

Candidate Name	Centre Number				Candidate Number			



GCSE BIOLOGY
COMPONENT 1
Concepts in Biology
HIGHER TIER
SAMPLE PAPER
(2 hours 15 minutes)



For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	8	
3.	14	
4.	4	
5.	9	
6.	11	
7.	9	
8.	6	
9.	11	
10.	5	
11.	6	
12.	6	
13.	17	
14.	6	
Total	120	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
 Write your name, centre number and candidate number in the spaces at the top of this page.
 Answer **all** questions.
 Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
 The assessment of the quality of extended response (QER) will take place in question **14**.

Answer **all** questions

1. (a) A breeder of prize-winning roses has two different rose bushes. One bush produces large red roses but has many thorns on its stems. The other bush produces small red roses and has stems with very few thorns. Explain how, by selective breeding, the rose breeder could produce a rose bush with large red flowers and very few thorns on its stems. [3]

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- (b) If the rose breeder was successful, he could produce many more rose bushes by taking cuttings from the new parent bush.

- (i) Why would the cuttings produce bushes identical to the parent bush? [1]

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- (ii) Suggest **two** reasons why it would be unwise to produce all rose bushes in the country only from cuttings. [2]

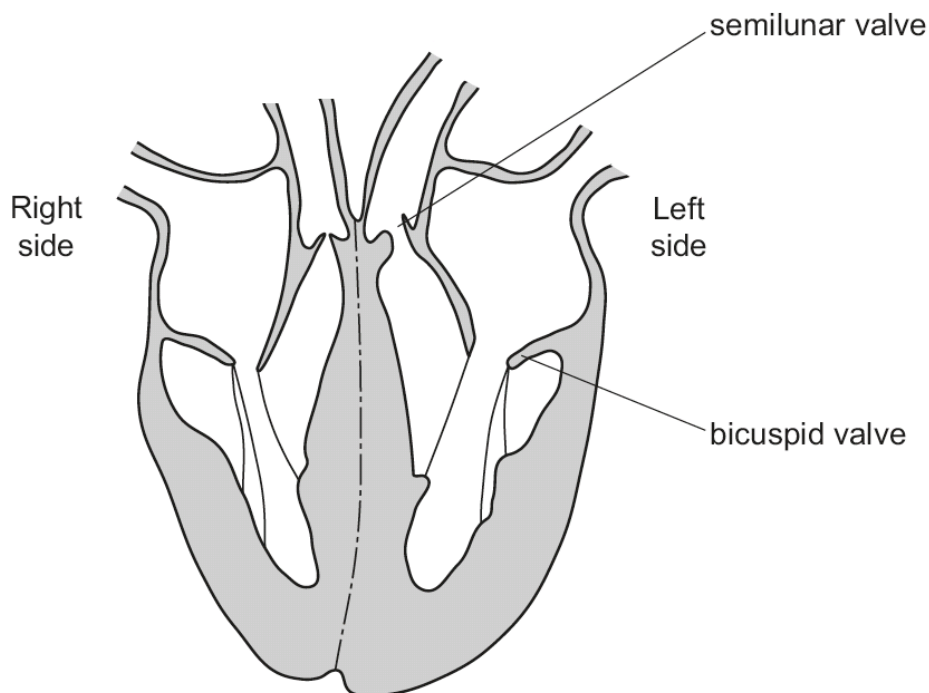
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- (c) In roses, the allele for white flowers (r) is recessive to the allele for red flowers (R).

A rose bush with red flowers was self-fertilised. The seeds were collected and grown. 25% of these rose bushes produced white flowers. Using the symbols for the alleles given above, explain these results using a Punnett square in the space below. Give a key to the symbols used. [2]

2. The diagram shows a section through a heart.



(a) Complete the table below to show what is happening to the following parts of the **left** side of the heart during the passage of blood through the heart. [6]

Left atrium	Left ventricle	Bicuspid valve	Semi-lunar valve
contracts to force blood into left ventricle			
relaxes and fills with blood			

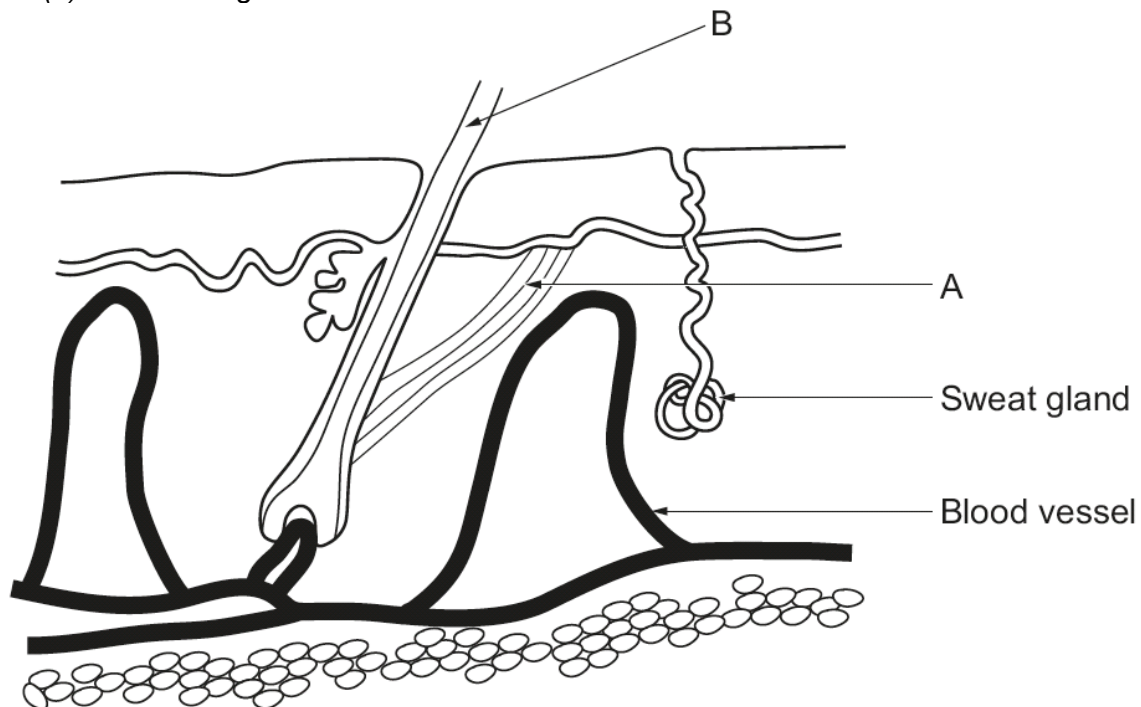
(b) Explain why the walls of the ventricles are thicker than those of the atria. [2]

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3. (a) The diagram shows the structure of human skin.



(i) Explain how the structures labelled **A** and **B** function to help reduce heat loss in cold conditions. [3]

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(ii) Blood vessels and sweat glands are important in lowering the body temperature if it becomes too high. If the body temperature reaches 40 °C “Heat Stroke” can occur, which can be fatal.

I State how the blood vessels help in cooling the body in hot conditions, such as on a sunny beach. [2]

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II In hot, humid conditions the air may contain a very high level of water vapour. Explain why it is possible for heat stroke to occur in these conditions, even if sweat glands are functioning normally. [2]

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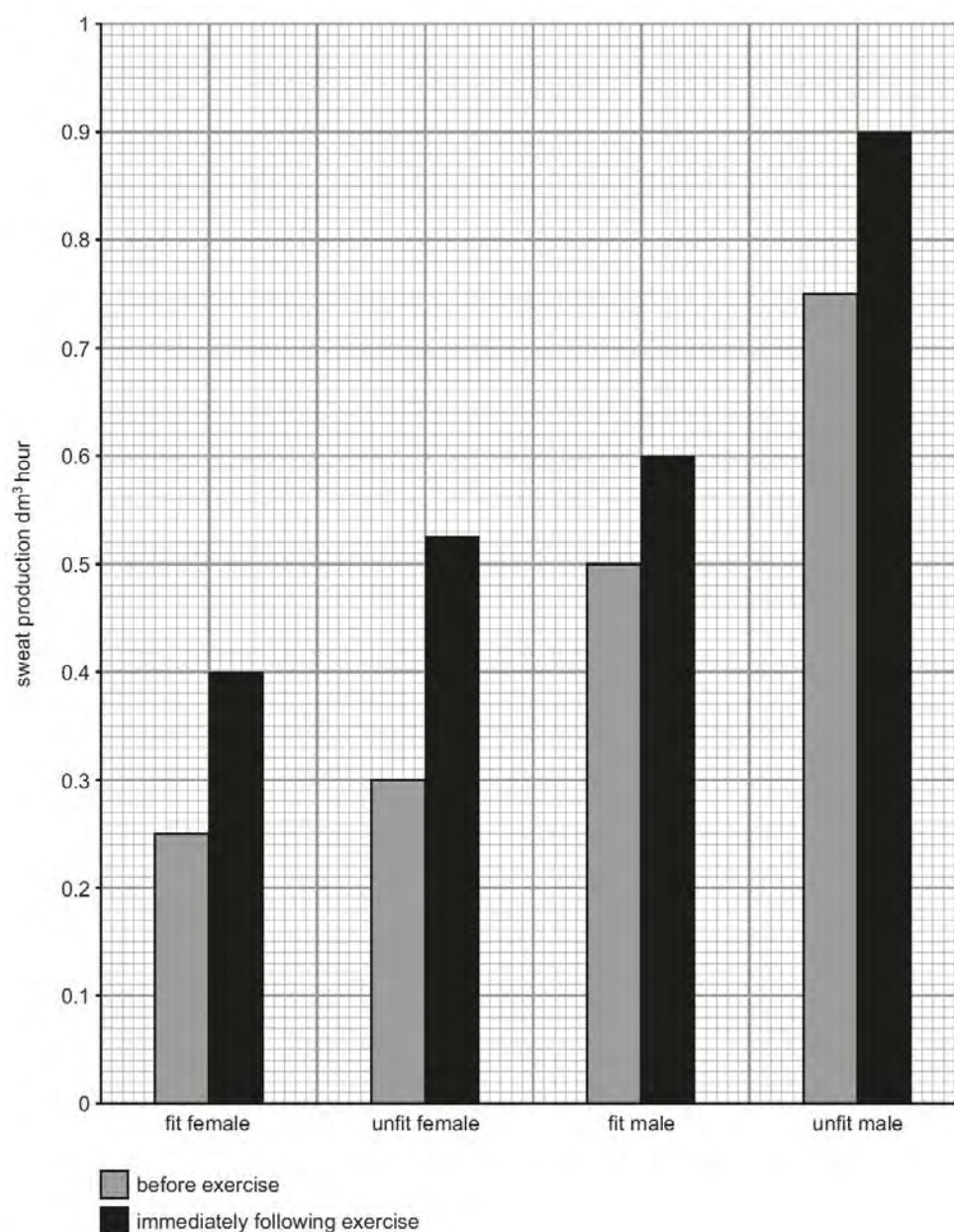
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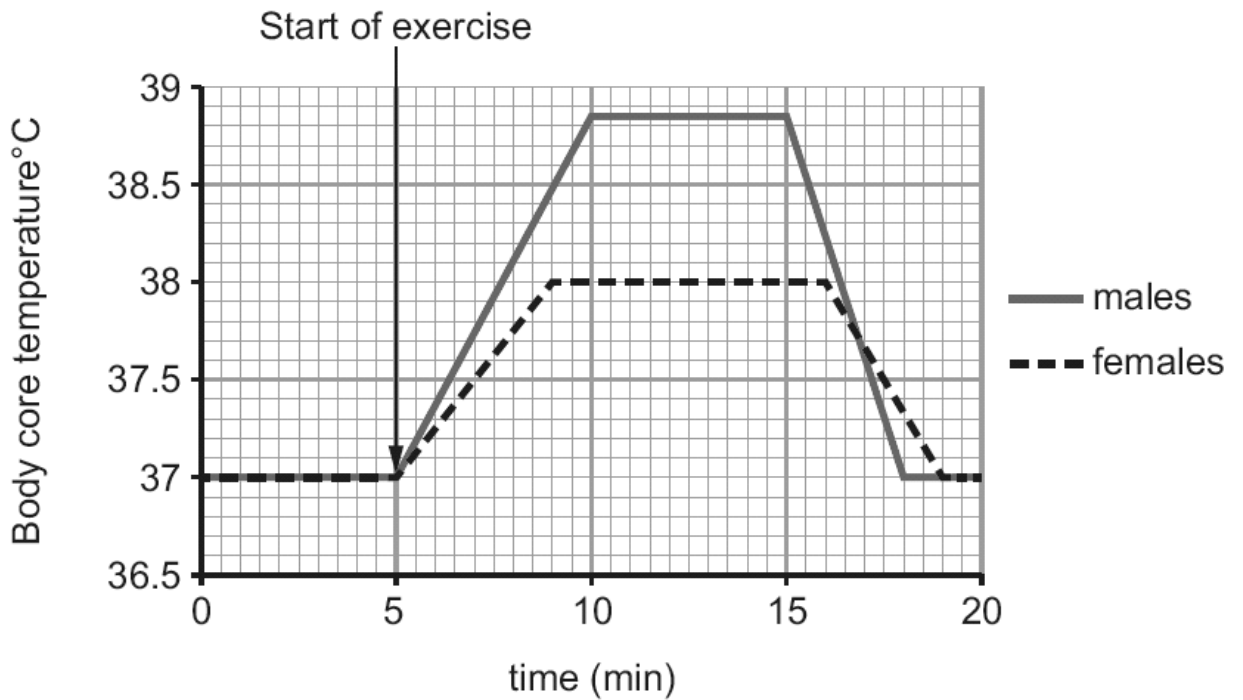
- (b) A student investigated how sweating changed during exercise in four people, two males and two females aged between 22 and 49.

He measured their rates of sweat production at rest and while they used an exercise cycle at a constant level of effort for 10 minutes, in a controlled environment.

Two of the people were fit athletes and two were not athletically fit. Sweat rates were measured on the arms or the forehead. Body temperature was also recorded.

The results are shown in the following graphs.





Use the graphs to answer the questions below.

- (i) Compare the effect of exercise on the rates of sweating in fit and unfit people. [2]

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- (ii) Calculate the percentage increase in the fit male's sweating rate after exercise. Show your working. [2]

Sweating rate = %

- (iii) Describe **one** difference in the way the body temperature of males and females changes during exercise. [1]

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- (iv) What is the evidence that sweating is more efficient at lowering body temperature in males? [1]

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- (v) State **one** way in which the student could improve his investigation in order to make it a fairer test. [1]

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4. (a) What are stem cells? [2]

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- (b) Stem cell transplants are classified differently depending on the individual providing the stem cells.

- Stem cells which come from the patient are called autologous stem cells.
- Stem cells which come from a donor are called allogenic stem cells.

- (i) Explain the advantage to the patient of treating them with autologous stem cells rather than allogenic stem cells. [1]

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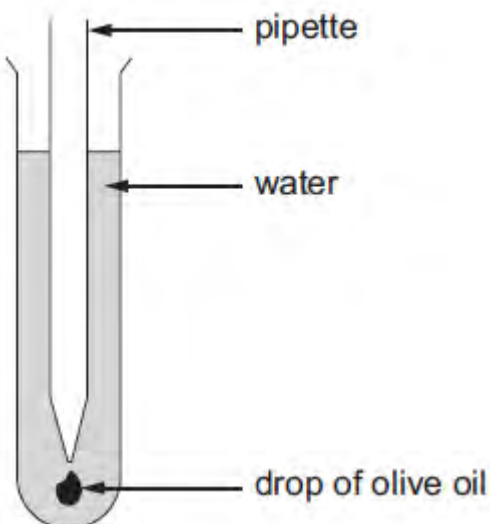
- (ii) Name the source of allogenic (donor) stem cells whose use, for some people, raises a serious ethical issue. [1]

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5. A student investigated the process of digestion of fat as follows:

She filled a test tube with water of pH7. Any change in pH could be detected by a pH sensor connected to a computer. A drop of fat (olive oil) was released into the test tube from a pipette as shown in the diagram.



When the drop of oil was released from the pipette it floated to the surface. Two different types of milk, **A** and **B**, were used in a similar way to the olive oil in two different test tubes of water. The drop of milk **A** floated to the surface but the drop of milk **B** sank.

- (a) What does this observation tell you about the fat content of milk **A** compared to that of milk **B**? [1]

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- (b) 5 cm³ of milk **A** was placed in a test tube with 2 cm³ of lipase at pH7. The mixture was left at 35 °C for 10 minutes. After this time, the pH of the mixture had changed from pH7 to pH5. Explain what happened to cause the change in pH. [2]

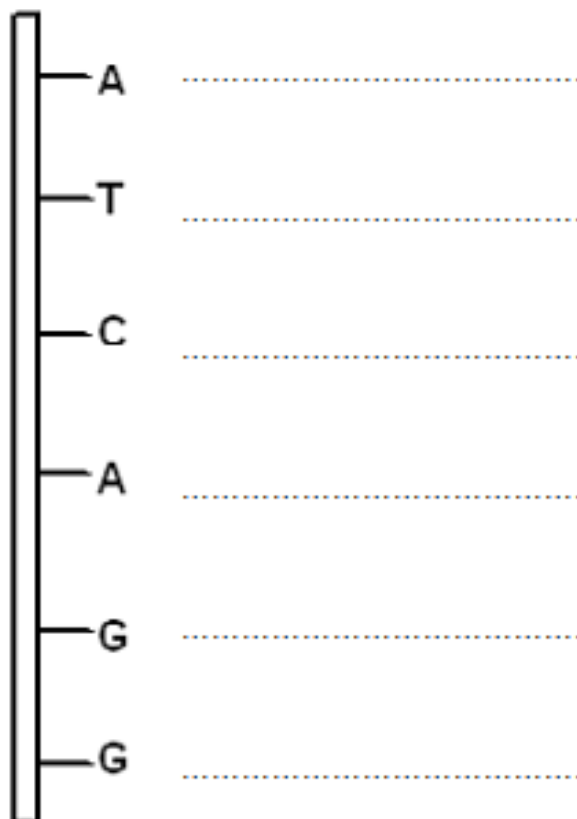
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- (c) The same procedure was repeated with milk **B**.
- (i) What would you expect the pH to be after 10 minutes? [1]
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- (ii) Give a reason for your answer to (c)(i). [1]
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- (d) When the procedure was repeated with milk **A** and lipase, which had been boiled and cooled, the mixture remained at pH7. Explain this observation. [4]
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6. The diagram shows part of a sequence of bases that code for adrenaline in a molecule of DNA.



- (a) (i) **Write the order of bases** in the **complementary strand of DNA** from the top to the bottom by giving their **chemical names**. [2]
- (ii) How many different amino acids are coded for in the sequence shown? [1]
-
- (iii) A DNA molecule contains 2 000 base pairs. 30% of the bases are **G**. Calculate how many **A** bases are contained in this DNA molecule. [2]

number of **A** bases =

(b) Describe the structure of a nucleotide. [3]

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(c) Explain how a mutation in the sequence of bases which codes for adrenaline may prevent it from functioning. [3]

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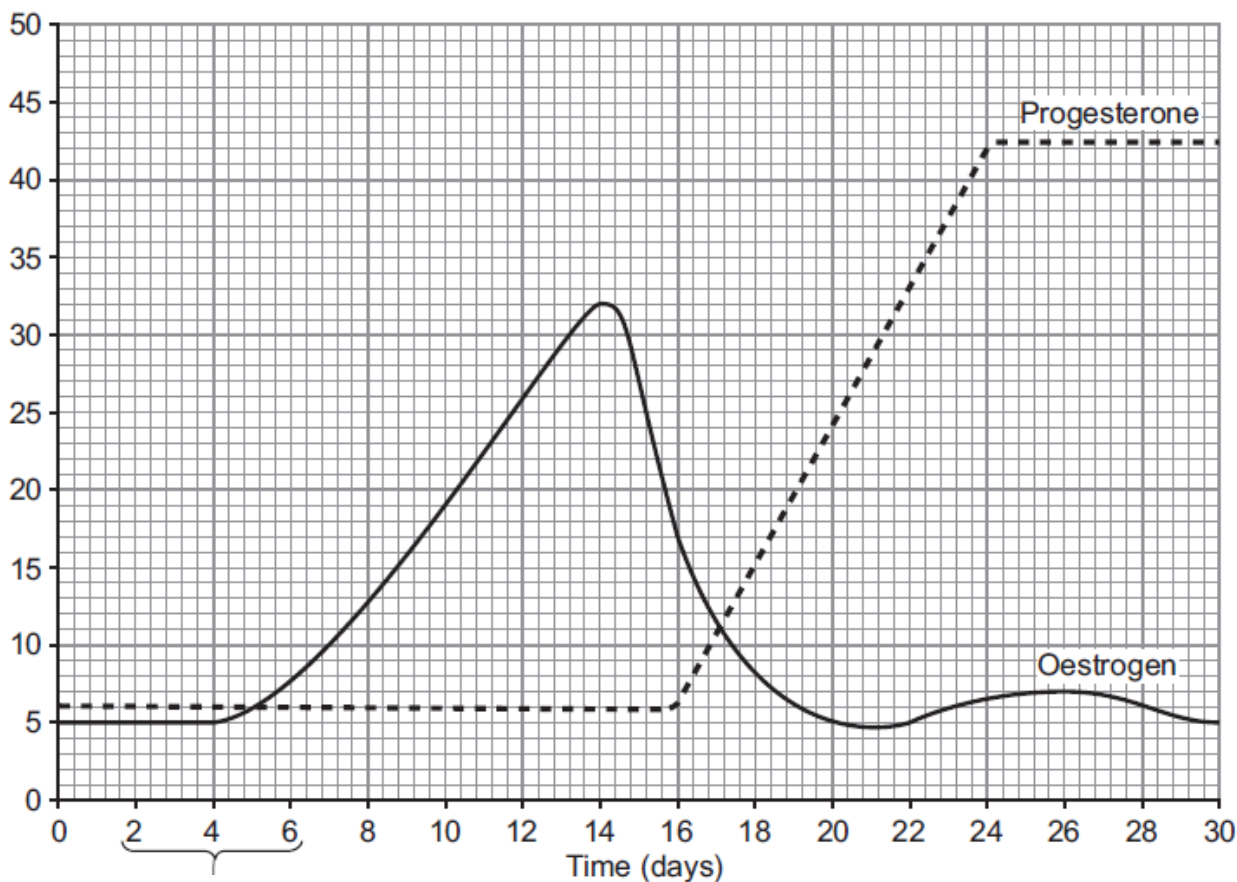
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7. In some women infertility may be treated with the drug, clomiphene. The graph shows the blood-oestrogen and blood-progesterone levels in a woman during and after treatment with clomiphene. It also shows that she has become pregnant.

Concentration of hormone in blood (a.u.)



Days when clomiphene is taken

Use the information in the graph and your knowledge to answer the following questions.

(a) (i) On which days were the levels of oestrogen and progesterone equal? [1]

day and day

(ii) Which process occurred between day 0 and day 5? [1]

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(iii) State **one** function of:

I oestrogen; [1]

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II progesterone. [1]

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- (b) Clomiphene stimulates the production of a hormone by the pituitary gland in the brain.
- (i) From the timing of the treatment with clomiphene shown in the graph, name the hormone whose secretion is stimulated by clomiphene. [1]
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- (ii) Explain how this hormone brings about the change in oestrogen secretion shown in the graph. [2]
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- (iii) **Mark on the graph** with an **X** the day when the ovulation would be most likely. [1]
- (iv) State how the graph shows that the woman is pregnant. [1]
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8. A student wanted to estimate the population size of the two-spot ladybird, *Adalia bipunctata* which had invaded a garden in large numbers. He used a capture/recapture method as follows.

- He captured as many as possible in two hours and recorded the number.
- He marked each one with a harmless coloured dye and then released them.
- Two days later, he captured as many as possible in two hours in the garden.
- He recorded the number captured and also any that were marked with the dye previously.

If **Q** equals the number captured on the first day; **R** the total number captured two days later, and **S** the number of marked ones captured, the following formula gives an estimate of the population.

$$P = \frac{Q \times R}{S}$$

- (a) State **three** factors which this formula does not account for and so could lead to an inaccurate answer. [3]

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- (b) *Adalia bipunctata* is normally red with two black spots. However, variants occur which are black with two red spots. The variant is caused by an allele which only expresses itself as a homozygote.

- (i) What name is given to such an allele? [1]

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- (ii) Using the example of *Adalia bipunctata*, distinguish between the terms phenotype and genotype. [2]

The phenotype is:

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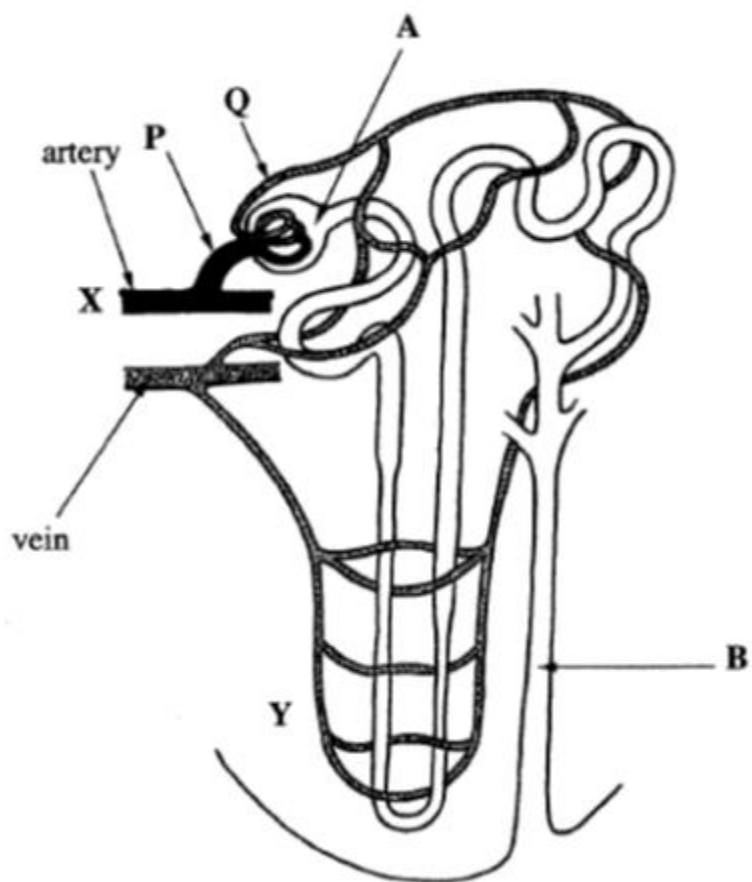
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The genotype is:

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9. The diagram shows a nephron and its associated blood vessels.



- (a) (i) **Draw** arrows at points **X** and **Y** on the diagram to show the direction of flow of blood. [1]
- (ii) Explain how the difference in the diameter of **P** and **Q** helps a process taking place in the kidney. [2]

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- (b) The table below shows the presence or absence of some substances in parts **A** and **B** in the diagram. The numbers represent units recorded per day.

Substance	Part A	Part B
water	18 000	3 000
salts	2 600	150
glucose	800	0
urea	56	56
protein	0	0

Explain the data for the following substances:

- (i) Protein [1]

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- (ii) Glucose [1]

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- (iii) Water [1]

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- (c) Calculate the percentage difference between the data for salts in part A and Part B. Show your working. [2]

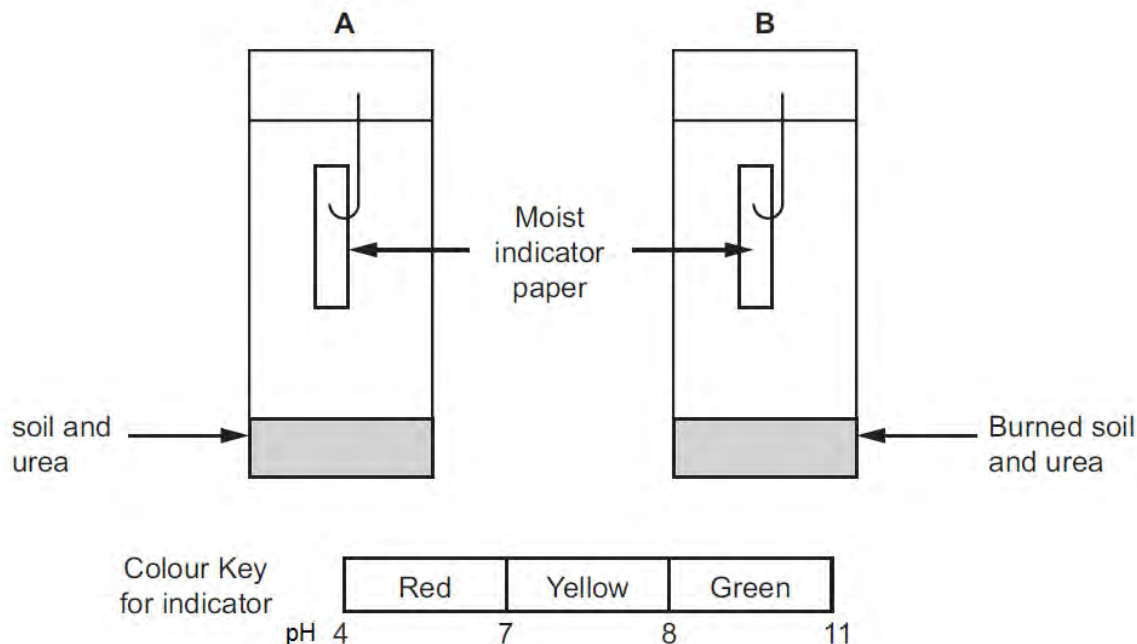
percentage difference = %

- (d) If the concentration of ADH was increased in the blood, state **three** changes that you would expect in the composition of urine. [3]

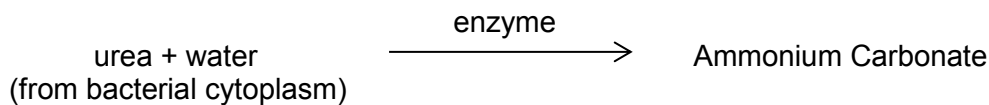
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10. In order to investigate how nitrogen is recycled by bacteria in soil, the apparatus shown in the diagram was kept at 25 °C for two days.

At the start, the indicator paper in both tubes was yellow. After two days, the indicator paper in tube A was green but the indicator paper in tube B was still yellow.



A word equation representing the reaction in tube A is:



What do you conclude about the results obtained in:

- (a) tube A; [2]

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- (b) tube B? [3]

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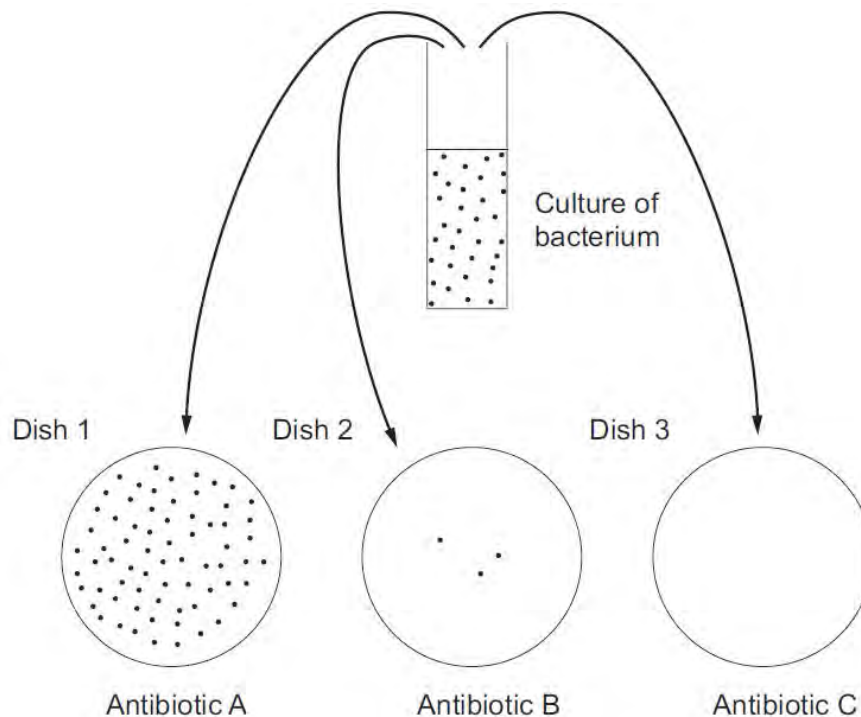
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11. Equal sized samples from a culture of a bacterium were inoculated on to three Petri dishes containing nutrient agar. In each of the Petri dishes the agar contained a different antibiotic **A**, **B** and **C**.

The Petri dishes were incubated at the same temperature for the same time. The results after incubation are shown below. The dots represent colonies of bacteria.



(a) What conclusions can you draw about the effects of the three antibiotics on this type of bacterium?

(i) Antibiotic **A** [1]

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(ii) Antibiotic **B** [1]

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(iii) Antibiotic **C** [1]

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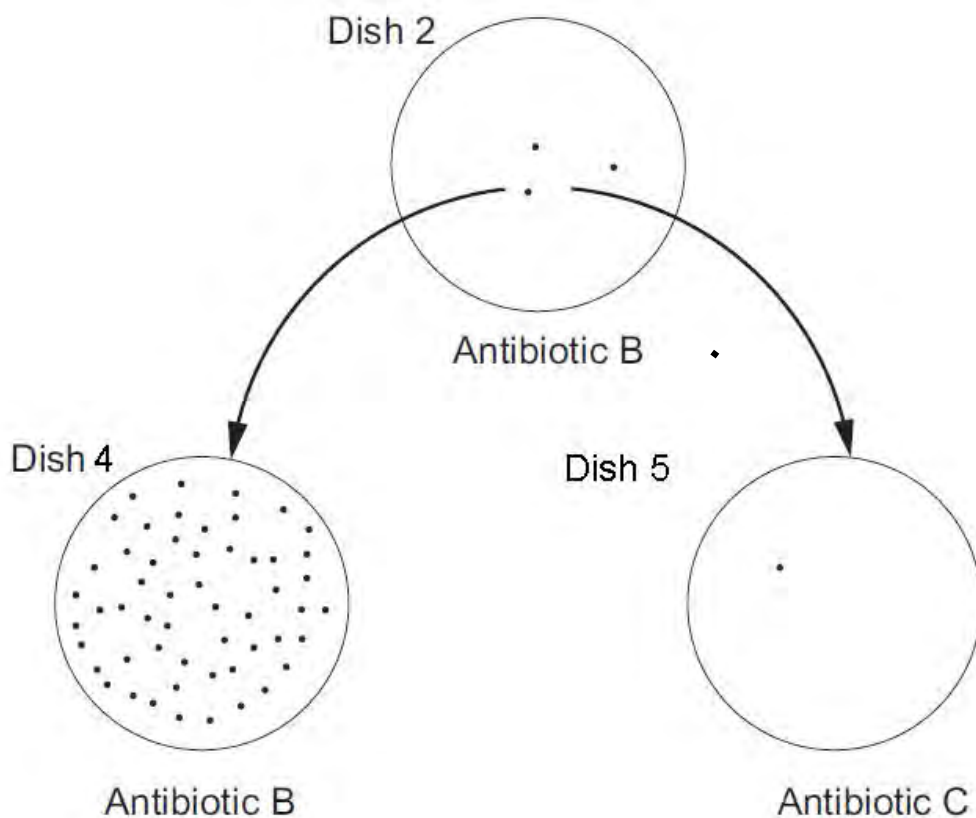
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(b) What would you use as a control? [2]

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(c) Bacteria from one of the colonies growing on dish 2 were later inoculated on to two other Petri dishes, 4 and 5, one containing antibiotic **B**, and one containing antibiotic **C**. The results are shown below after incubation at the same temperature for the same time.

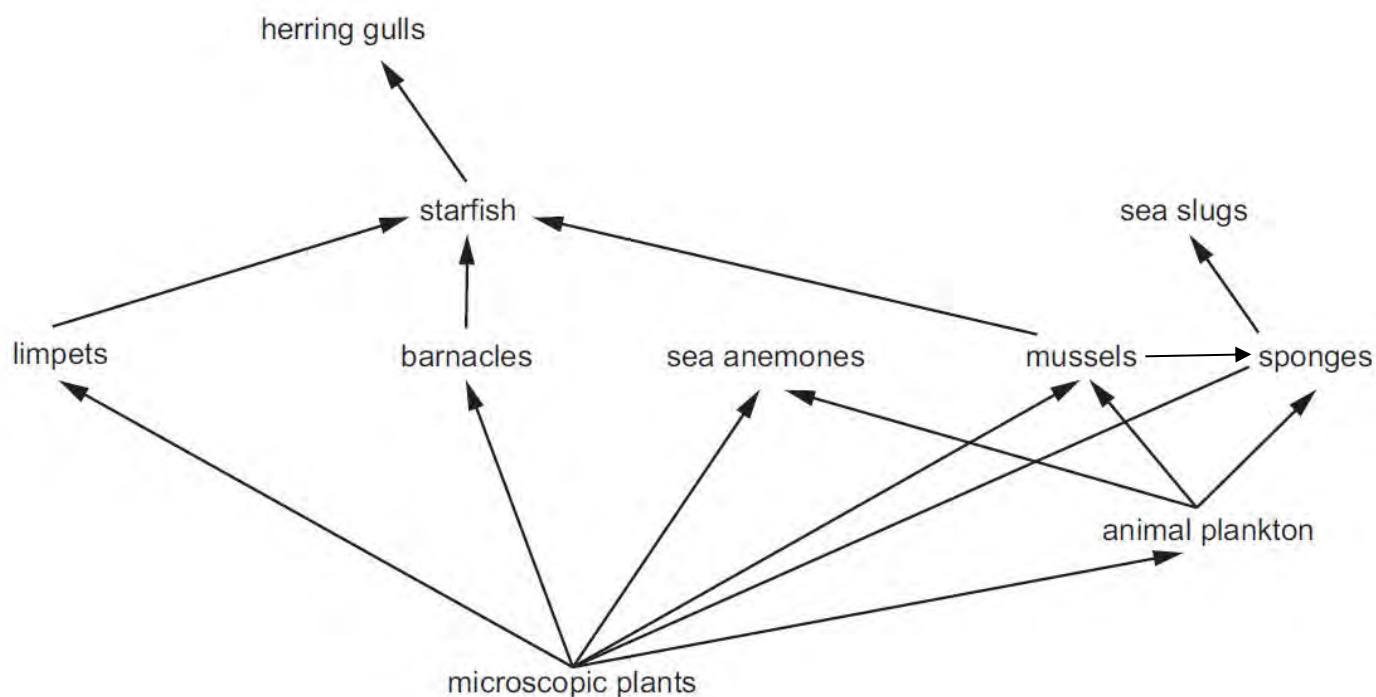


Account for the differences in the results seen in Petri dish 2 compared with Petri dishes 4 and 5. [1]

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12. The common starfish *Asterias rubens* lives on a mussel bed on a rocky shore in South Wales. The following diagram shows part of the food web for the mussel bed.



An investigation was carried out in which all the starfish were removed from an 8 m x 2 m area of the mussel bed. In an equal area, on the mussel bed, the starfish were **not** removed.

The abundance of other organisms in the food web was monitored each month for a year.

The observations were:

- In the area in which starfish were removed the abundance of limpets, sea anemones, sponges and sea slugs **decreased** and the barnacles and mussels **increased**.
- In the area in which starfish were **not** removed, the abundance of all organisms remained the same as at the beginning of the investigation.

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(a) (i) State the purpose of not removing starfish from one area. [1]

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(ii) Suggest how the investigation was made valid. [1]

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(b) Explain the decrease in number of limpets in the area from which starfish were removed. [1]

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(c) Explain the decrease in numbers of sea slugs in the area from which starfish were removed. [3]

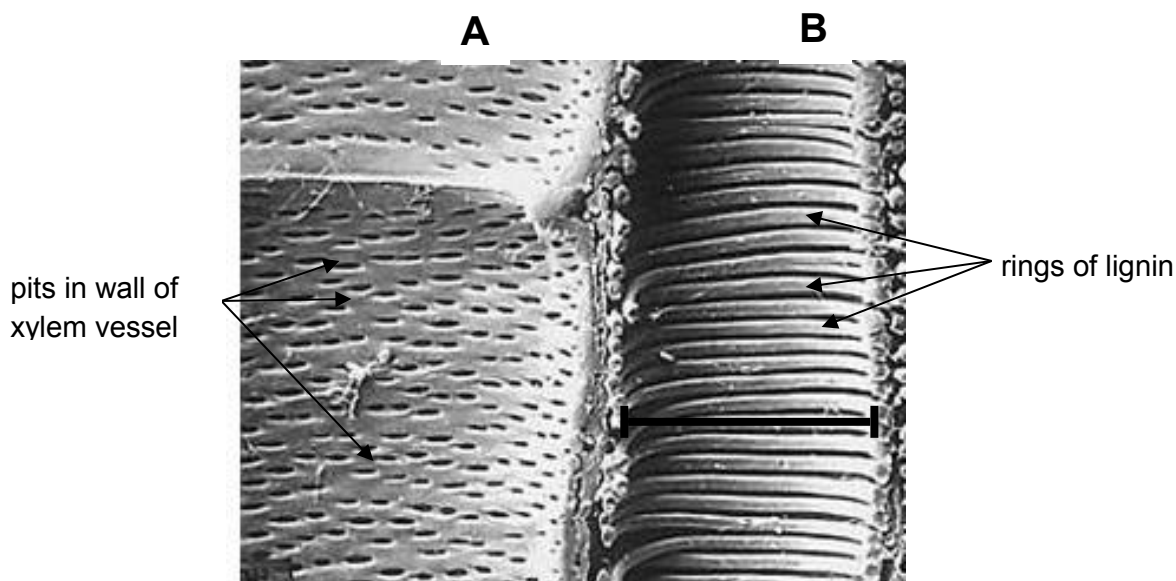
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13. Xylem vessels are responsible for the transport of water and ions in a plant and also provide support for stems. The walls are made of lignin which is laid down in different ways depending on the main function of the xylem vessel. The electron micrograph below shows a longitudinal section through two xylem vessels, **A** and **B**. The image is x800 greater than actual size.



- (a) (i) Calculate the diameter of xylem vessel **B** at the point shown by the line . [2]

diameter = mm

- (ii) Assuming that the xylem vessel is a cylinder, calculate the cross sectional area of xylem vessel **B** using the formula πr^2 . Give your answer to two significant figures. Use $\pi = 3.142$ [2]

cross-sectional area =mm²

- (b) Identify the functions of xylem vessels A and B and explain how each is adapted to its function. [4]

A

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B

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(c) *Ophiostoma ulmi* is a fungus that infects elm trees. It enters damaged xylem vessels and then spreads through the plant. Infected trees respond to the fungal infection by plugging the infected xylem vessels. However, if too many xylem vessels are plugged the leaves die first followed by the roots.

- (i) Explain why plugging the xylem vessels reduces a tree's ability to absorb water through its roots. [3]

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- (ii) Explain why the roots of the tree die after the death of the leaves. [2]

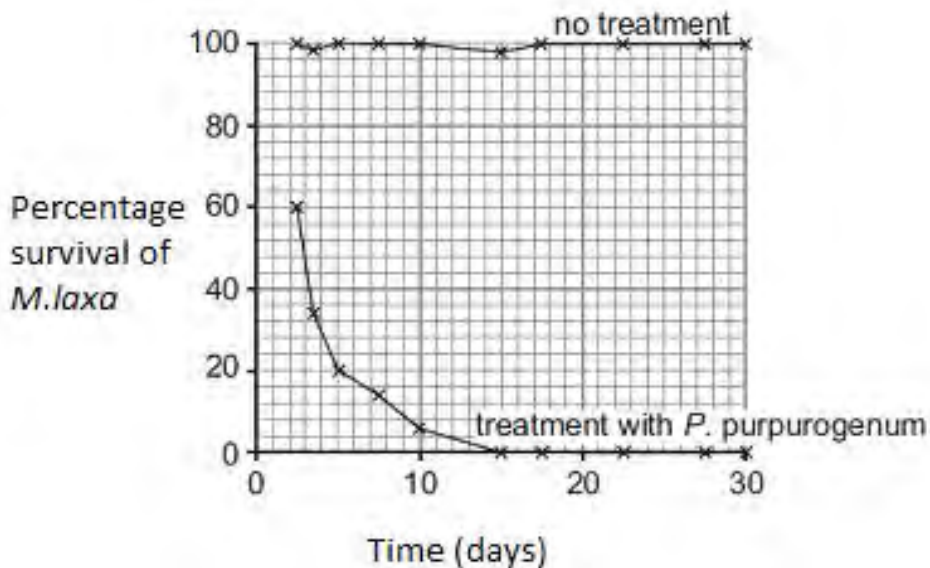
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- (d) *Monilinia laxa* is a fungus that infects apricot and peach trees in Spain. Another fungus, *Penicillium purpurogenum*, secretes an enzyme that can break down the cell wall of *Monilinia laxa*. The graph shows the effect of *Penicillium purpurogenum* on *Monilinia laxa*.



It has been proposed that *Penicillium purpurogenum* could be used as a biological control agent to cure trees infected with *Monilinia laxa*.

- (i) Explain how the results shown in the graph indicate that *Penicillium purpurogenum* could be used as a biological control agent. [2]

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- (ii) It has also been proposed that *Penicillium purpurogenum* could be used to control the spread of Ash Dieback disease which is also caused by a fungus. Explain why both laboratory and field trials would need to be carried out before *Penicillium purpurogenum* could be used in the UK. [2]

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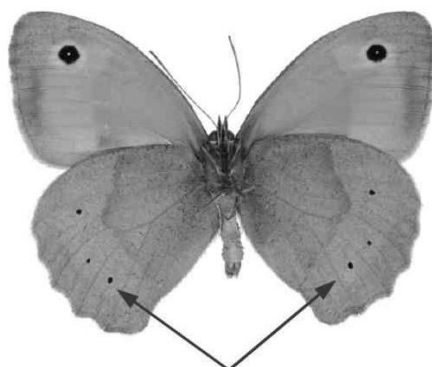
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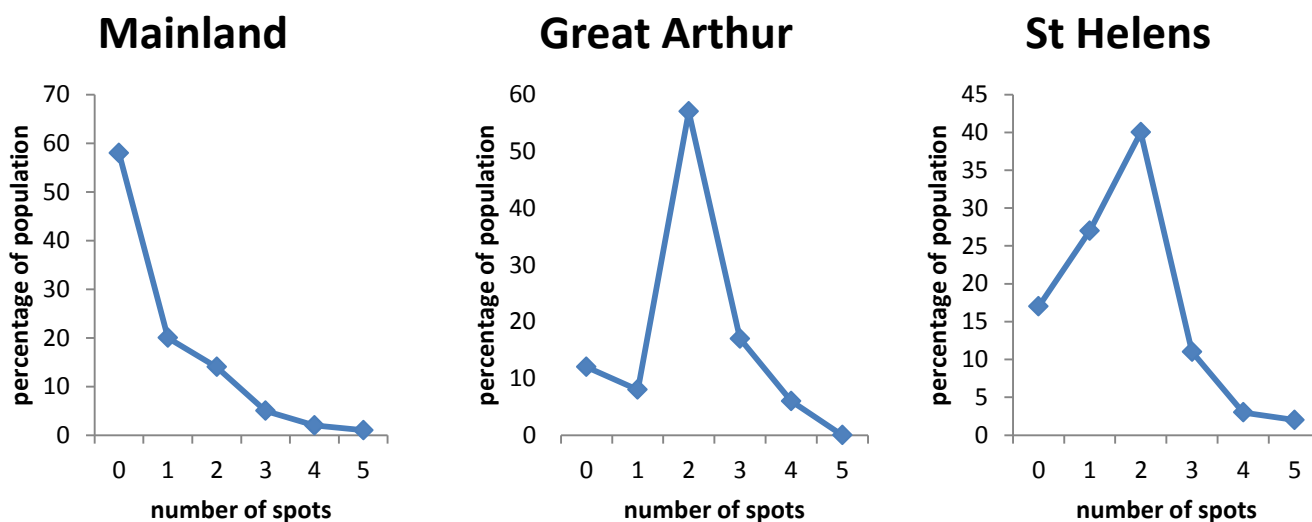
14. In the 1950s, the scientist E. B. Ford studied variation in populations of the Meadow Brown butterfly (*Maniola jurtina*). He counted the number of spots on the hind wings of butterflies found on the Isles of Scilly and on the UK mainland. The butterfly can have from zero to five spots on each hind wing. The image below shows a three-spotted butterfly.



three spots on each hind wing

The caterpillar larvae of these butterflies feed on grasses while the adults feed on the nectar of a range of plants. They will not fly over open water of more than 10 m width and are believed to have been blown, by strong winds, to the Isles of Scilly which lie about 45 km off the coast of Cornwall. Small populations of the butterfly are found on most of the Isles of Scilly; on the mainland the butterfly is found across the whole of the UK.

The distribution of butterflies with different numbers of spots is shown below for the mainland and for two of the islands.



Use this information to suggest a possible explanation for the differences in the distribution of butterflies with different numbers of spots in these locations. [6 QER]

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