Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/13**

Paper 1 Multiple Choice **October/November 2023**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

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[Turn over

1 Which statement about light microscopy is correct?

A As the resolution increases, the magnification increases.

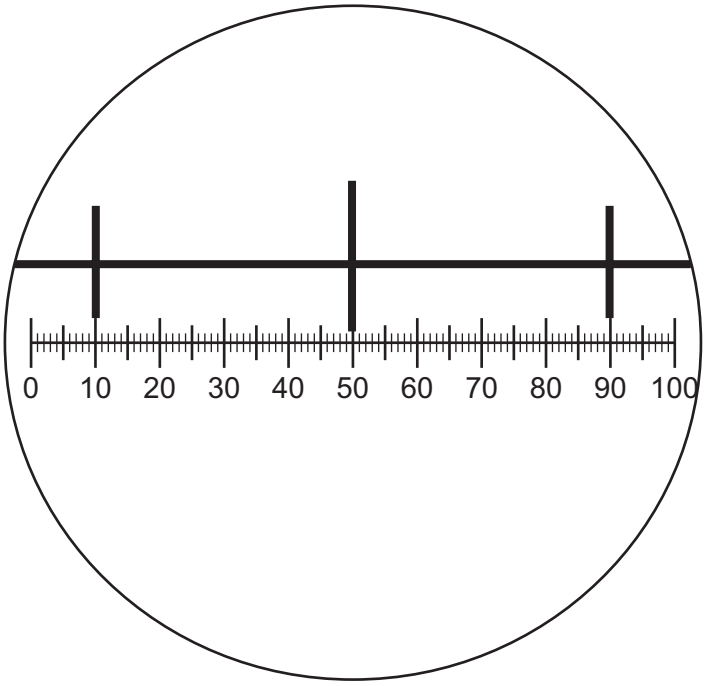
B As the magnification increases, the image always becomes clearer.

C The resolution will decrease as coloured light of increasing wavelengths is used.

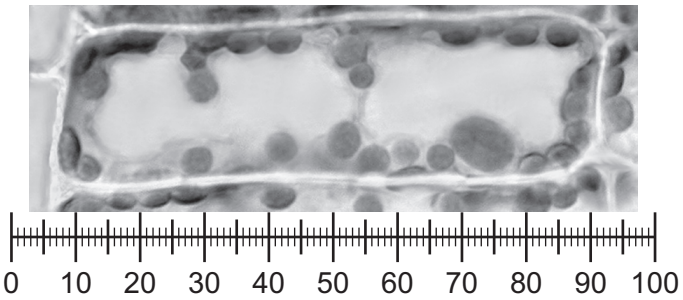
D Magnification and resolution are terms that relate to the same factor.

2 The diagram shows a stage micrometer scale viewed through an eyepiece containing a graticule.

The small divisions of the stage micrometer scale are 0.1 mm.



The stage micrometer scale is replaced by a slide of a plant cell.



What is the maximum actual length of the nucleus in the plant cell?

A 8 µm **B** 25 µm **C** 200 µm **D** 0.8 mm

3 What is the correct order for the involvement of the cell structures in the synthesis and secretion of an enzyme?

1 cell surface membrane

2 Golgi body

3 nucleus

4 rough endoplasmic reticulum

A $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$

B $2 \rightarrow 1 \rightarrow 3 \rightarrow 4$

C $3 \rightarrow 4 \rightarrow 2 \rightarrow 1$

D $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

4 Centrioles, cilia, microtubules and microvilli are structures found in eukaryotic cells.

Which statement about these cellular structures is correct?

A Centrioles, cilia and microvilli are composed of microtubules.

B Centrioles play a role in mitosis and semi-conservative DNA replication.

C Cilia and microvilli both increase the cell surface area for absorption.

D Microtubules are made of protein and form the spindle in mitosis.

5 Which description of plasmodesmata is correct?

A They are channels through plant cell walls, lined by the cell surface membrane.

B They are channels through plant cell walls that are formed from proteins.

C They are channels required for the movement of water through the apoplast pathway.

D They can become lignified and form pits in the walls of xylem vessel elements.

6 Which cell organelle does **not** have nucleic acids?

A chloroplast

B Golgi body

C mitochondrion

D ribosome

[Turn over

7 Which processes occur in eukaryotes **and** prokaryotes?

1 hydrolysis
2 mitosis
3 transcription
4 translation

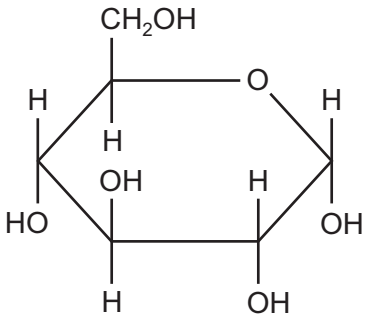
A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

8 Which bonds are present in **all** viruses?

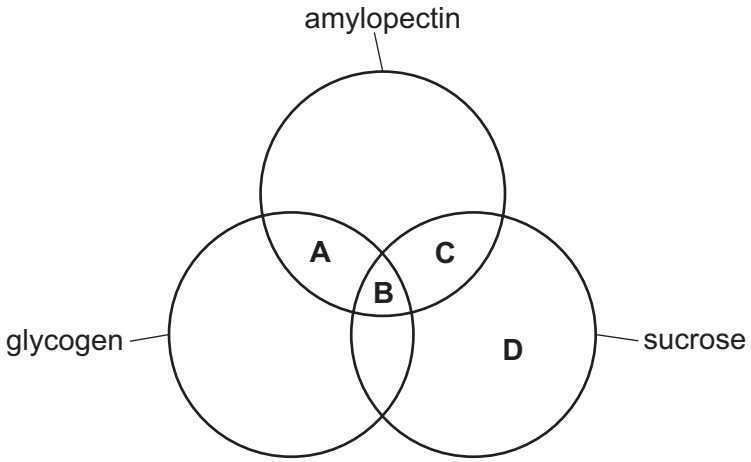
1 covalent
2 ester
3 phosphodiester

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

9 The diagram shows the structure of a monomer.

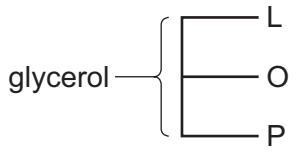


Which molecules contain this monomer?



10 A triglyceride consists of glycerol and three different fatty acids: linoleic acid (L), oleic acid (O) and palmitic acid (P).

The diagram shows one possible arrangement of the fatty acids L, O and P in the molecule.



What is the total number of different arrangements of the fatty acids in this triglyceride?

A 3 **B** 4 **C** 5 **D** 9

11 Which statement about phospholipid molecules is correct?

A They contain one saturated fatty acid and two unsaturated fatty acids.

B They contain three phosphodiester bonds.

C They contain hydrophobic regions and hydrophilic regions.

D They contain a hydrophobic phosphate group that is soluble in water.

12 Hydrogen bonding explains many of the properties of water, including the high latent heat of vaporisation and high specific heat capacity.

For which processes in plants is hydrogen bonding in water important on hot sunny days?

1 preventing denaturation of enzymes in leaves

2 reducing water loss by evaporation

3 allowing leaves to cool down quickly at night

4 holding the column of water in xylem vessels together

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1, 3 and 4 only

D 2 and 3 only

13 Which feature of cellulose molecules contributes to the function of plant cell walls?

A Adjacent cellulose molecules are linked by glycosidic bonds.

B Branched chains of β-glucose molecules are linked by hydrogen bonds.

C Molecules of α-glucose are linked by 1-6 glycosidic bonds.

D Unbranched chains of β-glucose are linked by hydrogen bonds.

14 Which statements describe some enzyme actions?

1 Enzymes hold reacting molecules so that their reactive groups are close together.

2 In an enzyme-catalysed reaction, more molecules have sufficient energy to react than without the enzyme.

3 Reactions catalysed by enzymes take place at a lower temperature than they would without the enzyme.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

15 Influenza virus has an enzyme called neuraminidase which breaks down glycoproteins in the surface membrane of the cell that the virus will infect. The glycoprotein binds to the active site of neuraminidase by induced fit.

Which statements about the induced fit hypothesis of enzyme action are correct?

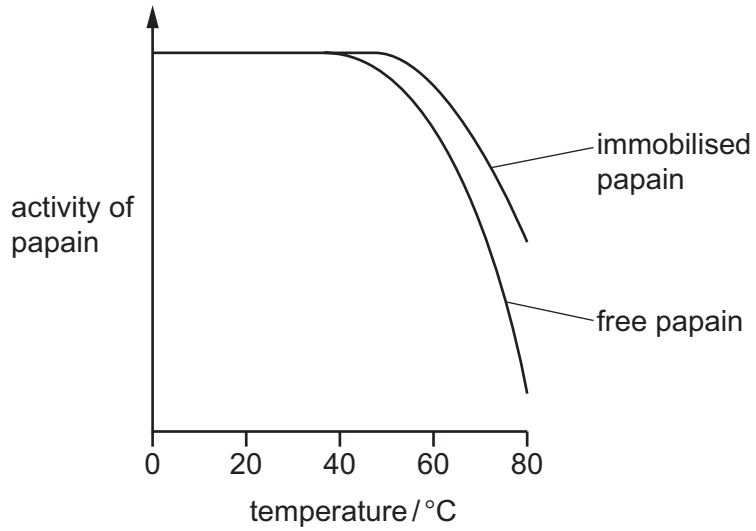
1 The active site must have the same shape as the substrate for them to bind together.

2 This enzyme is less likely to be affected by non-competitive inhibitors than an enzyme working by the lock-and-key mechanism.

3 The substrate is converted to product by specific R-groups in the active site just like the lock-and-key mechanism.

A 1 and 2 **B** 2 and 3 **C** 2 only **D** 3 only

16 The graph compares the effect of temperature on the activity of the protease enzyme, papain, when in solution (free) and when immobilised in alginate beads.



Which statement about the effect of immobilisation of papain is correct?

A It alters the shape of papain's active site at higher temperatures.

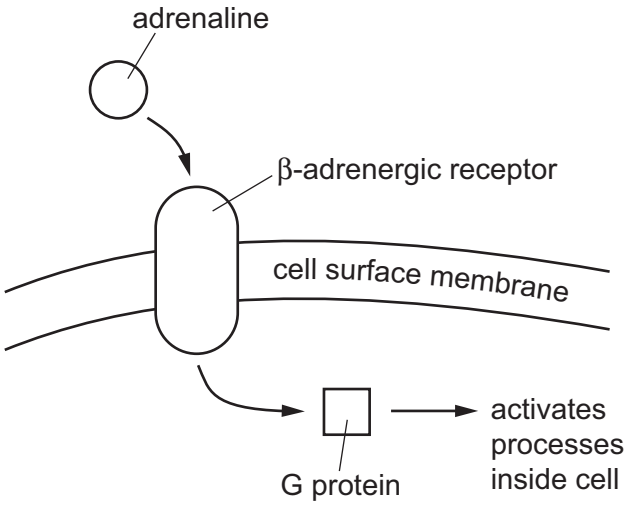
B It decreases the activity of papain at higher temperatures.

C It increases the stability of papain at higher temperatures.

D It reduces the number of collisions of papain with the substrate.

[Turn over

17 The diagram shows how adrenaline activates processes inside a cell.



Which row is correct?

	type of receptor molecule	result of ligand binding to the receptor
A	phospholipid	receptor leaves membrane
B	protein	receptor changes shape
C	phospholipid	receptor changes shape
D	protein	receptor leaves membrane

18 The statements are comparisons of endocytosis and exocytosis.

- Both are mechanisms that involve vesicles or vacuoles and the transport of materials across the cell surface membrane.
- Both mechanisms occur to allow bulk transport across the cell surface membrane.
- Endocytosis involves taking materials into the cell, whereas exocytosis involves the release of materials from the cell.
- Some of the cell surface membrane is lost when endocytosis occurs and there is an increase in the cell surface membrane when exocytosis occurs.

How many statements are correct?

A 1 **B** 2 **C** 3 **D** 4

19 A student was asked to calculate the surface area : volume ratio for an agar cube with a side length of 5.5 mm.

Which surface area : volume ratio is correct?

A 0.2 : 1 **B** 0.9 : 1 **C** 1.0 : 1 **D** 1.1 : 1

20 Which statement about the behaviour of chromosomes during telophase is correct?

A Chromosomes attach to the spindle fibres at the equator.

B Chromosomes start to uncoil inside the newly formed nucleus.

C Chromosomes move towards the opposite poles of the cell.

D Chromosomes condense into compact structures in the cytoplasm.

21 The transmission electron micrograph shows a cell in a stage of the mitotic cell cycle.

Which statement explains why it is difficult to identify the stage of the mitotic cell cycle shown?

A Chromosomes have supercoiled and are visible, but centrioles are not visible.

B Anaphase may be continuing, or telophase may be starting.

C It is unclear whether the electron micrograph shows two cells in metaphase.

D Some people may consider interphase to have started.

[Turn over

22 During lagging strand replication, short fragments of DNA are produced. The fragments are joined together by DNA ligase.

Which row correctly describes the structure of these short fragments of DNA?

	have base sequences that are complementary to the newly synthesised leading DNA strand	consists of one polynucleotide strand	contains only carbon, hydrogen, oxygen and nitrogen
A	✗	✗	✓
B	✗	✓	✗
C	✓	✗	✓
D	✓	✓	✗

key

✓ = correct

✗ = not correct

23 The genome of the bacterium *Escherichia coli* has been altered to enable it to code for an amino acid that is not found in nature. All the ATC DNA stop triplets on the strand of DNA that is transcribed have been substituted to ATT. The ATC triplet can then be inserted to code for the new amino acid. A new tRNA can then be constructed to carry the new amino acid.

What is the anticodon of this new tRNA?

A ATC **B** AUC **C** TAG **D** UAG

24 40% of the bases in a section of a non-transcribed strand of DNA are purine molecules.

What will be the total percentage of cytosine **and** uracil bases in the primary transcript that is transcribed from the other strand of the DNA?

A 20% **B** 30% **C** 40% **D** 60%

25 Which statement about xylem vessel elements is correct?

A Hollow vessels enable the constant movement of water up and down a plant.

B Pits enable the movement of water into adjacent xylem vessels.

C Vessels contain numerous mitochondria to generate ATP for active transport.

D Vessels contain perforated cross-walls called sieve plates.

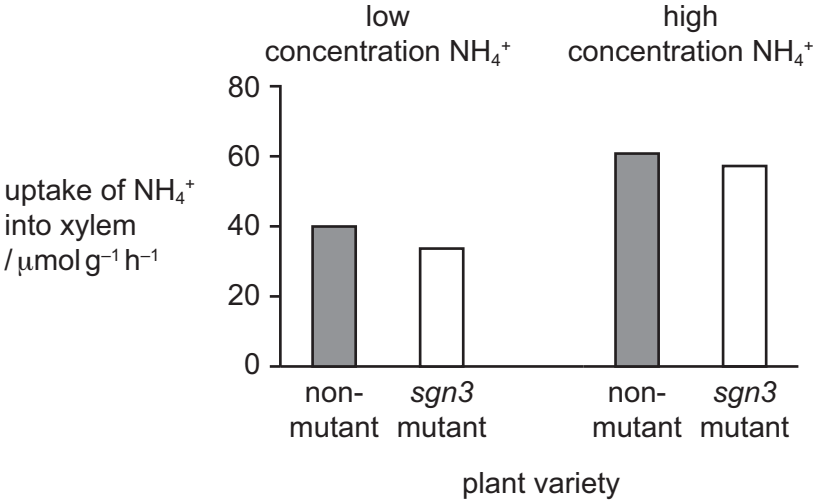
26 Ammonium ions, NH_4^+, can enter the xylem of plant roots by two pathways.

- In the apoplast pathway, ammonium ions move through cell walls until this pathway is blocked by the Casparian strip. Ammonium ions then enter the cytoplasm of root cells.
- In the symplast pathway, ammonium ions move through the cytoplasm of root cells.

A scientist measured the uptake of ammonium ions into the xylem of *Arabidopsis thaliana*.

The *sgn3* mutant of *A. thaliana* does not have a Casparian strip. In the *sgn3* mutant, ammonium ions can enter the xylem without entering the cytoplasm of root cells.

The bar charts show the scientist's results.



Which conclusion is correct?

A Fewer ammonium ions enter the xylem when they have to move through the cytoplasm of root cells.

B More ammonium ions enter the xylem at low soil concentrations of ammonium ions.

C The Casparian strip acts as a barrier to reduce the movement of ammonium ions into the xylem.

D The loss of the Casparian strip has little effect on the movement of ammonium ions into the xylem.

27 Which row correctly shows processes required for the movement of water from a root hair cell to the atmosphere?

	cohesion	diffusion	evaporation
A	✓	✓	✓
B	✗	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = required

✗ = not required

[Turn over

28 Which process can be carried out by a mature red blood cell?

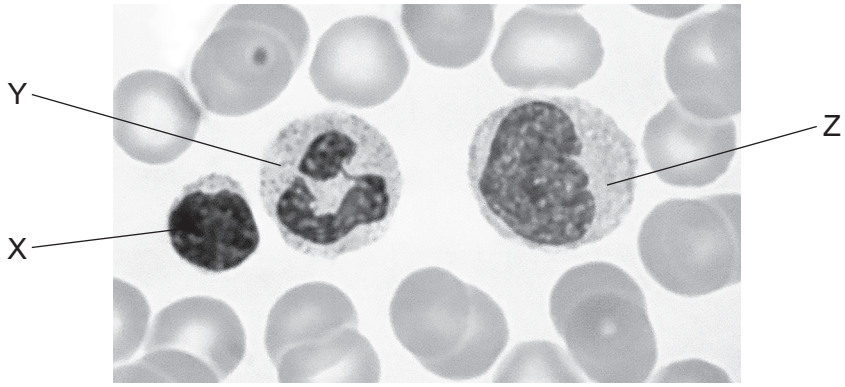
A active transport

B cell division

C phagocytosis

D protein synthesis

29 The photomicrograph shows three white blood cells labelled X, Y and Z.



Which row correctly identifies these cells?

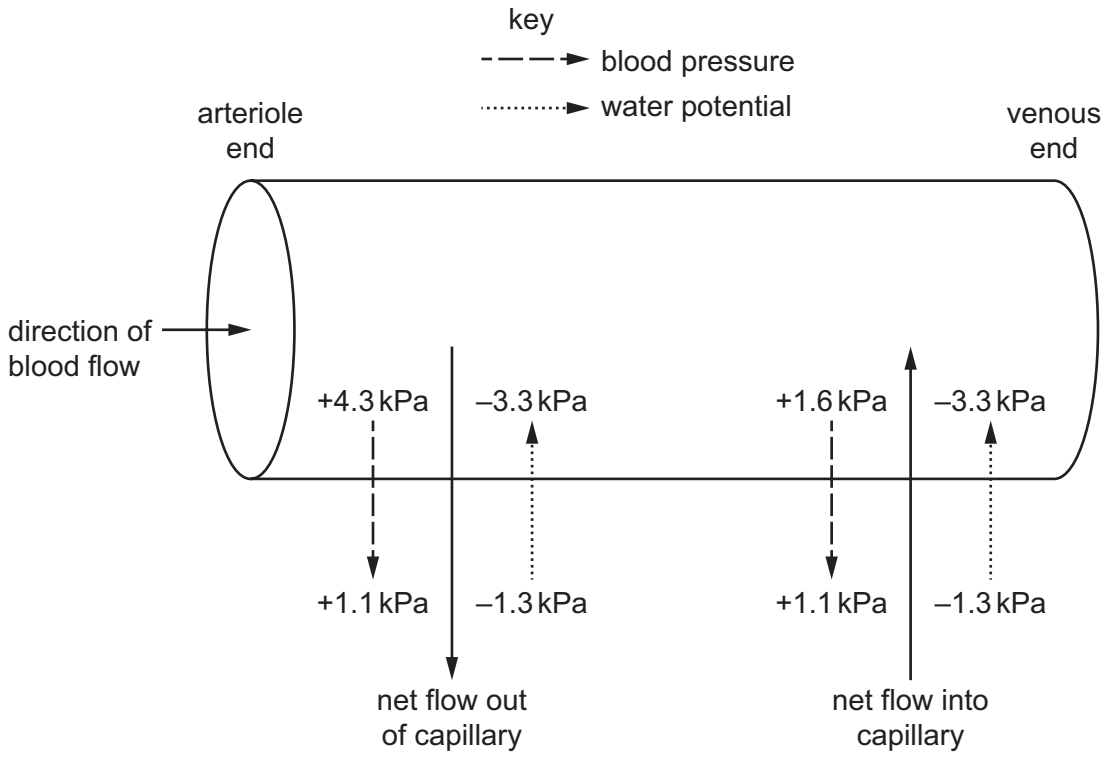
	cell X	cell Y	cell Z
A	lymphocyte	monocyte	neutrophil
B	lymphocyte	neutrophil	monocyte
C	monocyte	neutrophil	lymphocyte
D	neutrophil	monocyte	lymphocyte

30 When a blood vessel is damaged it can result in problems in the body.

Which row identifies the blood vessel that could have been damaged?

	blood is not being distributed to organs that need it	blood is not returning to the heart and is collecting in organs	blood surges mean that relatively constant blood pressure is not maintained
A	elastic artery	muscular artery	vein
B	elastic artery	vein	muscular artery
C	muscular artery	elastic artery	vein
D	muscular artery	vein	elastic artery

31 The diagram shows how tissue fluid is formed.



What is the net pressure causing tissue fluid to flow out of the capillary at the arteriole end?

A –1.5 kPa **B** +1.0 kPa **C** +1.2 kPa **D** +5.2 kPa

32 What happens when carbon dioxide is transported by red blood cells?

A Hydrogencarbonate ions move into the red blood cells and chloride ions move into the plasma.

B Chloride ions move into the red blood cells and bind to haemoglobin.

C Chloride ions move into the red blood cells and hydrogen ions move into the plasma.

D Chloride ions move into the red blood cells and hydrogencarbonate ions move into the plasma.

33 What is typically found in the trachea, bronchi and bronchioles in the human gas exchange system?

A cartilage

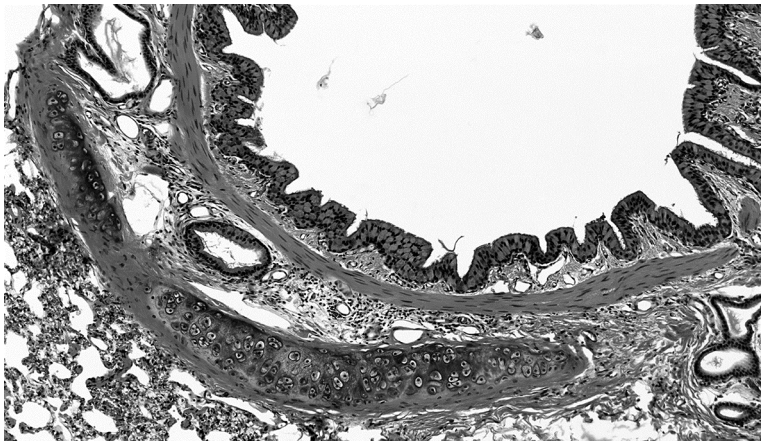
B ciliated epithelium

C squamous epithelium

D squamous endothelium

[Turn over

34 The photomicrograph shows a section through part of the human gas exchange system.



Which structure is shown?

A alveolus

B bronchiole

C bronchus

D trachea

35 Which factors are required for the **efficient** diffusion of oxygen and carbon dioxide in the human gas exchange system?

1 clean and warm air entering the lungs

2 maximised area of exchange surface

3 minimum distance between alveoli and blood

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

36 Which statements correctly identify why it is difficult to eliminate TB?

1 Humans have limited access to clean water.

2 Humans can be infected but the pathogen can be inactive.

3 A number of drug-resistant strains of the pathogen have evolved.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

37 Bacteria can become resistant to antibiotics.

What can help reduce the development of antibiotic resistance in bacteria?

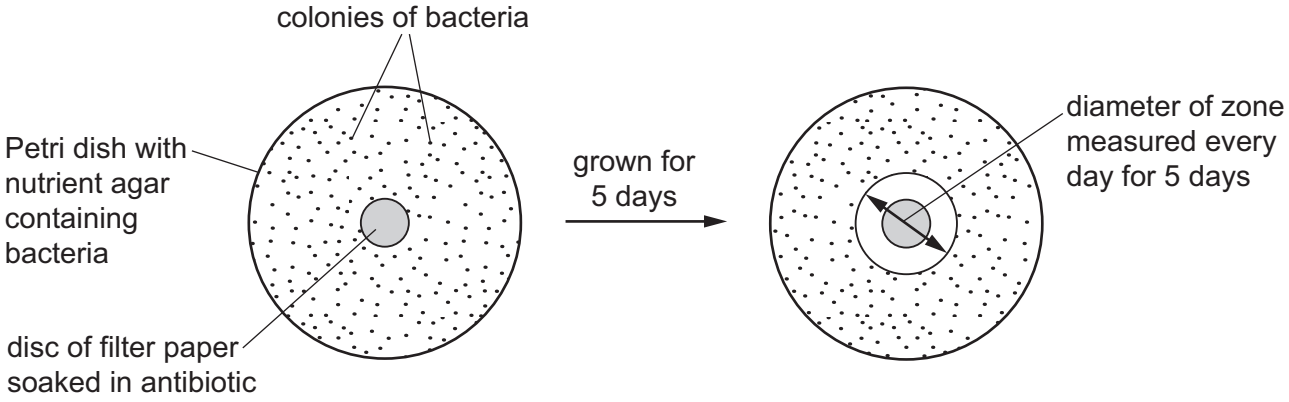
1 Use specific antibiotics instead of wide spectrum.

2 Use antibiotics to treat viral infections.

3 Develop new antibiotics.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

38 The diagram shows one way of testing the effect of an antibiotic on bacteria.



The table shows the results of testing five different types of bacteria.

Zones of less than 13.0 mm show the presence of resistant bacteria.

type of bacteria	diameter of zone / mm				
	day 1	day 2	day 3	day 4	day 5
1	24.1	21.9	19.0	17.6	14.3
2	18.6	15.4	12.2	9.0	2.0
3	17.9	12.8	12.4	11.1	10.9
4	19.4	15.3	13.2	8.1	2.0
5	22.0	21.0	20.5	20.4	20.4

Which statement can be supported by this data?

A All the types of bacteria become resistant to antibiotics over time.

B Only types 2, 3 and 4 of the bacteria show resistance to the antibiotic.

C The antibiotic can be used to treat types 1 and 3 only.

D Type 5 of the bacteria can never become resistant to the antibiotic.

[Turn over

39 Some responses made by cells of the immune system to a pathogen are listed.

1 mitosis

2 recognises a pathogen

3 produces memory cells

4 secretes enzymes

Which responses are correct for phagocytes?

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 3 only

D 2 and 4 only

40 Some vaccines do not contain antigens. The vaccines contain a molecule of mRNA. Cells in the immune system use the mRNA molecule to make a protein antigen.

The statements describe the stages of how mRNA vaccines work when they enter a cell of the immune system.

1 B-lymphocytes and T-lymphocytes with complementary receptors bind to the protein.

2 Lymphocytes differentiate into memory cells that give long lasting immunity.

3 Ribosomes translate the mRNA molecule to make a protein.

4 The cell displays the protein on its cell surface membrane.

What is the correct order of the stages of how mRNA vaccines work?

A $1 \rightarrow 2 \rightarrow 4 \rightarrow 3$

B $3 \rightarrow 1 \rightarrow 2 \rightarrow 4$

C $3 \rightarrow 4 \rightarrow 1 \rightarrow 2$

D $4 \rightarrow 1 \rightarrow 2 \rightarrow 3$