Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/11**

Paper 1 Multiple Choice **May/June 2024**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

8862199181

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.

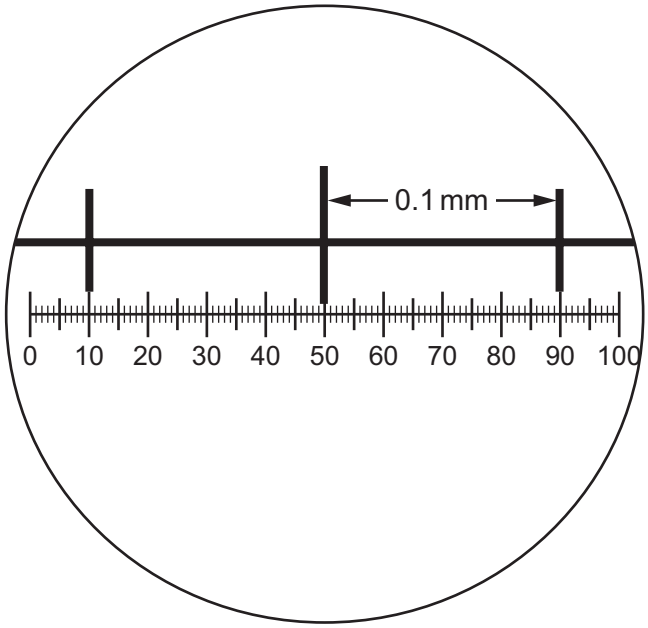
INFORMATION

- 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 diagram shows a stage micrometer scale viewed with an eyepiece graticule, using a magnification of ×200.



Using the same magnification, a chloroplast is measured as 4 eyepiece graticule divisions long.

How long is the chloroplast?

A $1.0 \times 10^{1}\,\mu m$

B $4.0 \times 10^{2}\,\mu m$

C $2.5 \times 10^{-1}\,\mu m$

D $2.5 \times 10^{-2}\,\mu m$

2 Which range of cell diameters is typical for prokaryotic cells?

A 1 nm to 5×10^{2} nm

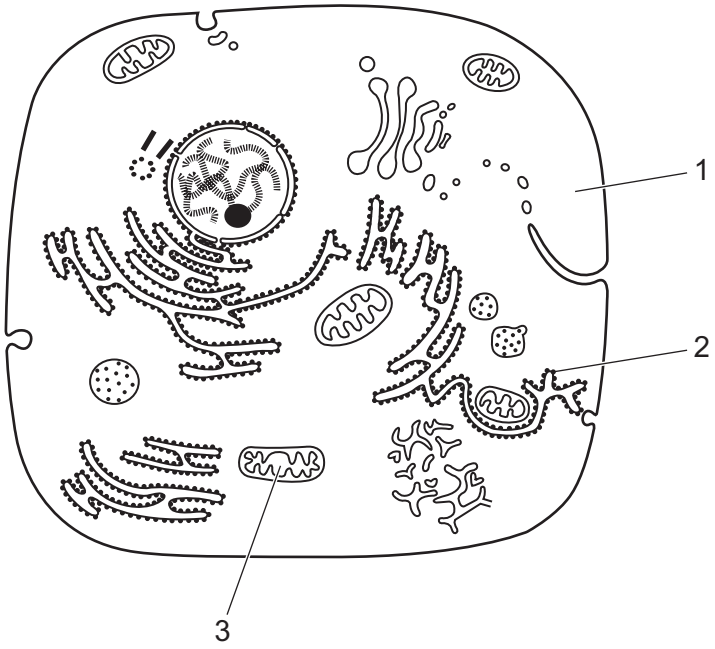
B 1×10^{3} nm to 5 μm

C $1 \times 10^{1}\,\mu m$ to $5 \times 10^{2}\,\mu m$

D $1 \times 10^{2}\,\mu m$ to $5 \times 10^{3}\,\mu m$

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3 The diagram shows a typical animal cell.



Where would nucleic acids be found?

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

4 Which structure is found in a typical bacterial cell?

A intron

B telomere

C template strand

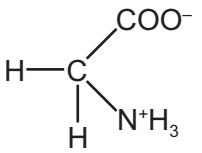
D capsid

5 What is the maximum number of hydrogen bonds that can form between a single water molecule and other water molecules?

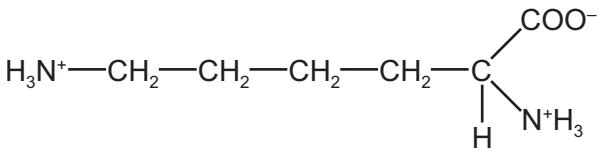
A 1 **B** 2 **C** 3 **D** 4

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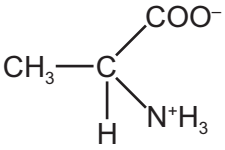
6 The diagrams show the structure of four amino acids in aqueous solution.



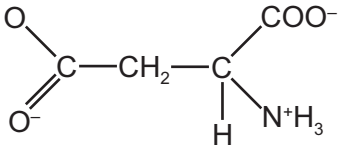
glycine



lysine



alanine



aspartate

Which two structures have an overall charge?

A alanine and aspartate

B alanine and glycine

C aspartate and lysine

D glycine and lysine

7 The table shows the number of carbon atoms and the number of carbon–carbon double bonds in molecules of three triglycerides and the fatty acids they contain.

The information is shown in the format 'number of carbon atoms : number of carbon–carbon double bonds'.

triglyceride	fatty acid 1	fatty acid 2	fatty acid 3
54 : 1	15 : 0	18 : 0	18 : 1
56 : 4	17 : 0	X	18 : 2
57 : 3	18 : 0	18 : 1	18 : 2

Which description matches fatty acid 2 of the 56 : 4 triglyceride, identified in the table as X?

A saturated with 17 carbon atoms

B saturated with 18 carbon atoms

C unsaturated with 17 carbon atoms

D unsaturated with 18 carbon atoms

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8 Collagen molecules are made up of three polypeptide chains interacting together. The individual polypeptide chains consist of a regular pattern of amino acids. Almost every third amino acid is glycine.

Which protein structures of collagen are described?

A primary and secondary

B primary and quaternary

C secondary and tertiary

D tertiary and quaternary

9 The masses of the parts of haemoglobin are shown in the table.

component	mass / Da
α-globin chain	15 126
β-globin chain	15 868
haem group	617

There are 1000 Da in 1 kDa.

What is the mass of a haemoglobin molecule in kDa?

A 31.6 **B** 33.5 **C** 62.6 **D** 64.5

10 What is the correct order of locations in the cell for the production of an extracellular enzyme?

A nucleus → ribosome → rough endoplasmic reticulum → Golgi body

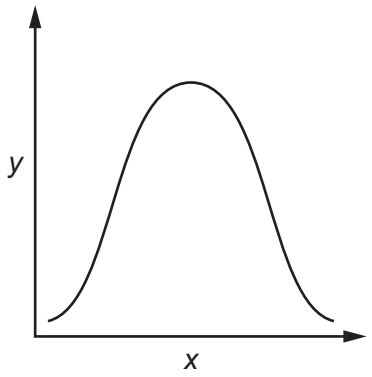
B ribosome → nucleus → Golgi body → rough endoplasmic reticulum

C ribosome → rough endoplasmic reticulum → nucleus → Golgi body

D rough endoplasmic reticulum → nucleus → Golgi body → ribosome

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11 The graph shows the trend from an enzyme-catalysed reaction.



Which labels are correct for the *x*-axis and *y*-axis?

	x-axis	*y*-axis
A	rate of reaction	substrate concentration
B	enzyme concentration	temperature
C	pH	rate of reaction
D	substrate concentration	pH

12 Which statements about the Michaelis–Menten constant (K_m) are correct?

1 The higher the K_m, the higher the enzyme affinity for the substrate.

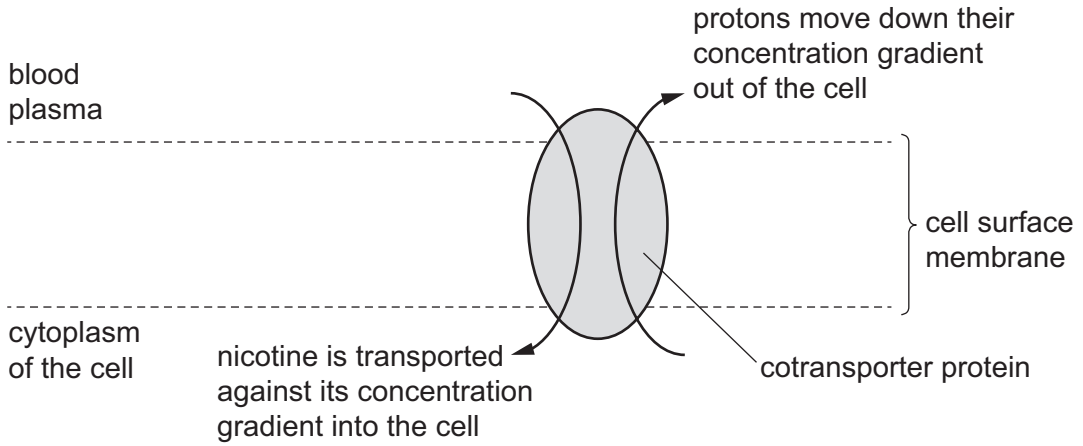
2 K_m is a measure of the degree of enzyme affinity for the substrate.

3 K_m is defined as the substrate concentration at which the enzyme functions at half its maximum rate.

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

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13 The diagram shows how nicotine is transported from the blood plasma into a cell using a type of cotransporter mechanism.



In the phloem tissue, there is a cotransporter mechanism that moves sucrose into the cytoplasm of a companion cell.

Which statement correctly describes a similarity between the cotransport of nicotine and the cotransport of sucrose?

A The cotransporter proteins generate a proton gradient by moving protons out of the cell by active transport.

B The protons are transported through the cotransporter proteins by facilitated diffusion.

C The protons move through the cotransporter proteins in the opposite direction to the movement of nicotine and sucrose.

D The cotransporter proteins use energy from ATP to transport protons with nicotine and sucrose.

14 The diagram shows a simple metabolic pathway.

$$W \rightarrow X \rightarrow Y \rightarrow Z$$

The letters W, X, Y and Z represent four different substances. At each step in the diagram the substrate undergoes a chemical reaction catalysed by an enzyme. The reaction produces the next substance in the pathway.

Which statements correctly describe the enzymes taking part in this metabolic pathway?

1 They are all globular proteins.

2 They all have the same tertiary structure.

3 They all contain hydrogen atoms in their structure.

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

15 A student observed the effect of two different concentrations of salt solution on blood cells.

The student added each concentration of salt solution to one of two microscope slides, and then a small drop of fresh blood was added.

Each slide was viewed using the high power lens of a microscope and the student's observations were recorded.

slide 1 No red blood cells were visible.

slide 2 The red blood cells were visible but looked slightly crinkled.

Which row correctly explains the results obtained?

	slide 1	slide 2
A	Swelling of the cells caused them all to burst.	The Ψ of the cell was more negative than the Ψ of the external solution.
B	The Ψ of the cell was more negative than the Ψ of the external solution.	The Ψ of the external solution was more negative than the Ψ of the cell.
C	The Ψ of the cell was less negative than the Ψ of the external solution.	There is a net movement of water out of the cell by osmosis.
D	The Ψ of the external solution was less negative than the Ψ of the cell.	The Ψ of the cell was very similar to, but slightly more negative than, the Ψ of the external solution.

key
Ψ = water potential

16 Which statement correctly describes facilitated diffusion?

A The process only occurs using channel proteins that change shape and that use energy provided by the cell.

B The process occurs using channel proteins or carrier proteins that may or may not change shape.

C The process occurs using channel proteins or carrier proteins that use energy provided by the cell.

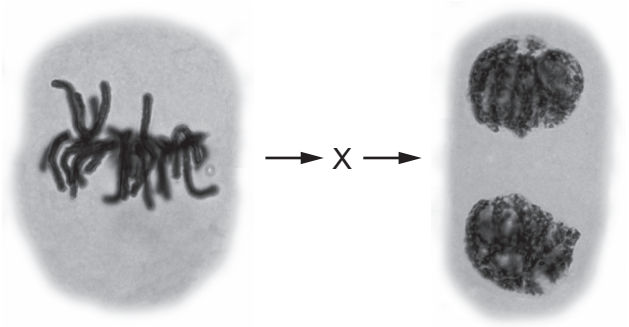
D The process only occurs using carrier proteins that create a gradient to move ions in opposite directions.

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17 Which row is correct for stem cells?

	can repair cells	can be involved in the formation of phagocytes
A	yes	no
B	yes	yes
C	no	no
D	no	yes

18 Eukaryotic organisms grow and increase in size as a result of cell division. The diagram shows some stages of mitosis with one stage missing, labelled X.



What happens in stage X?

A Spindle fibres attach to the centromeres and the chromosomes line up along the equator.

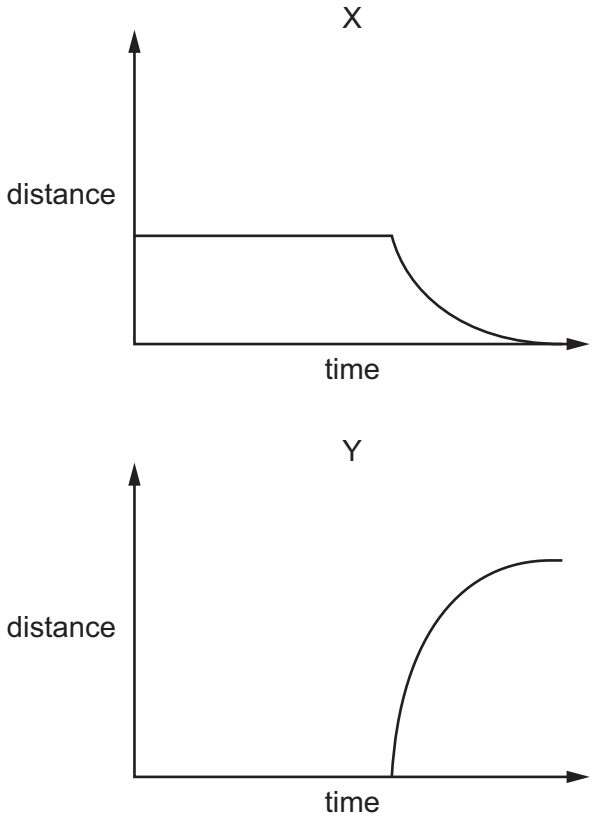
B The chromatin coils and condenses and the nuclear membrane disintegrates.

C The chromosomes line up in pairs along the equator of the cell.

D Microtubules shorten so that spindle fibres contract and the centromeres divide.

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19 The graphs show various distance measurements taken from the start of metaphase of mitosis. The graphs are to scale when compared to one another.



Which row correctly identifies the distance measurement for each graph?

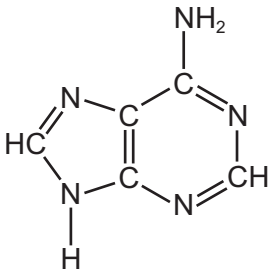
	X	Y
A	distance between poles of spindle	distance of centromeres from poles of spindle
B	distance between poles of spindle	distance between sister chromatids
C	distance of centromeres from poles of spindle	distance between sister chromatids
D	distance of centromeres from poles of spindle	distance between poles of spindle

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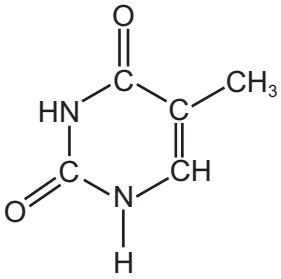
20 Which row is correct for the start of anaphase of mitosis?

	form of DNA	DNA is associated with histone proteins	state of the cell surface membrane
A	chromosomes	always	broken apart
B	chromosomes	sometimes	intact
C	separated sister chromatids	always	intact
D	separated sister chromatids	sometimes	broken apart

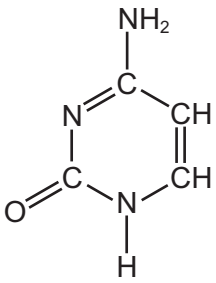
21 The diagrams show the chemical structure of four bases.



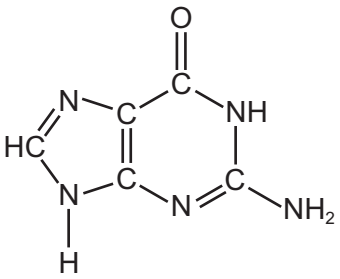
1



2



3



4

Which diagrams show thymine and cytosine?

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

22 The diagram shows the nucleotide sequence of a small section of the transcribed strand of a gene.

CGG GCC CCG CGG

The table shows the amino acids coded for by 10 mRNA codons.

mRNA codon	amino acid
AAG	Lys
ACG	Thr
CGG CGC CGU	Arg
CCG	Pro
GCC GCG	Ala
GGC	Gly
UGC	Cys

What is the sequence of the four amino acids in the polypeptide translated from this small section of a gene?

A Ala-Ala-Cys-Ala

B Ala-Arg-Gly-Ala

C Arg-Ala-Pro-Arg

D Arg-Arg-Thr-Arg

23 What does the process of translation require?

A DNA, free nucleotide bases and mRNA

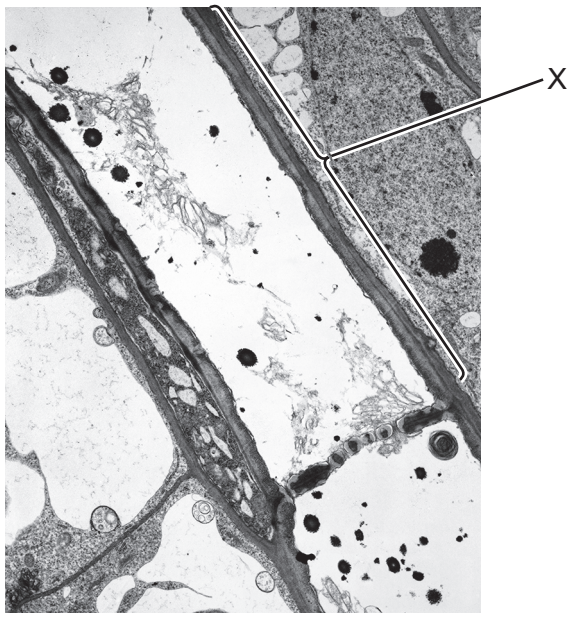
B DNA, mRNA, amino acids and RNA polymerase

C mRNA, ribosomes and RNA polymerase

D mRNA, ribosomes, amino acids and tRNA

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24 The electron micrograph shows a longitudinal section of part of the stem of a plant.



What is the name of the structure labelled X?

A companion cell

B Casparian strip

C phloem sieve tube element

D xylem vessel element

25 Which substance makes xylem vessel walls impermeable to water?

A cellulose

B lignin

C suberin

D collagen

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[Turn over

26 The following tissues carry an electrical impulse during the cardiac cycle.

1 atrioventricular node

2 muscle wall of atria

3 Purkyne tissue

4 sinoatrial node

In which order does the electrical impulse travel during the cardiac cycle?

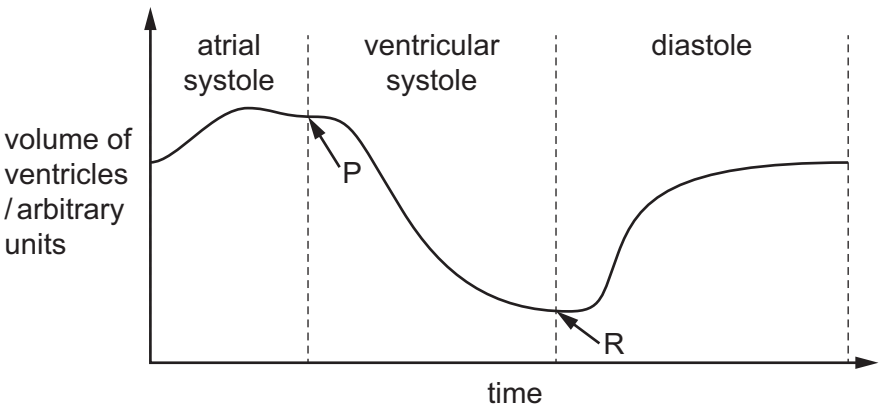
A $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$

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

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

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

27 The graph shows changes in the volume of the ventricles during a single cardiac cycle.

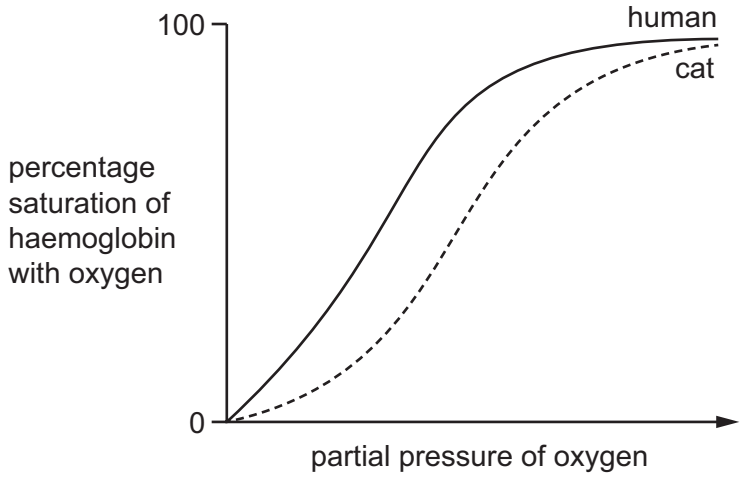


Which row is correct for the atrioventricular valve at P and for the semilunar valve at R?

	atrioventricular valve at P	semilunar valve at R
A	closes	closes
B	closes	opens
C	opens	closes
D	opens	opens

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28 The graph shows how changes in oxygen concentration affect the percentage oxygen saturation of human haemoglobin and cat haemoglobin under normal physiological conditions. The partial pressure of carbon dioxide was kept constant at 5.0 kPa and the temperature was kept constant at 37 °C.



Which conclusion is supported by the graph?

A The affinity of cat haemoglobin for oxygen is greater than the affinity of human haemoglobin for oxygen.

B At high partial pressures of oxygen, cat haemoglobin picks up oxygen more easily than human haemoglobin picks up oxygen.

C At low partial pressures of oxygen, oxygen is released more easily from cat haemoglobin than from human haemoglobin.

D The shift in the oxygen dissociation curve caused by the Bohr effect is larger for cat haemoglobin than for human haemoglobin.

29 Which statement is correct about how oxygen combines with haemoglobin?

A Combining all four oxygen molecules with haemoglobin does **not** affect the shape of haemoglobin.

B One oxygen molecule can combine with each haem group of the haemoglobin molecule.

C The first oxygen molecule to combine with haemoglobin does **not** affect the shape of haemoglobin.

D The third oxygen molecule to combine with haemoglobin makes it more difficult for the fourth oxygen molecule to combine with haemoglobin.

30 How are alveoli adapted to their function?

A They contain squamous epithelium for a short diffusion distance.

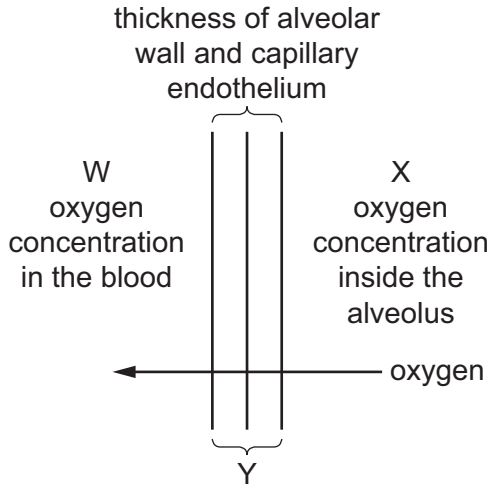
B They contain goblet cells to produce mucus.

C They contain ciliated epithelium to move mucus.

D They contain cartilage to prevent alveolar collapse.

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31 The diagram shows oxygen diffusing from the space inside an alveolus into the blood through the gaseous exchange surface.



What would increase the rate of diffusion of oxygen from the alveolus to the blood?

	increase	decrease	keep the same
A	W	X	Y
B	W	Y	X
C	Y	X	W
D	X	Y	W

32 Which tissues are present in a bronchus?

	cartilage	ciliated epithelium	smooth muscle
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = present

✗ = not present

33 Steep concentration gradients must be maintained for efficient gaseous exchange to occur in the human lungs.

Which row correctly describes how steep concentration gradients can be maintained?

	elastic fibres in the walls of the alveoli recoil when breathing out	continual supply of deoxygenated blood by the pulmonary artery
A	✓	✓
B	✗	✓
C	✓	✗
D	✗	✗

key

✓ = helps maintain

✗ = does not help maintain

34 A scientist investigated the effect of an antibiotic on the treatment of cholera.

320 people with cholera were divided into two groups. One group was treated with the antibiotic while the other group was not given the antibiotic. Both groups were given fluids containing sugars and mineral salts (oral rehydration therapy).

The scientist recorded the number of days that each person had diarrhoea.

The table shows the results.

treatment	mean time person had diarrhoea / days
antibiotic and oral rehydration therapy	3.2
oral rehydration therapy	5.3

What is the percentage decrease in the mean time that a person had diarrhoea when they were treated with the antibiotic?

A 39.6% **B** 60.4% **C** 165.6% **D** 252.4%

35 How does the antibiotic penicillin affect the metabolism of a bacterial cell?

A Penicillin reduces cell growth by preventing water uptake.

B Penicillin inhibits the formation of cross-links in the cell wall between peptidoglycan molecules.

C Penicillin inhibits the hydrolysis of peptidoglycan links in the cell wall during cell extension.

D Penicillin weakens the cell wall by digesting peptidoglycan molecules.

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36 Scientists studied the multidrug-resistant bacterial infections in children caused by one type of bacteria between 2007 and 2015. The percentage of multidrug-resistant infections rose from 0.2% to 1.5%.

What was the percentage increase in multidrug-resistant infections between 2007 and 2015?

A 1.3% **B** 87% **C** 130% **D** 650%

37 Whooping cough is a highly infectious disease of the gas exchange system, caused by the bacterium *Bordetella pertussis*.

Which method provides protection to infants against whooping cough and reduces the chance of developing this disease later?

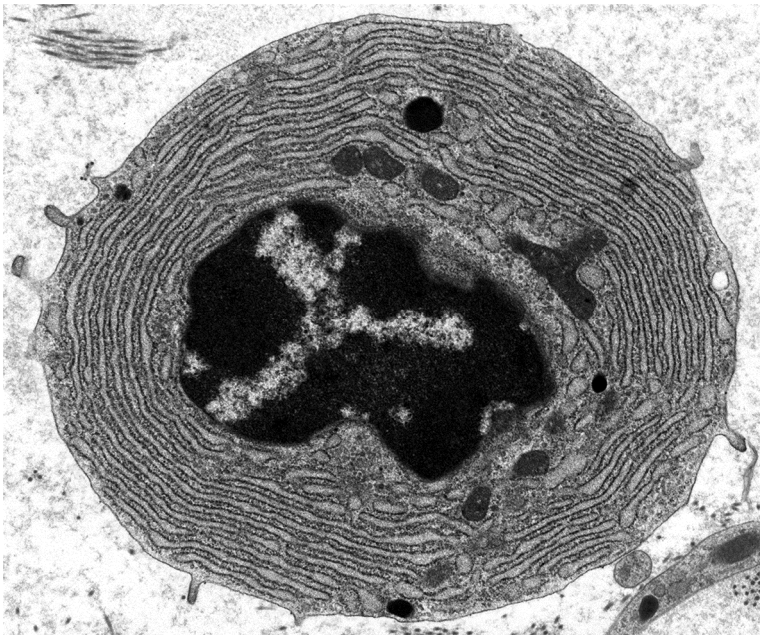
A a short course of more than one type of antibiotic

B a six-month course of one type of antibiotic

C injections of antibodies specific to *Bordetella pertussis*

D injections of antigens from *Bordetella pertussis* bacteria

38 The electron micrograph shows a type of blood cell.



What can be concluded from the electron micrograph?

A The cell secretes products that are toxic to pathogens.

B The cell synthesises a large quantity of proteins.

C The cell synthesises large quantities of antigens.

D The cell digests pathogenic bacteria.

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39 Why is mitosis important in the immune response?

A It allows B-lymphocytes to produce plasma cells.

B It allows B-lymphocytes to synthesise antibodies.

C It allows neutrophils to carry out phagocytosis.

D It allows T-lymphocytes to recognise foreign antigens.

40 What is fused with a B-lymphocyte to form a hybridoma cell in monoclonal antibody production?

A antigen

B clone

C macrophage

D myeloma cell

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Cambridge International AS & A Level

BIOLOGY **9700/12**

Paper 1 Multiple Choice **May/June 2024**

1 hour 15 minutes

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1 A prokaryotic cell which is 1 μm in diameter is magnified 50 000 times in an electron micrograph.

What is the diameter of the cell in the electron micrograph?

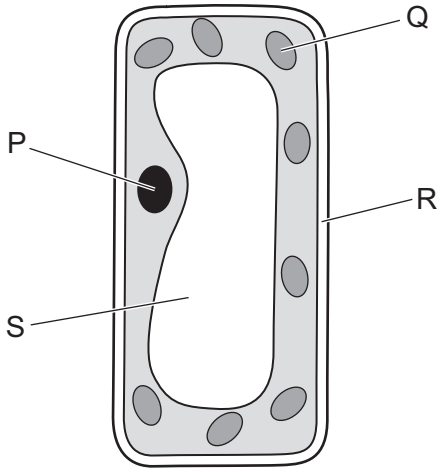
A 5×10^{-1} mm

B 5×10^{0} mm

C 5×10^{1} mm

D 5×10^{2} mm

2 The diagram shows a plant cell with some labelled structures.



Which labelled structures are bound by a double membrane?

A P and Q **B** P and S **C** R and Q **D** R and S

3 Which size of ribosome is found in mitochondria **and** typical prokaryotic cells?

A 50S **B** 60S **C** 70S **D** 80S

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4 Which row about typical prokaryotic cells **and** typical animal cells is correct?

	lysosomes present for the break down of old organelles	ATP is produced by the cell
A	✓	✗
B	✓	✓
C	✗	✓
D	✗	✗

key

✓ = correct for typical prokaryotic cells **and** typical animal cells

✗ = **not** correct for both cells but correct for **either** typical prokaryotic cells **or** typical animal cells

5 Which row is correct for the structures present in typical plant cells **and** typical animal cells?

	cell structure	plant cell	animal cell
A	plasmodesmata	present	present
B	Golgi body	present	not present
C	centriole	not present	present
D	tonoplast	not present	not present

6 Which row is correct for cellulose?

	rotation of alternate monomers by 180°	shape of molecule	hydrogen bonds between molecules
A	✓	branched	✗
B	✗	branched	✓
C	✗	unbranched	✗
D	✓	unbranched	✓

key

✓ = present

✗ = not present

7 Which statements about peptide bond formation are correct?

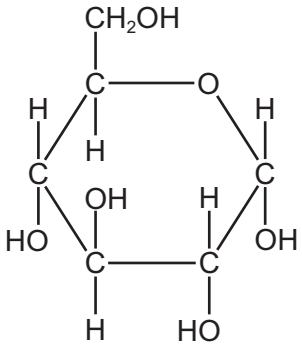
1 The bond formation occurs between a carbon of one amino acid and a nitrogen of the next amino acid after the amino acids detach from tRNA.

2 The bond formation occurs at the ribosome while the amino acids are still attached to tRNA, and is a hydrolysis reaction.

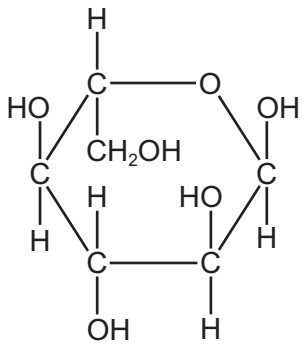
3 The bond formation is important for growth of an organism and when the bond forms, a water molecule is removed.

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

8 The diagram shows naturally occurring D-glucose and a form of glucose that can be synthesised in the laboratory, known as L-glucose.



D-glucose



L-glucose

The enzyme glucose oxidase catalyses the oxidation of D-glucose. The enzyme **cannot** catalyse the oxidation of L-glucose.

Which statement about L-glucose explains this?

A L-glucose does **not** fit into the active site of glucose oxidase.

B L-glucose has a different structural formula to D-glucose.

C L-glucose is a synthetic sugar.

D L-glucose is the mirror image of D-glucose.

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9 Tests for biological molecules were carried out on three solutions. Each solution contained only one type of biological molecule.

The observations were as follows.

solution	test	observation
1	Benedict's test	blue to orange
2	Benedict's test after acid hydrolysis	blue to red
3	biuret test	blue to purple

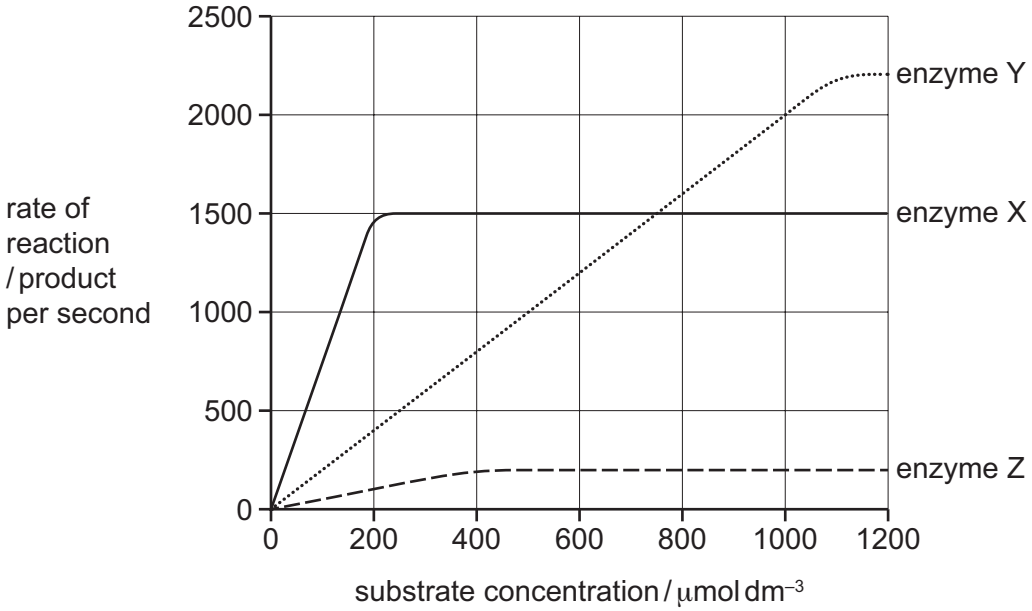
Which solutions would contain either sucrose or amylase?

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

10 Which row describes the expected effect on V_{max} and K_m when a competitive reversible inhibitor is added to an enzyme-catalysed reaction?

	effect on V_{max}	substrate concentration at K_m
A	no change	increases
B	no change	no change
C	decreases	increases
D	decreases	no change

11 The graph shows the effect of substrate concentration on the rates of reaction of three enzymes, X, Y, and Z.



What is the correct order of affinity of these enzymes for their substrates, starting with the enzyme with the highest affinity?

A $X \rightarrow Y \rightarrow Z$ **B** $X \rightarrow Z \rightarrow Y$ **C** $Y \rightarrow X \rightarrow Z$ **D** $Z \rightarrow X \rightarrow Y$

12 Which row correctly identifies the weak and strong bonds in the tertiary and quaternary structure of a typical protein?

	type of bond			
	disulfide	hydrogen	hydrophobic	ionic
A	strong	strong	weak	weak
B	strong	weak	weak	weak
C	weak	weak	strong	strong
D	weak	weak	weak	strong

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13 Which row correctly describes haemoglobin?

A	four polypeptide chains, each containing a haem group	iron ions can associate with oxygen, forming oxyhaemoglobin	in each chain, hydrophobic R-groups of amino acids point towards the centre of the molecule	at 50% saturation, two oxygen molecules are transported by the molecule
B	polypeptide chains interact to produce a globular chain	each chain contains a haem group of amino acids surrounding an iron ion	consists of two identical alpha chains and two identical beta chains	each chain can transport an oxygen molecule
C	polypeptide chains interact to produce an almost spherical molecule	an iron ion is present within each haem group	quaternary structure has two alpha chains and two beta chains	each molecule can transport a total of four oxygen atoms
D	polypeptide chains produce a loose helical shape, which folds to form a spherical molecule	iron ions in the molecule can bind reversibly with oxygen	in each chain, hydrophobic R-groups of amino acids surround the iron ion	each molecule can transport a total of eight oxygen atoms

14 Which process always takes place **without** the involvement of energy from ATP?

A active transport

B endocytosis

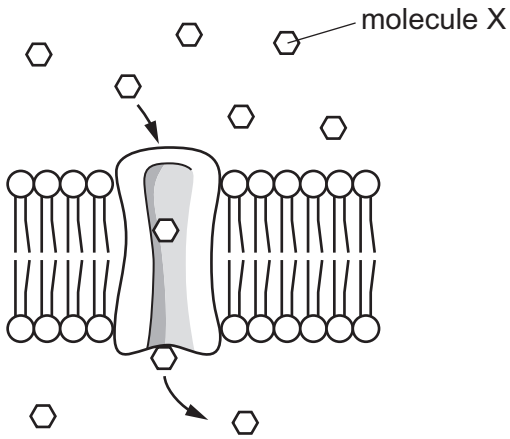
C exocytosis

D facilitated diffusion

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[Turn over

15 The diagram shows the entry of molecule X into a cell.

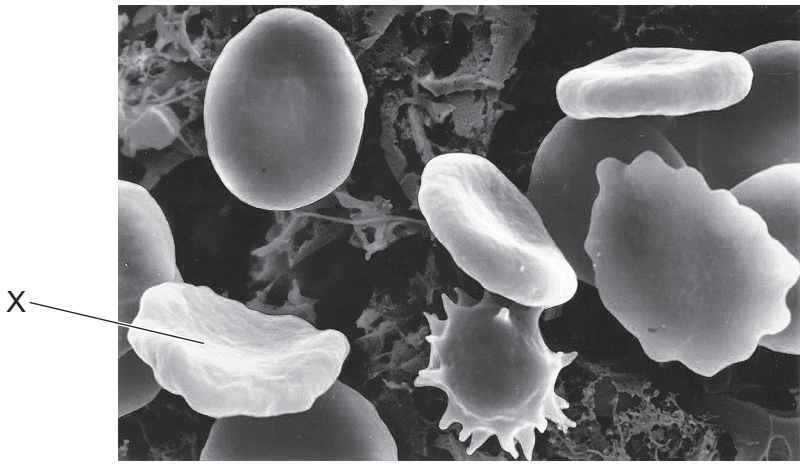


Which row shows a property of molecule X and the effect of the concentration of ATP in the cytoplasm on the rate of entry of molecule X?

	property of molecule X	concentration of ATP in the cytoplasm
A	non-polar	affects rate of entry of molecule X
B	non-polar	has no effect on rate of entry of molecule X
C	polar	affects rate of entry of molecule X
D	polar	has no effect on rate of entry of molecule X

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16 The electron micrograph shows some human blood cells.



Which row correctly shows the net movement of water by osmosis and the water potential of the cytoplasm of cell X compared with the solution surrounding the cells?

	net movement of water by osmosis	water potential of cytoplasm of cell X compared with the solution
A	into the cell	higher
B	into the cell	lower
C	out of the cell	higher
D	out of the cell	lower

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17 A red indicator solution was mixed with agar and the resulting solid was cut into small cylindrical blocks. The blocks were placed in an acid which turns the indicator yellow and all other variables were kept constant. The dimensions of the blocks are shown.

block 1	height 3 mm	diameter 6 mm
block 2	height 6 mm	diameter 12 mm
block 3	height 8 mm	diameter 16 mm

The formula for calculating the surface area of a cylinder is $2\pi rh + 2\pi r^2$. The formula for calculating the volume of a cylinder is $\pi r^2 h$.

Which row shows the correct surface area (SA) to volume (V) ratio for each block and the time taken for the block to turn yellow?

	block 1		block 2		block 3	
	SA to V ratio	time to turn yellow / mins	SA to V ratio	time to turn yellow / mins	SA to V ratio	time to turn yellow / mins
A	0.75 : 1.0	4	1.5 : 1.0	5	2.0 : 1.0	11
B	0.75 : 1.0	11	1.5 : 1.0	5	2.0 : 1.0	4
C	1.33 : 1.0	4	0.67 : 1.0	5	0.5 : 1.0	11
D	1.33 : 1.0	11	0.67 : 1.0	5	0.5 : 1.0	4

18 Which metabolic processes will be very active in a cell that has just completed cytokinesis?

1 ATP formation

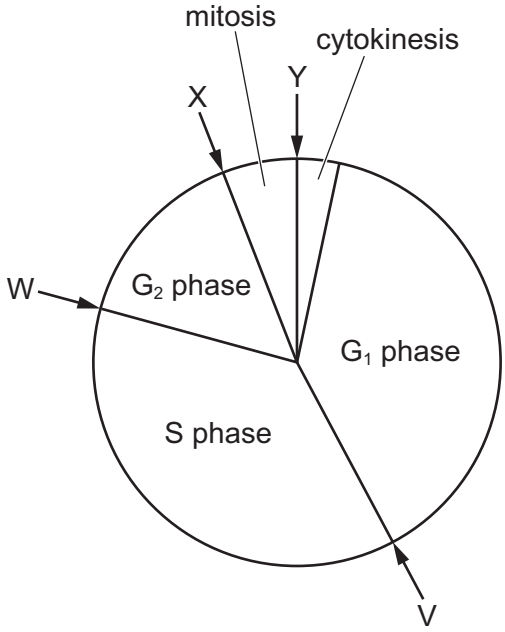
2 DNA replication

3 protein synthesis

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

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19 The diagram shows a typical mitotic cell cycle and the point in the cell cycle that has been reached by each of four cells, V, W, X and Y.

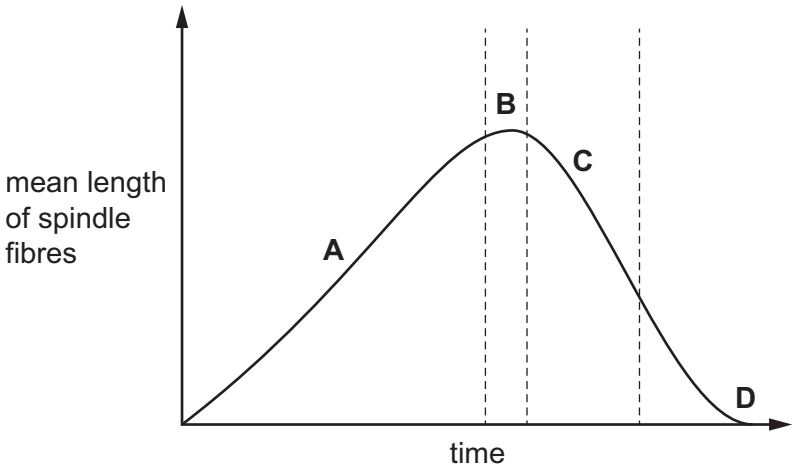


Which row correctly identifies the cells that match the two descriptions?

	DNA replication is complete but the cell has **not** yet reached its maximum size	preparation for microtubule formation is nearly complete but chromosomes have **not** yet condensed
A	V	X
B	W	Y
C	V	Y
D	W	X

20 The graph shows the mean length of the spindle fibres during mitosis.

Which region of the graph shows when all the centromeres have detached from the spindle fibres?



21 The mRNA codons ACU, ACC, ACA and ACG all code for the same amino acid, threonine.

Which anticodons could specify an amino acid other than threonine?

1 UCA

2 ACC

3 UGU

4 UGC

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

22 Which bond formation does DNA polymerase catalyse?

A hydrogen bonds between bases

B hydrogen bonds between nucleotides

C phosphodiester bonds between bases

D phosphodiester bonds between nucleotides

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23 In eukaryotes, the RNA molecules formed during transcription are modified by the removal of non-coding sequences. This is followed by the joining together of coding sequences to form mRNA.

What are the coding sequences also called?

A codons

B exons

C introns

D primary transcripts

24 Which row correctly identifies sinks for sucrose transported by mass flow in plants?

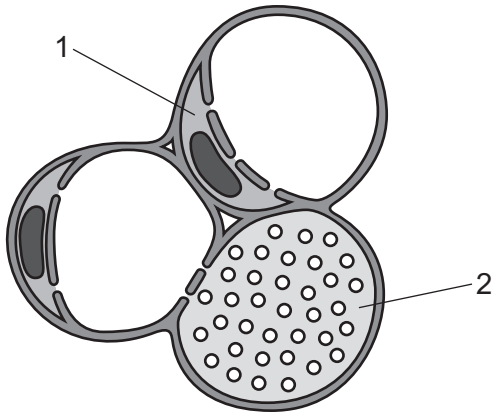
	root storage organ	growing leaf bud	growing shoot tip
A	✓	✓	✓
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ = sink

✗ = not a sink

25 The diagram shows a transverse section through a transport tissue in a plant.



Which row correctly identifies cell 1 and cell 2?

	cell 1	cell 2
A	companion cell	phloem sieve tube element
B	companion cell	xylem vessel element
C	phloem sieve tube element	phloem sieve tube element
D	phloem sieve tube element	xylem vessel element

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26 Which statement correctly describes the movement of solutes in the symplast pathway?

A Cell surface membranes regulate the selective absorption of solutes into the symplast pathway.

B Plasmodesmata control the movement of solutes from the symplast pathway to the apoplast pathway.

C The symplast pathway transports dissolved mineral ions from the soil that **cannot** be transported by the apoplast pathway.

D The movement of solutes through plasmodesmata in the symplast pathway is prevented in the endodermis by suberin.

27 Which statement helps to explain why water molecules are forced to move through xylem vessel elements as a consequence of transpiration?

A Water molecules form hydrogen bonds with cellulose in the walls of xylem vessel elements in a process known as adhesion.

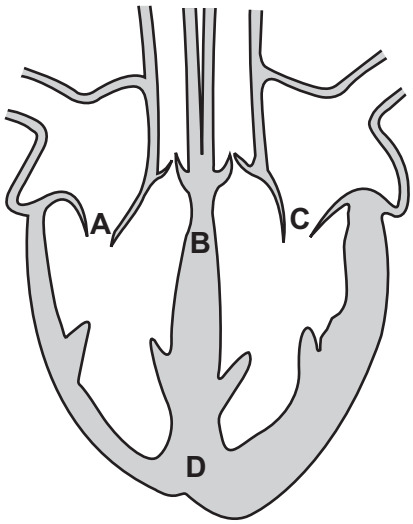
B Water molecules form hydrogen bonds with neighbouring water molecules in a process known as cohesion.

C Water molecules form ionic bonds with dissolved mineral ions, which helps to keep the water molecules together in a continuous column.

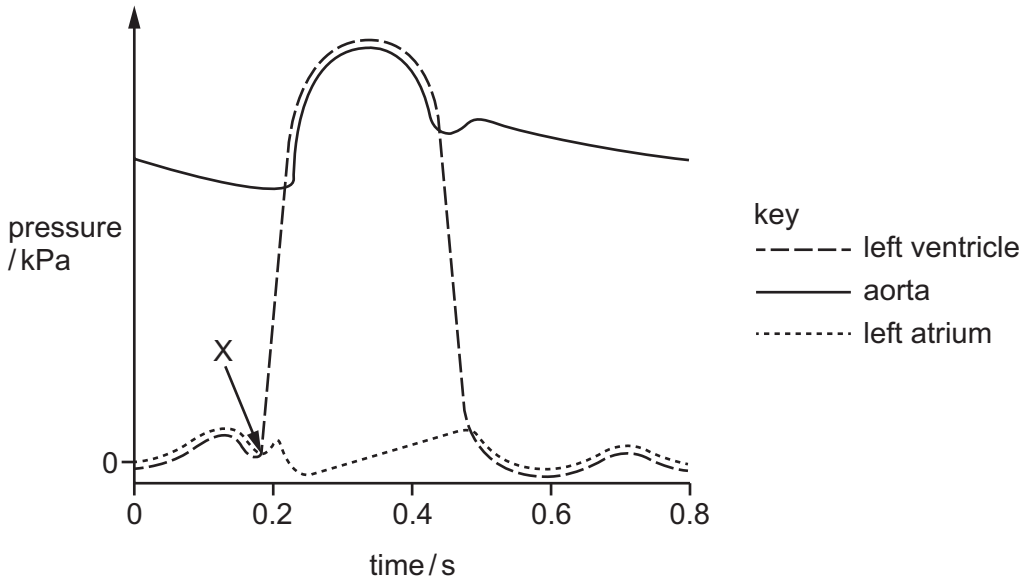
D Water has a high latent heat of vaporisation and this prevents the evaporation of water in the xylem vessel elements.

28 The diagram shows the internal structure of the mammalian heart.

Which letter identifies the location of the atrioventricular node?



29 The diagram shows pressure changes in the left side of the heart during the cardiac cycle.



What happens in the heart at X?

A The atrioventricular valves close.

B The atrioventricular valves open.

C The semilunar valves close.

D The semilunar valves open.

30 Which components of blood are present in tissue fluid?

	phagocytes	some proteins	sodium ions
A	✓	✓	✓
B	✓	✗	✗
C	✗	✓	✓
D	✗	✓	✗

key
✓ = present
✗ = not present

31 In the lungs, movement of dissolved carbon dioxide out of the capillaries occurs in one of two ways:

- by diffusion through the endothelial cells of the capillaries
- by leakage through pores in the endothelial cells of the capillaries.

What is the **minimum** number of times that a carbon dioxide molecule that has been transported to the lungs in a red blood cell must cross a cell surface membrane to reach an air space in an alveolus?

A 2 **B** 3 **C** 4 **D** 5

32 What maintains the steep concentration gradients needed for successful gas exchange in the lungs?

1 Air flow in the alveoli is in the opposite direction to blood flow in the capillaries.

2 Blood arrives in the lungs with a lower oxygen concentration and a higher carbon dioxide concentration than the air in the alveoli.

3 Blood is constantly flowing through and out of the lungs, bringing a fresh supply of red blood cells.

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

33 Where is cartilage tissue always found in the human gas exchange system?

A in the trachea only

B in the bronchi only

C in the bronchioles and trachea

D in the bronchi and trachea

34 Scientists compared the density of goblet cells in the lungs and the density of mucus in the lungs of three groups of people:

- people who do not smoke and do not have lung disease
- people who smoke tobacco but do not have lung disease
- people who smoke tobacco and have lung disease.

The results are shown in the table.

group	goblet cell density / cells per mm^2	mucus density / arbitrary units
non-smokers	19	6
smokers who do not have lung disease	54	26
smokers with lung disease	37	15

What is indicated by these data?

1 There is a positive correlation (relationship) between density of goblet cells and density of mucus.

2 Lung disease results in an increase in goblet cell density.

3 There is an association between tobacco smoking and an increase in mucus density.

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 Which disease does *Mycobacterium bovis* cause?

A cholera

B HIV / AIDS

C malaria

D tuberculosis

36 An antibiotic inhibits the formation of cross-links between the molecules that form cell walls in bacteria.

Which statements explain why bacteria are killed by the antibiotic?

1 The bacterial cell is destroyed by osmotic lysis.

2 Cellulose molecules **cannot** form hydrogen bonds.

3 The cell wall is no longer partially permeable.

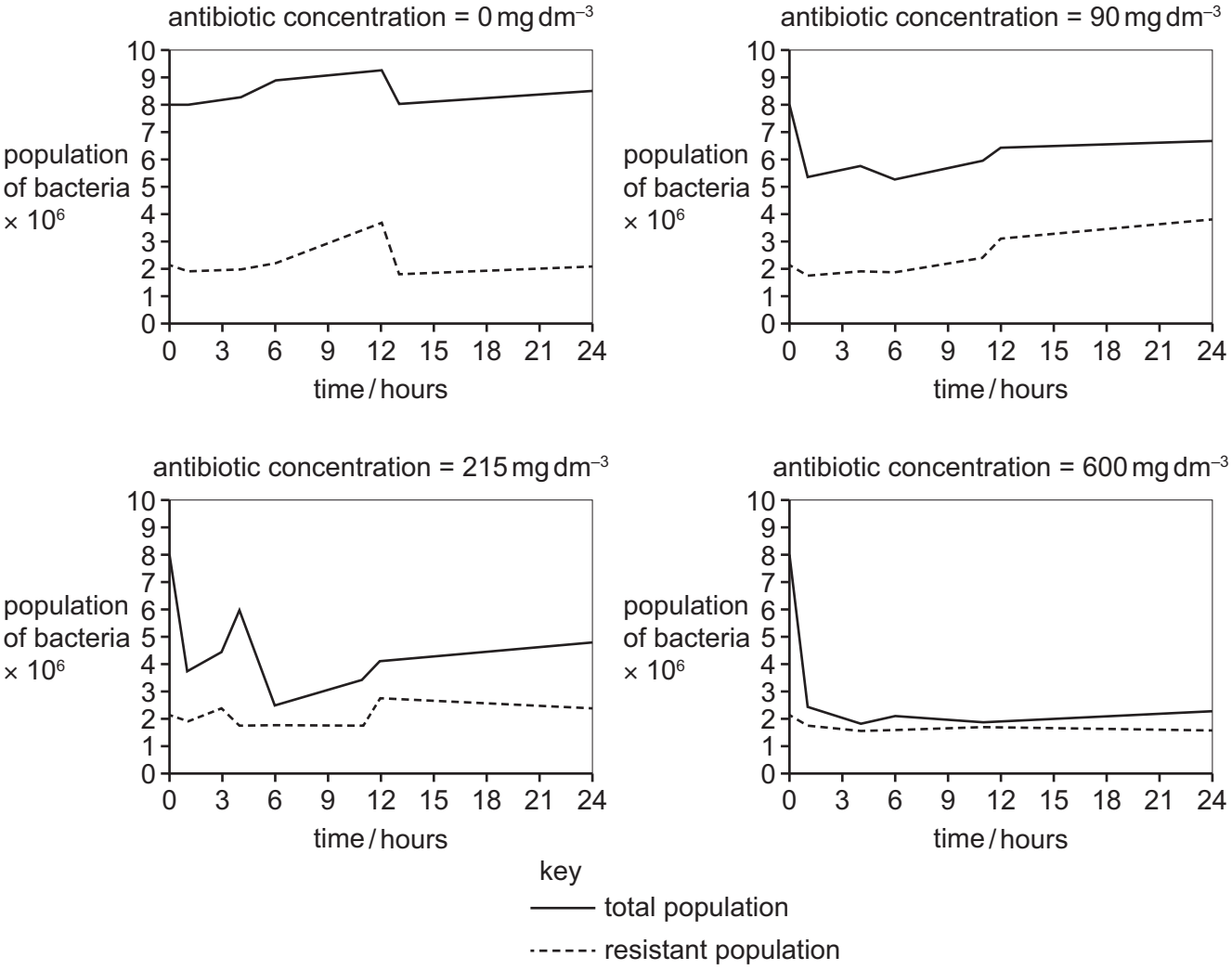
A 1 and 2 only **B** 2 and 3 only **C** 1 only **D** 2 only

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37 Scientists investigated the effect of increasing concentrations of an antibiotic on the development of antibiotic resistance in bacteria.

The scientists grew four groups of bacteria and added a different concentration of antibiotic to each group. The number of resistant bacteria and the total population of bacteria were measured at intervals for 24 hours for each group.

The graphs show the results.



Which statements are correct conclusions that can be made from the results of this investigation?

1 Increasing the concentration of antibiotic decreases the population of non-resistant bacteria at the end of 24 hours.

2 The proportion of antibiotic-resistant bacteria increases with increasing concentrations of antibiotics.

3 Increasing the concentration of antibiotic always increases the number of resistant bacteria.

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

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38 What is the correct sequence of events in a primary immune response?

A T-lymphocyte activation → B-lymphocyte selection → plasma cell release

B antigen presentation by macrophages → cytokines released by T-helper cells → B-lymphocyte differentiation

C antigen presentation by neutrophils → T-memory cell activation → B-lymphocyte selection

D T-memory cell activation → B-memory cell activation → antibody production

39 Which statement about the properties of the antigen-binding sites in different antibody molecules is correct?

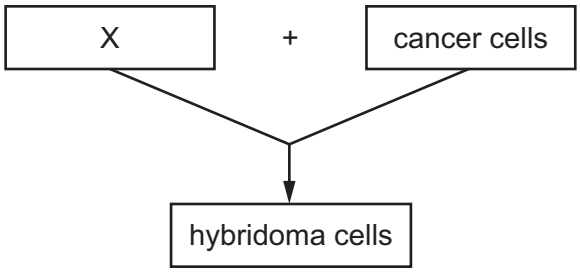
A They are located on the light chains only.

B They have a hinge region to give flexibility for different antigens.

C They have binding sites for receptors on phagocytes.

D They have variable amino acid sequences for different antigens.

40 The diagram shows a stage in monoclonal antibody production.



What is represented by X?

A T-lymphocytes

B B-lymphocytes

C antigens

D antibodies

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BIOLOGY **9700/13**

Paper 1 Multiple Choice **May/June 2024**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

1518005877

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 An eyepiece graticule can be calibrated using a stage micrometer.

What is the correct reason why an eyepiece graticule is calibrated?

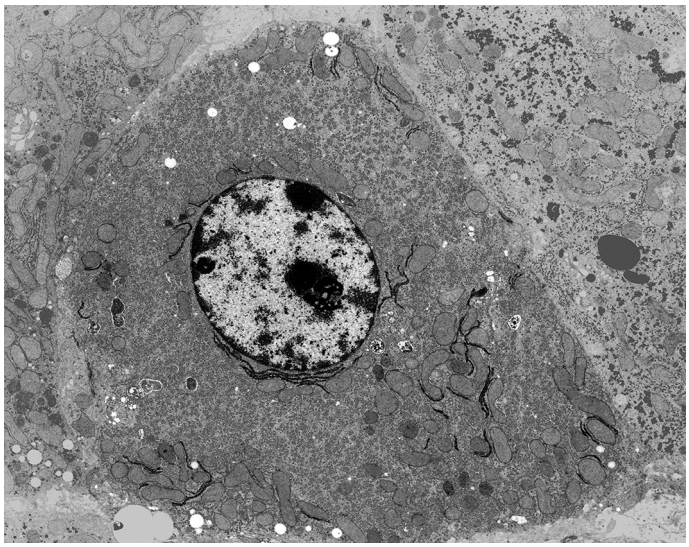
A An eyepiece graticule can be used to make measurements.

B An eyepiece graticule is magnified by the objective lens.

C An eyepiece graticule magnifies the specimen.

D An eyepiece graticule makes comparisons.

2 The image is an electron micrograph of a typical eukaryotic cell.



What can be concluded about the eukaryotic cell from the electron micrograph?

A It is an animal cell because it does **not** have a cell wall.

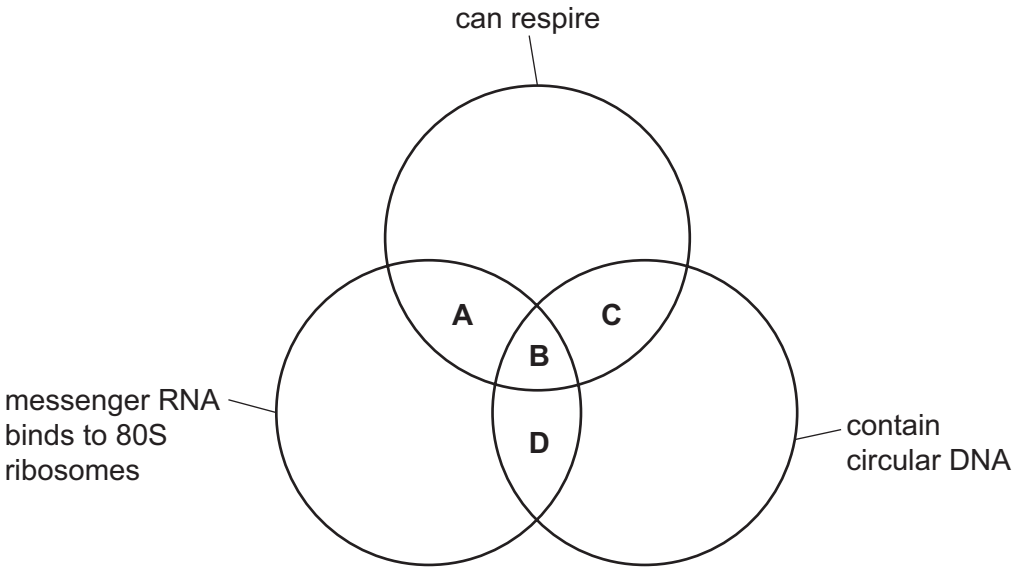
B It is an animal cell because it contains a permanent vacuole.

C It is a plant cell because it contains many chloroplasts.

D It is a plant cell because it contains many lysosomes.

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3 Which features are found in typical eukaryotes **and** also in typical bacteria?



4 Which type of cell will have the highest proportion of its volume taken up with cell structures bound by a single membrane?

A ciliated epithelial cell

B goblet cell

C red blood cell

D companion cell

5 What causes the phosphate heads of phospholipids to become polar?

A The phosphate heads are joined to water molecules by hydrogen bonds.

B The phosphate heads are insoluble in water.

C The phosphate heads become ionised in water.

D The phosphate heads are joined to water molecules by covalent bonds.

6 Which statements describe features of cellulose that adapt it for its function in plant cells?

1 Three cellulose molecules coil around each other to form a triple helix structure.

2 Many hydrogen bonds form between adjacent cellulose molecules.

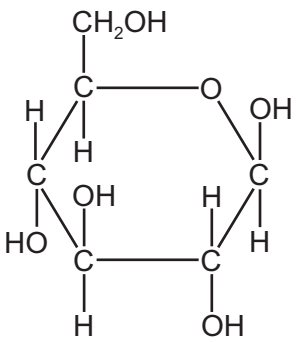
3 Covalent bonds form between adjacent cellulose molecules.

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

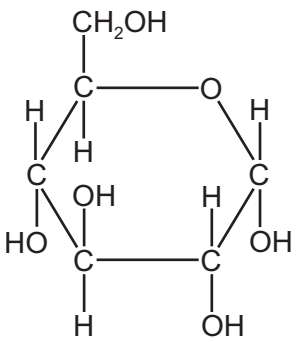
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7 Which structure shows α-glucose?

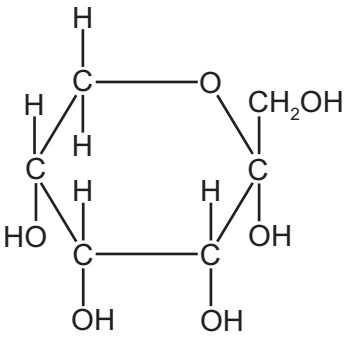
A



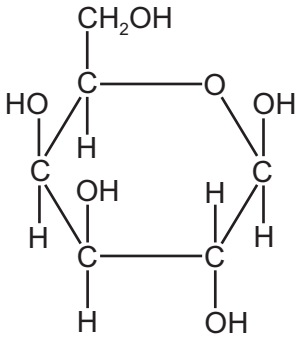
B



C



D



8 What **cannot** occur as a result of a condensation reaction?

A breaking of a glycosidic bond

B formation of a disaccharide

C joining together of two amino acids

D production of a molecule of water

9 Which fact about the quaternary structure of proteins is correct?

A consists of four polypeptides

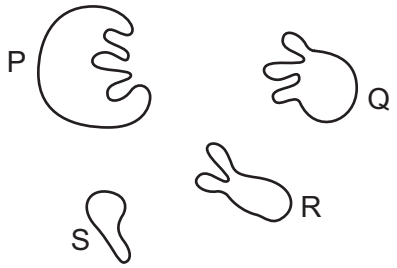
B depends on the presence of metal ions

C depends on the primary structure of the polypeptides

D is made of α and β polypeptides

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10 The diagram shows different molecules in a solution.



Which statement could explain what happens when some of the molecules are mixed together?

A Molecule P forms an enzyme–substrate complex with the non-competitive inhibitor molecule Q.

B Molecule Q binds to molecule P, increasing the activation energy.

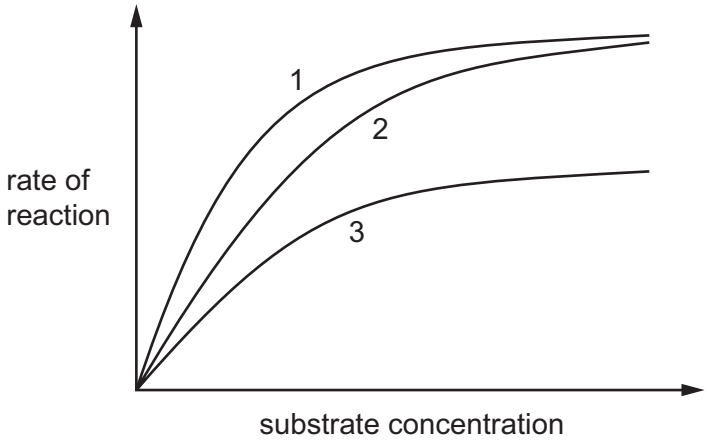
C Molecules R and S bind to the active site of molecule P.

D Molecules S and R are the products of the breakdown of molecule P.

11 The effect of substrate concentration on an enzyme-catalysed reaction was measured in three different conditions:

- without an inhibitor
- with a competitive inhibitor
- with a non-competitive inhibitor.

The graph shows the results.



Which row is correct?

	without an inhibitor	with a competitive inhibitor	with a non-competitive inhibitor
A	1	2	3
B	1	3	2
C	3	1	2
D	3	2	1

12 Which aspect of enzyme activity can be compared by the Michaelis–Menten constant?

A activation energy of a reaction with or without an enzyme

B affinity of different enzymes for their substrates

C affinity of an enzyme at different substrate concentrations

D maximum rate of reaction (V_{max}) at different temperatures

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13 The number of substrate molecules one enzyme molecule can convert to product in a second is called the turnover number. This number is obtained when all conditions are optimum for the specific enzyme-catalysed reaction.

enzyme	turnover number / s^{-1}
catalase	2 800 000
carbonic anhydrase	600 000
phosphatase	971
protease	100

How many times faster at converting substrate to product is catalase compared to phosphatase?

A 29 **B** 288 **C** 2884 **D** 28 836

14 A red indicator solution was mixed with agar, and the resulting solid was cut into small cuboid blocks. The blocks were placed in an acid which turns the indicator yellow, and all other variables were kept constant. The dimensions of the three blocks used are shown.

block 1 3 mm × 3 mm × 3 mm

block 2 8 mm × 8 mm × 8 mm

block 3 11 mm × 11 mm × 11 mm

Which row shows the correct surface area (SA) to volume (V) ratio for each block, and the time taken for the block to turn yellow?

	block 1		block 2		block 3	
	SA to V ratio	time to turn yellow / mins	SA to V ratio	time to turn yellow / mins	SA to V ratio	time to turn yellow / mins
A	0.5 : 1.0	4	1.33 : 1.0	11	1.83 : 1.0	13
B	0.5 : 1.0	13	1.33 : 1.0	11	1.83 : 1.0	4
C	2.0 : 1.0	4	0.75 : 1.0	11	0.55 : 1.0	13
D	2.0 : 1.0	13	0.75 : 1.0	11	0.55 : 1.0	4

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15 The statements describe some events in the process of exocytosis of glycoprotein molecules.

1 Membrane of the Golgi body folds around glycoprotein molecules.

2 Vesicle binds to and fuses with the cell surface membrane.

3 Vesicle attached to microtubules moves through the cytoplasm.

4 Secretory vesicle forms.

What is the correct order of events for exocytosis?

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

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

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

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

16 Four cylinders that were identical in size, **A**, **B**, **C** and **D**, were cut from potatoes that had been stored for different lengths of time.

The cylinders were weighed, immersed in 10% salt solution for 45 minutes and then reweighed.

The percentage change in mass was then calculated.

Which cylinder had a water potential similar to the 10% salt solution?

	percentage change in mass
A	–7.2
B	–2.5
C	–0.9
D	+3.4

17 The contents of a daughter cell are compared to the parent cell after one cell cycle.

Which row is correct?

	number of chromosomes	volume of cytoplasm	length of telomeres
A	increases	remains the same	decreases
B	increases	decreases	remains the same
C	remains the same	remains the same	remains the same
D	remains the same	decreases	decreases

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18 A high-power photomicrograph shows a cell in a stage of mitosis.

The chromosomes are visible and lined up along the cell equator but there is no nuclear envelope.

Which stage of mitosis is shown by the photomicrograph?

A prophase

B metaphase

C anaphase

D telophase

19 Which statements about the cell cycle are correct?

1 The cell cycle includes interphase and mitosis.

2 DNA replication takes place in interphase.

3 A cell can remain in interphase for several months.

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

20 A scientist stains the chromosomes of a plant cell with a fluorescent dye to observe the telomeres.

This cell has 38 chromosomes.

How many telomeres will the scientist observe in one of the nuclei during telophase of mitosis?

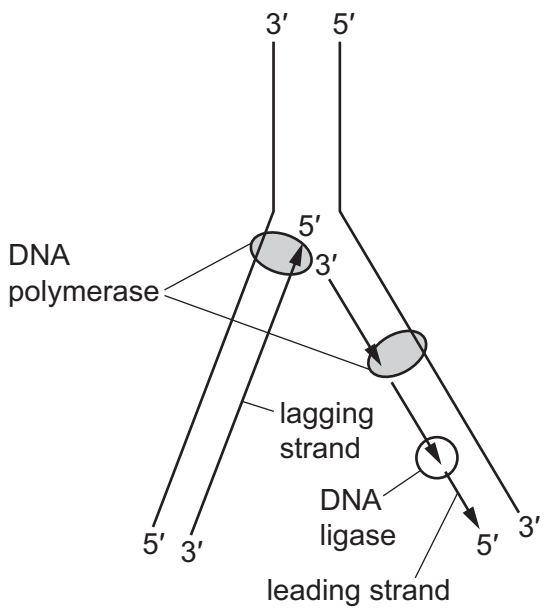
A 38 **B** 76 **C** 114 **D** 152

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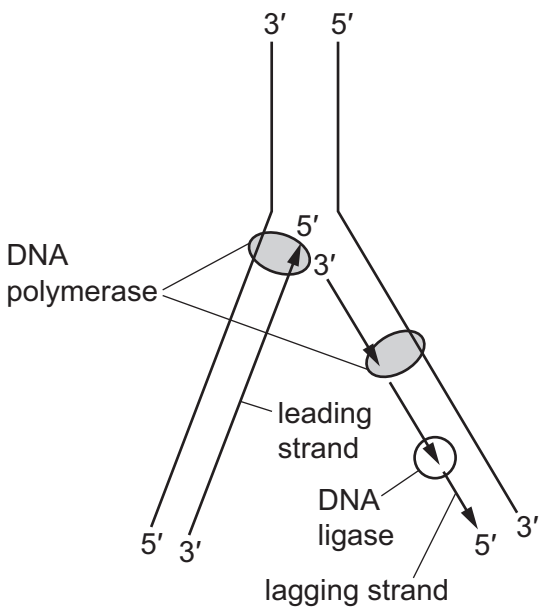
21 During the semi-conservative replication of DNA, the double helix is unwound by an enzyme.

Which diagram shows how the strands are copied?

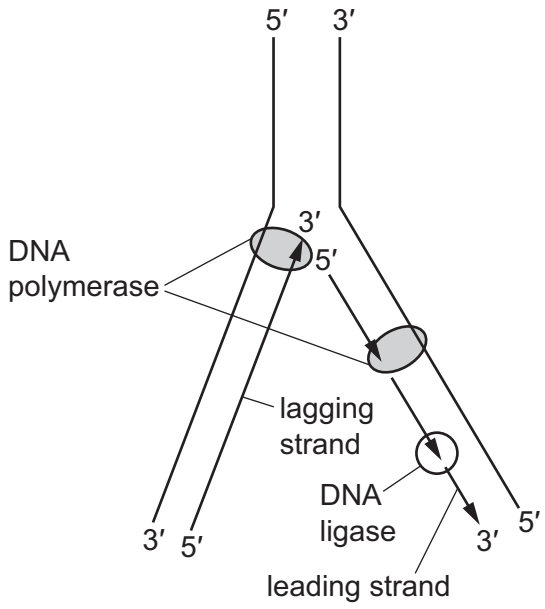
A



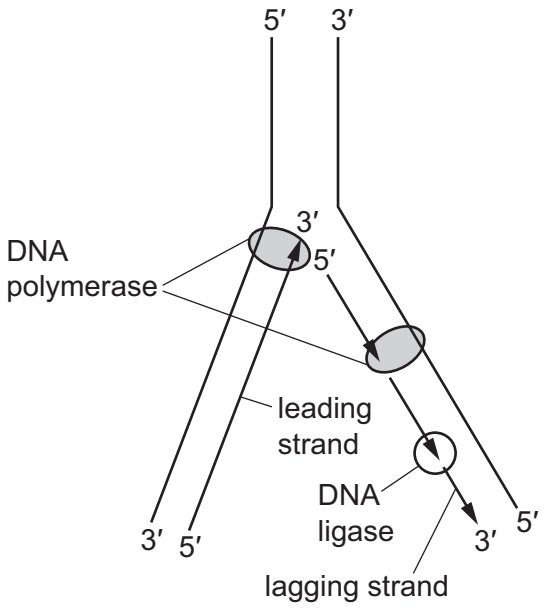
B



C



D



22 A transcription error results in the deletion of one nucleotide from the middle of a primary transcript. mRNA forms from the primary transcript.

Which statement describes one possible effect of this deletion on the protein translated from this mRNA?

A The protein will be unchanged as the same amino acids can be coded by another codon formed by the deletion.

B The tertiary structure of the protein is **not** affected as only one amino acid has been changed by the deletion.

C Only one amino acid has been changed by the deletion but this changes the quaternary structure of the protein.

D The sequence of amino acids in the protein will be different as all the codons from the deletion onwards are changed.

23 Which statements correctly describe the process of translation?

1 The nucleotide sequence on an mRNA molecule is used to produce a specific amino acid chain.

2 A section of DNA is copied into an mRNA molecule by RNA polymerase.

3 A polypeptide is produced because anticodons on tRNA molecules attach to mRNA codons through peptide bonds.

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

24 A molecule of mRNA was used in translation. Part of its sequence is shown.

GAU CUG UAA CGG

There were no introns present in the section of DNA that was transcribed to make this mRNA.

What is the sequence of the **non-transcribed** DNA strand for this section?

A CTA GAC ATT GCC

B CUA GAC AUU GCC

C GAT CTG TAA CGG

D GAU CUG UAA CGG

25 Which properties of water are dependent on hydrogen bonding between water molecules?

	cohesion	high latent heat of vaporisation	solvent action	high specific heat capacity
A	✓	✓	✓	✗
B	✓	✓	✗	✓
C	✓	✗	✓	✓
D	✗	✓	✓	✓

key

✓ = dependent

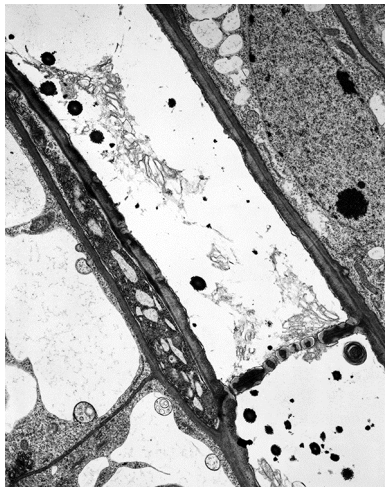
✗ = not dependent

26 Which substances in xylem tissue are impermeable to water and prevent the collapse of the vessels?

	impermeable to water	prevent collapse
A	cellulose	cellulose only
B	cellulose	lignin only
C	lignin	cellulose only
D	lignin	cellulose and lignin

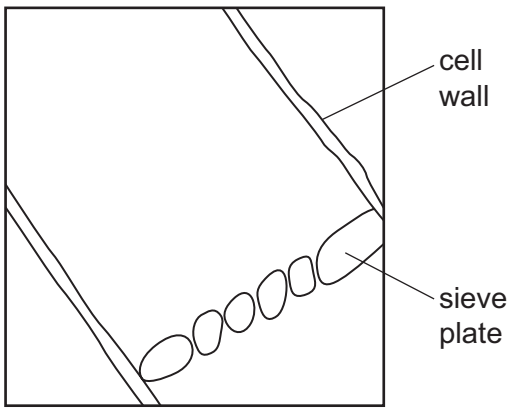
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27 The electron micrograph shows a longitudinal section through phloem tissue.

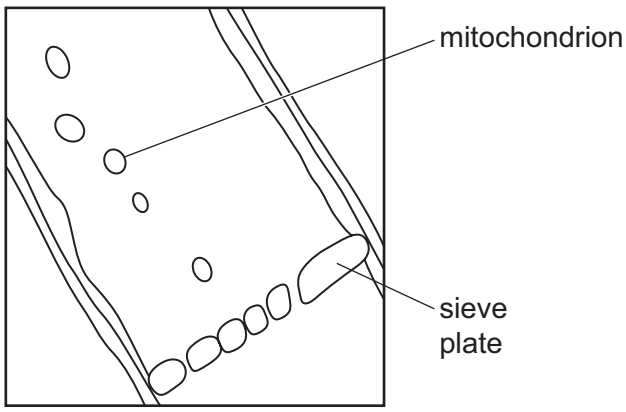


Which student's drawing of a sieve tube element is correctly drawn and labelled?

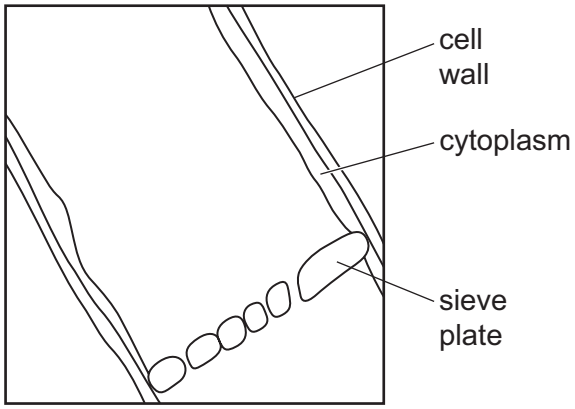
A



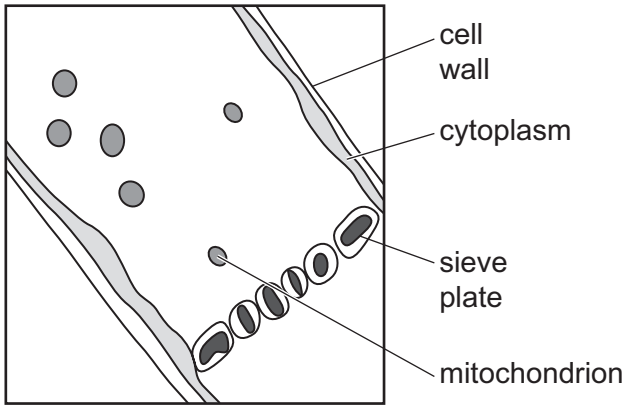
B



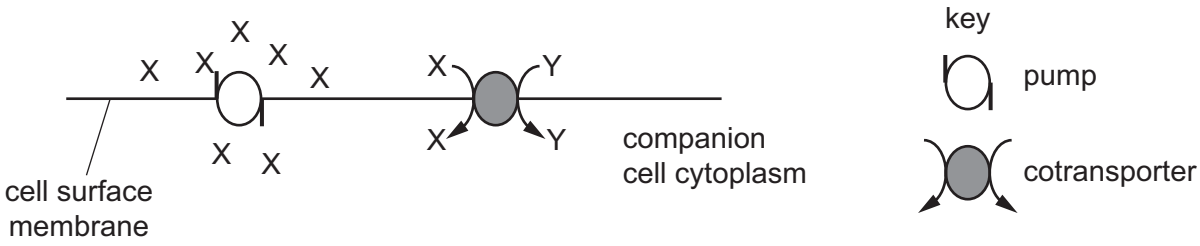
C



D



28 Carrier proteins in the cell surface membranes of companion cells are involved in the transfer of assimilates to phloem sieve tubes. The diagram represents the use of two types of carrier protein in this process.

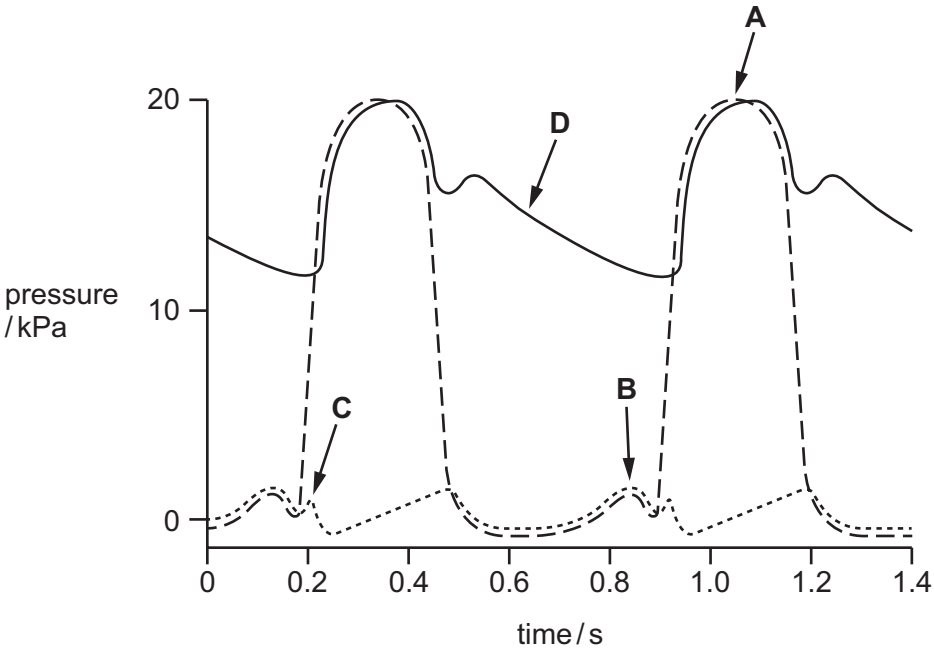


What are the substances labelled X and Y?

	X	Y
A	H^+ ions	sucrose
B	H^+ ions	glucose
C	sucrose	H^+ ions
D	glucose	H^+ ions

29 The diagram shows pressure changes during two cardiac cycles.

Which arrow indicates atrial systole?



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30 An irregular heartbeat may be the result of ineffective electrical stimulation of the atria.

Which area of the heart could be damaged, causing this irregular heartbeat?

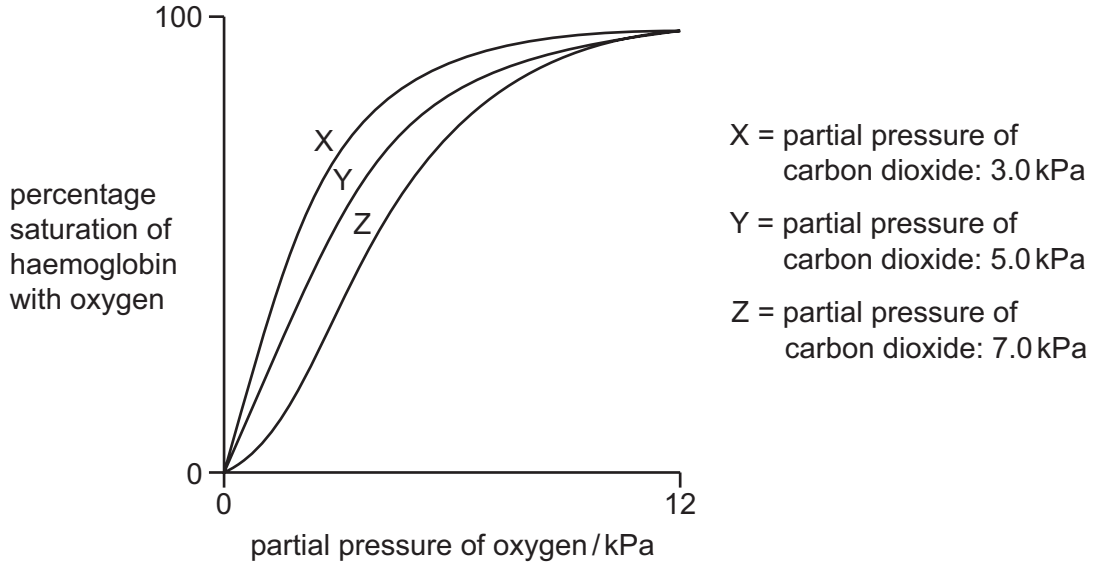
A atrioventricular node

B septum

C Purkyne tissue

D sinoatrial node

31 The diagram shows the effect of three different concentrations of carbon dioxide on the oxygen dissociation curve for human haemoglobin.



Which effect does increasing carbon dioxide concentration have on haemoglobin?

A It makes haemoglobin less efficient at taking up oxygen and less efficient at releasing oxygen.

B It makes haemoglobin less efficient at taking up oxygen and more efficient at releasing oxygen.

C It makes haemoglobin more efficient at taking up oxygen and less efficient at releasing oxygen.

D It makes haemoglobin more efficient at taking up oxygen and more efficient at releasing oxygen.

32 Which reactions will be taking place in blood in a capillary that is next to an alveolus?

1 $Hb + 4O_2 \rightarrow HbO_8$

2 $H_2O + CO_2 \rightarrow H_2CO_3$

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

key

Hb = haemoglobin

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

33 Which structure of the gas exchange system always contains cartilage?

A alveoli

B bronchiole

C capillary

D bronchus

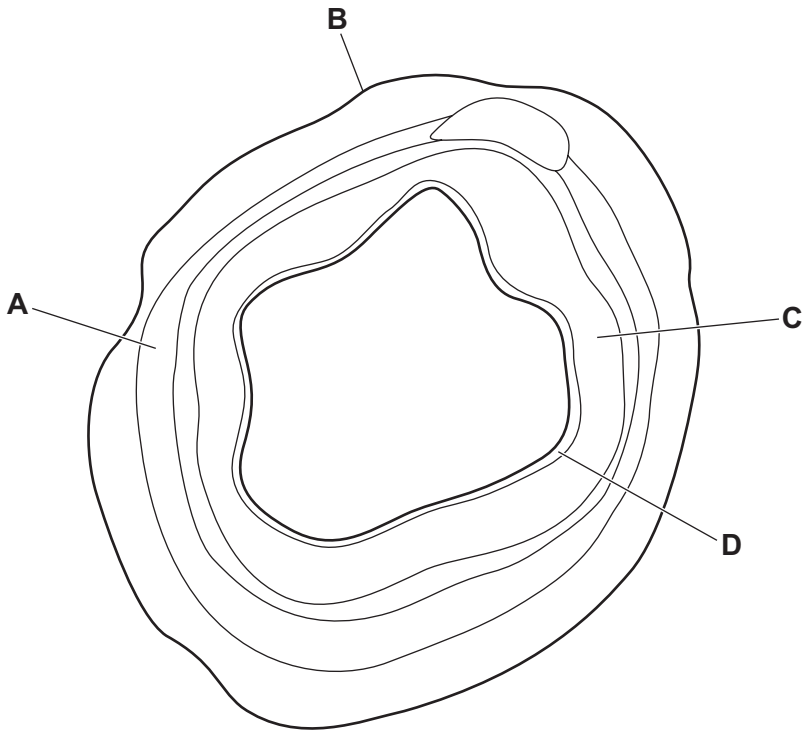
34 Exchange of carbon dioxide and oxygen occurs between air in the alveoli and blood in the capillaries of the lung.

Which partial pressures of the gases will allow gaseous exchange to occur?

	CO_2 in alveolar air / kPa	CO_2 in blood / kPa	O_2 in alveolar air / kPa	O_2 in blood / kPa
A	5.3	6.0	13.3	13.9
B	5.3	6.0	13.9	5.3
C	6.0	5.3	13.9	5.3
D	6.0	5.3	13.3	13.9

35 The plan diagram shows a cross-section of a trachea.

Which labelled tissue prevents the trachea from collapsing?

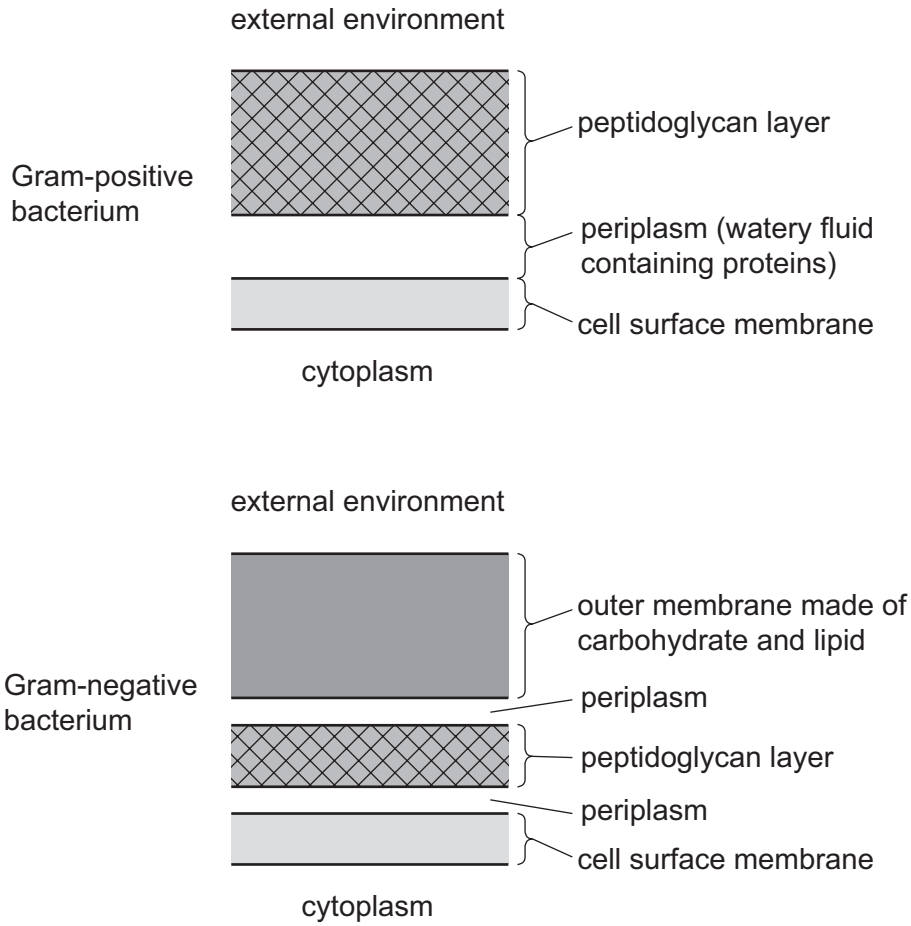


36 Which layers of cells does an oxygen molecule diffuse through when moving from an alveolus into an alveolar capillary?

	alveolus	alveolar capillary
A	squamous epithelium	squamous epithelium
B	endothelium	squamous epithelium
C	squamous epithelium	endothelium
D	endothelium	endothelium

37 Bacteria may be classified according to differences in cell wall structure. The differences are shown by using the Gram stain.

The diagram shows part of a Gram-positive bacterium and part of a Gram-negative bacterium, drawn to the same scale.



The antibiotic penicillin kills bacteria by inhibiting the synthesis of the cell walls during bacterial cell growth.

Which type of bacteria will be killed by penicillin more easily and why?

A Gram-positive bacteria because the peptidoglycan layer is exposed to penicillin directly

B Gram-positive bacteria because it has a thinner layer surrounding the cell membrane overall

C Gram-negative bacteria because the thin peptidoglycan layer can be broken down faster

D Gram-negative bacteria because there is more periplasm available, which gives a weaker structure

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38 Which facts relate to the disease TB or its pathogen?

1 Viruses change their antigens to a limited extent.

2 TB is caused by only one species of pathogen.

3 HIV / AIDS makes the bacterial infection worse.

4 The pathogen may be transmitted by ingestion.

5 The pathogen may be transmitted from animals.

6 Multi-drug resistance occurs.

A 1, 4, 5 and 6

B 1, 2 and 6

C 2, 3 and 5

D 3, 4, 5 and 6

39 The events listed occur during the primary immune response to a specific pathogen.

1 activation of B-lymphocyte to produce plasma cells and memory cells

2 phagocytosis of invading pathogens by macrophages

3 T-helper cell activation and production of T-killer cells

4 expression of antigens on phagocyte cell surface

5 production and release of antibodies

Which row identifies a correct sequence of events?

	first → last				
A	5	1	2	4	3
B	2	4	3	1	5
C	4	2	1	5	3
D	4	2	3	1	5

40 Influenza is an infectious disease caused by a virus.

It is possible to have influenza more than once.

Which statements explain why it is possible to have influenza more than once?

1 The viral antigens change as a result of mutations.

2 The immune system may be weak and make few B-memory cells.

3 Untreated HIV infection has resulted in a low T-helper cell count.

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

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