



**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

- 1** A problem that has developed in recent years is the emergence of bacteria that are resistant to some antibiotics.

(a) (i) Which of the following will lead to fewer resistant bacteria?

(1)

- ☐ **A** antibiotics being given to farm animals to prevent disease
- ☐ **B** doctors only prescribing antibiotics that are effective against the pathogen
- ☐ **C** doctors only prescribing antibiotics for viral infections
- ☐ **D** patients stopping taking the antibiotics when they feel better

(ii) Which of the following would cause an increase in resistant bacteria?

(1)

- ☐ **A** antibiotic use leads to increased competition between bacteria
- ☐ **B** the antibiotic reducing the frequency of mutations in the bacteria
- ☐ **C** the resistant bacteria being killed by the antibiotic
- ☐ **D** the resistant bacteria surviving the antibiotic

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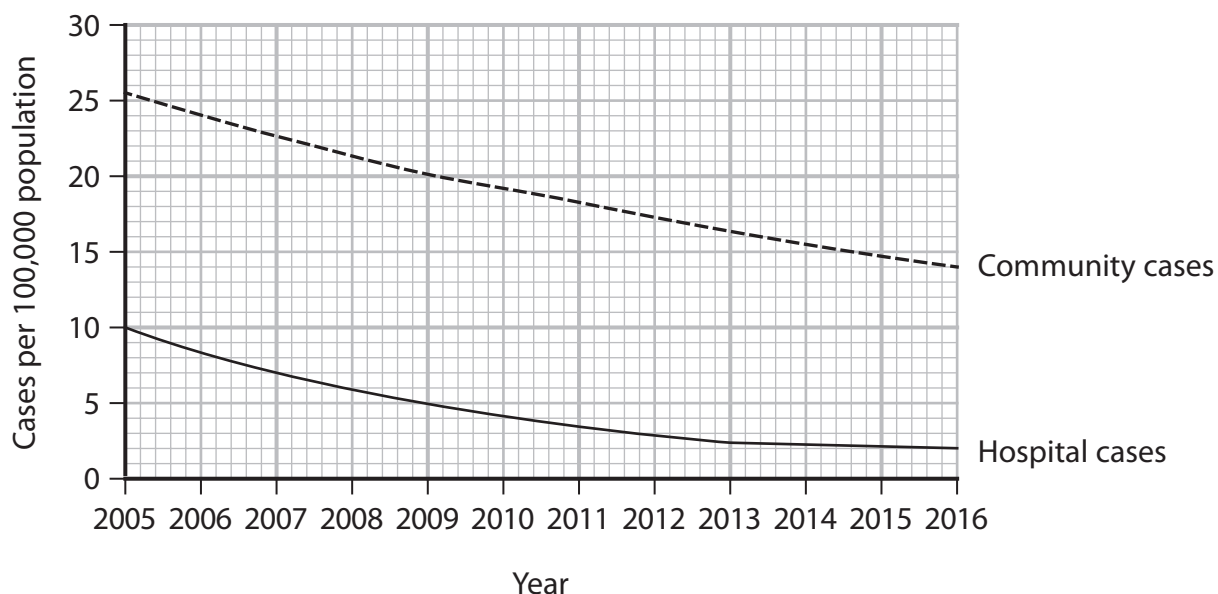
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- (b) The bacteria referred to as MRSA are resistant to many antibiotics.

The graph shows the number of cases of MRSA in several US states from 2005 to 2016.



- (i) Explain why the number of hospital cases of MRSA is lower than the number of community cases of MRSA.

(2)

- (ii) Explain the changes in hospital cases and community cases from 2012 to 2016.

(2)



(c) Describe how DNA sequencing of pathogens may help doctors to prescribe antibiotics more effectively.

(2)

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(Total for Question 1 = 8 marks)



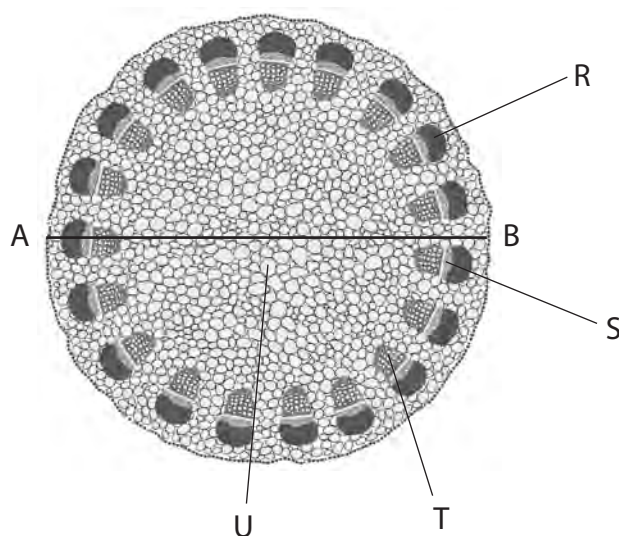
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- 2 (a) The photograph shows a section through a plant stem as seen using a light microscope.



(Source: © Aldona Griskeviciene/Shutterstock)

- (i) Which structure is the xylem?

(1)

- ☐ **A** R
- ☐ **B** S
- ☐ **C** T
- ☐ **D** U

- (ii) The actual diameter of the stem section A to B is 12 mm.

Calculate the magnification of the photograph.

(2)

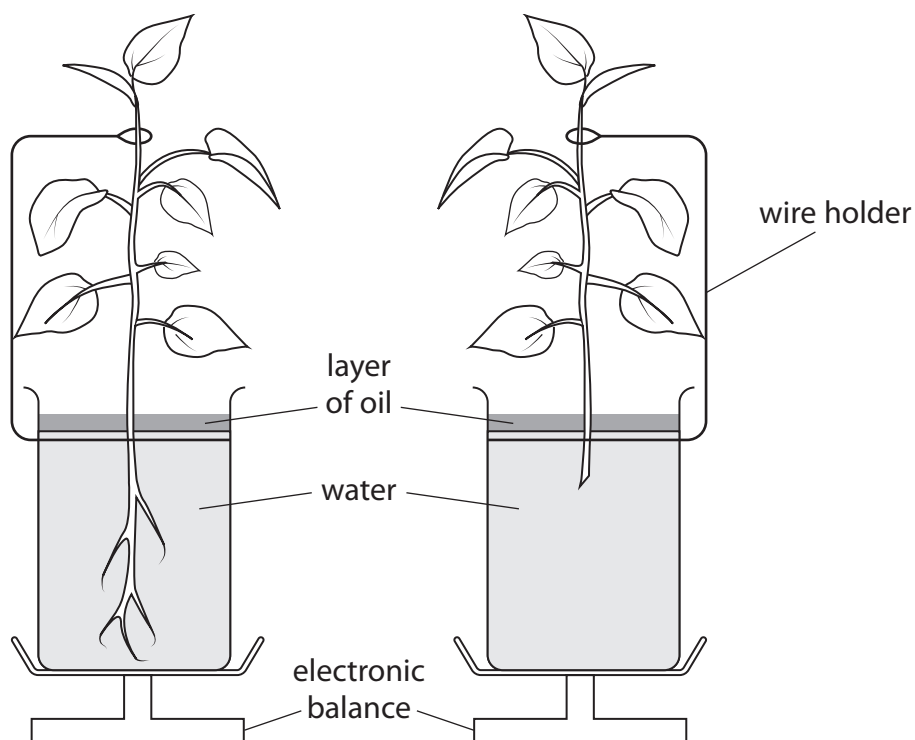
Answer .....



**Turn over** ►

3 A student investigated the rate of water loss by a seedling.

The diagram shows the apparatus used in this investigation.



The student recorded the mass of each apparatus every 10 minutes for three hours.

(a) (i) State the hypothesis being tested by the investigation.

(1)

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(ii) Explain **one** feature of the plants that should be controlled in this investigation.

(2)

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(iii) State the function of the layer of oil in this apparatus.

(1)

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(b) The student assumed that the rate of water loss is equal to the rate of water uptake.

Explain why these two rates could be different.

(2)

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(c) Describe how this investigation could be modified to determine the effect of humidity on the rate of water uptake by seedlings.

(4)

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(Total for Question 3 = 10 marks)



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**4** Biodiversity can be measured within a habitat and within a species.

Students measured out a small area within woodland A. They then identified and counted the number of species present and the numbers of individuals of the different species in that area.

The table shows the results for woodland A.

Species	Number of individuals of each species
Woodrush	4
Holly	8
Bramble	1
Sedge	3
Ivy	4

(a) Calculate the index of diversity (D) for woodland A.

Use the formula:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

where N = total number of organisms of all species

and n = total number of organisms of a particular species.

(3)

Answer .....



(b) The students then collected data from the same sized area in woodland B.

The table shows the results for woodland B.

Species	Number of each species
Woodrush	0
Holly	10
Bramble	4
Sedge	0
Ivy	4

The index of diversity (D) for woodland B was found to be lower than for woodland A.

Comment on the biodiversity of each woodland.

(3)

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(c) Describe how the students could modify their procedure to obtain a valid comparison of the diversity of each woodland.

(2)

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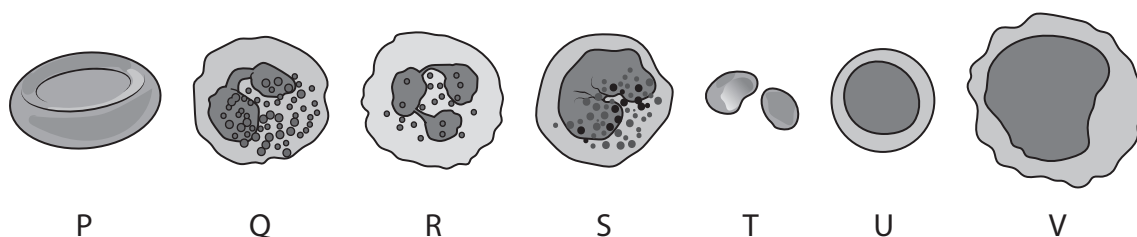
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(Total for Question 4 = 8 marks)



**5** Blood cells carry out a wide variety of roles in the body.

The diagram shows some of the components present in a sample of blood.



(a) (i) Which of these components is involved in blood clotting?

(1)

☐ **A** Q

☐ **B** R

☐ **C** S

☐ **D** T

(ii) Which of these pairs of components is involved in the immune response?

(1)

☐ **A** P and Q

☐ **B** S and T

☐ **C** T and U

☐ **D** U and V

(iii) Which of these components is a lymphocyte?

(1)

☐ **A** P

☐ **B** R

☐ **C** T

☐ **D** U

\*(b) The relative number of each type of blood cell can be used to diagnose blood conditions.

Tables 1 and 2 show data for the blood conditions, A, B, C and D.

The tables also show the normal number of blood cells.

**Table 1**

Condition	Number of lymphocytes per $\text{dm}^3$
A	below $1.5 \times 10^9$
Normal range	$1.5 \times 10^9$ to $4.5 \times 10^9$
B	above $4.8 \times 10^9$

**Table 2**

Condition	Number of neutrophils per $\text{dm}^3$
C	below $1.0 \times 10^9$
Normal range	$2.0 \times 10^9$ to $7.5 \times 10^9$
D	above $8.0 \times 10^9$

Table 3 gives some of the possible symptoms and medical advice for patients with each condition.

**Table 3**

Condition	Possible symptoms	Medical advice
A	infections that do not get better	have a seasonal flu vaccine avoid uncooked foods
B	swelling of lymph nodes	if condition persists check for no underlying condition such as leukaemia
C	increased susceptibility to infection in severe cases, bacteria that are normally present in the mouth can cause serious infections	cancer treatments such as chemotherapy often cause this condition
D	can occur as a normal response to infection	if condition persists check for no underlying condition such as leukaemia





Analyse the data in Tables 1, 2 and 3 to explain the consequences for patients with these conditions.

(6)

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(Total for Question 5 = 9 marks)



- 6 (a) A species may be defined as a group of organisms with similar characteristics that interbreed to produce fertile offspring.

Explain the limitations of this definition.

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- (b) The evolutionary relationship between species can be determined using gel electrophoresis.

Which of the following describes the movement of DNA fragments in gel electrophoresis?

(1)

- ☐ **A** all fragments travel the same distance
- ☐ **B** larger fragments travel faster than smaller fragments
- ☐ **C** larger fragments travel further than smaller fragments
- ☐ **D** smaller fragments travel further than larger fragments



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- This image shows a blank sheet of white paper with ten horizontal dashed lines spaced evenly apart, resembling notebook paper. The lines are thin and grey, extending across the full width of the page. There is no handwriting or other markings on the paper.



- (ii) Describe **two** other pieces of information the scientists could use to confirm if the new plant is a new species.

(2)

(Total for Question 6 = 10 marks)

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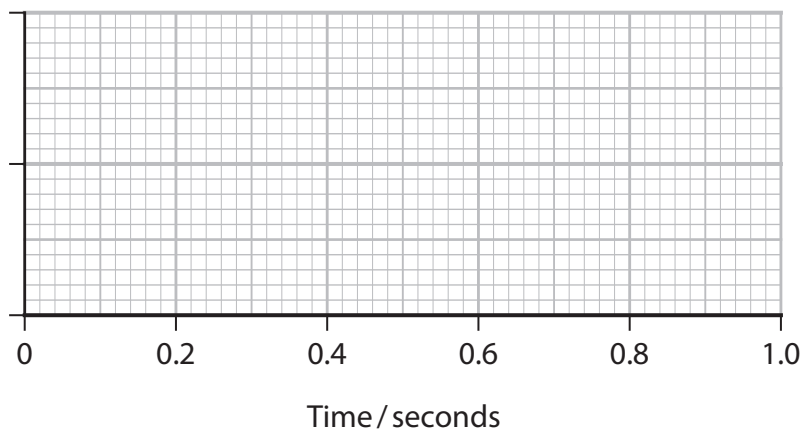
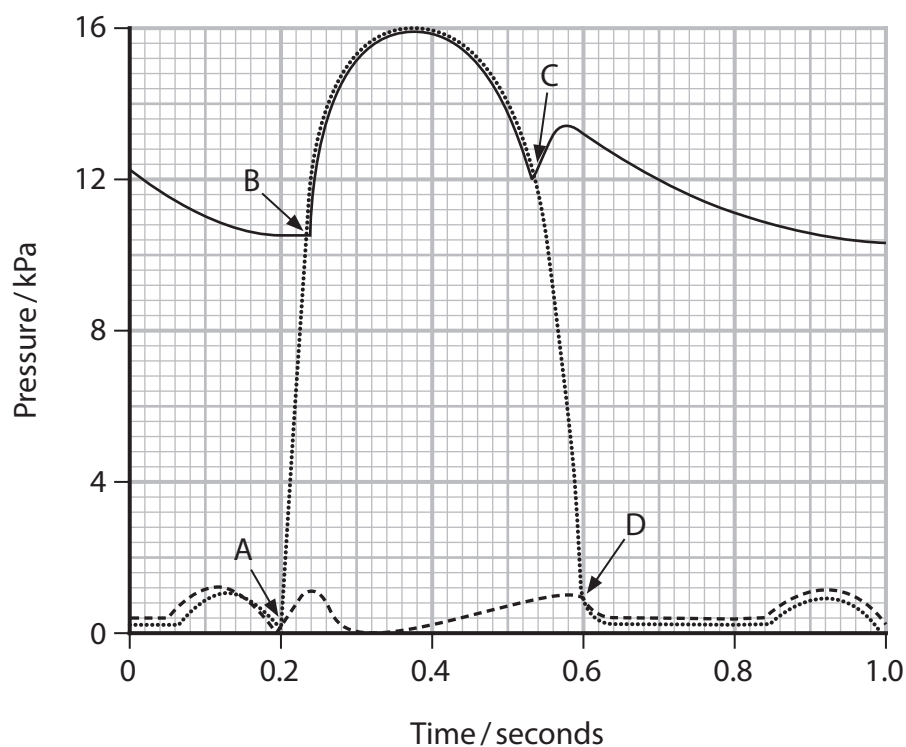
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- 7 The graph shows the pressure changes in the left side of the heart and in the aorta during the cardiac cycle.



- (a) (i) Draw, on the blank grid, an ECG recording for this cardiac cycle and label the parts P, Q, R, S and T.

(2)

- (ii) Determine how many cardiac cycles there are in one minute, using the graph.

(1)

Answer .....



(b) Explain what is happening at each point, labelled A, B, C and D, on the graph.

(4)

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(c) Describe the myogenic stimulation of the heart.

(4)

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(Total for Question 7 = 11 marks)





- 8 (a) Describe **three** named methods of passive transport by which substances can enter or leave a cell.

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- (b) The properties of cell membranes were investigated using samples of tissue from a beetroot.

The following method was used.

**Step 1** Equal sized discs of beetroot were cut, washed, and placed in a boiling tube containing 10 cm<sup>3</sup> of ethanol with a concentration of 20%.

**Step 2** The boiling tube was placed in a water bath at 20°C for 30 minutes.

**Step 3** The discs of beetroot were then removed from the boiling tube.

**Step 4** A colorimeter was then used to measure the absorbance of the liquid in the boiling tube.

**Steps 1 to 4** were repeated using ethanol concentrations of 10%, 30%, 40%, 50%, 60% and 0% using distilled water.

Each ethanol concentration was tested 6 times.

The boiling tubes contained a red pigment that had leaked out of the beetroot discs.

The darker the red colour of the liquid in the boiling tube, the higher the absorbance.

The table shows the results of this investigation.

Concentration of ethanol (%)	Absorbance / a.u.							
	1	2	3	4	5	6	Mean	Standard deviation
0 (distilled water)	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.01
10	0.04	0.02	0.02	0.02	0.03	0.03	0.03	0.01
20	0.06	0.07	0.08	0.11	0.10	0.09	0.09	0.02
30	0.10	0.12	0.12	0.11	0.12	0.13	0.12	0.01
40	0.15	0.14	0.16	0.12	0.15	0.16	0.15	0.02
50	0.19	0.21	0.22	0.18	0.22	0.21	0.21	0.02
60	0.70	0.53	0.64	0.58	0.65	0.78	0.65	

- (i) State why the discs were washed in **Step 1**.

(1)



(ii) Explain the purpose of **Step 2**.

(2)

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(iii) Calculate the standard deviation (s) for the results at 60% ethanol.

Give your answer to **two** decimal places.

(3)

Use the formula:

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

Answer .....



(iv) State which ethanol concentration shows the lowest range of absorbance.

(1)

(v) Explain why standard deviation is a better measure of variation than range.

(2)

(vi) Explain the effect of increasing ethanol concentration on membrane permeability.

(3)

**(Total for Question 8 = 15 marks)**

**TOTAL FOR PAPER = 80 MARKS**

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