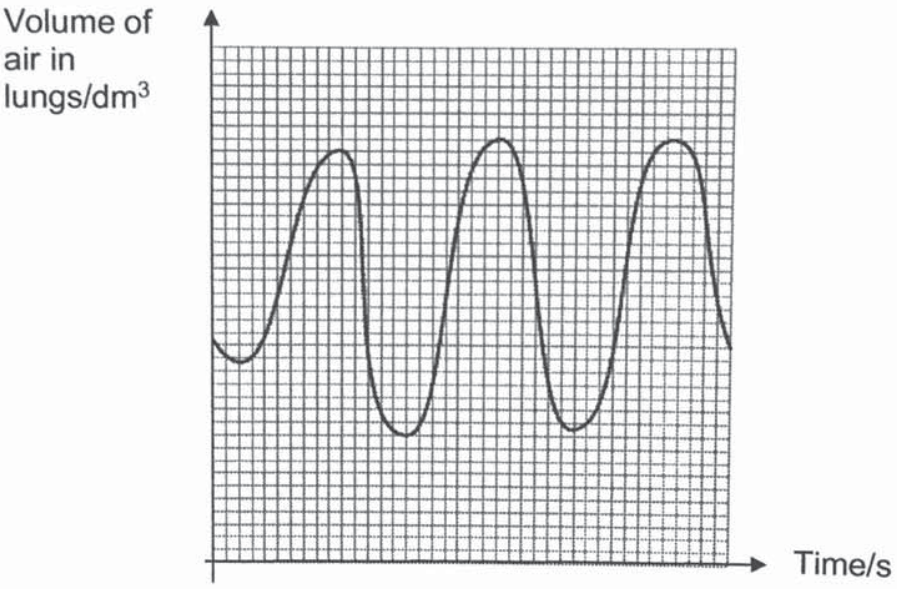
(ii) A spirometer can be used to trace the movements of air during breathing. The graph below shows the spirometer trace of a normal person at rest. [1]

Draw the spirometer trace obtained from a person with emphysema in the grid below.



c) Structure **D** is affected by a major component of tobacco smoke. Identify the component and explain how it affects the normal functioning of **D**. [2]

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[Total: 6 marks]

6 Figure 6.1 shows the percentage composition of solutes in fluid samples P and Q taken from two sites of the human nephron.

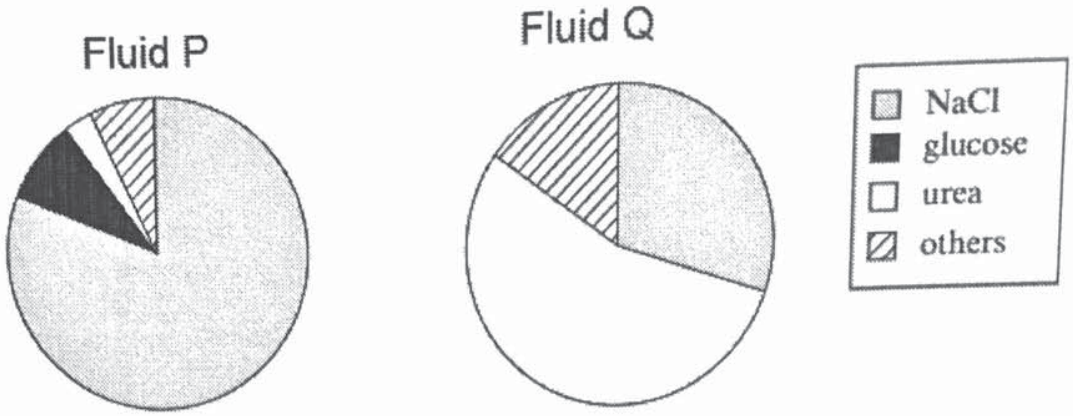

Figure 6.1

a) **(i)** Name fluids **P** and **Q**. [1]

Fluid **P**: .....

Fluid **Q**: .....

(ii) Explain the difference in percentage of glucose in fluids **P** and **Q** as shown in Figure 6.1. [2]

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b) Patients with kidney failure have to go for weekly dialysis treatment.

Figure 6.2 outlines the procedure of dialysis.

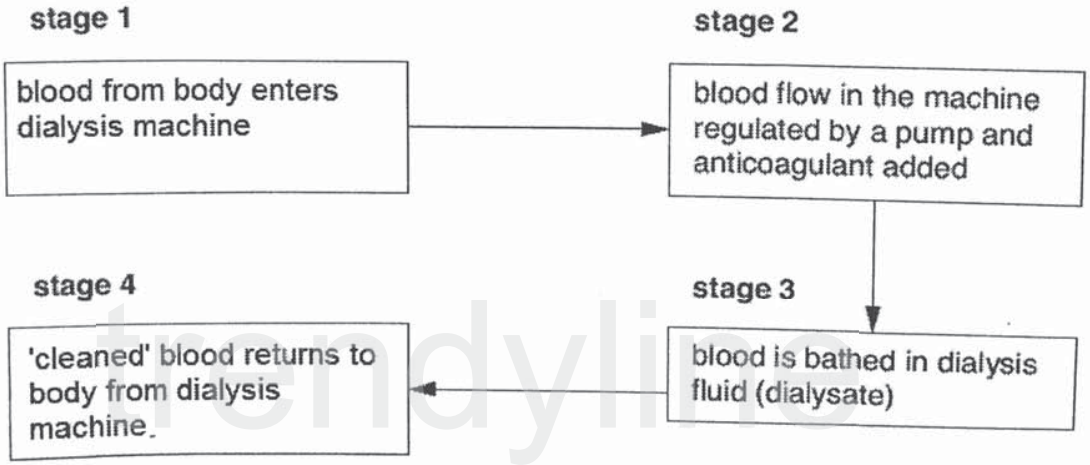

Figure 6.2

Figure 6.3 shows further details of how stage **3** is achieved.

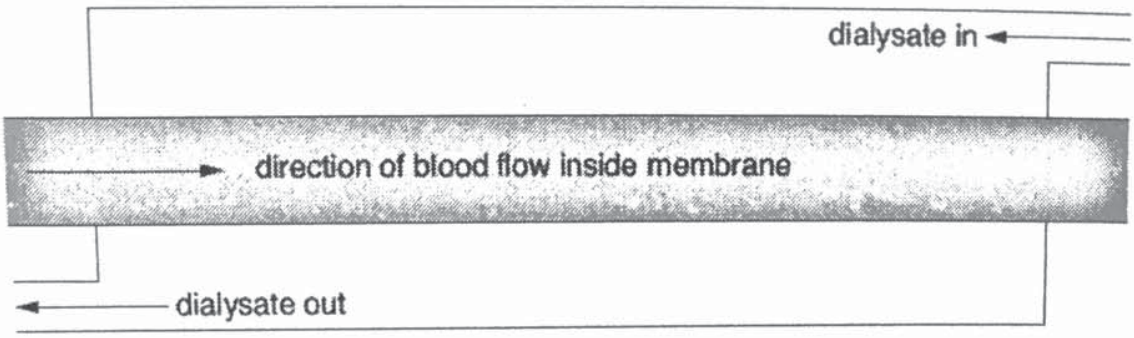

Figure 6.3

(i) Suggest why it is necessary to add an anticoagulant to the blood in stage **2**. [1]

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(ii) Explain how the dialysis machine ensures that 'cleaned' blood returns to the body. [2]

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[Total: 6 marks]

7 In maize, wind pollination occurs. An investigation was carried out to find out how the length of time that maize pollen is in the air affects its ability to bring about fertilisation in a female flower.

1. Pollen grains were removed from maize flowers and left exposed to the air for varying amounts of times.
2. The pollen grains were then placed onto groups of female flowers in another plot of land in the farm.
3. The groups of fertilised flowers developed into 'ears', each containing many seeds. The number of seeds per ear was counted.

a) **(i)** Identify the type of pollination described. Explain your answer. [1]

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(ii) Explain why the type of pollination stated in (i) is more beneficial to maize. [2]

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b) Cultivated maize is related to a wild Mexican grass, teosinte. Teosinte looks very different from maize as shown in Figure 7. In particular, teosinte has a very hard layer surrounding the fruit, making it impossible to use as an edible grain.

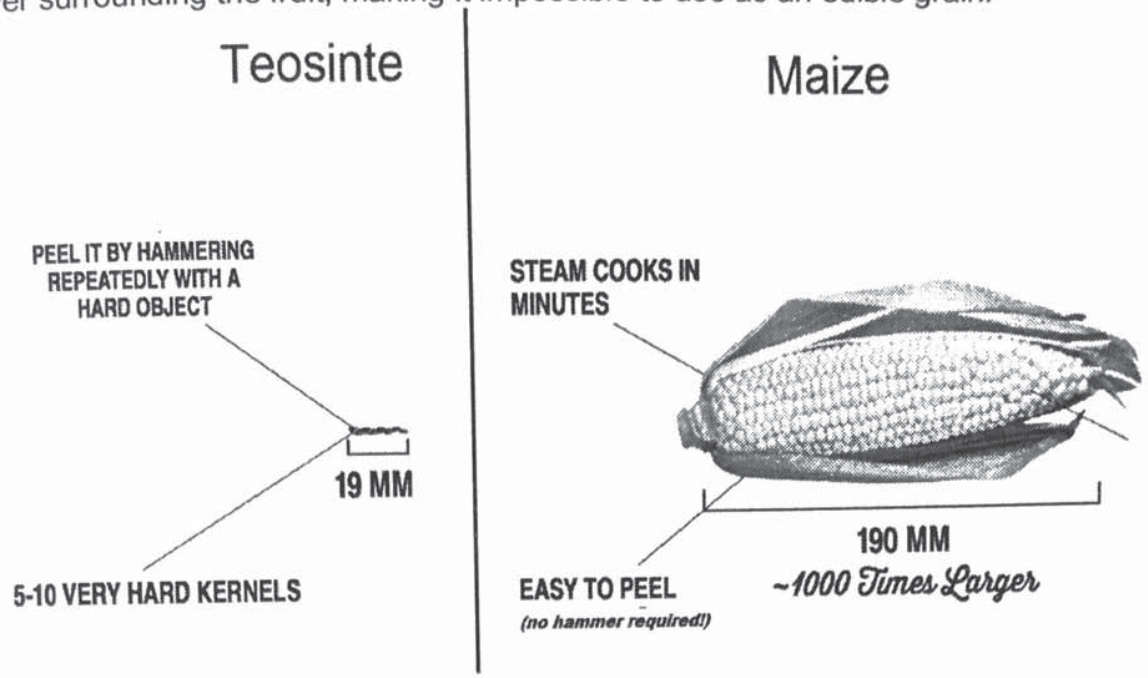

Figure 7

(i) Describe how farmers can use artificial selection to produce maize from teosinte. [2]

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(ii) A gene on chromosome 4, *tga 1*, was found to be responsible for all the structural differences between teosinte and maize. The DNA sequence is shown below:

teosinte	GAT TGG GAT CTC AAG GCG GCG GGC GCG TGG
maize	GAT TGG GAT CTC AAC GCG GCG GGC GCG TGG

Suggest how the difference in the *tga 1* gene could cause large differences in phenotype between teosinte and maize. [2]

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[Total: 7 marks]

11

8 Male and female ants of a species of Australian ant, *Myrmecia pilosula*, have different number of chromosomes in each of their cells. Female ants are diploid, while males are haploid.

a) Define the term *diploid*. [1]

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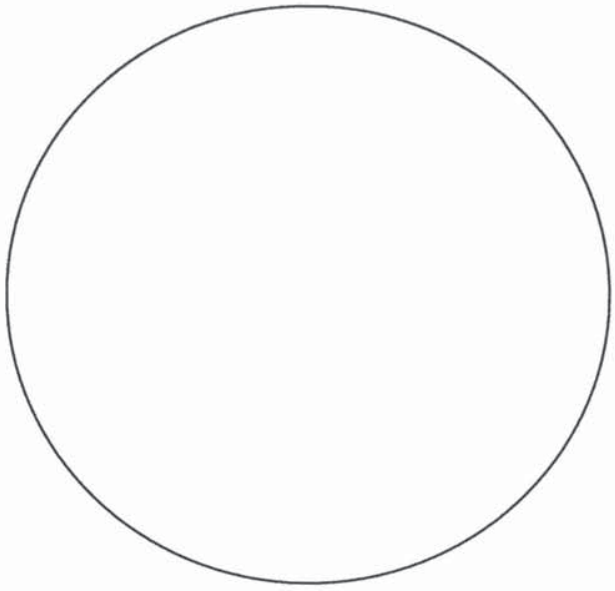
b) In the cell outline provided below, make a labelled drawing to show the appearance of a female ant cell at anaphase I of meiosis (Assume there are two chromosomes in the sperm cell of the male ant). [2]



c) Figure 8.1 shows the events that take place in a body cell of a female ant.

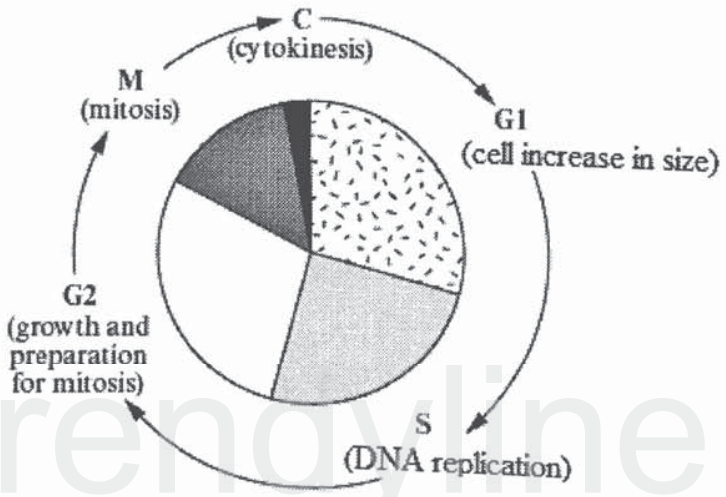


Figure 8.1

Table 8.2 shows the DNA content of a cell measured during one cell cycle.

Table 8.2

stage	DNA content of cell/arbitrary units
G1	2x
S	
G2	
M	
C	

Complete Table 8.2 to determine the DNA content at different stages of the cell cycle. [2]

d) During mating, the queen ant collects sperm cells from male ants, which she stores in an organ. The haploid egg cells from the queen's ovaries pass by the organ as they are laid. Some eggs are fertilised as they pass out, while others pass out unfertilised.

(i) Suggest how ants that develop from fertilised egg cells differ from the ants that develop from unfertilised egg cells. [1]

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(ii) Explain the significance of the queen ant producing haploid egg cells. [2]

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[Total: 8 marks]

Section B

Answer **three** questions. Question **11** is in the form of an **Either/Or** question. Only one part should be answered.

9 An investigation into feeding relationships in a forest community was carried out using radioactively labelled phosphorus (^{32}P). A solution containing ^{32}P phosphate ions was supplied to a plant using a stem well.

Figure 9.1 shows a vertical section through a stem well.

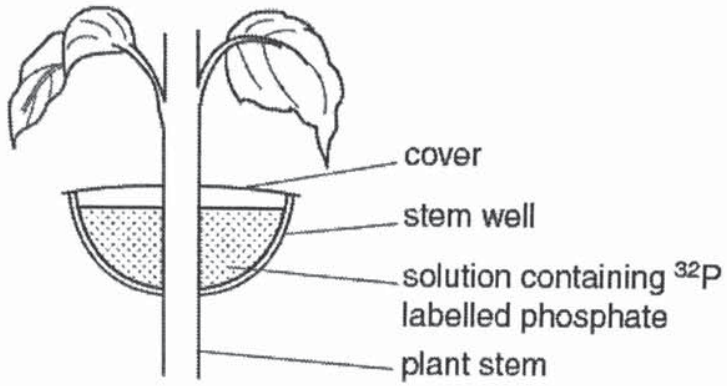
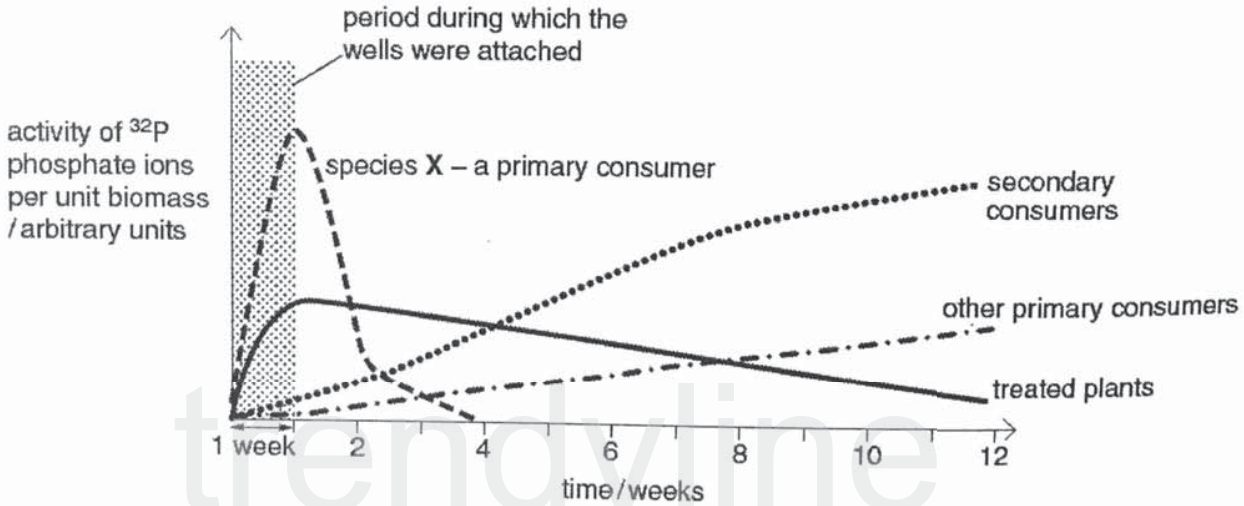


Figure 9.1

- Stem wells were used to supply 200 individual plants in the community with a solution containing ^{32}P phosphate ions.
- The stem wells were left at the same place for one week and then removed.
- At intervals during the first week and for a further 11 weeks after the wells were removed, tissue samples were taken from the plants and from other members of the community.
- The activity of ^{32}P phosphate ions per unit biomass was measured in each sample.

Graph 9.2 shows the results of this investigation.



Graph 9.2

a) Identify two variables that should be kept constant in this investigation. [1]

1. .....

2. .....

b) Define the term *consumer*. [1]

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c) With reference to Graph 9.2, describe **and** explain the level of activity of ^{32}P phosphate ions observed in the four populations of organisms. [6]

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d) Describe how processes that occur in a green leaf play a part in the carbon cycle. [3]

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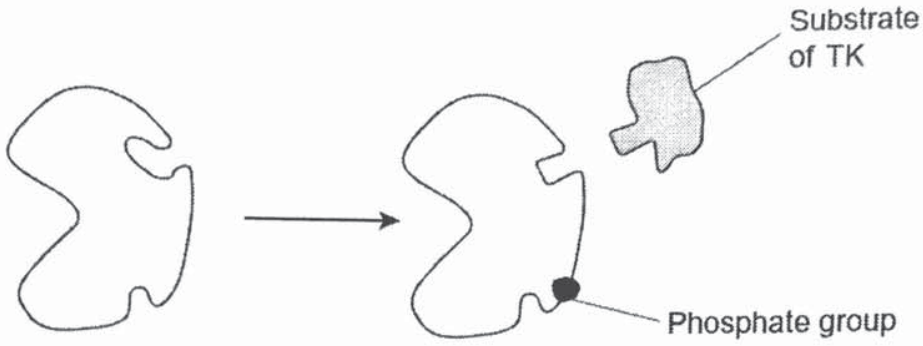
[Total:11 marks]

10 The enzyme tyrosine kinase (TK) is found in human cells. TK can exist in a non-functional and a functional form. The functional form of TK is only produced when a phosphate group is added to TK. This is shown in Figure 10.1.



Non-functional form of TK Functional form of TK

Figure 10.1

a) Based on Figure 10.1, explain how the activation of TK is regulated in human cells. [3]

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b) The binding of the functional form of TK to its substrate leads to cell division. In chronic myeloid leukaemia, a faulty form of TK is produced. Figure 10.2 shows the faulty form of TK.

Faulty form of TK

Figure 10.2

Suggest how faulty TK leads to chronic myeloid leukemia. [2]

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c) Imatinib is a drug used to treat chronic myeloid leukemia. Figure 10.3 shows how Imatinib inhibits faulty TK. [4]

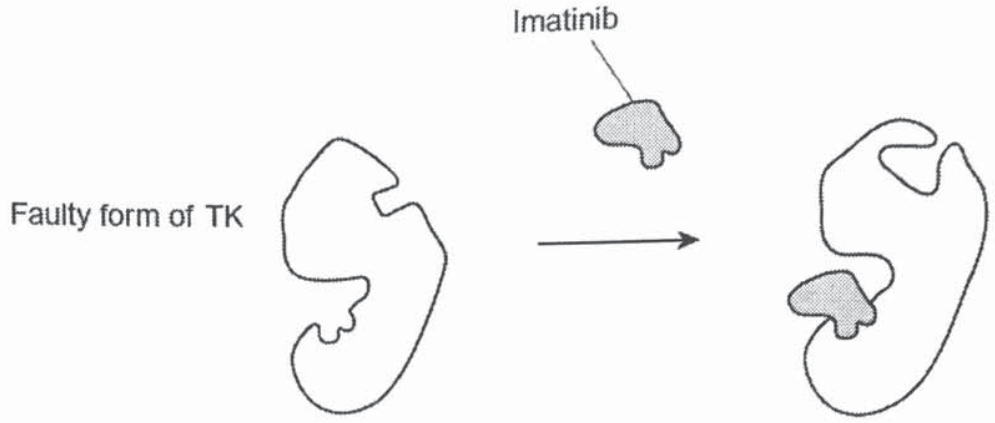
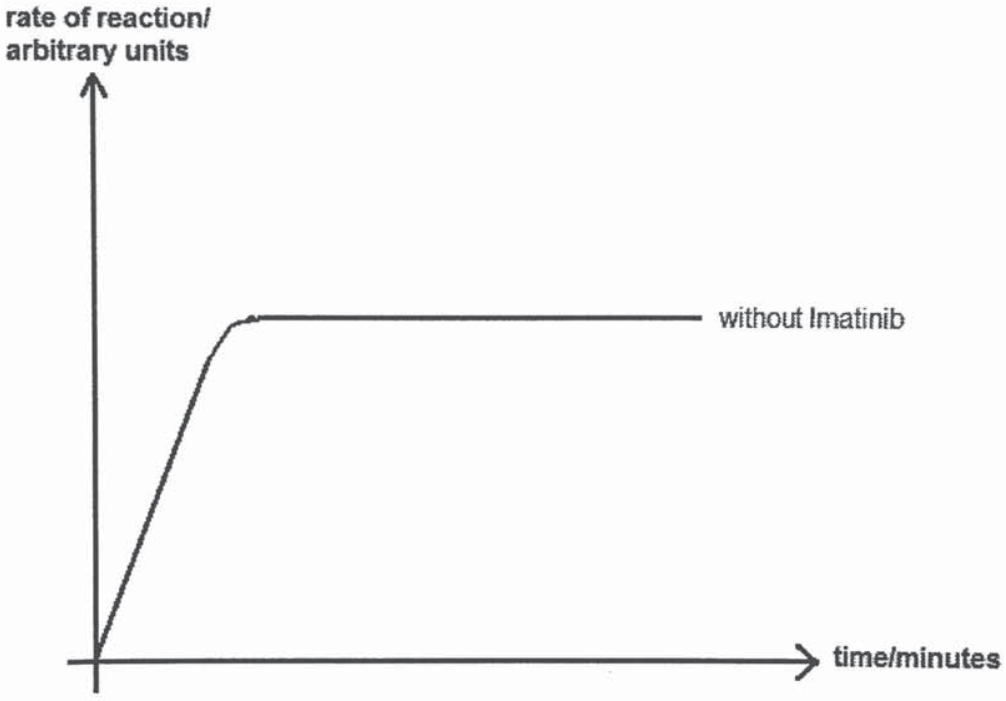


Figure 10.3

Sketch on the axes below a labelled graph how the rate of reaction will be with Imatinib added.



Explain how Imatinib can be used to treat chronic myeloid leukemia.

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[Total: 9 marks]

Either

11 a) A student used the set-up shown in Figure 11 to estimate the rate of transpiration in a leafy shoot.

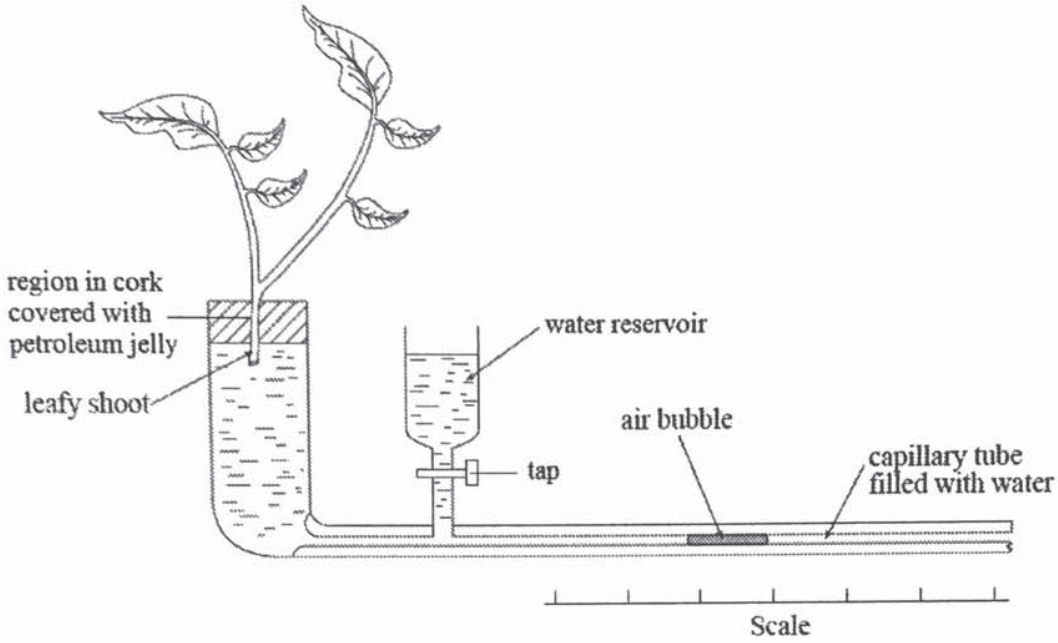

Figure 11

Describe **and** explain how you would use the experimental set-up to measure the effect of air movement on transpiration rate of the plant. [5]

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b) Describe how the structures within a leaf are adapted for photosynthesis. [5]

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[Total:10 marks]

Or

11 a) *David enters the forest wearing only shorts and a sleeveless shirt when the air temperature is below 10 °C.* [4]

Explain, with reference to the principles of homeostasis, how his body will respond.

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b) *David spots a hungry bear standing five meters in front of him and his heart beats faster.* [6]

Describe the nervous pathway that resulted in his response.

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[Total:10 marks]