Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/11**

Paper 1 Multiple Choice **May/June 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.

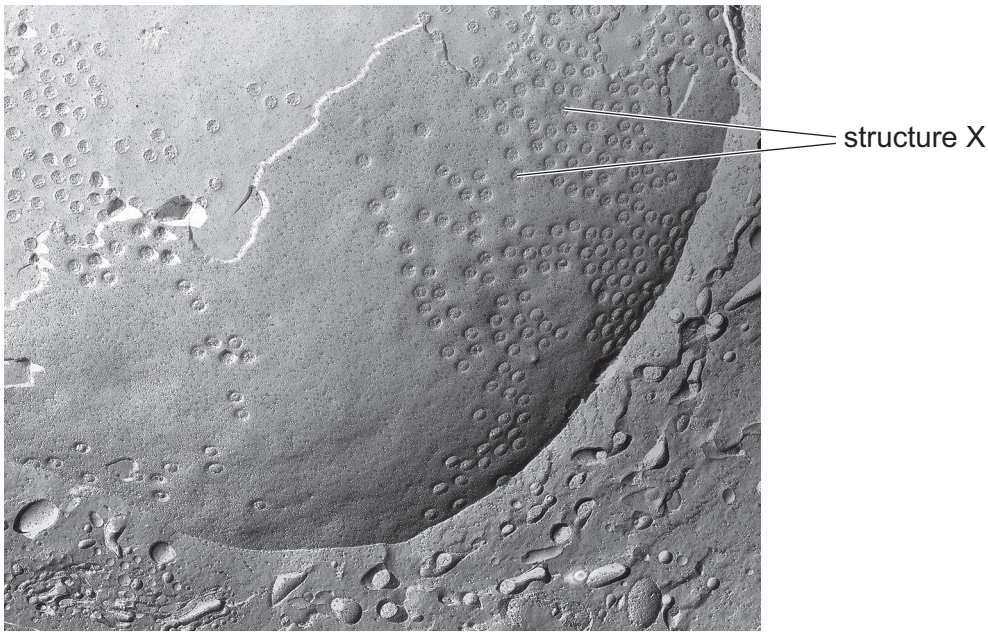
INFORMATION

- 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 **20** pages. Any blank pages are indicated.

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1 The electron micrograph shows onion root cells prepared using a freeze-fracture technique. The cells were quickly frozen and then physically broken apart. Freeze fracture breaks apart cells along weak areas, such as membranes and the surfaces of organelles.



×20 000

Which statement best explains the appearance of the electron micrograph?

A The cells were broken apart at the endoplasmic reticulum; structure X is a ribosome.

B The cells were broken apart at the nuclear envelope; structure X is a nuclear pore.

C The cells were broken apart at the nuclear envelope; structure X is a ribosome.

D The cells were broken apart at the tonoplast; structure X is a plasmodesma.

2 Which cell structures can form vesicles?

	cell surface membrane	endoplasmic reticulum	Golgi body
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = can form vesicles

✗ = cannot form vesicles

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3 Four students were asked to match the function with the appearance of some cell structures in an animal cell.

The functions were listed by number.

1 synthesis of polypeptides

2 synthesis of lipids

3 packaging of hydrolytic enzymes that will remain in the cell

The appearances were listed by letter.

V membranes which surround an enclosed inner cavity

W non-membrane-bound, spherical structures

X a double membrane interspersed with pores

Y non-membrane-bound, cylindrical structures

Z membrane-bound sacs, arranged as a flattened stack

Which student correctly matched the numbered function with the appearance of the cell structure?

	1	2	3
A	W	V	Z
B	W	Z	Y
C	Z	W	Z
D	Z	V	W

4 Which cells contain a tonoplast?

	root hair	companion	sieve tube element	endodermis
A	✓	✓	✓	✓
B	✓	✗	✓	✓
C	✗	✓	✓	✗
D	✓	✓	✗	✓

key

✓ = contain tonoplast

✗ = do not contain tonoplast

5 Which organelles found in animal or plant cells are surrounded by double membranes?

A chloroplasts, mitochondria, vacuoles

B chloroplasts, mitochondria, nuclei

C chloroplasts, nuclei, vacuoles

D mitochondria, nuclei, vacuoles

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6 Some scientists think that mitochondria evolved from bacteria that entered the cytoplasm of a different cell and were able to survive there.

Which structural features of mitochondria support this hypothesis?

	folded internal membrane	circular DNA	70S ribosomes
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = supports

✗ = does not support

7 What is present in all viruses, all prokaryotes **and** all eukaryotes?

A ribose

B deoxyribose

C cytosine

D thymine

8 The table shows some steps that can be made in carrying out the Benedict's test.

Which combination of steps is required to carry out a semi-quantitative test on a reducing sugar solution?

	standardise volume of Benedict's solution and volume of test solution	boil with hydrochloric acid and then neutralise with alkali	standardise boiling time with Benedict's solution and compare final colour with numbered colour standards
A	✓	✗	✗
B	✗	✓	✗
C	✓	✗	✓
D	✗	✗	✓

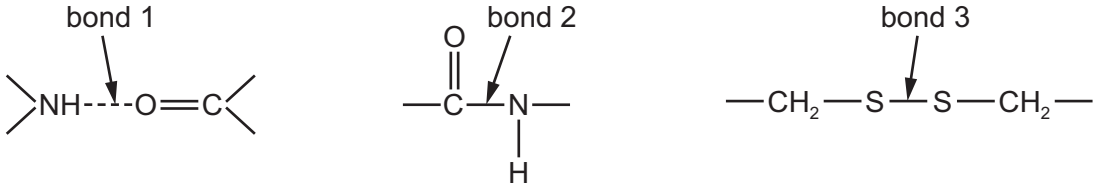
key

✓ = step made

✗ = step not made

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9 The diagrams show three examples of different bonds.



Which bonds hold the secondary structure of proteins together?

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

10 Insulin is a globular protein involved in cell signalling. It is transported in the blood plasma from the cells that synthesise it to its target cells. A molecule of insulin contains six sulfur-containing amino acids and has two polypeptide chains.

Which statements about insulin are correct?

1 An insulin molecule has a quaternary structure.

2 Insulin polypeptides are held together by six disulfide bonds.

3 Amino acids with hydrophobic R groups would be found in the centre of an insulin molecule.

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

11 Which statement correctly explains why blood plasma can be maintained at a stable temperature?

A It has a low specific heat capacity.

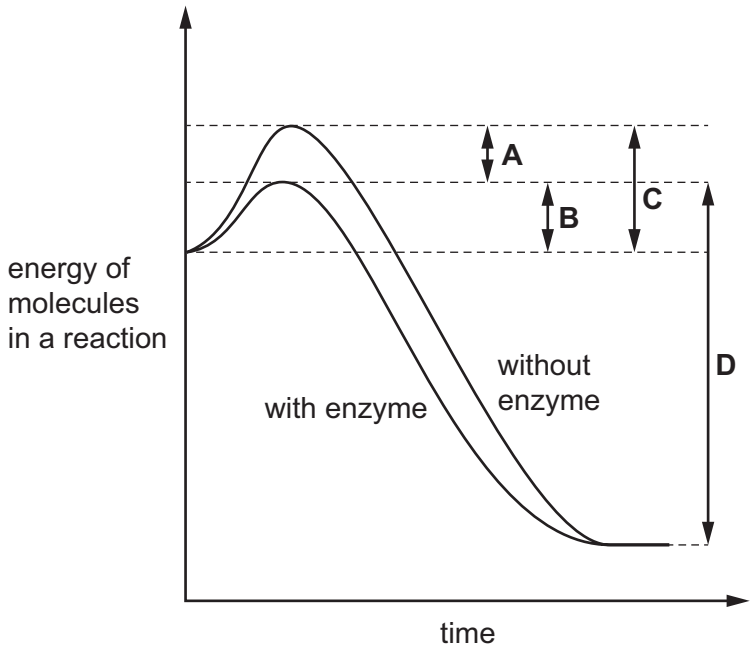
B It has a high specific heat capacity.

C It has a low latent heat of vaporisation.

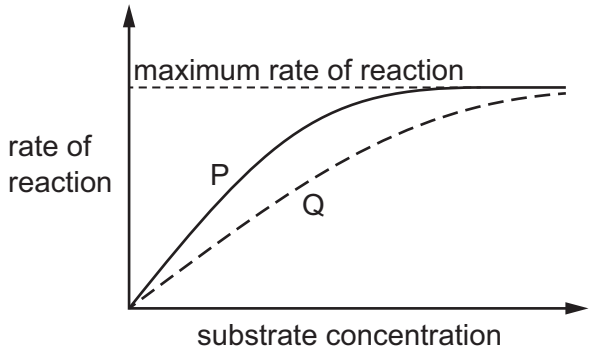
D It has a high latent heat of vaporisation.

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12 Which region on the graph shows the activation energy of an enzyme-catalysed reaction?



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



Line P represents the result when the enzyme is used at its optimum pH and optimum temperature and without an inhibitor.

Line Q represents the result when the reaction conditions are changed.

Which descriptions of changes to the reaction conditions could result in line Q if all other conditions were kept the same?

1 Add an inhibitor that attaches to a site other than the active site.

2 Add an inhibitor that has a similar shape to the substrate.

3 Add an inhibitor that blocks the active site of the enzyme.

4 Carry out the reaction at a higher temperature.

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

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14 Which statement about cell signalling is correct?

A One type of receptor molecule will recognise all ligands in the body.

B The binding of a ligand may cause a change to the shape of the receptor.

C The receptors for ligands are always found on the inside of cells.

D The same ligand is made by all of the cells in the body.

15 Four students, **A**, **B**, **C** and **D**, observed plant epidermal cells that had been placed in a concentrated sucrose solution for 30 minutes. They were asked to identify the partially permeable layer and to explain the appearance of the cells in terms of water potential and movement of water.

Which student is correct?

	partially permeable layer	water potential at start of experiment	movement of water during experiment
A	cell surface membrane	cell contents have a lower water potential than the sucrose solution	water moved out of the cell and no water moved in
B	cell surface membrane	cell contents have a higher water potential than the sucrose solution	more water moved out of the cell than moved in
C	cell wall	cell contents have a lower water potential than the sucrose solution	more water moved out of the cell than moved in
D	cell wall	cell contents have a higher water potential than the sucrose solution	water moved out of the cell and no water moved in

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[Turn over

16 The table compares the surface area to volume ratios of five agar blocks that differ in dimensions but which all have the same volume.

The agar blocks can be used to measure the efficiency of diffusion, where efficiency is measured as the time taken for a dye to reach all parts of the block.

	length / mm	width / mm	height / mm	surface area / mm^2	volume / mm^3	surface area : volume ratio
1	8	8	8	384	512	0.75
2	16	16	2	640	512	1.3
3	32	4	4	544	512	1.1
4	32	32	0.5	2112	512	4.1
5	64	4	2	784	512	1.5

Which prediction can be made about the way in which size and dimensions of these blocks affect the efficiency of diffusion?

A The efficiency of diffusion will decrease as the width of a block increases.

B The efficiency of diffusion will increase as the height of a block increases.

C The efficiency of diffusion will increase as a block of fixed volume is flattened.

D The efficiency of diffusion will decrease as a block of fixed volume is elongated.

17 The cell cycle includes mitosis.

What are features of this type of nuclear division?

1 forms cells of equal size to the parent cell

2 forms genetically identical nuclei

3 semi-conservative replication of DNA

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

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18 A student observed the cells in the growing region (meristem) of an onion root and obtained the data shown.

stage	number of cells
interphase	886
prophase	73
metaphase	16
anaphase	14
telophase	11

Which percentage of cells contains chromosomes that appear as two chromatids?

A 7.3% **B** 8.9% **C** 95.9% **D** 97.5%

19 Which statement about messenger RNA is correct?

A In eukaryotic cells, mRNA is made by removing exons from the primary RNA transcript.

B mRNA is a single-stranded polynucleotide containing a different purine base than DNA.

C mRNA molecules contain ribose sugars joined to phosphate groups by phosphodiester bonds.

D The monomers of mRNA contain a phosphate group, deoxyribose sugar and a nitrogenous base.

20 Which structures are involved in transcription only?

	DNA template strand	anticodons	RNA polymerase
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ = involved

✗ = not involved

21 One gene provides the code for the production of which type of molecule?

A amino acid

B DNA

C nucleotide

D polypeptide

22 The table shows some mRNA codons that code for certain amino acids.

mRNA codon	amino acid
GCG, GCA, GCC, GCU	alanine
ACG, ACA, ACC, ACU	threonine
UGC, UGU	cysteine
UAC, UAU	tyrosine
CAG, CAA	glutamine
CGG, CGA, CGC, CGU	arginine

A DNA template strand has the base sequence shown.

ACAGTATTATTTGCAACG

What would the change in the amino acid be if the first base in the fifth DNA triplet was substituted for an A base?

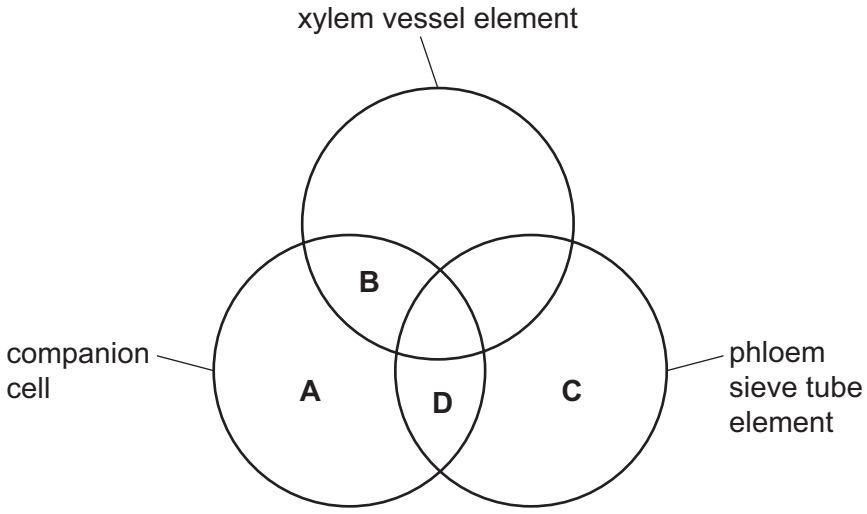
A alanine to cysteine

B alanine to threonine

C arginine to cysteine

D arginine to threonine

23 Which structures contain cytoplasm with mitochondria and a nucleus?



24 What is the correct term to describe intermolecular hydrogen bonding between water molecules?

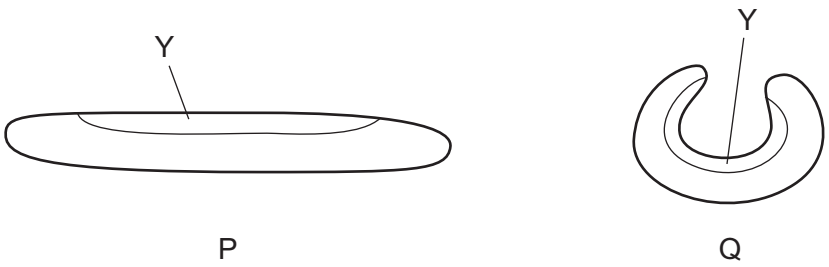
A adhesion

B cohesion

C osmosis

D diffusion

25 The diagram shows the outline of a xerophytic leaf that had been left for 45 minutes in different conditions, P and Q.



Which statements about the cells in layer Y of the leaf in each of the conditions P and Q **after** 45 minutes are correct?

1 There is a less negative water potential in P than in Q.

2 The cells may be turgid in P and plasmolysed in Q.

3 The cells are less turgid in P than in Q.

4 There is no net diffusion of water into Y in either P **or** Q.

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

26 How does sucrose move from chloroplasts to the phloem?

1 diffusion

2 apoplast pathway

3 symplast pathway

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

27 How are companion cells involved in loading sucrose into phloem sieve tube elements?

A actively through cotransporter proteins and passively through plasmodesmata

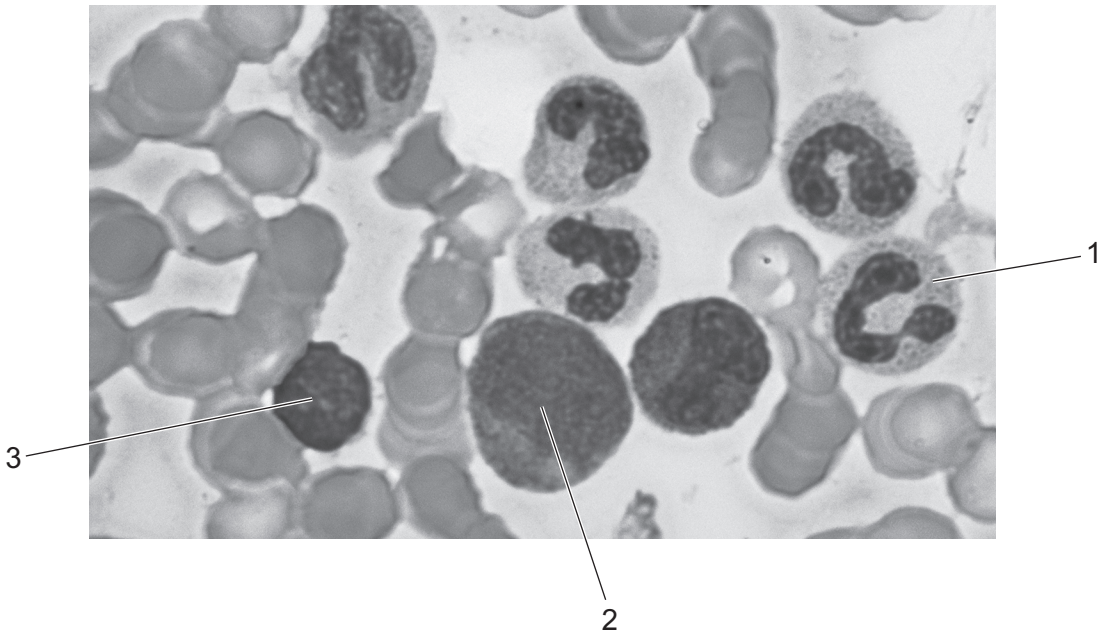
B actively through cotransporter proteins and plasmodesmata

C passively through cotransporter proteins only

D actively through plasmodesmata only

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28 The photomicrograph shows blood cells as seen using a high-power light microscope.

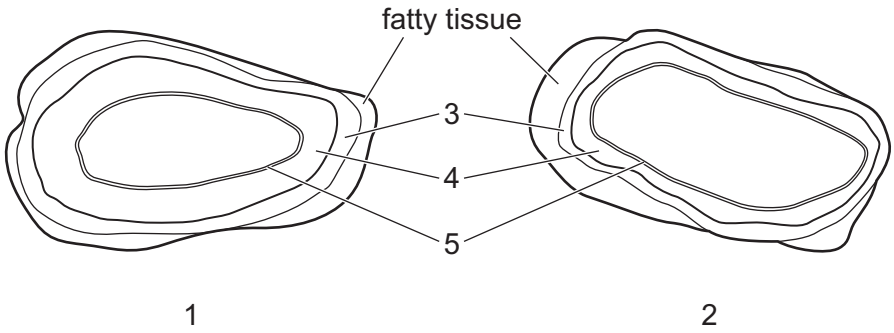


Which row correctly identifies the different types of white blood cell?

	1	2	3
A	lymphocyte	monocyte	neutrophil
B	monocyte	neutrophil	macrophage
C	neutrophil	monocyte	lymphocyte
D	phagocyte	lymphocyte	monocyte

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29 Plan diagrams of two blood vessels are shown.



Which labels are correct?

	1	2	3	4	5
A	aorta	vena cava	elastic fibres	smooth muscle	epithelium
B	artery	vein	collagen fibres	smooth muscle and elastic tissue	endothelium
C	vein	artery	collagen fibres	elastic fibres	squamous cells
D	coronary artery	coronary vein	elastic fibres	smooth muscle and elastic tissue	epithelium

30 What are found in blood and tissue fluid?

1 carbon dioxide

2 fatty acids

3 white blood cells

4 proteins

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 2 and 4 only

D 3 and 4 only

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31 Which reactions would be slowed down by an inhibitor of carbonic anhydrase?

1 CO_2 + haemoglobin $\rightarrow$ carbaminohaemoglobin

2 $CO_2 + H_2O \rightarrow H_2CO_3$

3 $H_2CO_3 \rightarrow H^+ + HCO_3^-$

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

32 Which sequence of letters correctly identifies the order of events during the cardiac cycle?

T atrial walls contract

U impulse is delayed by a fraction of a second

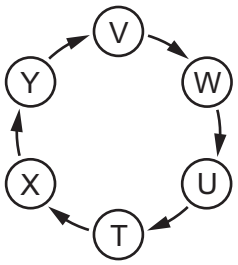
V wave of excitation enters the atrioventricular node

W wave of excitation passes down the Purkyne tissue

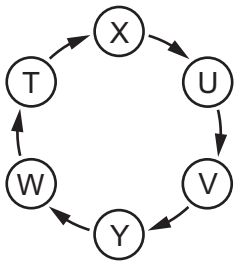
X wave of excitation spreads from the sinoatrial node

Y ventricles contract

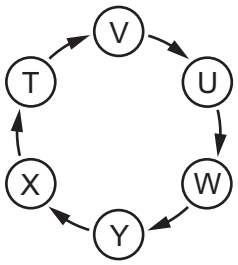
A



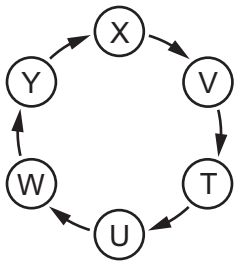
B



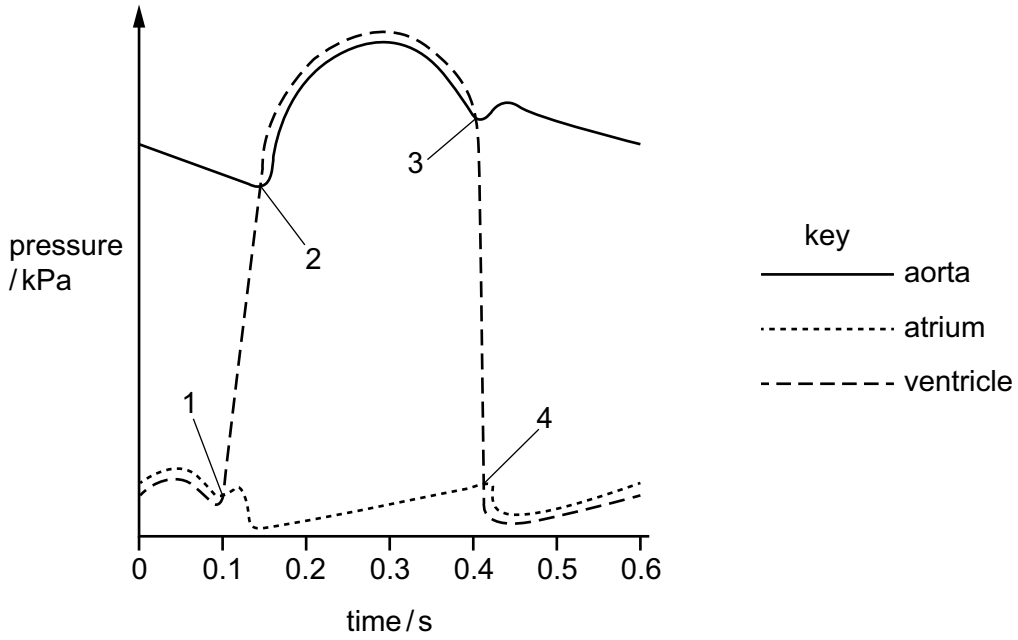
C



D



33 The diagram gives information about blood pressure in the left side of the heart during the cardiac cycle.



Valves open and close at the points numbered.

Which row identifies the valves opening or closing at the points numbered?

	atrioventricular valve opens	semilunar valve opens	atrioventricular valve closes	semilunar valve closes
A	1	3	4	2
B	2	4	3	1
C	3	1	2	4
D	4	2	1	3

34 A person with no breathing conditions rests for an hour. Their breathing in this time is shallow and slow, so little air from outside the body reaches the alveoli. The person's heart rate remains constant.

Which statement is correct?

A The carbon dioxide concentration in the blood in the pulmonary vein will be higher than in the pulmonary artery.

B Carbon dioxide molecules in the air of the alveoli move out of the blood by active transport.

C The air in the alveoli has a lower concentration of oxygen than the blood in the pulmonary vein.

D Oxygen molecules diffuse from the air in the alveoli into the blood at a slower rate than when the person is active.

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

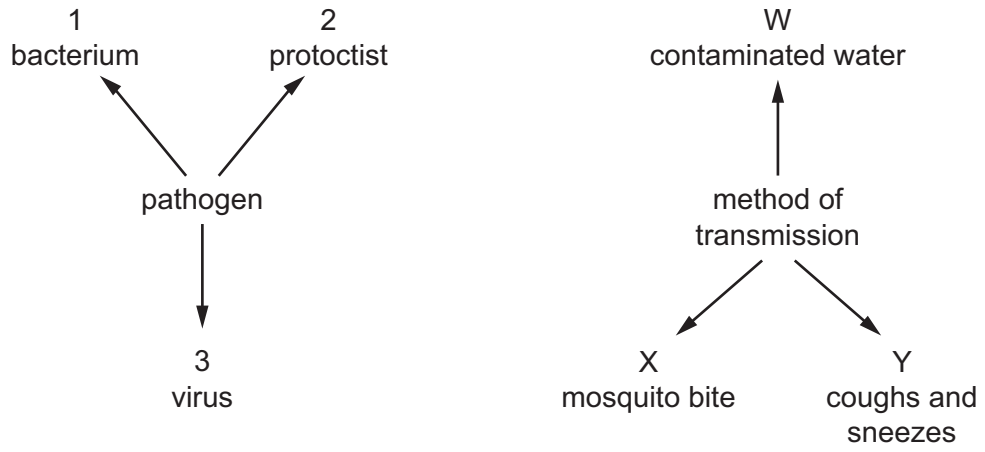
1 They have epithelium.

2 They have goblet cells.

3 They have muscle tissue.

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

36 The diagram shows some of the pathogens that cause disease in humans and some of the ways they are transmitted.



What is the correct pathogen and method of transmission for malaria?

A 1 and X **B** 2 and W **C** 2 and X **D** 3 and Y

37 Some of the processes which result in the formation of a population of bacteria that are resistant to a new antibiotic are listed.

1 change in reproductive success of bacteria

2 increase in frequency of the resistance allele in the population

3 increase in genetic variation within the population

4 random mutation occurs in bacterial DNA

What is the correct order of these processes?

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

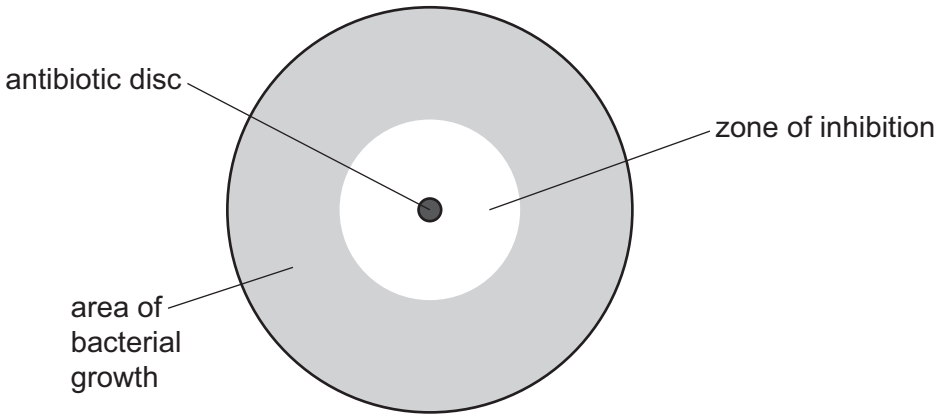
B $2 \rightarrow 1 \rightarrow 3 \rightarrow 4$

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

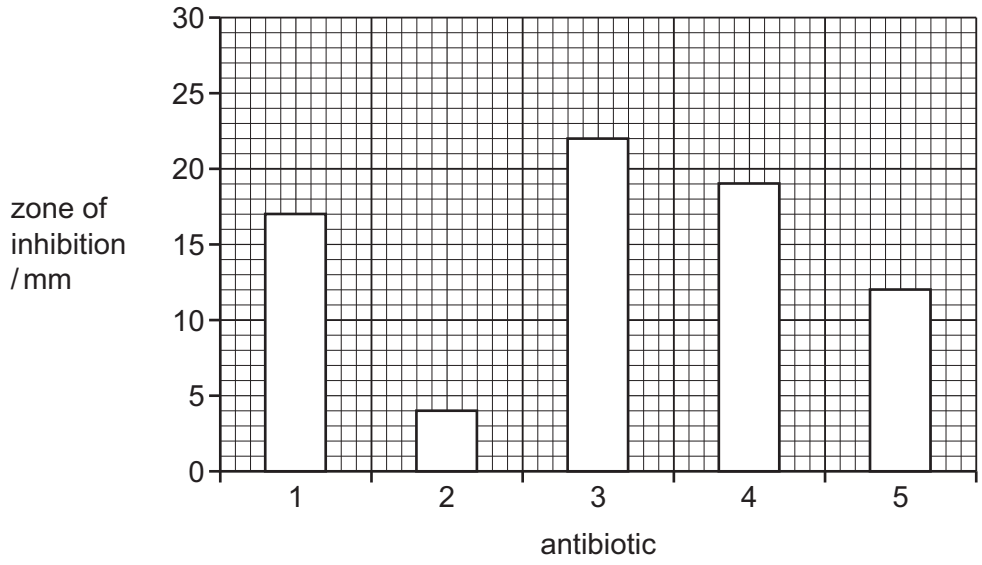
D $4 \rightarrow 3 \rightarrow 1 \rightarrow 2$

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38 When bacteria are grown in a Petri dish containing discs with antibiotics, there will be zones of inhibition of bacterial growth.



The chart shows the size of the zones of inhibition when a species of bacteria was incubated on five different plates of agar, each containing a disc with a different antibiotic.



Which conclusions can be made about the most and least effective antibiotics on this species of bacteria?

	most effective antibiotic	least effective antibiotic
A	3	2
B	4	3
C	3	1
D	2	3

39 Which blood cell type does **not** recognise, engulf and digest non-self particles?

A macrophages

B neutrophils

C phagocytes

D T-killer cells

40 Repeated infections with malaria result in more effective immunity to malaria.

Which type of immunity is responsible for the more effective immunity?

A artificial active

B artificial passive

C natural active

D natural passive

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Cambridge International AS & A Level

BIOLOGY **9700/12**

Paper 1 Multiple Choice **May/June 2023**

1 hour 15 minutes

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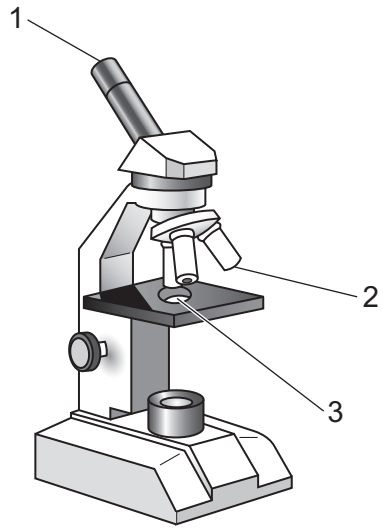
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1 A graticule and a micrometer scale can be used to measure the size of biological structures that are viewed with a microscope.

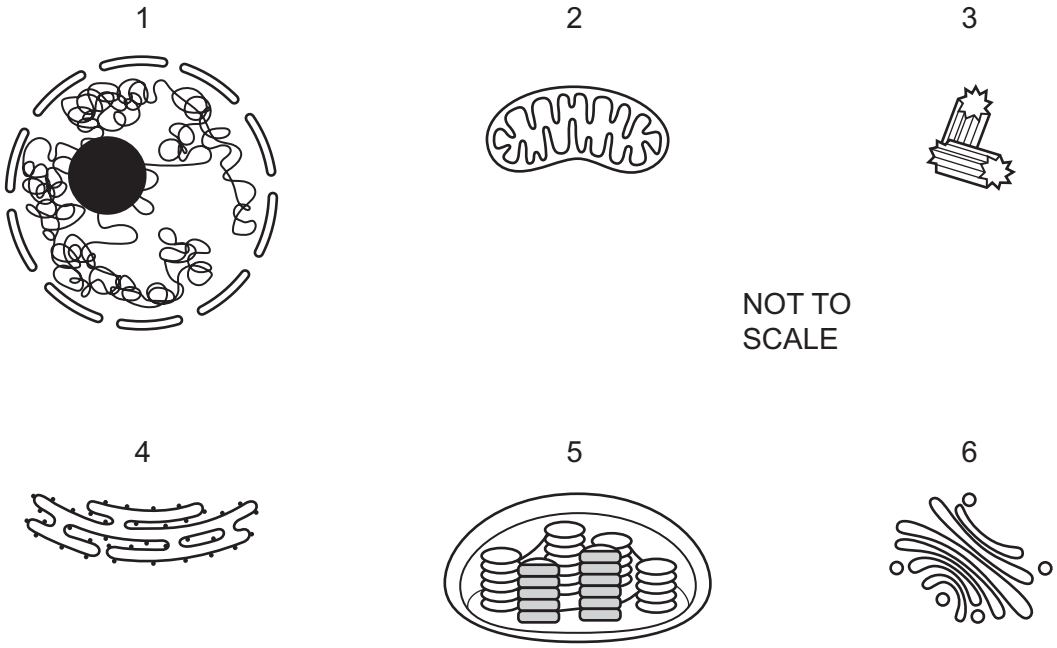


Which row shows the correct locations for the placement of a graticule and a micrometer scale on the microscope shown?

	graticule	micrometer scale
A	1	2
B	1	3
C	2	3
D	3	1

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2 Six organelles found in eukaryotic cells are shown.



Which organelles are involved in the synthesis and secretion of a glycoprotein?

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

3 Which cell structures can have mRNA inside them?

1 chloroplast

2 mitochondrion

3 nucleus

4 rough endoplasmic reticulum

A 1, 2, 3 and 4

B 1, 2 and 3 only

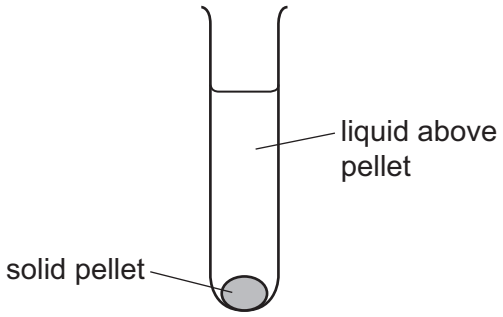
C 2, 3 and 4 only

D 3 and 4 only

4 A scientist carried out an experiment to separate the organelles in an animal cell by mass.

The scientist mixed the cells with a buffer solution which had the same water potential as the cells. The cells were broken open with a blender to release the organelles.

The extracted mixture was filtered and then spun in a centrifuge at a high speed to separate the heaviest type of organelle. These sank to the bottom, forming solid pellet 1.



The liquid above pellet 1 was poured into a clean centrifuge tube and spun in the centrifuge at a higher speed to separate the next heaviest type of organelle. These organelles sank to the bottom, forming solid pellet 2.

This procedure was repeated twice more to obtain pellet 3 and pellet 4, each containing a single type of organelle.

What is the main function of the type of organelle extracted in pellet 2?

A digestion of old organelles

B production of ATP

C production of mRNA

D synthesis of protein

5 Which structures are found in palisade mesophyll cells **and** photosynthetic prokaryotes?

1 cell surface membrane

2 cellulose wall

3 ribosomes

4 chloroplasts

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 3 only

D 2 and 4 only

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6 Which polymers are present in all viruses **and** all prokaryotes?

1 polynucleotides

2 polypeptides

3 polysaccharides

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

7 Which set of steps is the best method for conducting the emulsion test for lipids?

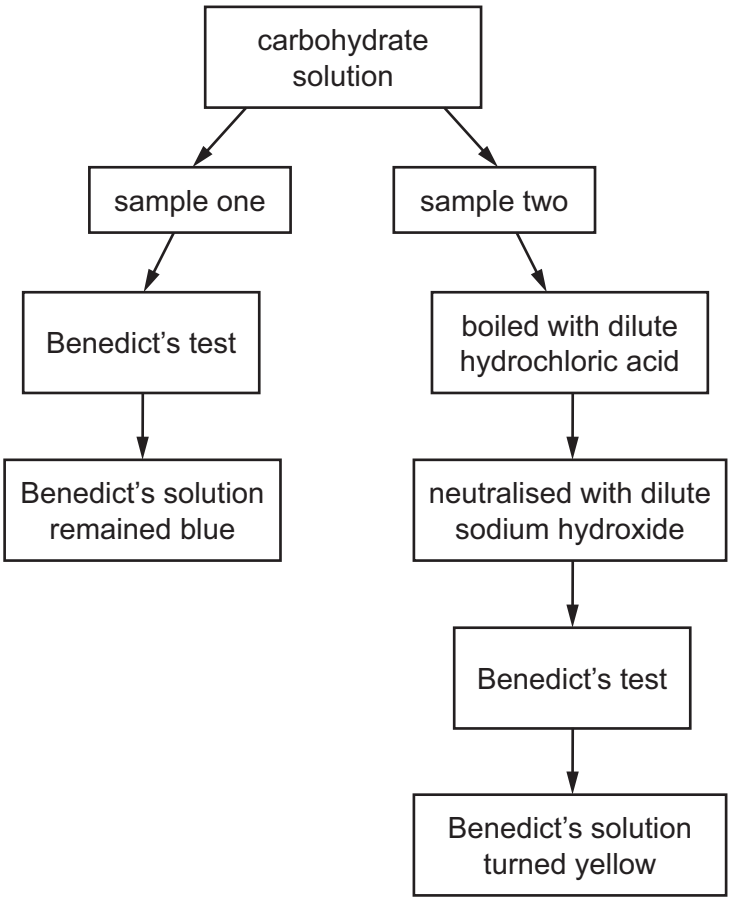
A Add 2 cm^3 of water to the sample.
Pour the water into a test-tube containing 2 cm^3 of ethanol.
Lipids are present if the mixture becomes cloudy.

B Add 2 cm^3 of ethanol to the sample and shake.
Pour the ethanol into a test-tube containing 2 cm^3 of water and boil.
Lipids are present if the mixture becomes clear.

C Add 2 cm^3 of water to the sample and shake.
Pour the water into a test-tube containing 2 cm^3 of ethanol and boil.
Lipids are present if the mixture becomes cloudy.

D Add 2 cm^3 of ethanol to the sample and shake.
Pour the ethanol into a test-tube containing 2 cm^3 of water and shake again.
Lipids are present if the mixture becomes cloudy.

8 A student was provided with a solution of carbohydrate. They removed two samples from the solution and performed tests on each sample, as shown.



Which statement explains the results?

A Condensation reactions occur in sample two to release reducing sugar.

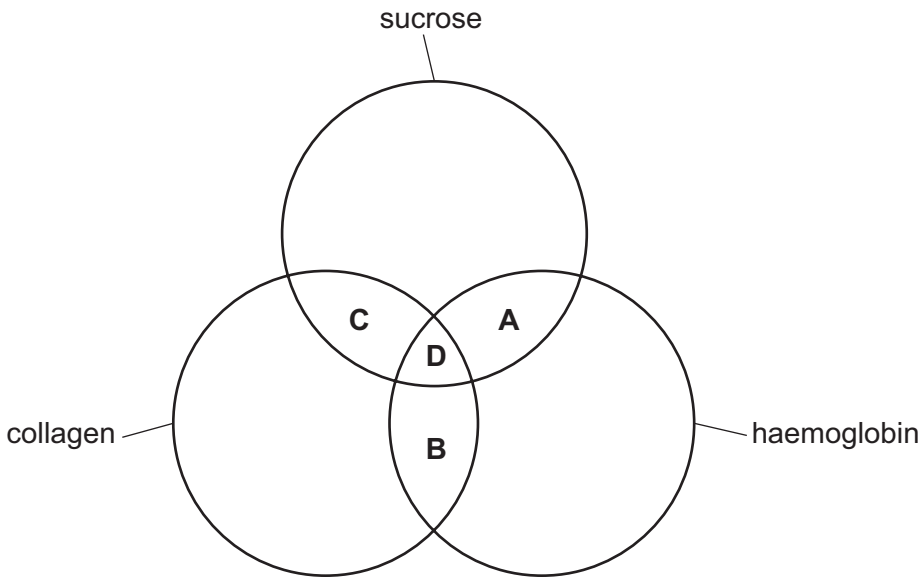
B Glycosidic bonds in a polysaccharide have been broken to release reducing sugar.

C Sample one shows that sucrose is present in the carbohydrate solution.

D The change in colour to a yellow solution shows that glucose is present.

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9 Which molecules contain at least two double bonds?



10 What describes cellulose?

A a branched chain of 1-4 α-glucose

B a branched chain of 1-4 β-glucose

C an unreactive linear chain of 1-4 α-glucose

D an unreactive linear chain of 1-4 β-glucose

11 Which part of the structure of haemoglobin carries oxygen?

A four polypeptide chains

B haem groups

C hydrogen bonds

D hydrophilic R groups

12 What is the maximum number of hydrogen bonds that can form between two single water molecules?

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

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13 CYP3A4 is an important enzyme in the human digestive system where it is needed to break down a range of different toxins. The activity of CYP3A4 has been shown to be reduced by substances called furanocoumarins. Furanocoumarins are found in some fruits and so dangerous concentrations of toxins may develop in the human digestive system when fruits containing furanocoumarins are eaten.

From the information provided, what can be concluded about molecules of the enzyme CYP3A4?

A They lower the activation energy of the toxin breakdown reactions.

B They bind specifically through the active site to a substrate found in some fruits.

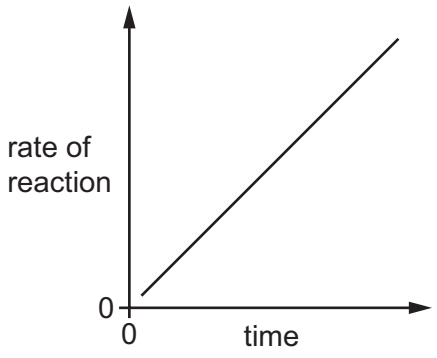
C They change permanently when acted upon by furanocoumarin molecules.

D They resume normal activity when concentrations of furanocoumarins decrease.

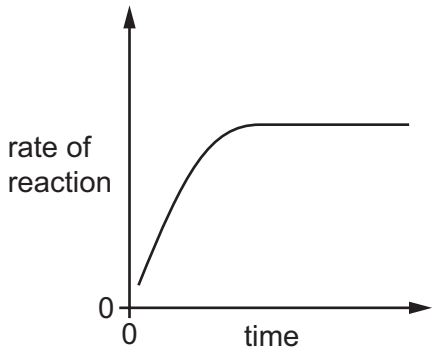
14 A fixed volume and concentration of substrate and enzyme were mixed. All other variables were kept constant. The enzyme-catalysed reaction was left until it was complete.

Which graph shows how the rate of reaction changes with time?

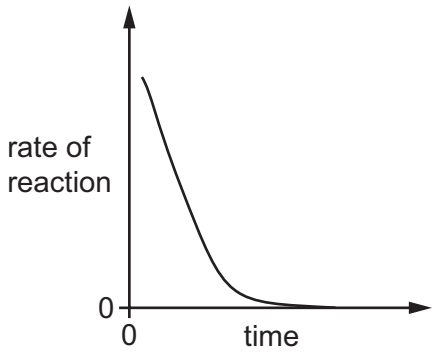
A



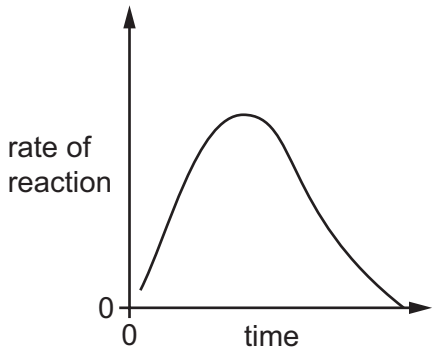
B



C



D



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15 Which molecules in cell surface membranes are typically involved in cell recognition?

	cholesterol	glycolipids	glycoproteins	phospholipids
A	✓	✓	✗	✗
B	✓	✗	✗	✓
C	✗	✓	✓	✗
D	✗	✗	✓	✓

key

✓ = involved

✗ = not involved

16 What can increase the fluidity of the cell surface membrane?

1 single bonds between carbon atoms in the fatty acid chains

2 cholesterol

3 longer-chained fatty acids

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

17 The three main factors that affect the rate of diffusion across a membrane can be expressed by the relationship shown.

$$\text{rate of diffusion is proportional to } \frac{\text{surface area} \times \text{concentration difference}}{\text{thickness of membrane}}$$

Which changes in the factors would result in the rate of diffusion doubling?

1 Surface area has doubled.

2 Concentration difference has halved.

3 Thickness of membrane has doubled.

4 Thickness of membrane has halved.

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

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18 A student measured the time taken for complete diffusion of a dye into agar blocks of different sizes which were suspended in the dye.

The results are shown.

size of agar block / mm × mm × mm	time for diffusion / s
5 × 5 × 5	6.2
10 × 10 × 10	16.1
15 × 15 × 15	34.5
5 × 10 × 15	

What is the predicted time for complete diffusion of the dye into the agar block measuring 5 mm × 10 mm × 15 mm?

A 6.2 s

B 16.1 s

C 34.5 s

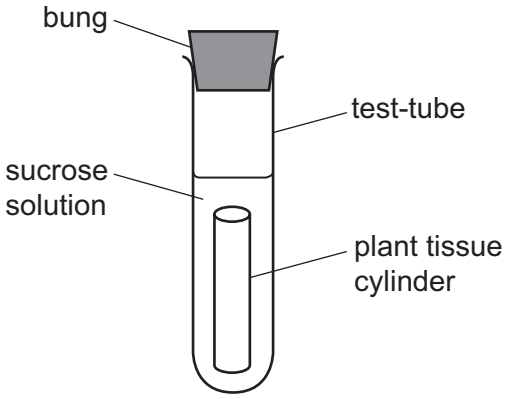
D more than 34.5 s

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19 An experiment was carried out to investigate the effect of concentration of sucrose solution on cells in a plant tissue.

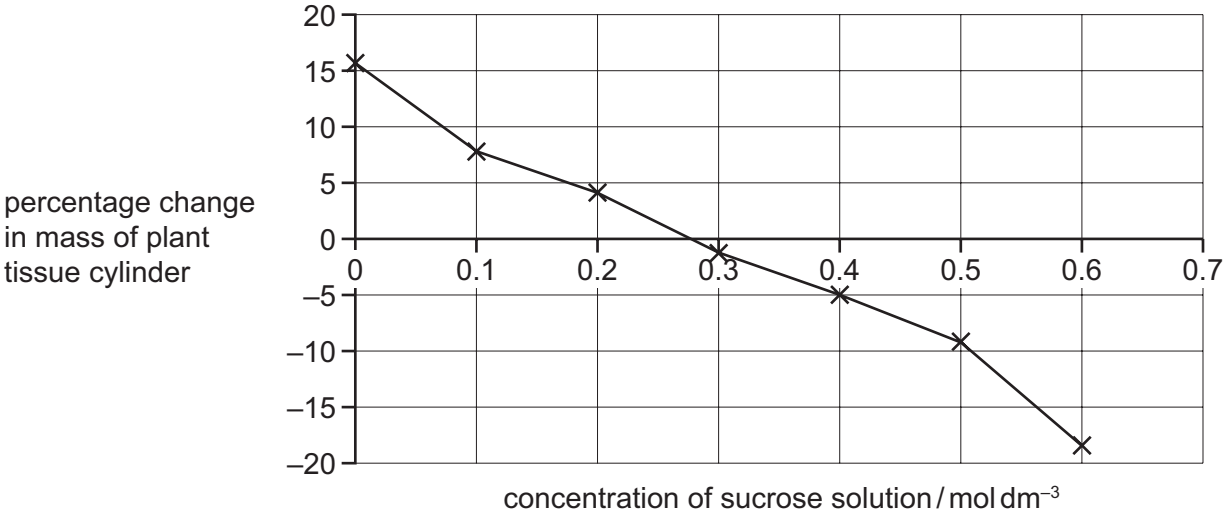
A sample of plant tissue was cut into seven cylinders of equal length and diameter. The mass of each cylinder was recorded.

Each of the seven cylinders was put into a different sucrose solution concentration.



After two hours, the cylinders were removed, blotted dry and reweighed. The percentage change in mass of each cylinder was recorded.

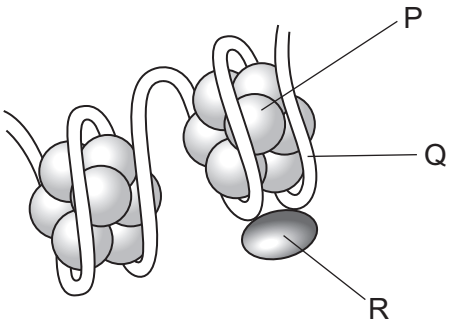
The graph shows the results of this investigation.



Which row explains the results if plant tissue cells were put in a sucrose solution of 0.45 mol dm^{-3}?

	water potential of the cytoplasm of the cells at the start of the experiment compared with the water potential of 0.45 mol dm^{-3} sucrose solution	change in volume of the vacuoles of the cells at the end of the experiment, that were initially placed in 0.45 mol dm^{-3} sucrose solution
A	less negative	decreased
B	less negative	increased
C	more negative	decreased
D	more negative	increased

20 The diagram shows part of the organisation of a section of a DNA molecule and the associated histones, P and R, in prophase of mitosis.



Which statement about the features labelled P, Q and R during prophase of mitosis is correct?

A The coiled DNA molecule forms Q and wraps around histone R to form small clusters held in place by histone P.

B The groups of histones, P, and its associated DNA, Q, move closer together as the chromosome condenses around R.

C The histones P and R are made of protein around which the DNA molecule, Q, is wrapped so that the DNA molecule can fit inside the nucleus.

D The linked groups of histones P and R and the associated DNA, Q, form strands that fold and twist together to form a chromatid.

21 How many copies of each DNA molecule will be found in a cell at the **start** of the stages of the mitotic cell cycle shown?

	G_1 of interphase	cytokinesis
A	1	1
B	1	2
C	2	1
D	2	2

22 One characteristic of DNA is that it is a universal genetic code.

What is meant by a universal genetic code?

A All living organisms use the same triplet code for amino acids.

B All DNA triplets code for a different amino acid.

C Not all DNA triplets code for an amino acid.

D All living organisms contain the same four nucleic acids.

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23 Which statement about mRNA is correct?

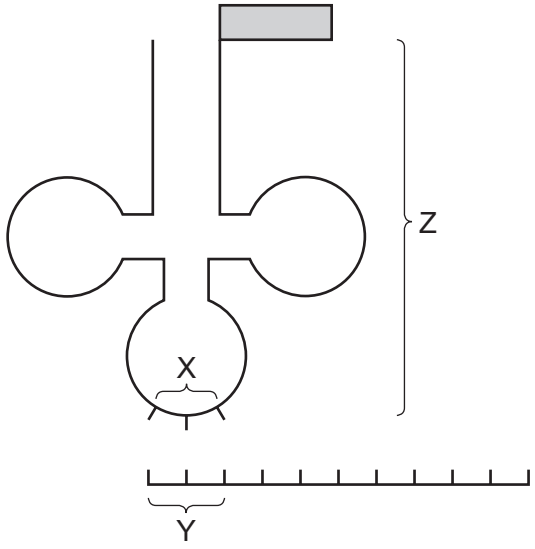
A It is a polymer made of nucleotides all joined with hydrogen bonds.

B Each nucleotide subunit contains the sugar ribose.

C It always has an equal proportion of adenine and uracil.

D The mRNA sequence is identical to the template strand of DNA.

24 The diagram shows part of the process of translation.



What are the names of the structures labelled X, Y and Z?

	X	Y	Z
A	anticodon	codon	mRNA
B	anticodon	codon	tRNA
C	codon	anticodon	mRNA
D	codon	anticodon	tRNA

25 The DNA triplets of genes are translated as amino acids or stop signals during protein synthesis. The table shows some of these triplets.

DNA triplet	name of amino acid
ATA	tyrosine
ATG	tyrosine
ACA	cysteine
ACG	cysteine
ATC	*stop signal*
ACC	tryptophan

What could be the effects of **one** substitution mutation in a triplet coding for tyrosine?

1 The triplet is translated as cysteine.

2 The triplet is translated as tryptophan.

3 The triplet is translated as tyrosine.

4 Translation stops at this triplet.

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

26 Which row identifies cells with plasmodesmata?

	phloem sieve tube element	companion cell	xylem vessel element
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = plasmodesmata present

✗ = plasmodesmata not present

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27 Which statements about the apoplast and symplast pathways are correct?

1 In the apoplast pathway, water molecules move through free spaces in the cellulose cell walls of plant roots.

2 In the symplast pathway, water molecules diffuse through the cytoplasm and plasmodesmata of cells.

3 Water molecules travelling through plant tissue move by mass flow along the apoplast pathway.

4 The Casparian strip blocks the symplast pathway and forces all water molecules to enter the cytoplasm of endodermis cells.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 2 only

D 3 and 4 only

28 Where does water evaporate from during transpiration?

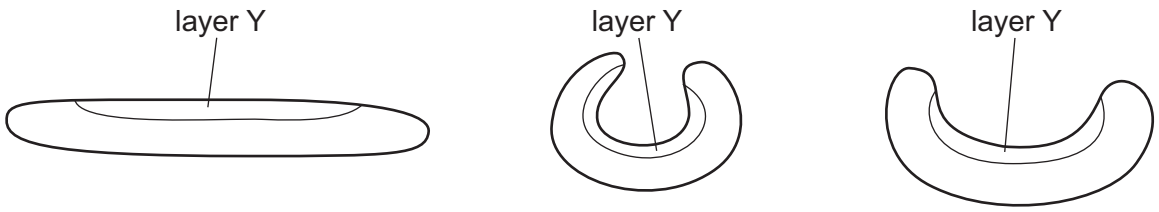
A intercellular spaces

B leaf surface

C mesophyll cell walls

D stomatal pores

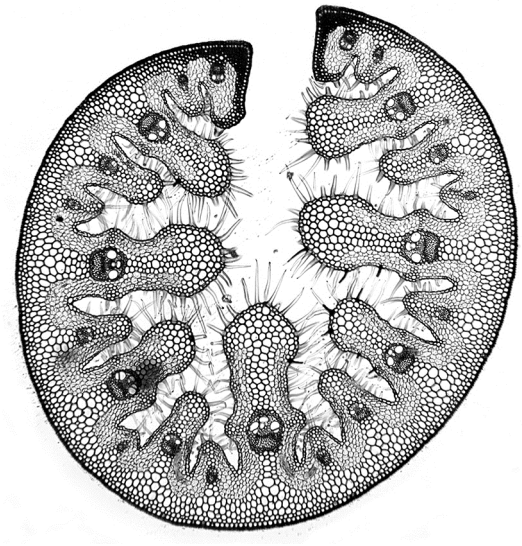
29 The diagram shows the outline of three xerophytic leaves of the same type in three different conditions, P, R and S.



Which description of the water potential of the cells in layer Y is correct?

	water potential of cells in layer Y		
	P	R	S
A	higher than R and S	lower than P and S	lower than P
B	higher than S	lower than P	higher than P
C	lower than R	higher than S	higher than R
D	lower than R and S	higher than P	lower than P

30 The photomicrograph shows a transverse section of the leaf of a species of grass.



The grass is specially adapted to grow in a dry habitat.

Which row correctly explains how the features help the grass to grow in this habitat?

	hair-like structures	leaf shape
A	increase internal humidity	decrease external humidity
B	decrease external humidity	increase internal humidity
C	increase internal humidity	increase internal humidity
D	decrease external humidity	decrease external humidity

31 Which statement supports the theory of active loading of sucrose into companion cells?

A The pH decreases in the cell wall of the companion cells compared with the cytoplasm.

B The pH decreases in the cytoplasm of the companion cells compared with the cell wall.

C The pH decreases in the companion cells and sieve tube elements.

D The pH decreases in the sieve tube elements compared with the companion cells.

32 Which properties of water are essential for its role in the transport of blood in mammals?

	high latent heat of vaporisation	solvent for polar substances
A	✓	✗
B	✗	✓
C	✓	✓
D	✗	✗

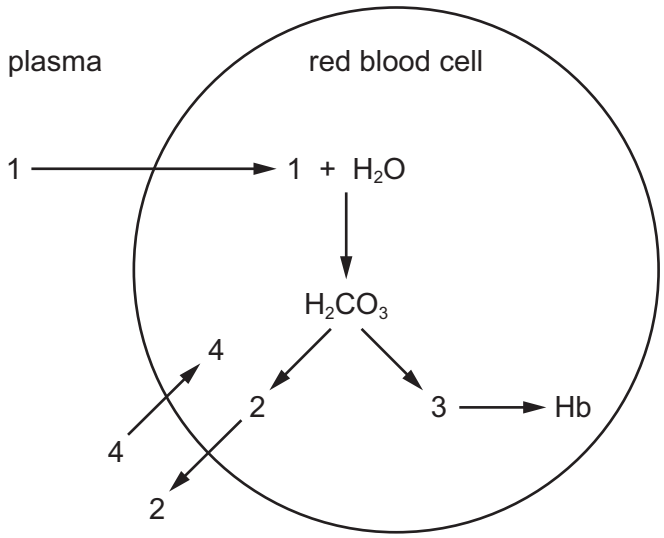
key

✓ = essential

✗ = not essential

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33 The diagram shows some of the events that happen between the plasma and the red blood cells in the circulatory system.



What do the numbers 1, 2, 3 and 4 represent?

	1	2	3	4
A	Cl^-	HCO_3^-	H^+	CO_2
B	CO_2	HCO_3^-	H^+	Cl^-
C	HCO_3^-	Cl^-	CO_2	H^+
D	CO_2	H^+	HCO_3^-	Cl^-

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[Turn over

34 The diagrams show the valves in the heart when viewed in cross-section from above at different stages in the cardiac cycle.

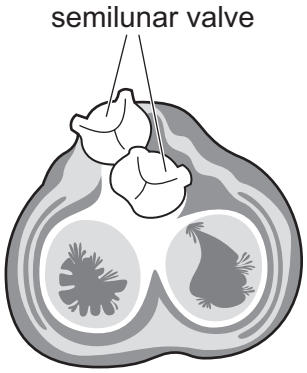


diagram 1

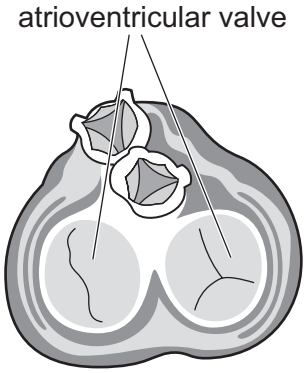


diagram 2

Which stages in the cardiac cycle are shown?

	diagram 1	diagram 2
A	diastole	ventricular systole
B	atrial systole	diastole
C	ventricular systole	diastole
D	diastole	atrial systole

35 Where are squamous epithelial cells found in the human gas exchange system?

	trachea	bronchus	alveolus
A	✓	✓	✓
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ = found

✗ = not found

36 Which statement about gas exchange between air in the alveoli and blood in the pulmonary capillaries is correct?

A The oxygen concentration in the capillaries leaving the pulmonary artery is higher than the oxygen concentration in the alveoli.

B Gases must diffuse across the endothelium of the pulmonary capillaries and the endothelium of the alveoli.

C The elastic fibres in the alveoli walls allow the alveoli to expand to increase the surface area available for diffusion into the pulmonary capillaries.

D Breathing out reduces the carbon dioxide concentration gradient between the blood in the pulmonary capillaries and the air in the alveoli.

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37 The average thicknesses for some structures in the human respiratory system are shown.

structure	average thickness of structure / nm
human cell membrane	5
cytoplasm of alveolar wall cells	190
cytoplasm of capillary wall cells	90
tissues between alveolar wall and capillary wall	300

A molecule of oxygen is in the alveolar air space next to the wall of the alveolus.

What is the shortest distance that the molecule needs to diffuse from its current position to the haemoglobin that completely fills a red blood cell in the nearest capillary?

(Assume that the red blood cells touch the walls of a capillary.)

A 595 nm **B** 600 nm **C** 605 nm **D** 610 nm

38 The statements refer to the disease tuberculosis (TB).

1 The pathogen is **not** accessible to the immune system.

2 The bacterial pathogen reproduces slowly.

3 The pathogen is **not** very sensitive to antibiotics.

Which statements explain why antibiotic treatment for TB takes a long time?

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

TURN OVER FOR QUESTIONS 39 AND 40.

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39 The average sizes of some pathogens are shown.

pathogen	average size / nm
HIV particle	100
Mycobacterium tuberculosis	3 000
Plasmodium	20 000
Vibrio cholerae	1 500

One type of air filter has been shown to be effective at preventing any pathogens of 1 μm or larger from entering the air system of a room.

Based on their size **and** mode of transmission, which diseases would the air filter prevent from entering the air system of a room?

	HIV infection	TB	malaria	cholera
A	✗	✓	✓	✓
B	✗	✗	✓	✓
C	✓	✗	✗	✗
D	✗	✓	✗	✗

key

✓ = prevented

✗ = not prevented

40 A successful vaccination programme provides a level of immunity where the majority of a population is protected.

There are several factors that can affect the success of a vaccination programme.

Which row correctly shows the factors that can affect the success of a vaccination programme?

	frequent mutation of the pathogen	vaccination from eight weeks old	pathogen is able to invade T-cells	booster vaccinations needed frequently
A	✓	✓	✗	✓
B	✓	✗	✓	✓
C	✗	✓	✓	✗
D	✓	✗	✓	✗

key

✓ = affects

✗ = does not affect

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Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/13**

Paper 1 Multiple Choice **May/June 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)

8864591307

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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1 Which feature is visible with a light microscope using a natural light source?

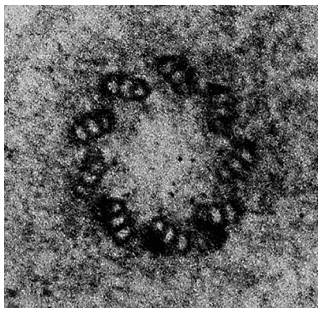
A DNA molecule of diameter 2 nm

B *Paramecium* cell of diameter 200 μm

C phospholipid bilayer of width 8 nm

D ribosome of diameter 20 nm

2 The electron micrograph shows a structure found in the cytoplasm of an animal cell.



Which biological molecules are found in this structure?

1 nucleic acids

2 proteins

3 phospholipids

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

3 Which cell structures contain nucleic acid?

1 cytoplasm

2 lysosomes

3 mitochondria

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

4 Mitochondria are thought to have evolved from prokaryotic cells that were ingested by an ancestral cell.

Which feature have prokaryotes lost during their evolution into mitochondria?

A cell wall

B circular chromosome

C endoplasmic reticulum

D ribosomes

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5 Which polymers are present in all viruses, all prokaryotes **and** all eukaryotes?

1 polynucleotides

2 polypeptides

3 polysaccharides

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

6 How many of the listed structures typically contain genetic material that has telomeres?

- bacterial cell
- chloroplast
- mitochondrion
- nucleus

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

7 Steps 1, 2, 3 and 4 are used to test for a non-reducing sugar.

1 Put 5 cm^3 of solution into a test-tube.

2 Add a few drops of acid.

3 Neutralise with alkali.

4 Add 6 cm^3 of Benedict's solution.

When is the solution heated or boiled?

A between steps 1 and 2

B between steps 2 and 3, and after step 4

C between steps 2 and 3 only

D after step 4 only

8 Which features contribute to the function of a cellulose molecule?

1 Long chains of glucose molecules coil into a helix.

2 Many hydrogen bonds form between adjacent chains.

3 It is insoluble in water.

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

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9 What correctly describes triglycerides?

A non-polar molecules that are soluble in ethanol

B non-polar molecules that are soluble in water

C polar molecules that are soluble in ethanol

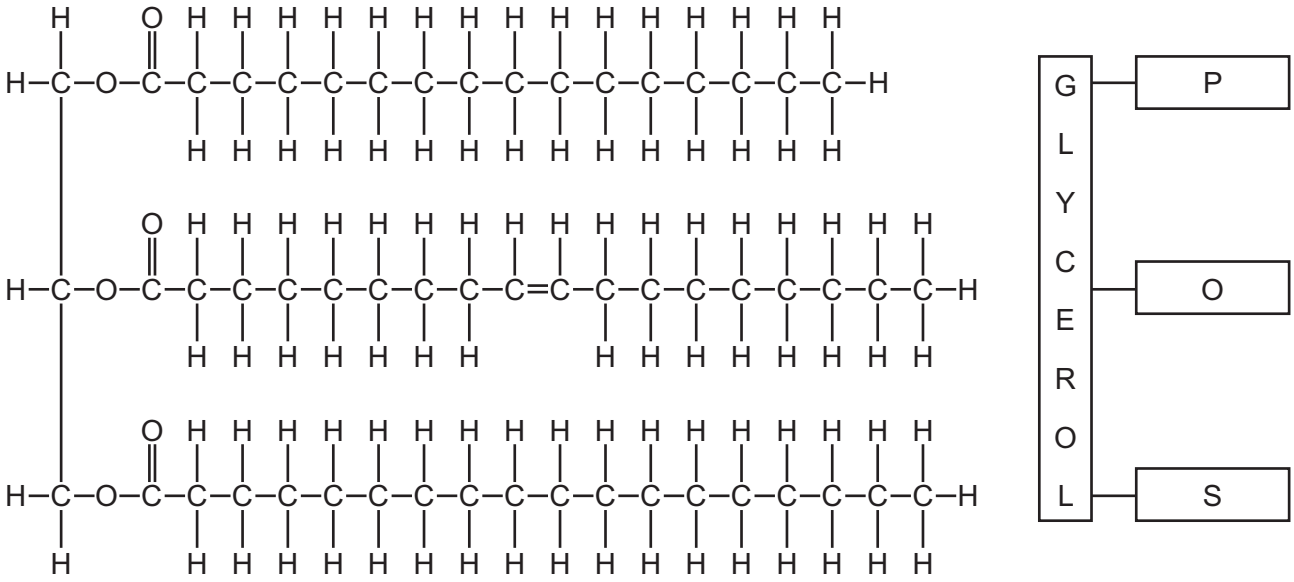
D polar molecules that are soluble in water

10 Cocoa butter contains three different triglycerides. These triglycerides are made from the fatty acids:

- oleic acid (O)
- palmitic acid (P)
- stearic acid (S).

The three triglycerides found in cocoa butter are POS, SOS and POP.

The chemical structure of the triglyceride POS is shown next to a diagrammatic representation of POS.



Which statement is correct?

A Triglyceride POP contains two unsaturated fatty acids joined by ester bonds to glycerol.

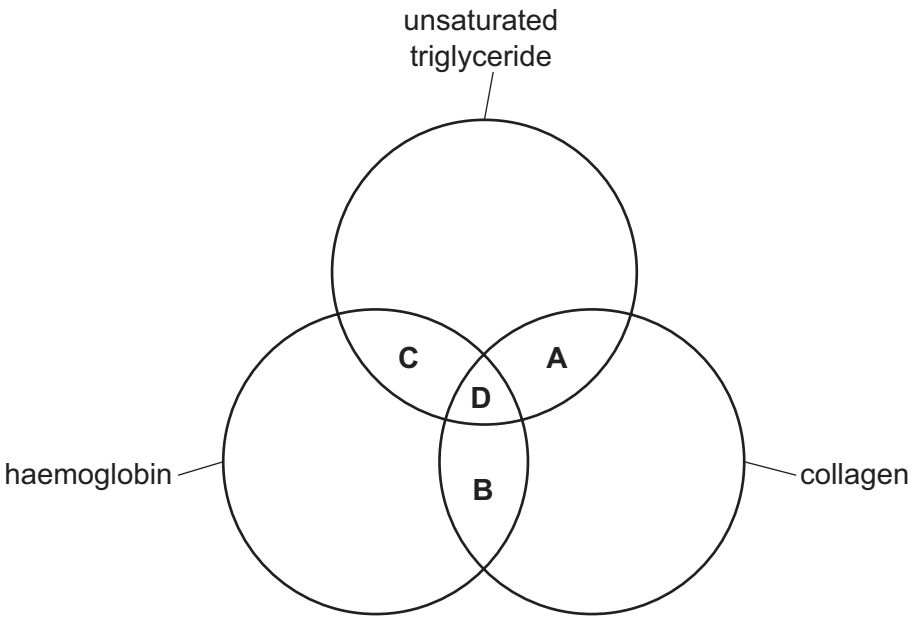
B Triglyceride POS contains two less carbon atoms than triglyceride POP.

C Triglyceride SOS contains four more carbon atoms than triglyceride POP.

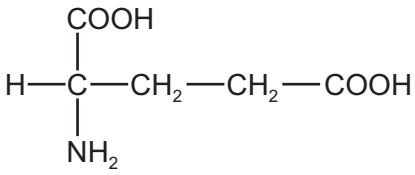
D Triglyceride SOS contains two saturated fatty acids joined by hydrolysis to glycerol.

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11 Which molecules contain at least four double bonds?



12 The diagram shows the amino acid glutamic acid.



What is the R group for glutamic acid?

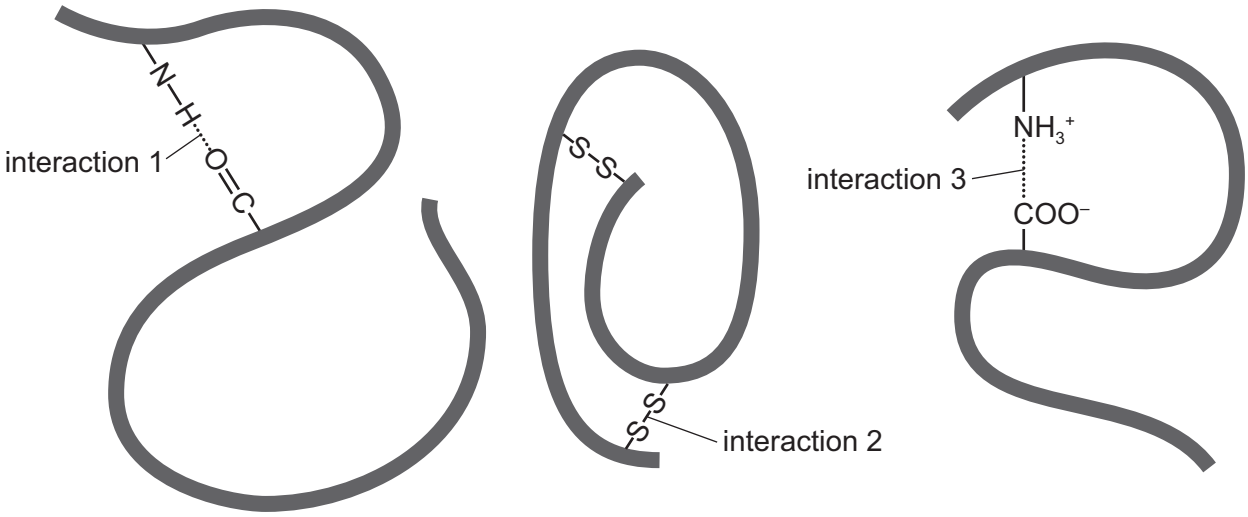
A NH_2

B H

C COOH

D CH_2—CH_2—COOH

13 The diagram shows three interactions that hold protein molecules in shape.



Which row identifies these interactions?

	interaction 1	interaction 2	interaction 3
A	hydrogen bond	disulfide bond	hydrophobic interaction
B	hydrogen bond	covalent bond	ionic bond
C	hydrophobic interaction	ionic bond	hydrogen bond
D	ionic bond	disulfide bond	peptide bond

14 Some animals produce antimicrobial proteins which protect them from pathogens. These proteins could be used to kill human pathogens, however when used as a medicine they are broken down by protein-digesting enzymes.

Replacing one of the amino acids found in the protein with an amino acid that had been synthesised in the laboratory resulted in a modified protein that was **not** broken down.

What could explain why this modified protein was not broken down by the protein-digesting enzymes?

1 The modified protein has a different tertiary structure to the original protein.

2 The modified protein is **not** complementary in shape to the enzyme's active site.

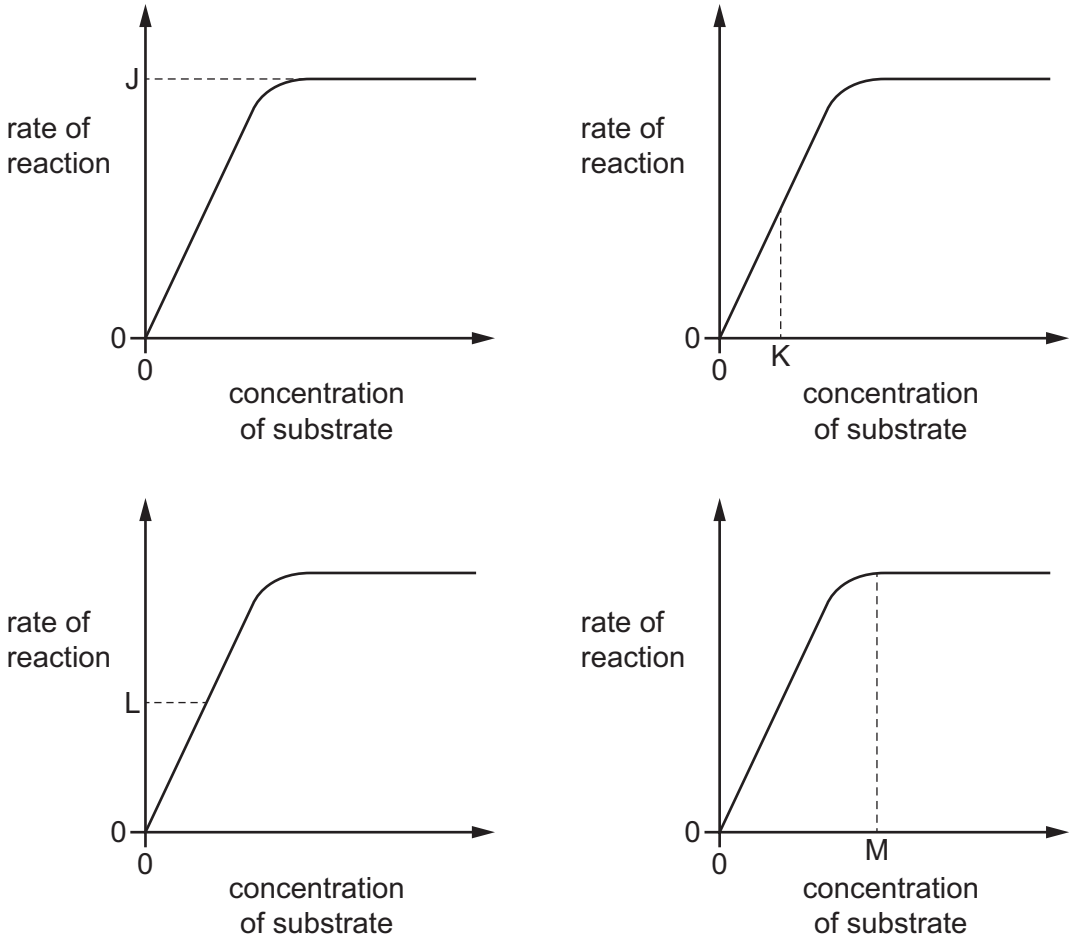
3 The modified protein is unable to induce a fit with the protein-digesting enzyme.

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

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15 A student investigated the effect of substrate concentration on the rate of an enzyme-catalysed reaction. A graph was plotted to show the relationship between these two variables. The student was asked to take readings from the graph that could be used to determine the Michaelis–Menten constant, K_m, for this enzyme.

J, K, L and M show points read from the graphs which the student could use to determine the value of K_m.

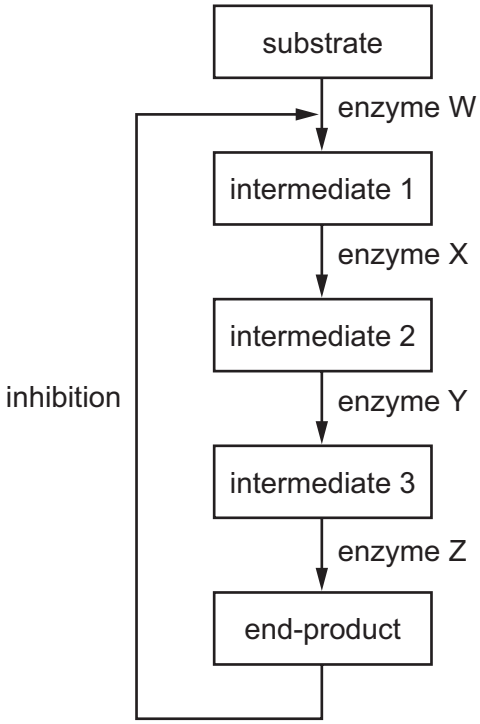


Which two readings must the student use to determine the value of K_m?

A J and K **B** J and M **C** K and L **D** L and M

16 The end-product of a metabolic pathway can act as a competitive inhibitor. This is called end-product inhibition and allows a cell to control a metabolic pathway.

The diagram shows a metabolic pathway where the end-product could act as an inhibitor of enzyme W.



What would be the effect if enzyme Z was inhibited by the end-product instead of enzyme W?

	quantity of intermediate 1	quantity of end-product
A	increase	decrease
B	increase	unchanged
C	decrease	decrease
D	decrease	unchanged

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17 Which row shows the distribution of cholesterol and the carbohydrate chains of glycolipids and glycoproteins in a cell surface membrane?

	cholesterol	carbohydrate chains of glycolipids	carbohydrate chains of glycoproteins
A	between phospholipid heads only	mainly on the outer surface	mainly on the inner surface
B	between phospholipid heads only	mainly on the inner surface	mainly on the outer surface
C	between phospholipids	mainly on the inner surface	mainly on the inner surface
D	between phospholipids	mainly on the outer surface	mainly on the outer surface

18 Which row correctly describes **all** the possible relative concentrations of a substance when the substance is moved by endocytosis or exocytosis?

	endocytosis	exocytosis
A	concentrations equal	concentrations equal
B	concentrations equal, greater inside or greater outside	concentrations equal, greater inside or greater outside
C	concentrations equal or greater outside	concentrations equal or lower outside
D	concentrations equal or lower outside	concentrations equal or greater outside

19 Which statement about simple diffusion is correct?

A It requires specific molecules in the cell surface membrane.

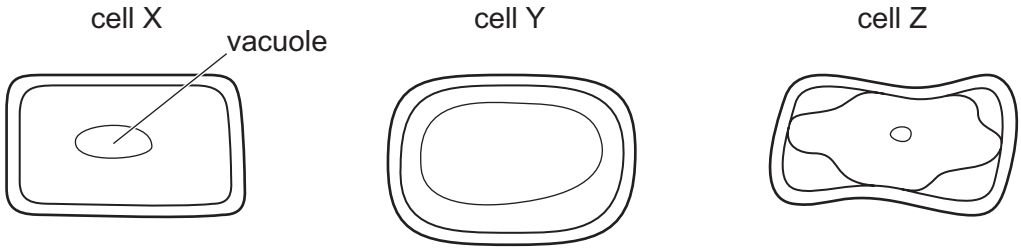
B It is a passive mode of transporting substances.

C It always requires a membrane for transport of substances.

D It only happens in the cells of prokaryotes and eukaryotes.

20 Plant cells with the same water potential in their cytoplasm were each put into one of three different concentrations of sugar solution, 10%, 5% and 2.5%.

The cells were left for 50 minutes and then observed using a light microscope.



Which statements are correct?

1 Cell Y had a lower water potential than the sugar solution it was put into.

2 Cell Z was put into the 10% sugar solution.

3 Cell Z had a less negative water potential than the sugar solution it was put into.

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

21 Which row describes some properties of stem cells?

	able to divide by mitosis to produce more stem cells	able to differentiate into specialised cells	able to repair damaged cells
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✗
D	✗	✗	✓

key

✓ = is a property

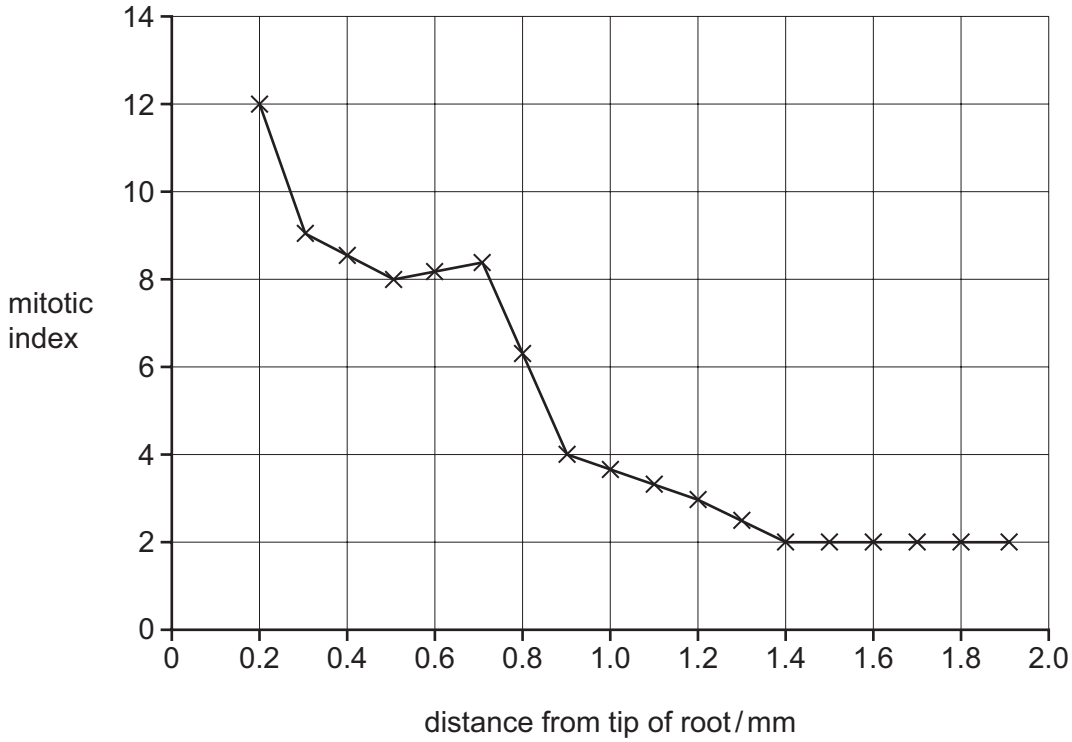
✗ = is not a property

22 The mitotic index is a measure of the proportion of cells that are undergoing mitosis in an area of tissue. It is calculated using the formula shown.

mitotic index = (number of cells undergoing mitosis ÷ total number of cells) × 100

A scientist calculated the mitotic index of areas of onion root at different distances from the tip of the root.

The results are shown.



Which statement is correct?

A No cell division occurs further than 1.4 mm from the tip of the root.

B The rate of cell division decreases as the distance from the root tip decreases.

C Most of the cells undergoing cell division are closer to the tip of the root.

D For a sample of 200 cells 0.2 mm from the tip of the root, 6 would be undergoing mitosis.

23 Which molecules make up the structure of ATP?

1 adenine

2 thymine

3 deoxyribose

4 phosphate

5 ribose

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

24 A short piece of DNA, 19 base pairs long, was analysed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown.

	number of nucleotide bases			
	A	C	G	T
strand 1				4
strand 2		7		5

How many cytosines were in strand 1?

A 2 **B** 3 **C** 5 **D** 7

25 Which statement about the role of DNA polymerase in the process of semi-conservative replication of DNA is correct?

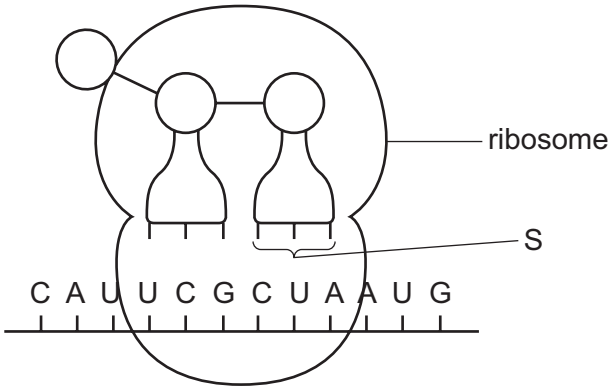
A DNA polymerase forms the hydrogen bonds between complementary base pairs.

B DNA polymerase moves along the lagging strand in the 3′ to 5′ direction.

C DNA polymerase joins new bases to the leading strand only.

D DNA polymerase moves along leading and lagging strands in the 5′ to 3′ direction.

26 The diagram shows the process of translation occurring at a ribosome.



What is the base sequence at S?

A CUA **B** CAT **C** GAU **D** GAT

27 Which row correctly explains how the structures of phloem sieve tube elements and xylem vessel elements are related to their functions as transport systems?

	phloem sieve tube elements	xylem vessel elements
A	contain mitochondria to make ATP for the active loading of sucrose into the phloem	cell walls are thickened and contain lignin which makes xylem vessels waterproof
B	contain no nucleus so that dissolved solutes can move easily through cells	end walls between cells are perforated so that water can move easily through xylem vessels
C	end walls between cells are perforated so that dissolved solutes can move between cells	lignin in cell walls gives strength so that xylem vessels do not collapse due to transpiration pull
D	no end walls between cells so that sucrose solution can move up and down the phloem	contain no cytoplasm so that a continuous column of water can move up the xylem vessels

28 Which component of plants is used by the apoplast pathway as water is moved from the soil to the xylem?

A Casparian strip

B cellulose

C endodermis

D suberin

29 Which statements correctly describe transport pathways in dicotyledonous plants?

1 In the symplast pathway, water may move through intercellular spaces.

2 The symplast pathway may be blocked by the tonoplast.

3 In the apoplast pathway, water does **not** move through plasmodesmata.

4 The apoplast pathway may be blocked by the Casparian strip.

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

30 Plants, such as the tobacco plant, retain very little of the water they take in and the volume of water lost during transpiration is very high. This is because these plants can only absorb carbon dioxide through open stomata.

Plants use carbon dioxide to synthesise glucose molecules. It is estimated that 400 molecules of water are lost for each carbon dioxide molecule gained.

How many water molecules are lost for a plant to synthesise one molecule of glucose?

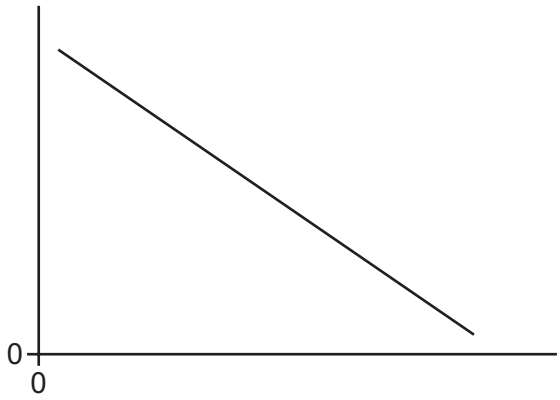
A 800 **B** 1200 **C** 2000 **D** 2400

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31 Which changes occur as sucrose is transferred from leaves into phloem sieve tubes to be transported to a sink?

	water potential in phloem sieve tubes becomes	volume of liquid in phloem sieve tubes
A	less negative	decreases
B	less negative	increases
C	more negative	decreases
D	more negative	increases

32 The graph shown does not have any axis labels.



Which row shows appropriate labels for the axes that would explain mass flow in phloem?

	x-axis	*y*-axis
A	distance from sink / m	hydrostatic pressure / kPa
B	hydrostatic pressure / kPa	distance from sink / m
C	distance from source / m	hydrostatic pressure / kPa
D	hydrostatic pressure / kPa	distance from source / m

33 What is present in the blood in human veins?

1 chloride ions

2 carbonic anhydrase

3 oxyhaemoglobin

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

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34 The photomicrograph shows two blood vessels P and Q.

Both these blood vessels are part of a network which transports blood around the body.



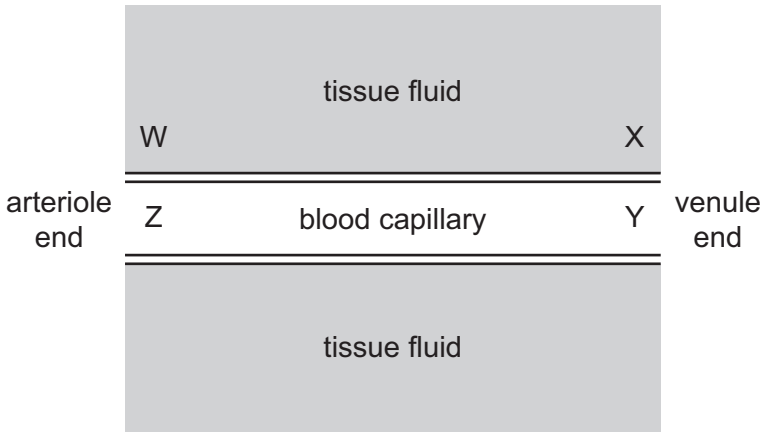
Which row is correct for blood vessel P and blood vessel Q?

	blood vessel P	blood vessel Q
A	carries blood into arterioles	carries blood into arterioles
B	carries blood into arterioles	carries blood from venules
C	carries blood from venules	carries blood into arterioles
D	carries blood from venules	carries blood from venules

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[Turn over

35 The diagram shows a blood capillary and the tissue fluid which surrounds it.



Tissue fluid is formed when fluid and solutes from blood plasma pass through tiny gaps in the capillary wall. Most tissue fluid is then returned to the blood in the capillary.

Which pressures will be needed at points W, X, Y and Z so that this system can function?

	pressure at W / mm Hg	pressure at X / mm Hg	pressure at Y / mm Hg	pressure at Z / mm Hg
A	18	26	36	26
B	26	26	18	36
C	26	36	26	18
D	36	18	26	26

36 What happens during ventricular systole in a mammalian heart?

A Aortic pressure increases.

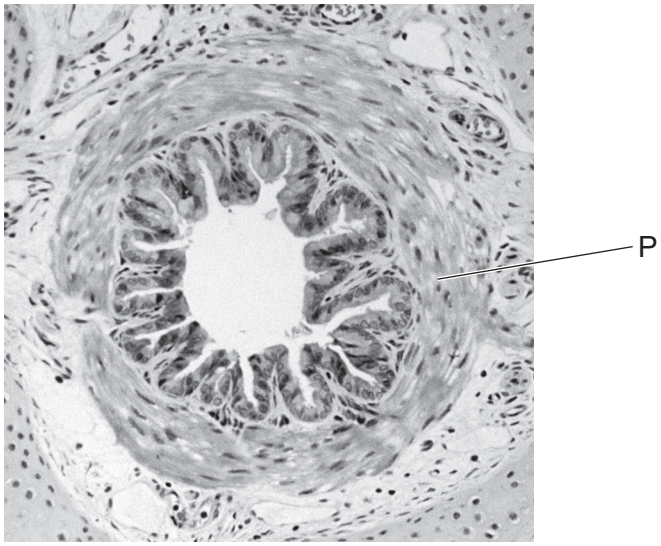
B Atrioventricular valves open.

C Semilunar valves close.

D Ventricular pressure decreases.

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37 The photomicrograph shows a part of the human gas exchange system with one tissue labelled P.



Which row is correct?

	part of gas exchange system	function of tissue P
A	bronchus	regulates the amount of air reaching the lungs
B	bronchus	provides support and prevents collapse
C	bronchiole	regulates the amount of air reaching the lungs
D	bronchiole	provides support and prevents collapse

38 How many times must a molecule of oxygen pass through a cell surface membrane as it diffuses from the airspace inside an alveolus, through a cell in the capillary wall, to bind to a molecule of haemoglobin?

A 3 **B** 4 **C** 5 **D** 10

39 A student wrote four statements about cholera.

Which statement is **not** correct?

A It can be controlled by vaccination.

B It is caused by bacteria spread by ingestion.

C HIV/AIDS increases the risk of infection.

D It may be transmitted by animal vectors.

40 Monoclonal antibodies are produced using the hybridoma method.

What are removed from the spleen of a mouse to produce monoclonal antibodies?

A antigens

B clones

C lymphocytes

D myeloma cells

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