Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/11**

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

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

3346162285

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.

This document has **20** pages. Any blank pages are indicated.

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[Turn over

1 Until recently, the typical viruses known to science were 20–150 nm in size.

In 2003, the Mimivirus was discovered with a size of approximately 680 nm.

In 2013, the Pandoravirus was discovered which has a size of over 1000 nm.

Which viruses can be seen using a light microscope with a maximum resolution of 0.25 μm **and** an electron microscope?

	typical virus	Mimivirus	Pandoravirus
A	✓	✓	✓
B	✗	✓	✓
C	✗	✗	✓
D	✗	✗	✗

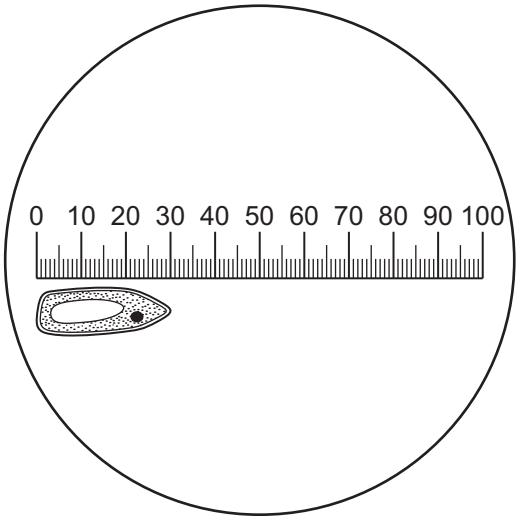
key

✓ = can be seen

✗ = cannot be seen

2 The diagram shows an eyepiece graticule and a cell viewed through a microscope. When the eyepiece graticule was calibrated at this magnification, the whole length of the graticule shown covered 12 divisions of a stage micrometer scale.

There were 100 divisions in 10 mm of the stage micrometer.



What is the actual length of the cell?

A 2.5 μm **B** 3.6 μm **C** 360 μm **D** 3 mm

3 Tay-Sachs disease results in a build-up of lipids in cells.

Which cell structure does **not** function correctly in this disease?

A Golgi body

B lysosome

C mitochondrion

D smooth endoplasmic reticulum

4 Which animal cells would have the most extensive Golgi bodies?

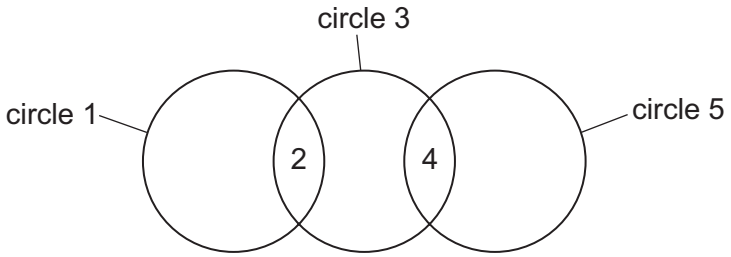
A ciliated epithelial cells

B goblet cells

C red blood cells

D smooth muscle cells

5 The diagram shows three circles, 1, 3 and 5, and the shared structures, 2 and 4.



Which row correctly identifies the three circles and some of the structures that are shared between them?

	circle 1	2	circle 3	4	circle 5
A	chloroplasts	circular DNA	mitochondria	80S ribosomes	prokaryotes
B	chloroplasts	80S ribosomes	mitochondria	circular DNA	prokaryotes
C	prokaryotes	circular DNA	mitochondria	circular DNA	chloroplasts
D	prokaryotes	70S ribosomes	chloroplasts	80S ribosomes	mitochondria

6 Which row about the genetic material in animal cells and prokaryotic cells is correct?

	animal cells contain linear DNA	prokaryotic genetic material is surrounded by a double membrane	prokaryotic genetic material is double-stranded DNA
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✗	✓

key

✓ = correct

✗ = not correct

7 What is present in **all** viruses?

A uracil

B ribose

C thymine

D guanine

8 The test for non-reducing sugars requires a second Benedict's test to be carried out.

Which set of steps is the correct method for carrying out the non-reducing sugar test **before** carrying out the second Benedict's test?

A Perform the Benedict's test, which gives a negative result.
Warm gently with dilute hydrochloric acid.
Neutralise with sodium hydrogencarbonate.

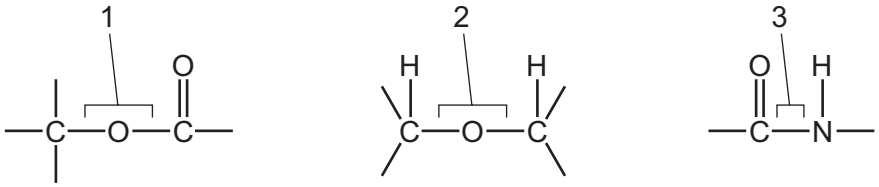
B Perform the Benedict's test, with the colour of the solution remaining red.
Boil with dilute hydrochloric acid.
Neutralise with sodium hydrogencarbonate.

C Perform the Benedict's test, with the colour of the solution remaining blue.
Boil with dilute hydrochloric acid.
Neutralise with sodium hydrogencarbonate.

D Perform the Benedict's test, which gives a negative result.
Neutralise with sodium hydrogencarbonate.
Warm gently with dilute hydrochloric acid.

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9 The diagrams show three types of covalent bonds.



Which bonds will be found in glycolipids and glycoproteins?

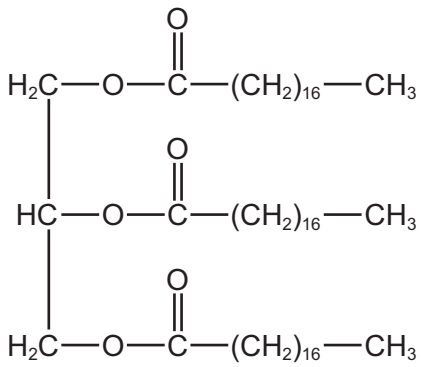
	bond 1	bond 2	bond 3
A	glycolipids only	glycolipids and glycoproteins	glycoproteins only
B	glycolipids and glycoproteins	glycolipids only	glycoproteins only
C	glycoproteins only	glycolipids only	glycolipids and glycoproteins
D	glycoproteins only	glycolipids and glycoproteins	glycolipids only

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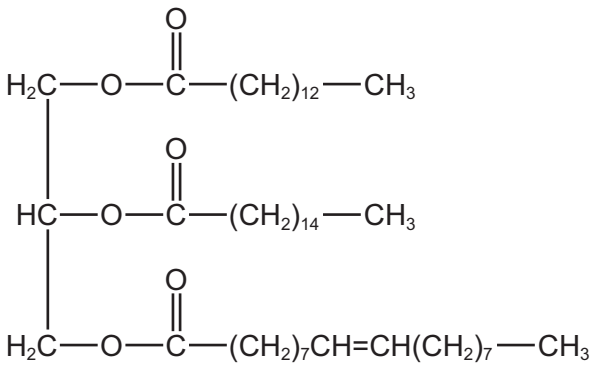
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10 Which molecules would be found in an oil (liquid) more than in a fat (solid)?

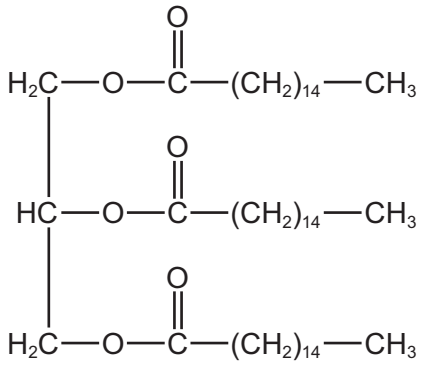
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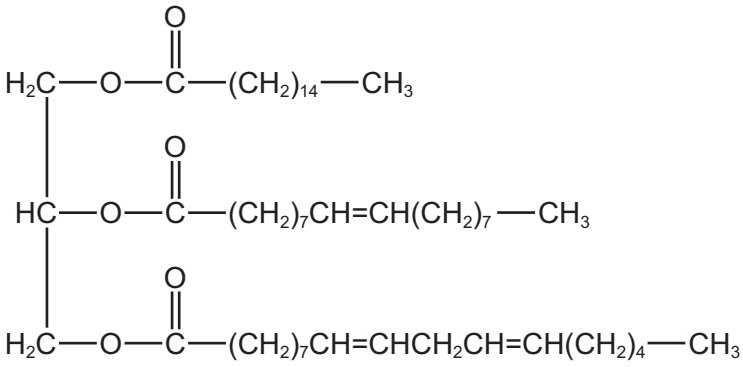
2



3



4



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

11 Which row about the bonding found in the primary, secondary, tertiary and quaternary structure of proteins is correct?

	primary	secondary	tertiary	quaternary
A	covalent	covalent	ionic and disulfide only	hydrogen and hydrophobic interactions only
B	covalent	hydrogen	hydrogen, ionic, covalent and hydrophobic interactions	hydrogen, ionic, covalent and hydrophobic interactions
C	peptide	covalent	hydrogen, ionic, disulfide and hydrophobic interactions	hydrogen, ionic and disulfide
D	peptide	hydrogen	ionic and disulfide only	ionic and disulfide only

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12 The specific heat capacity of different substances is shown.

substance	specific heat capacity / $J\,g^{-1}\,°C$
air	1.0
hydrogen gas	14.3
water (liquid)	4.2
water (steam)	2.1

Which statement is correct?

A Air is a more stable environment than water because it is more resistant to changes in temperature.

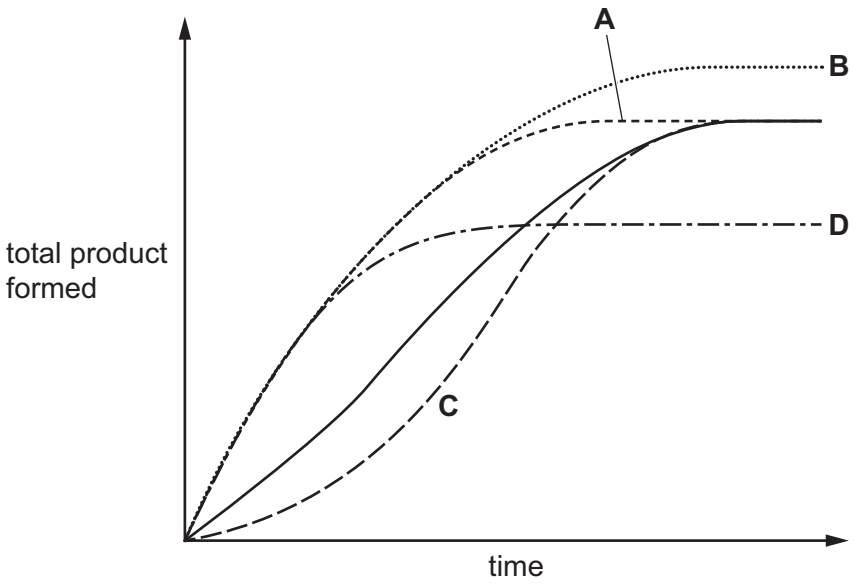
B It takes more energy to raise the temperature of hydrogen gas than it does to raise the temperature of water.

C A specific heat capacity of $4.2\,J\,g^{-1}\,°C$ means that it takes 4.2 J of energy to vaporise 1.0 g of liquid water.

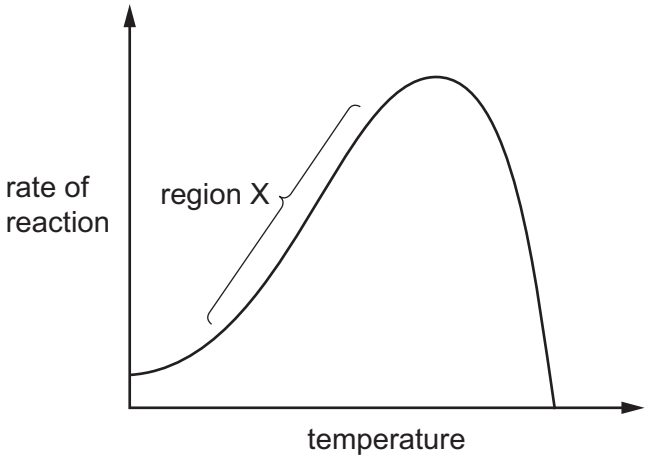
D There are more hydrogen bonds between water molecules in a gas than between water molecules in a liquid.

13 The solid line on the graph represents the product formed over time for a reaction in a cell.

Which other line represents the effect of adding the enzyme for this reaction?



14 The graph shows how the rate of an enzyme-controlled reaction is affected by the change in temperature. All other variables were standardised.



What is the factor limiting the rate in region X?

A substrate concentration

B enzyme concentration

C temperature

D number of empty active sites

15 How will the removal of a reversible non-competitive enzyme inhibitor affect an enzyme-catalysed reaction?

A The K_m will decrease and the V_{max} will increase.

B The K_m will increase and the V_{max} will not change.

C The K_m will not change and the V_{max} will increase.

D The K_m will not change and the V_{max} will not change.

16 The dimensions of three agar cylinders, X, Y and Z, are summarised in the table.

cylinder	radius / mm	length / mm
X	2	10
Y	1	20
Z	5	5

What is the correct order of surface area : volume ratio for the cylinders, from smallest to largest?

A X → Y → Z **B** Y → X → Z **C** Z → X → Y **D** Z → Y → X

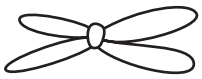
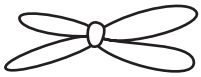
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17 Three individual plant leaf cells were each placed in a different solution for 30 minutes. Each solution had a different water potential.

Which row correctly shows the **change in volume** of the three cells after 30 minutes?

	water potential of solution		
	lower than cells	equal to cells	higher than cells
A	decreased	increased	decreased
B	decreased	no change	increased
C	increased	decreased	decreased
D	increased	no change	increased

18 Which row is a representation of one chromosome at the beginning of prophase of mitosis and the number of DNA strands in the chromosome?

	appearance of one chromosome	number of DNA strands
A		2
B		4
C		1
D		2

19 Which events are part of mitosis?

1 interphase

2 telophase

3 cytokinesis

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

20 The statements are about genes and proteins involved in breast cancer.

- The protein coded by the *BRAC1* gene inhibits the growth of breast cancer cells.
- The protein coded by the *p53* gene suppresses tumours.

Which combination of genes is **most likely** to result in breast cancer?

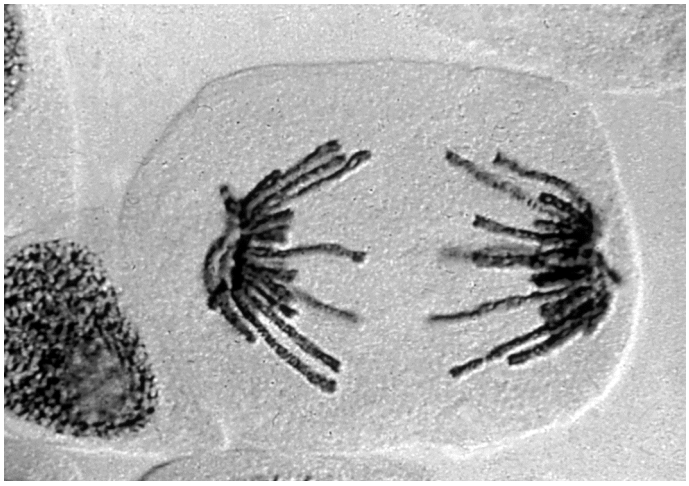
	BRAC1	*p53*
A	✗	✗
B	✗	✓
C	✓	✗
D	✓	✓

key

✓ = normal active gene

✗ = mutated gene

21 The photomicrograph shows a cell during mitosis.



What is happening in this cell?

1 Chromosomes are condensing.

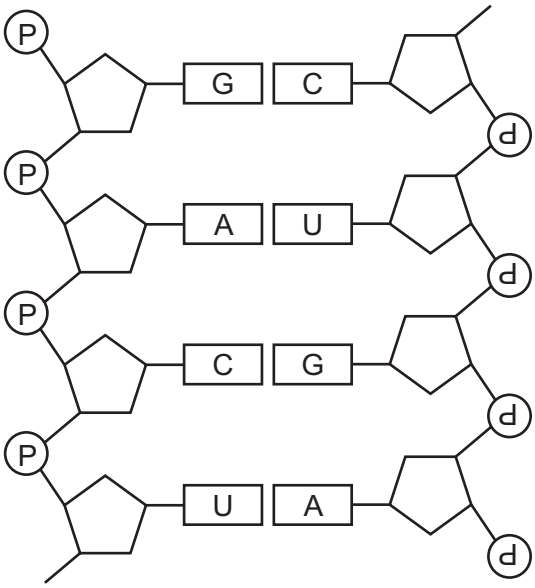
2 Centromeres are moving to opposite poles.

3 Spindle microtubules are shortening.

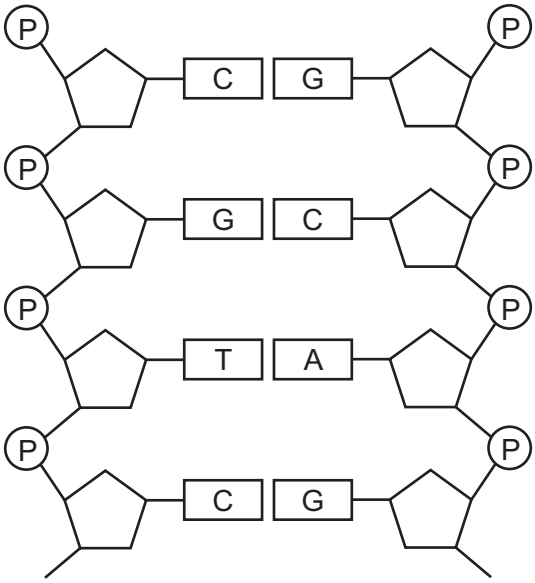
A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

22 Which diagram correctly shows the structure of a piece of DNA?

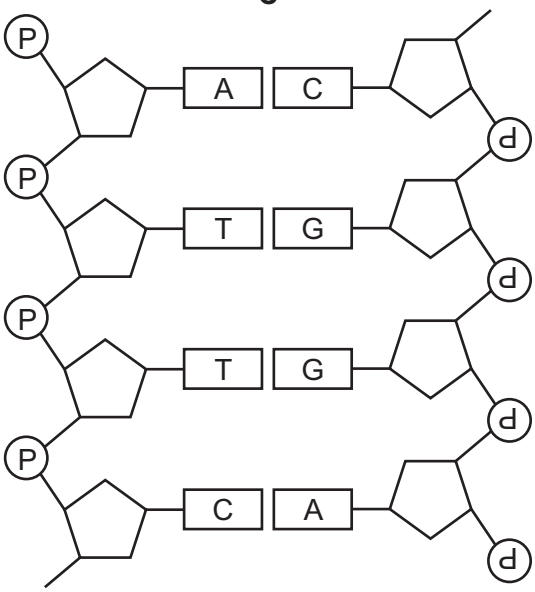
A



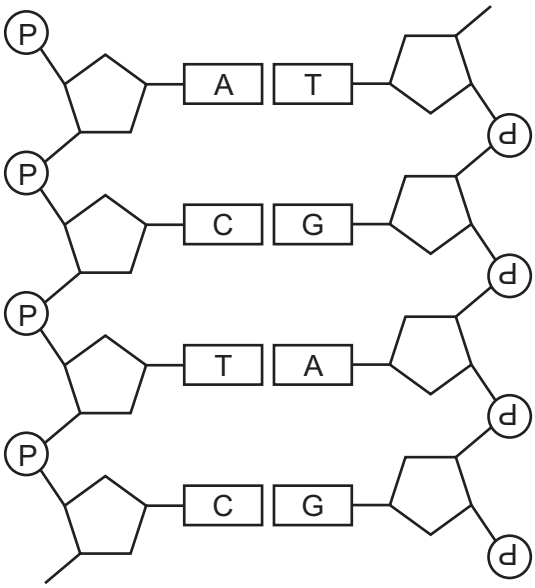
B



C



D



23 Bacteria were grown in a medium containing ^{15}N. After several generations, all of the bacterial DNA contained ^{15}N. Some of these bacteria were transferred to a medium containing the common isotope of nitrogen, ^{14}N. The bacteria were allowed to divide once. The DNA of some of these bacteria was extracted and analysed. This DNA was all hybrid DNA containing equal amounts of ^{14}N and ^{15}N.

The remaining bacteria were left in the medium with ^{14}N and allowed to divide one more time. The DNA of some of these bacteria was extracted and analysed.

What is the percentage of hybrid DNA?

A 25% hybrid DNA

B 50% hybrid DNA

C 75% hybrid DNA

D 100% hybrid DNA

24 Which statements correctly describe the process of transcription?

1 mRNA is decoded by a ribosome to produce a specific amino acid chain.

2 A section of DNA is converted to RNA by RNA polymerase.

3 tRNA transfers amino acids to the ribosome.

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

25 Sickle cell anaemia is caused by a mutation in an allele of the gene that codes for the β-globin polypeptide of haemoglobin.

The diagram shows the sequence of bases in a small section of the template strand of DNA for both the Hb^A (normal) and Hb^S (sickle cell) β-globin alleles.

Hb^A CTGACTCCTGAGGAGAAGTCT

Hb^S CTGACTCCTGTGGAGAAGTCT

Both the polypeptides for Hb^A and Hb^S are the same length.

How will the mutation in the allele result in the production of an altered version of the β-globin polypeptide?

A A tRNA molecule with the anticodon GUG will form hydrogen bonds with the altered codon on mRNA.

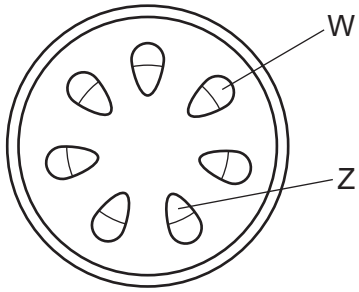
B All the amino acids coded for after the mutation will differ from those in the Hb^A protein.

C mRNA transcribed from the Hb^S allele will contain the codon CAC instead of the codon CTC.

D The ribosome will be unable to continue translation of the Hb^S mRNA after the altered codon.

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26 The plan diagram of a transverse section through a dicotyledonous plant stem was drawn by a student. They had stained the section with a chemical that stains lignin.



Which row is correct for tissues W and Z?

	W	Z	stained tissue
A	phloem	xylem	W
B	phloem	xylem	Z
C	xylem	phloem	W
D	xylem	phloem	Z

27 Which routes **must** water travel through in a plant, using the symplast pathway?

1 from soil into root hair cell vacuoles

2 from soil into root hair cell walls

3 from root hair cell walls to root cortex cell walls

4 from cortex cell walls into endodermis cells

5 from endodermis cells into xylem vessels

6 from leaf mesophyll cell walls into air spaces

A 1 and 4 **B** 2, 3 and 6 **C** 3, 5 and 6 **D** 4 and 5

28 A plant leaf seen in transverse section with a microscope shows the features listed.

- a thick waxy cuticle on upper surface
- sunken stomata on lower surface
- rolled leaf so the edges curl

What is this leaf adapted for?

A to decrease carbon dioxide uptake

B to increase carbon dioxide uptake

C to decrease water loss by transpiration

D to increase water loss by transpiration

29 What occurs as carbohydrate is taken out of a sink into a phloem sieve tube element?

	water potential in phloem sieve tube element becomes	volume of liquid in phloem sieve tube element
A	higher	decreases
B	higher	increases
C	lower	decreases
D	lower	increases

30 Which factors affect blood pressure?

1 the diameter of the blood vessels

2 the systolic pressure of the heart ventricles

3 the volume of blood returning to the heart in each cardiac cycle

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

31 Sulthiame is a molecule that inhibits carbonic anhydrase.

Which effect would sulthiame have inside a red blood cell in muscle tissue that is respiring at a high rate?

A a decrease in the rate of formation of haemoglobinic acid

B a decrease in the pH

C an increase in the rate of the chloride shift

D an increase in the dissociation of oxyhaemoglobin

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32 The partial pressure of oxygen in blood vessels in different parts of the body affects the percentage saturation of each haemoglobin molecule with oxygen.

blood vessel	partial pressure of oxygen / kPa	saturation of each haemoglobin molecule with oxygen / %
vein in active muscle	4	25
vein in resting muscle	7	75
arteriole in lungs	12	100

Which statement explains the difference in saturation between a resting and an active muscle?

A A small decrease in partial pressure causes two atoms of oxygen to leave each haemoglobin molecule because the oxygen dissociation curve is sigmoid shaped.

B A small decrease in partial pressure between 4 kPa and 7 kPa causes two molecules of oxygen to leave each haemoglobin molecule because the oxygen dissociation curve is steep.

C Loading of oxygen is slower between 4 kPa and 7 kPa due to binding of one oxygen molecule to each haemoglobin molecule making the next one harder to bind.

D Loading of oxygen is faster between 4 kPa and 7 kPa due to binding of one oxygen molecule to each haemoglobin molecule making the next one easier to bind.

33 Which statements about the Bohr shift are correct?

1 The shift is accelerated by the action of carbonic anhydrase.

2 A decrease in blood pH will cause oxyhaemoglobin to dissociate.

3 A decrease in carbon dioxide concentration will cause more oxygen to bind to haemoglobin.

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

34 Some of the events during a cardiac cycle are listed.

1 Left and right atria contract.

2 Left and right ventricles contract.

3 A wave of electrical activity is conducted by the Purkyne tissue.

4 A wave of electrical activity passes through the atrioventricular node.

What is the correct sequence of events after the sinoatrial node sends out a wave of electrical activity?

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

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

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

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

35 Oxygen and carbon dioxide enter and leave the blood in the capillaries of the alveoli.

Which statement about this process is correct?

A Oxygen and carbon dioxide only pass through one cell layer to reach their destination.

B Oxygen moves out of the blood and carbon dioxide moves into the blood during gaseous exchange.

C Oxygen rapidly diffuses into the alveoli and carbon dioxide rapidly diffuses out of the alveoli due to the large surface area of the alveoli.

D The capillaries have the lowest blood pressure in the body which allows the blood cells to remain in the alveolar capillaries to maximise gas exchange.

36 Which statement is correct?

A Cholera is caused by the virus *Vibrio cholerae*.

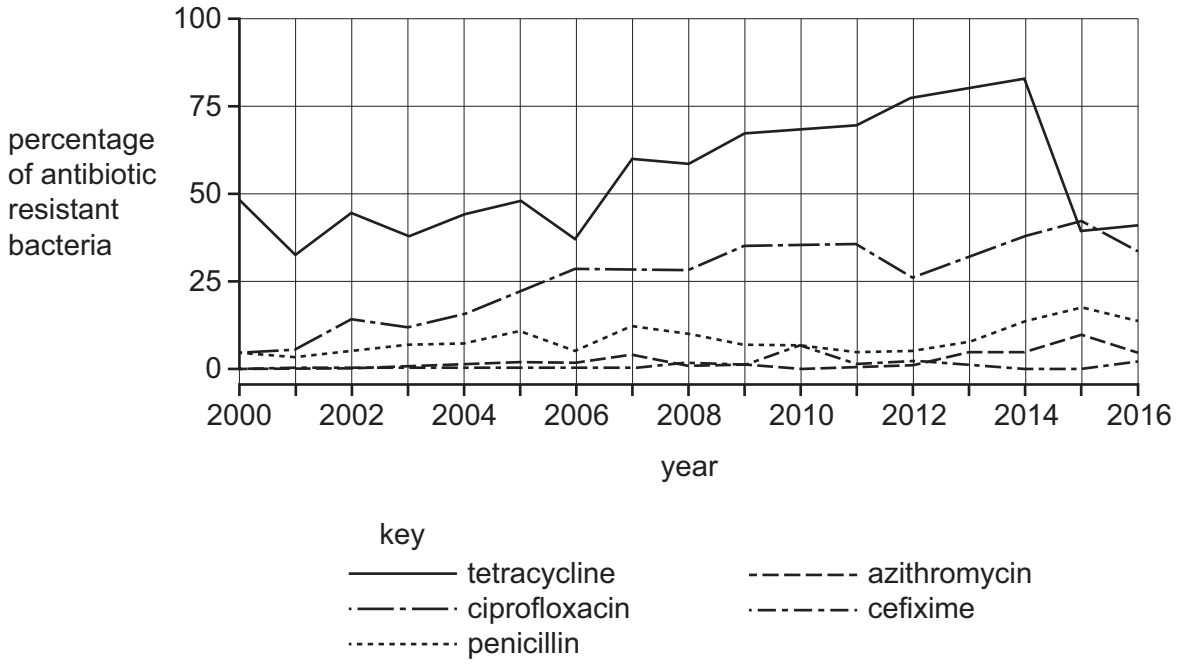
B Mosquitoes are pathogens that cause malaria.

C *Mycobacterium bovis* only causes TB in humans.

D *Plasmodium vivax* is an example of a protoctist.

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37 The graph shows changes in the antibiotic resistance of a species of bacterium between 2000 and 2016 in one country. Samples of bacteria were collected every year from 48 hospitals. The bacteria were tested to see if they showed resistance to five different antibiotics.



What can be concluded from the data in the graph?

A Overuse of ciprofloxacin has caused antibiotic resistance to increase by more than 20% between 2000 and 2016.

B Percentage resistance to three of the antibiotics was at a peak in 2015.

C Changes in treatment guidelines have caused resistance to some antibiotics to decrease from 2015 to 2016.

D The percentage of resistant bacteria is higher in 2016 than 2000 for all antibiotics.

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

1 mitosis

2 bind to specific antigens

3 produce memory cells

4 secrete antibodies

Which responses are correct for B-lymphocytes?

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 3 only

D 2, 3 and 4 only

39 Which statements about uses of monoclonal antibodies are correct?

1 Monoclonal antibodies can be injected into patients to give active immunity.

2 Monoclonal antibodies can be injected into patients to treat viral infections.

3 Monoclonal antibodies can be used as diagnostic tests for specific pathogens.

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

40 Which statement explains how a vaccination programme can control the spread of an infectious disease in a population?

A Unvaccinated individuals are less likely to meet a vaccinated individual.

B Unvaccinated individuals are less likely to meet an infected individual.

C Vaccinated individuals cannot catch the disease.

D Vaccinated individuals have natural active immunity.

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BIOLOGY **9700/12**

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

1 hour 15 minutes

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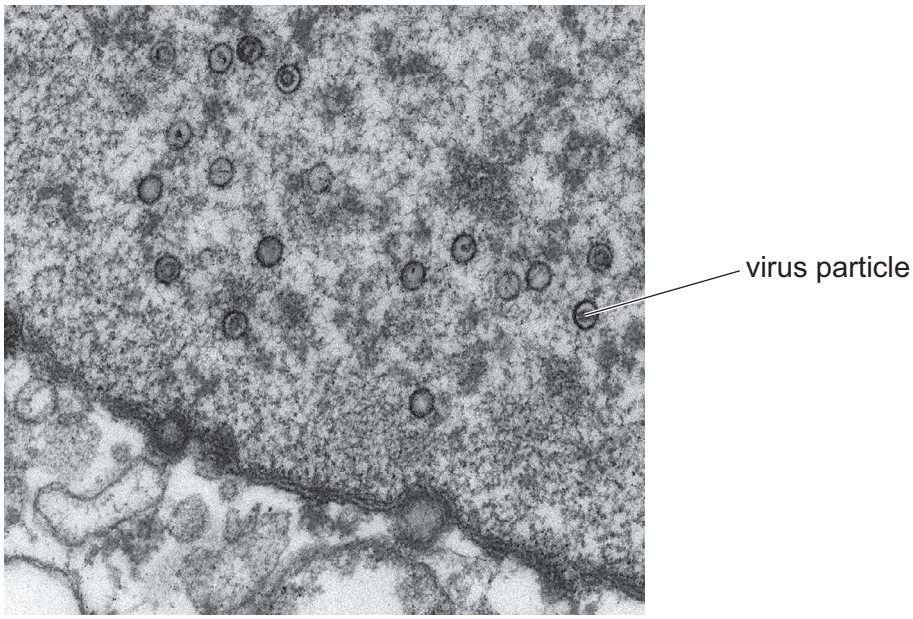
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1 Which combination of lenses for a light microscope will give the greatest magnification?

	eyepiece lens	objective lens
A	×5	×100
B	×10	×40
C	×15	×40
D	×15	×100

2 The diagram shows an electron micrograph of virus particles in a human nucleus.



×24 000

What is the diameter of the labelled virus particle?

A $1.5 \times 10^{0}\,\mu m$

B $1.5 \times 10^{-2}\,\mu m$

C $1.5 \times 10^{0}\,nm$

D $1.5 \times 10^{2}\,nm$

3 What is correct about the synthesis and release of the glycoprotein mucin in goblet cells?

1 The protein is produced on ribosomes and a carbohydrate chain is added in the Golgi body.

2 The glycoproteins are packed into vesicles in the Golgi body forming lysosomes.

3 Secretory vesicles containing the glycoprotein move from the Golgi body and fuse with the cell surface membrane.

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

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4 What are functions of microtubules?

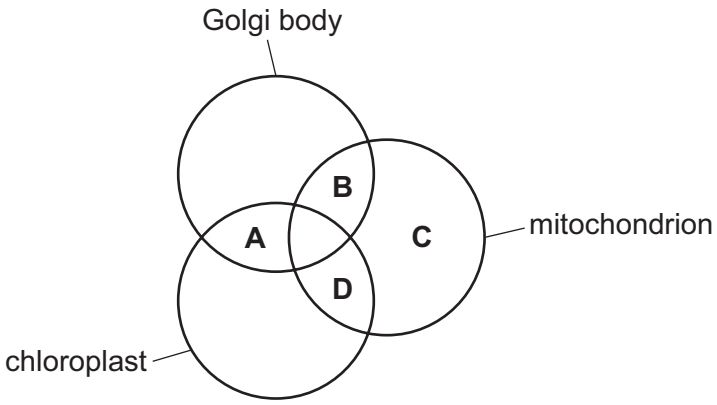
1 allowing movement of cilia in a bronchus

2 attachment to centromeres during metaphase

3 moving secretory vesicles around a cell

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

5 Which organelles contain nucleic acids?



6 Some features of cells are listed.

1 cell wall

2 cell surface membrane

3 ribosomes

Which features can be found in plant cells **and** in prokaryotic cells?

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

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

1 phosphodiester

2 peptide

3 covalent

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

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8 A student carried out the Benedict's test on four different concentrations of glucose solution and then recorded the time taken for the first appearance of a colour change (the end-point).

The student found it difficult to identify the first appearance of a colour change and consistently timed each solution for two seconds after the colour change first appeared. This introduced a source of error into the experiment.

Which statements about this error are correct?

1 The effect of the error will be reduced if the student performs three repeats at each concentration of glucose.

2 The error will prevent the student from identifying which solution has the highest concentration of glucose.

3 The error is systematic as the student consistently timed each solution for two seconds after the end-point.

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

9 Which statements about amylopectin and glycogen are correct?

1 Amylopectin and glycogen contain 1-4 glycosidic bonds.

2 Amylopectin contains β-glucose.

3 Glycogen contains more 1-6 branches than amylopectin.

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

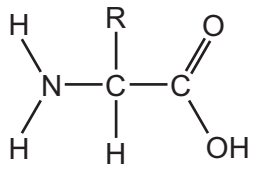
10 How many statements about fatty acids are correct?

- Fatty acids are either saturated or unsaturated.
- Fatty acids always have at least two double bonds.
- Long chains of fatty acids are very good energy stores.
- Fatty acids are insoluble in water and do not affect the water potential of the cell.

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

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11 The diagram represents an amino acid.



R represents a variable side chain.

What is **not** a possible side chain?

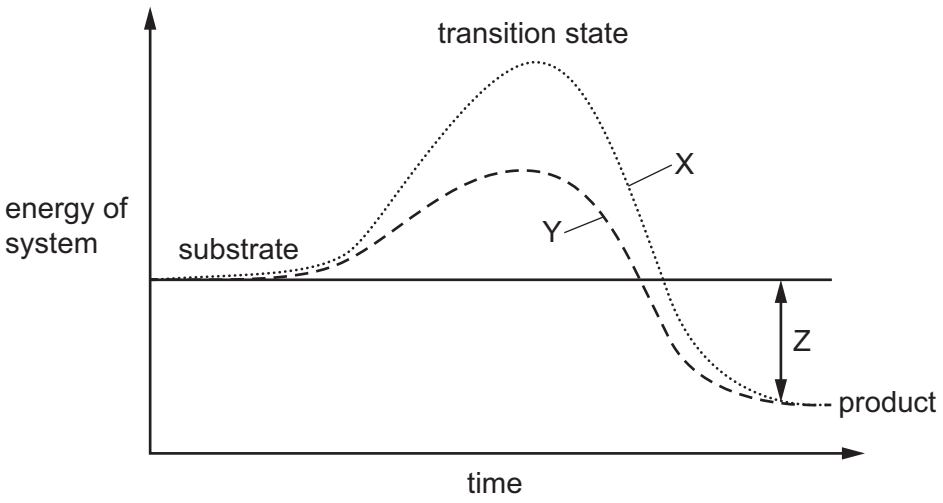
A CH_3

B $CH_2CH_2SCH_3$

C CH_2CONH_2

D $HOCH_2CH(OH)CH_2OH$

12 The graph shows the effect of an enzyme on a reaction.



Which row identifies X, Y and Z?

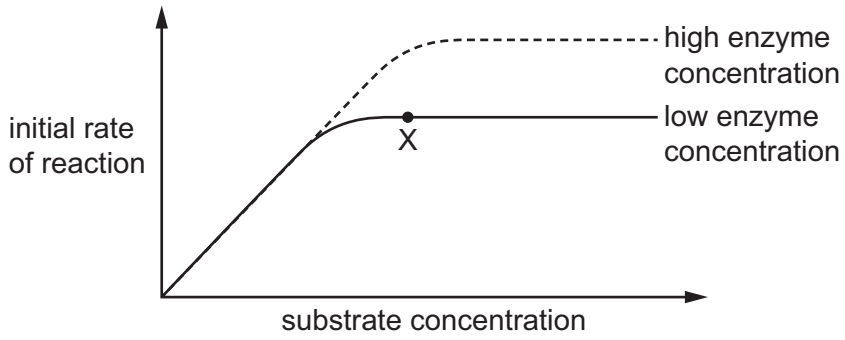
	X	Y	Z
A	catalysed reaction	uncatalysed reaction	energy lost by product
B	catalysed reaction	uncatalysed reaction	overall energy lost during reaction
C	uncatalysed reaction	catalysed reaction	energy gained by product
D	uncatalysed reaction	catalysed reaction	overall energy released during reaction

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13 The graph shows the results of two experiments on the effect of increasing substrate concentration on the rate of an enzyme-catalysed reaction.

One experiment was at a high concentration of enzyme and the second was at a low concentration of enzyme.

All other variables were standardised.



What would limit the initial rate of reaction at point X?

A enzyme concentration

B pH

C substrate concentration

D temperature

14 Which statements about the Michaelis–Menten constant (K_m) of an enzyme are correct?

1 At the K_m value, half the active sites of the enzyme should be occupied by the substrate.

2 K_m represents the substrate concentration at which the enzyme is working at half its maximum rate.

3 The lower the K_m value, the lower the affinity of the enzyme to its substrate.

4 When an enzyme has a high K_m value, the enzyme-catalysed reaction will proceed very slowly to its maximum rate.

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

15 Which component of cell surface membranes helps to reduce fluidity of the phospholipids at high temperatures?

A phosphate groups

B unsaturated fatty acids

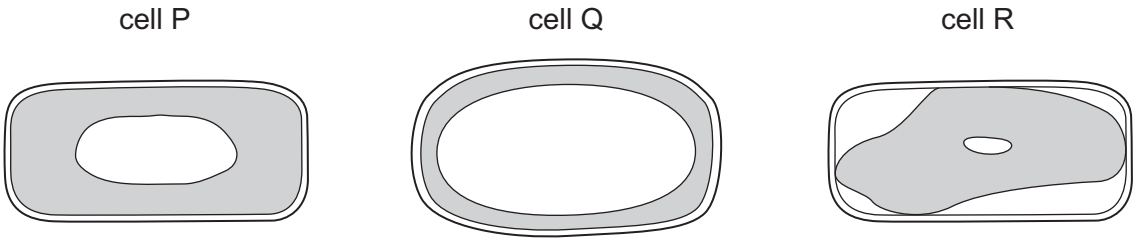
C cholesterol

D proteins

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16 Plant cells were left for 50 minutes in three different sugar solutions, 10%, 5% and 1%. The water potential in the cytoplasm of the three cells was the same at the start of the experiment.

The diagrams show the appearance of the cells after 50 minutes, using a light microscope.



Which conclusion is correct?

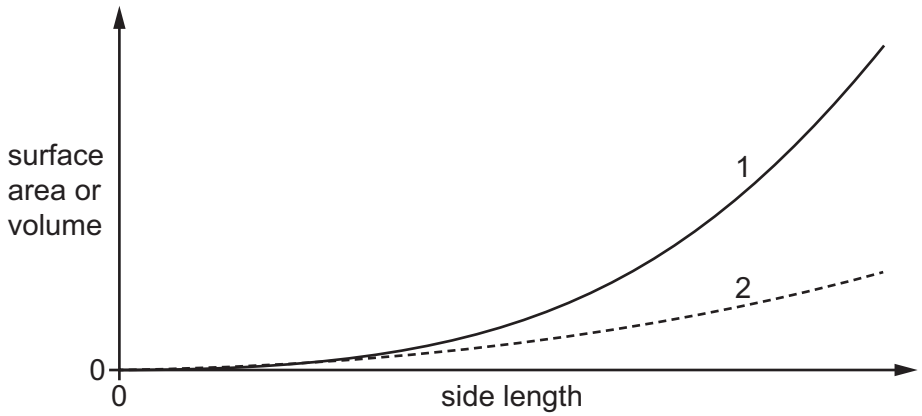
A Cell P has the same concentration of sugar inside and outside the cell.

B Cell Q is flaccid and cell P is plasmolysed.

C Cell Q was placed in the 1% solution.

D The sugar solution outside cell R has a less negative water potential than inside cell R.

17 The graph shows the effect of increasing the side length of agar cubes on the surface area and the volume of the cubes.



Which row correctly identifies line 1, line 2 and the effect of increasing side length on the surface area : volume ratio of the cubes?

	line 1	line 2	surface area : volume ratio
A	surface area	volume	decreases
B	surface area	volume	increases
C	volume	surface area	decreases
D	volume	surface area	increases

18 A human embryo consists of 12 cells at the start of day 1. The cells divide by mitosis for 4 complete days at a rate of 1 division every 32 hours.

What is the maximum number of cells in the embryo at the end of day 4?

A 48 cells

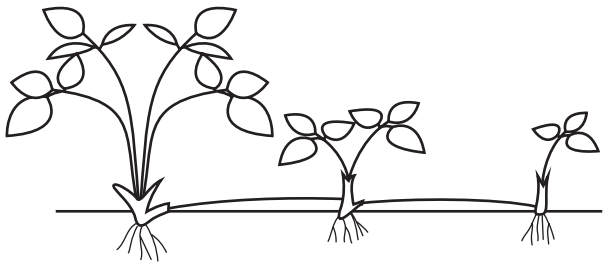
B 96 cells

C 192 cells

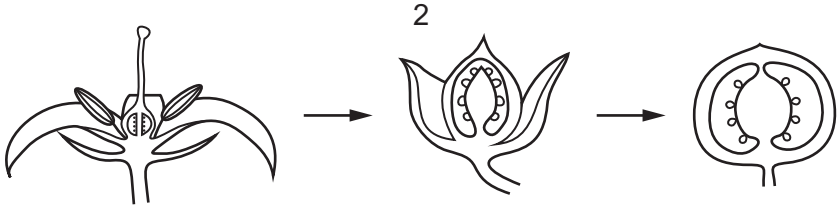
D 384 cells

19 Which diagrams show roles of mitosis?

1



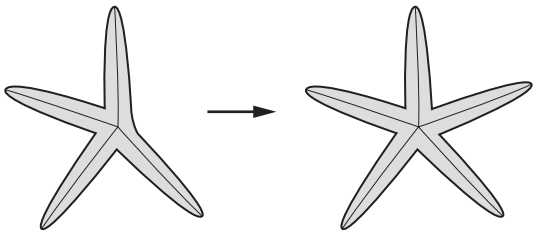
2



3



4



A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 2 only

D 3 and 4 only

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20 Which events are part of the mitotic cell cycle?

1 interphase

2 anaphase

3 cytokinesis

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

21 Which statement correctly describes a feature of a DNA molecule?

A It has two parallel strands twisted into a double helix.

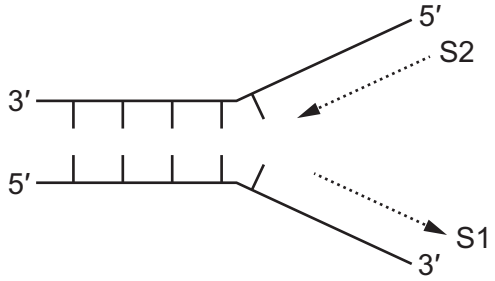
B It has complementary bases all held together by three hydrogen bonds.

C It has phosphodiester bonds that are formed using DNA ligase.

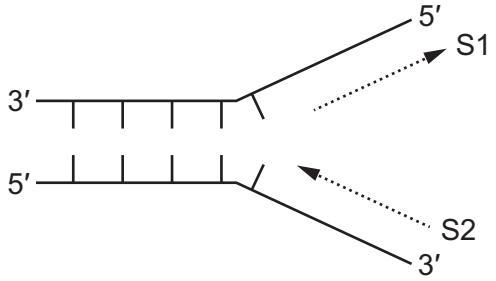
D It has a backbone of phosphate molecules and nucleotides.

22 Which diagram correctly shows the replication of DNA?

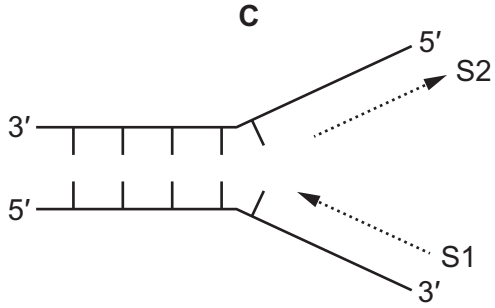
A



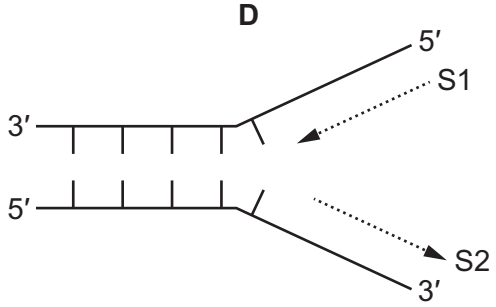
B



C



D



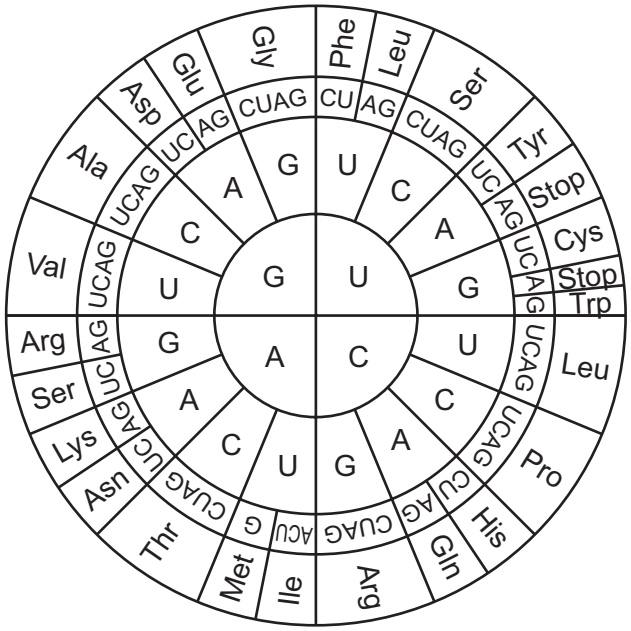
key

direction of replication

S1 leading strand

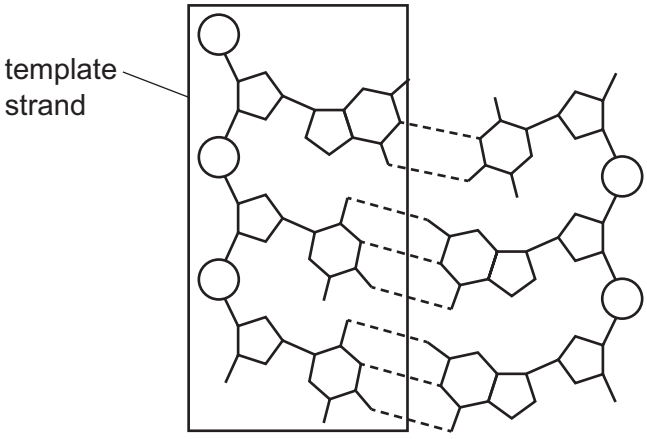
S2 lagging strand

23 The RNA codon wheel is a tool used to find which amino acid would be translated from an mRNA sequence.



Codon position 1 is in the centre of the wheel, codon position 2 is in the middle of the wheel and codon position 3 is near the edge of the wheel. The three letters on the outside edge of the wheel identify the amino acid.

The diagram shows a section of DNA coding for one amino acid. The template strand is outlined in a box and the DNA base sequence is read in the 5′ to 3′ direction.



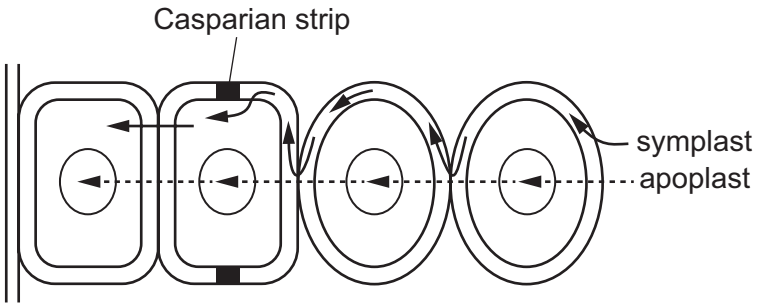
Which amino acid is coded for by this section of DNA?

A Gly **B** Pro **C** Trp **D** Thr

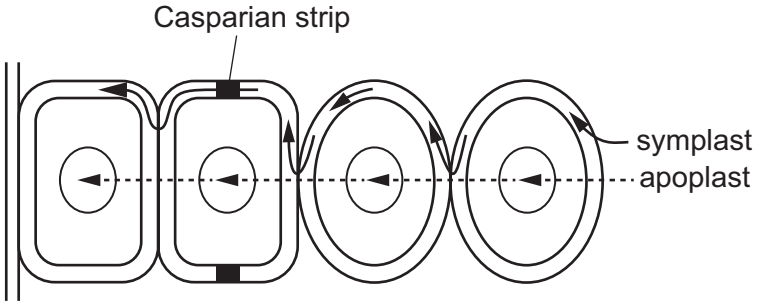
24 Four students sketched diagrams of the apoplast pathway and the symplast pathway.

Which sketch is the most accurate diagram of the two pathways?

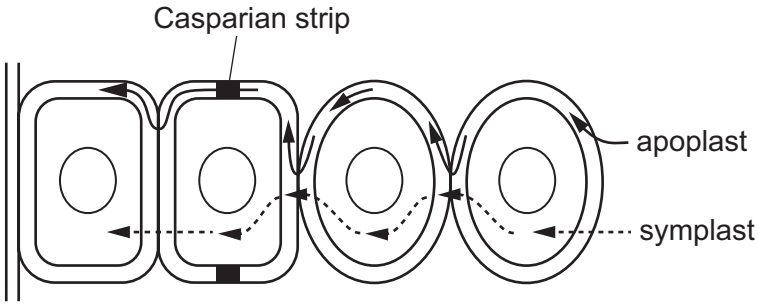
A



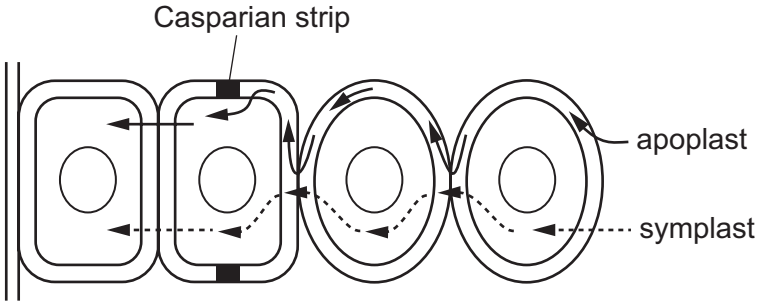
B



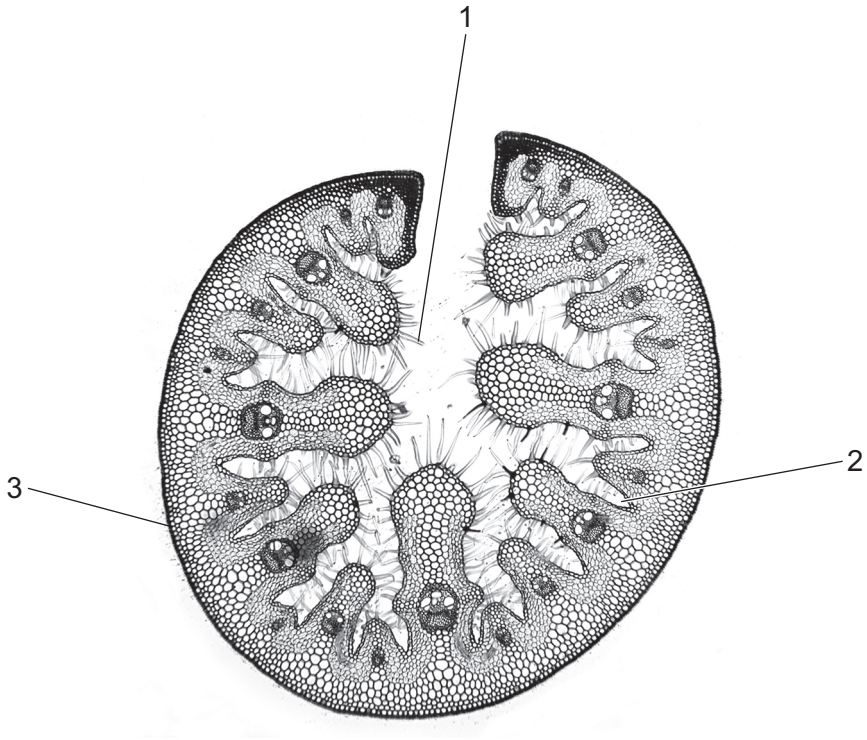
C



D



25 The photomicrograph shows some xerophytic adaptations in leaf tissue.



Which row shows the correct functions for structures 1, 2 and 3?

	reduces the water vapour concentration gradient between the inside and outside of the leaf	reduces evaporation from the epidermis of the leaf	traps a layer of moist air
A	1, 2 and 3	3 only	2 only
B	1 and 2 only	1, 2 and 3	1 and 2
C	1 only	2 and 3 only	1 and 2
D	2 and 3 only	1 and 2 only	1 only

26 Which processes are required for the transfer of assimilates from a source cell into a phloem sieve tube?

A active transport, facilitated diffusion and simple diffusion

B active transport and exocytosis

C active transport and simple diffusion only

D active transport only

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27 When sucrose is loaded into the phloem it has to travel from mesophyll cells to a companion cell and then into the phloem.

Which row shows the relative concentrations of sucrose in each type of cell in order for this process to take place?

	relative concentration of sucrose / arbitrary units		
	mesophyll cell	companion cell	phloem sieve tube element
A	5	10	15
B	5	15	10
C	15	10	5
D	15	5	10

28 Which feature of transport in plants is correct for xylem **and** phloem?

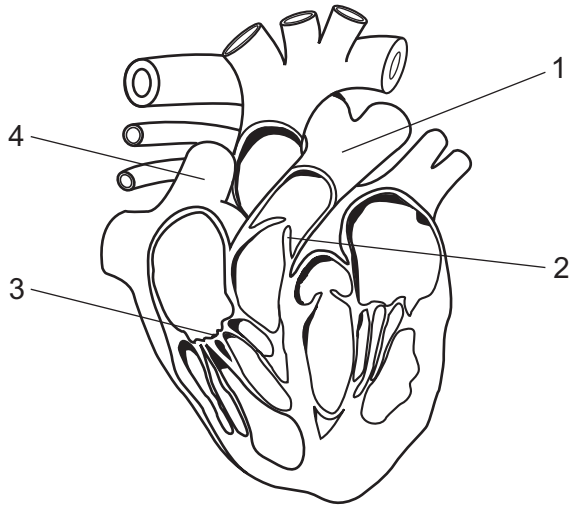
A It is passive.

B It occurs by mass flow.

C It occurs from source to sink.

D It occurs only in one direction.

29 The diagram shows an anterior view of a vertical section through the human heart.



Which row shows the correct labels for the diagram?

	1	2	3	4
A	aorta	atrioventricular valve	semilunar valve	pulmonary artery
B	pulmonary vein	semilunar valve	atrioventricular valve	pulmonary vein
C	pulmonary artery	semilunar valve	atrioventricular valve	vena cava
D	pulmonary vein	atrioventricular valve	semilunar valve	vena cava

30 What does the inner layer of veins **and** capillaries contain?

A collagen fibres

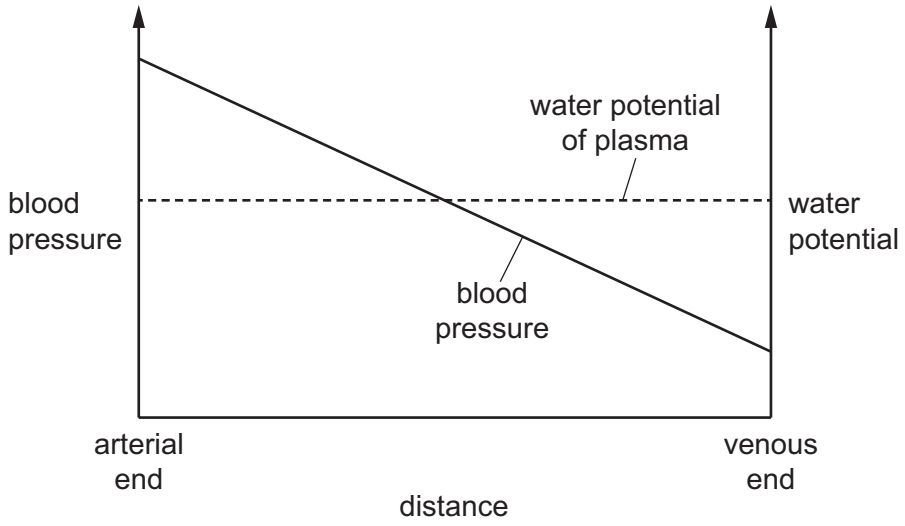
B elastic fibres

C endothelium

D smooth muscle

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31 The graph shows the changes in blood pressure and water potential across a blood capillary from the arterial end of the capillary to the venous end of the capillary.



What could result in an accumulation of excess tissue fluid?

A an increase in concentration of large proteins in the blood plasma

B an increase in blood pressure

C a decrease in the concentration of small proteins in tissue fluid

D a decrease in blood pressure

32 Which statement is correct about a red blood cell that has just entered a capillary in a respiring muscle?

A There is a net decrease in chloride ions.

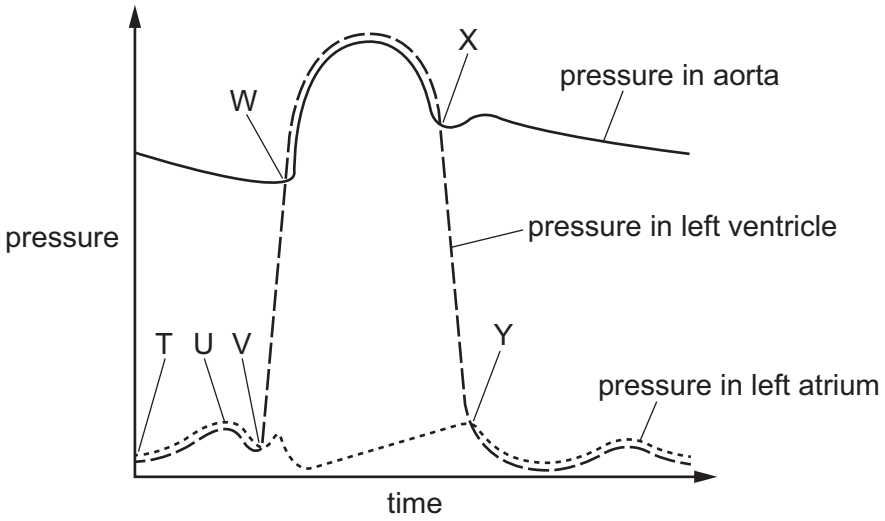
B There is a net decrease in haemoglobinic acid.

C There is a net increase in carbonic anhydrase.

D There is a net increase in carbaminohaemoglobin.

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33 The graph shows some blood pressure changes that occur in a human during one cardiac cycle.



When does systole start and end in the right atrium and in the right ventricle?

	in right atrium		in right ventricle	
	systole starts	systole ends	systole starts	systole ends
A	T	V	V	X
B	T	U	V	Y
C	U	V	W	X
D	V	W	W	Y

34 Which statements about **all** bronchioles are correct?

1 They have goblet cells.

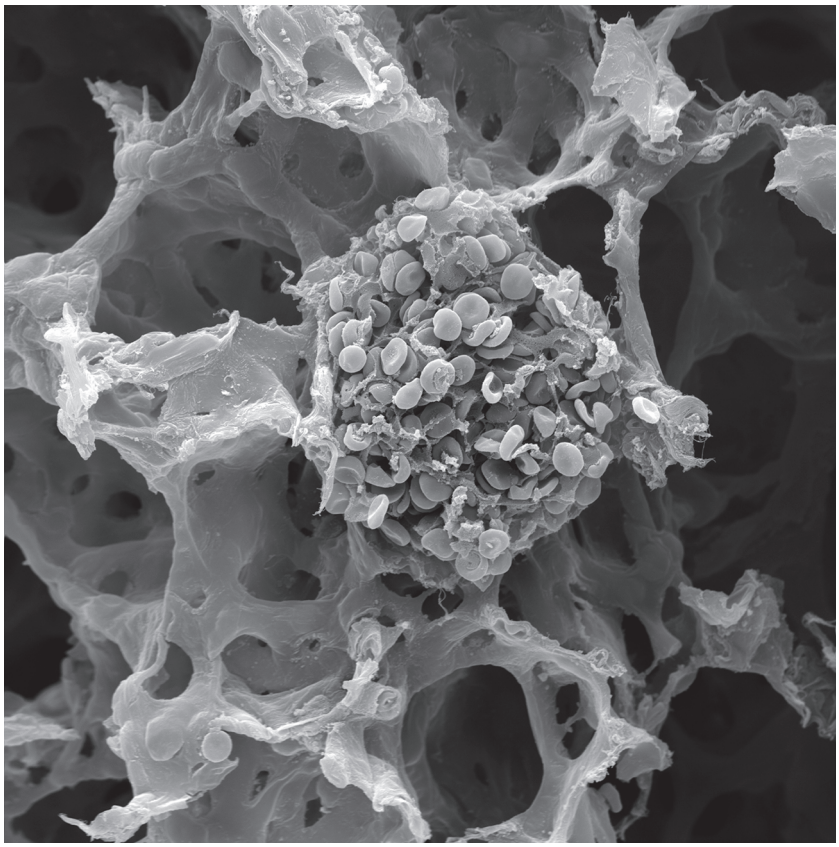
2 They have epithelial cells.

3 They have muscle tissue.

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

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35 What is shown in the electron micrograph?



×850

A scanning electron micrograph of bronchial epithelium and lymphocytes

B scanning electron micrograph of lung squamous epithelium and red blood cells

C transmission electron micrograph of bronchial epithelium and lymphocytes

D transmission electron micrograph of lung squamous epithelium and red blood cells

36 Which statement correctly describes infectious diseases?

A They are diseases caused by environmental factors that are not passed from one person to another.

B They are diseases caused by a fault in the DNA that can be passed from a parent to their offspring.

C They are diseases caused by a lack of a nutrient in the diet, such as a vitamin or mineral.

D They are diseases caused by a pathogen such as a bacterium, fungus, protoctist or virus.

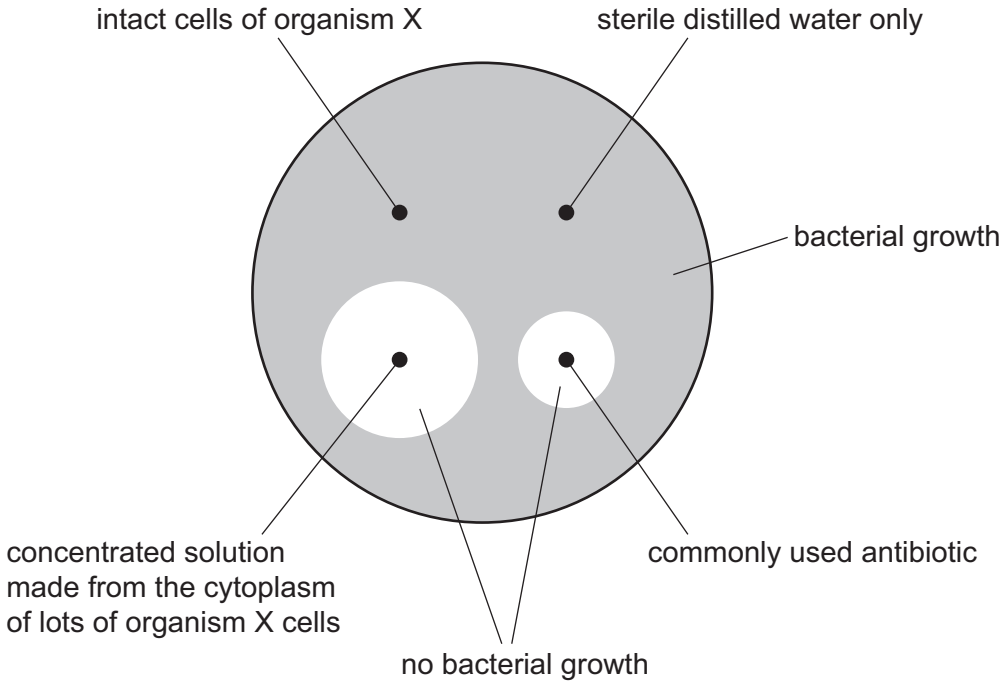
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37 Organism X produces molecule Y, which blocks the activity of 70S ribosomes.

An experiment was carried out to investigate the effect of Y on bacterial cells.

An agar plate with bacteria growing all over its surface had four wells cut into the agar. Different substances were added to each well and the agar plate with bacteria was incubated for a week.

The diagram shows the results after a week.



Which conclusions can be made from these results?

	molecule Y functions as an antibiotic	molecule Y cannot be released from cells of organism X	molecule Y would also affect the synthesis of proteins from nuclear DNA in a human cell
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = can be concluded

✗ = cannot be concluded

38 A patient has had repeated infections from the same pathogen over a few months. The patient has been treated with the same antibiotic on each occasion.

Which treatment could prevent an increase in the antibiotic resistance of the pathogen?

A a narrow spectrum antibiotic to treat a non-cellular pathogen

B a repeat prescription for the same antibiotic at a higher dose

C a specific antibiotic after testing for the pathogen

D a wide spectrum antibiotic to treat different strains of the pathogen

39 A patient with kidney failure can be given a kidney transplant. In a kidney transplant, a healthy kidney is taken from another person and put into the patient's body.

Sometimes the donated kidney cells are killed by the patient's body. In this primary immune response, T-lymphocytes bind to antigens on the donated kidney cells and are activated.

The statements describe the next stages of the primary immune response.

1 Activated T-lymphocyte secretes cytokines.

2 B-lymphocytes differentiate into plasma cells and make antibodies.

3 T-killer cells bind to antigens on donor kidney cells.

4 T-killer cells release toxins that destroy the donor kidney cells.

5 T-lymphocytes multiply by mitosis and differentiate into T-killer cells.

Which order correctly explains how donor kidney cells are killed?

A $1 \rightarrow 5 \rightarrow 2 \rightarrow 3$

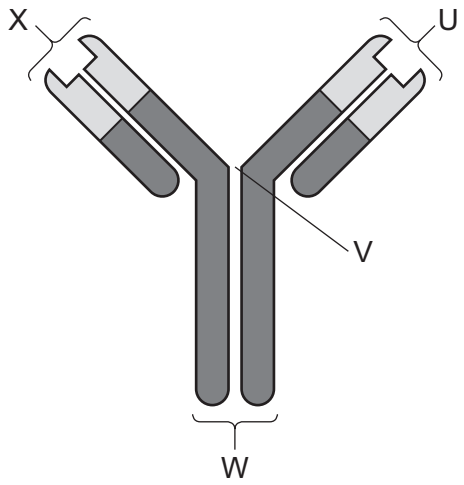
B $1 \rightarrow 5 \rightarrow 3 \rightarrow 4$

C $3 \rightarrow 1 \rightarrow 5 \rightarrow 2$

D $3 \rightarrow 5 \rightarrow 4 \rightarrow 1$

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40 The diagram shows the simplified structure of an antibody.



Which statement is correct?

A U and X allow the antibody to bind to two different antigens.

B V allows the antibody to be flexible to bind to two antigens.

C W can bind to one specific antigen.

D X can bind with a specific phagocyte receptor.

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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.

This document has **16** pages.

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1 Which statement about light microscopy is correct?

A As the resolution increases, the magnification increases.

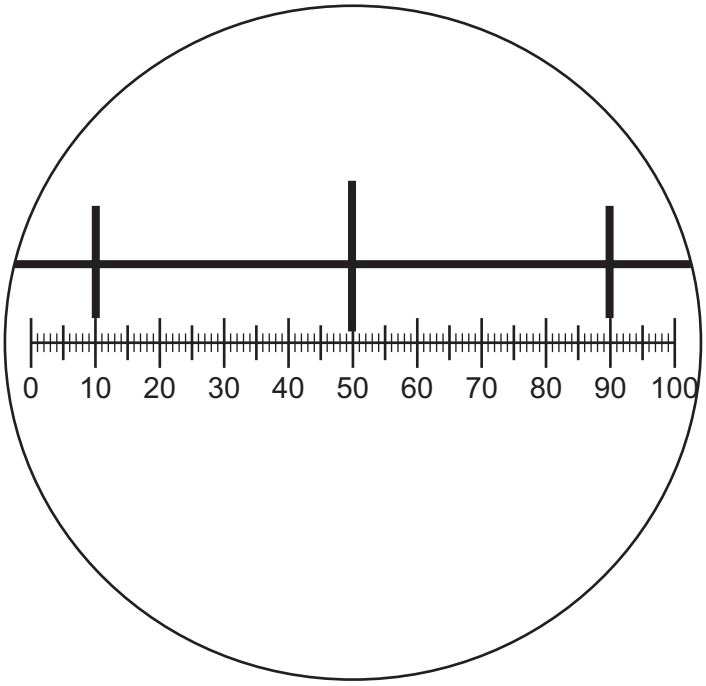
B As the magnification increases, the image always becomes clearer.

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

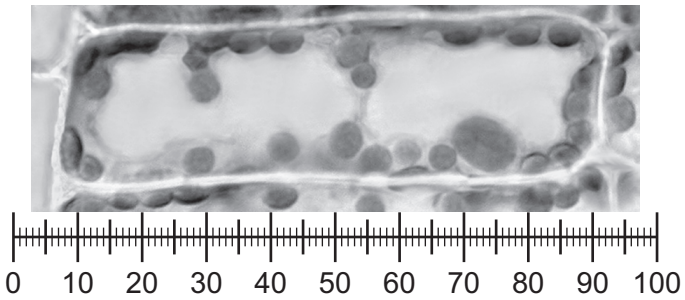
D Magnification and resolution are terms that relate to the same factor.

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

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

1 hydrolysis
2 mitosis
3 transcription
4 translation

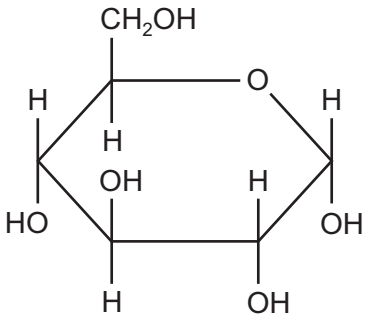
A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

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

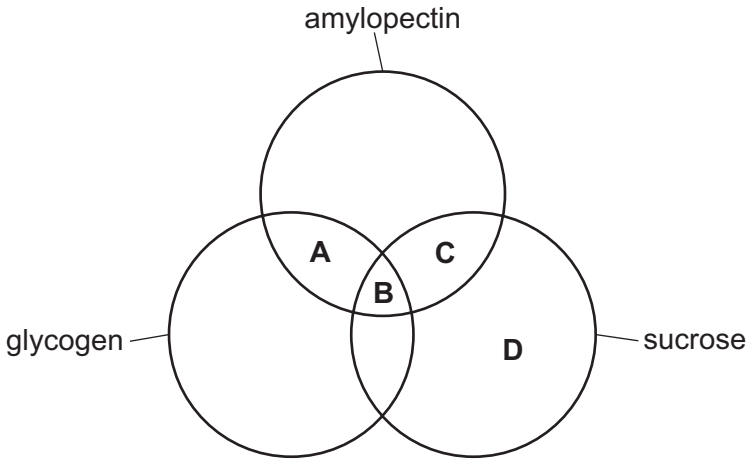
1 covalent
2 ester
3 phosphodiester

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.

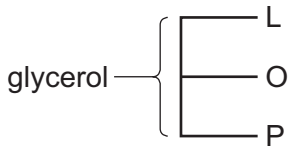


Which molecules contain this monomer?



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.

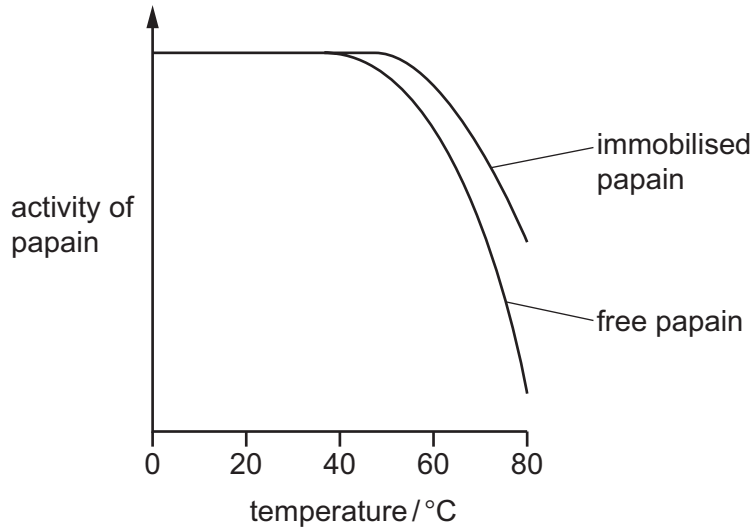
2 This enzyme is less likely to be affected by non-competitive inhibitors than an enzyme working by the lock-and-key mechanism.

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

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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?

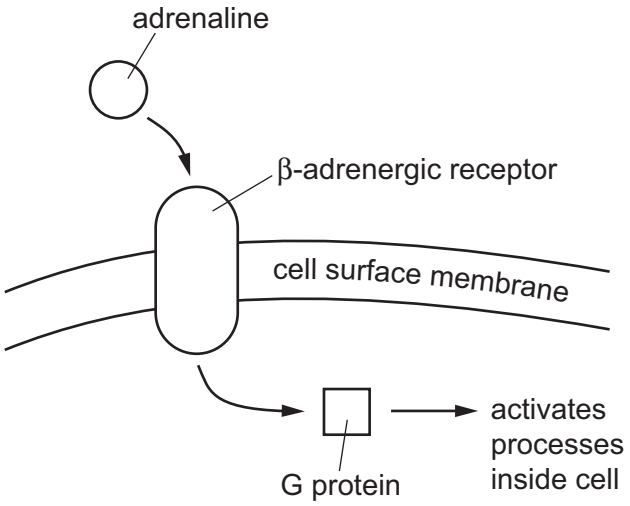
A It alters the shape of papain's active site at higher temperatures.

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.

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

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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.

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.

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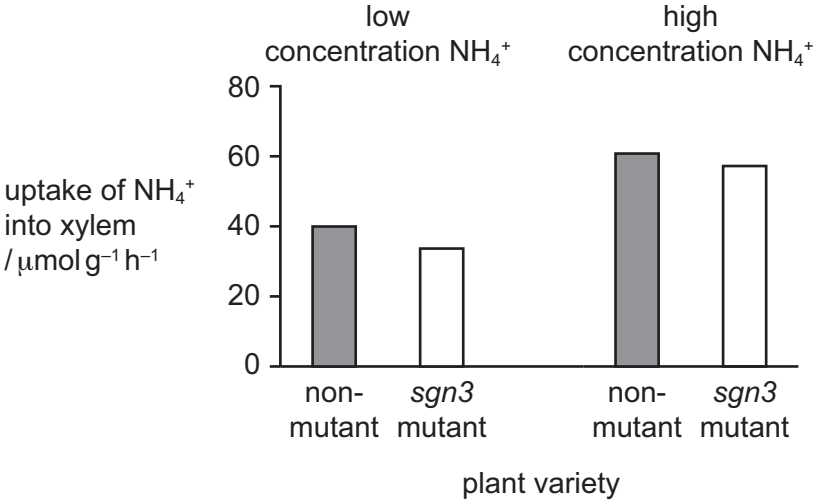
26 Ammonium ions, NH_4^+, can enter the xylem of plant roots by two pathways.

- 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

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

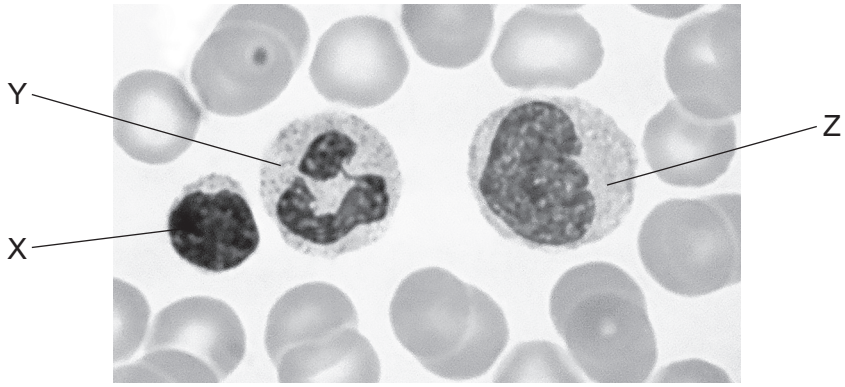
A active transport

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

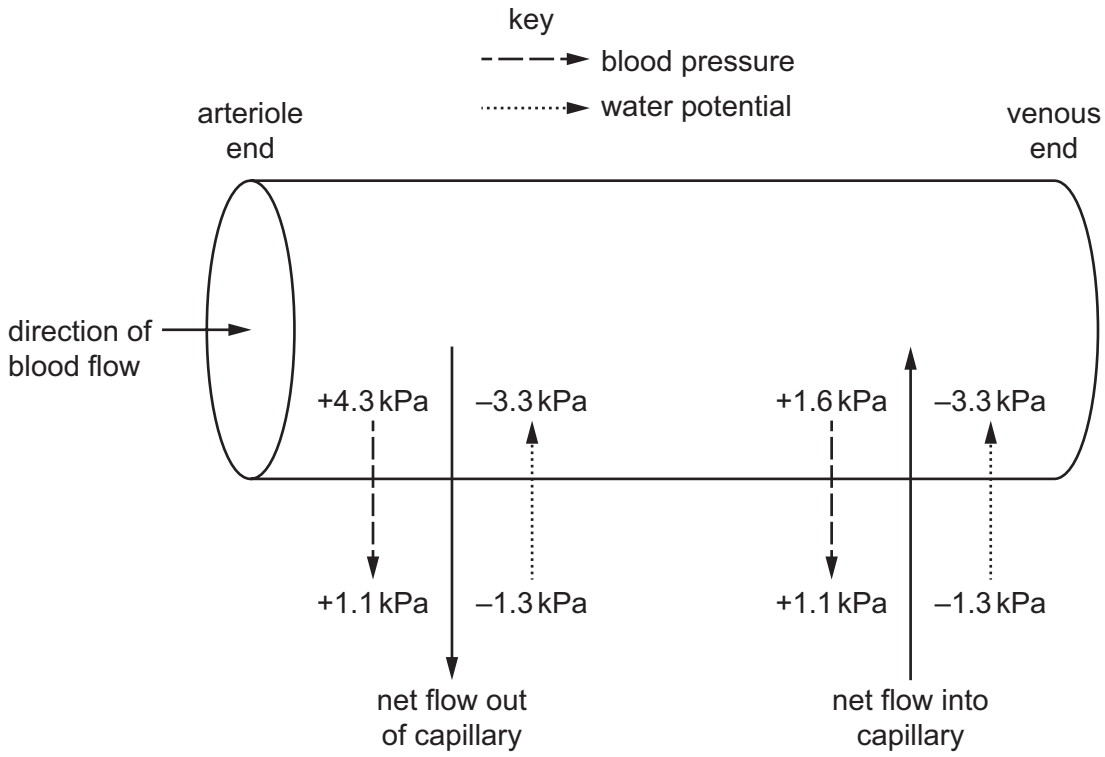
30 When a blood vessel is damaged it can result in problems in the body.

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

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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

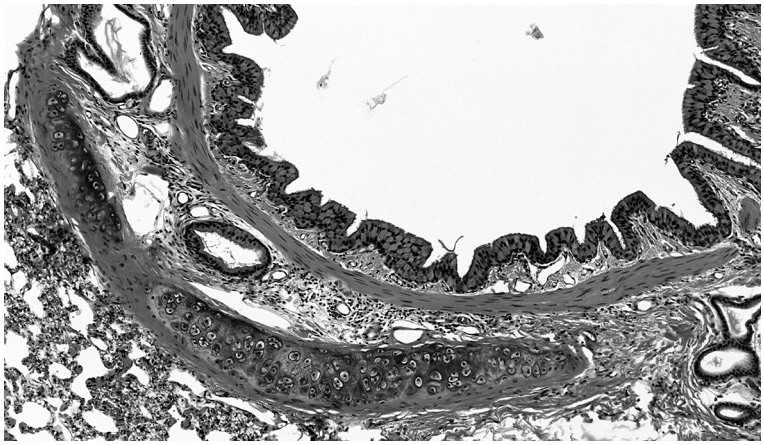
B ciliated epithelium

C squamous epithelium

D squamous endothelium

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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

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37 Bacteria can become resistant to antibiotics.

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

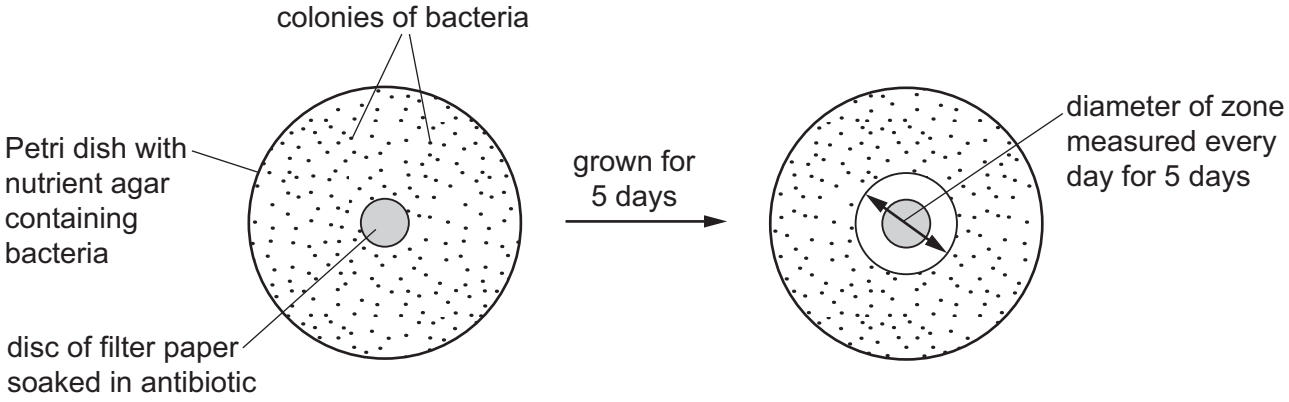
1 Use specific antibiotics instead of wide spectrum.

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.

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

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