Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/11**

Paper 1 Multiple Choice **October/November 2021**

1 hour

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.
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- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

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

This document has **16** pages.

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1 A student observes a cell using a light microscope. The student then draws the cell.

Which items will the student need to calculate the magnification of the drawing?

1 eyepiece graticule

2 ruler

3 hand lens

4 stage micrometer scale

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 3 only

D 2 and 4 only

2 Which equations correctly show the relationship between magnification, image size and actual size in microscopy?

1 $\text{magnification} = \frac{\text{image size}}{\text{actual size}}$

2 $\text{magnification} = \frac{\text{actual size}}{\text{image size}}$

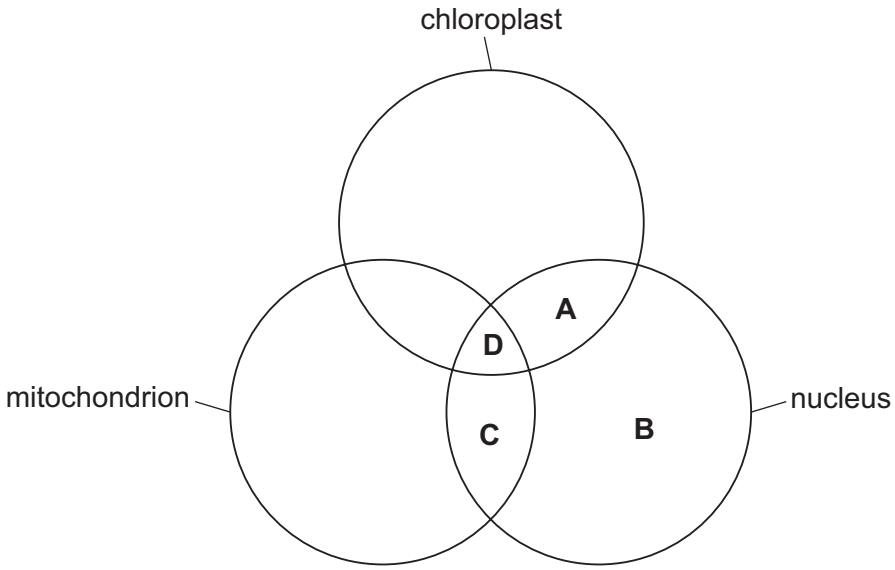
3 $\text{actual size} = \frac{\text{image size}}{\text{magnification}}$

4 $\text{actual size} = \frac{\text{magnification}}{\text{image size}}$

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

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3 In which cell structures does DNA transcription occur?



4 Which rows could correctly identify the nucleic acids present in two different virus particles in a sample of air?

	DNA	RNA
1	✓	✓
2	✓	✗
3	✗	✓
4	✗	✗

key
✓ = nucleic acid present
✗ = nucleic acid not present

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

5 Tests on four samples from a mixture of biological molecules gave the results shown in the table.

test	boiled with excess Benedict's solution	boiled with excess Benedict's solution after acid hydrolysis and neutralisation	biuret reagent	iodine solution
result	blue	red	purple	yellow

Which biological molecules were in the mixture?

A reducing sugar and protein

B reducing sugar, non-reducing sugar and starch

C non-reducing sugar and protein

D non-reducing sugar and starch only

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6 One molecule of X is formed by a single condensation reaction releasing one molecule of water.

What is molecule X?

A a disaccharide

B a phospholipid

C a polysaccharide

D a triglyceride

7 The table shows some information about carbohydrate polymers.

Which row describes glycogen?

	α-1,4 glycosidic bonds	α-1,6 glycosidic bonds	shape of molecule	function of molecule
A	✓	✓	branched	storage
B	✓	✗	helical	storage
C	✗	✓	branched	structural
D	✗	✗	helical	structural

key

✓ = present

✗ = not present

8 The diagrams show four phospholipid molecules.

Which molecule could contribute most to the fluidity of a cell surface membrane?

A



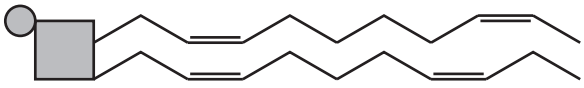
B



C



D



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9 Which properties of phospholipids explain why single layers of phospholipids added to water immediately form bilayers?

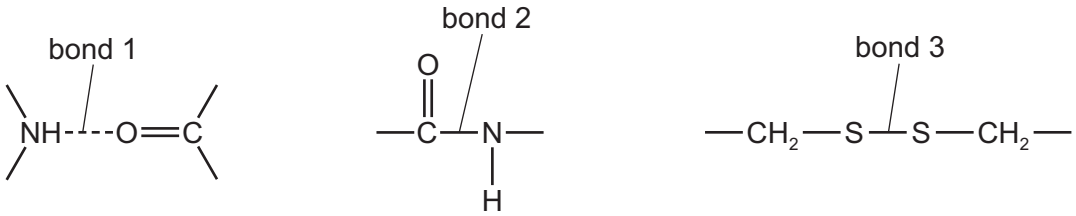
1 The hydrophobic fatty acid chains repel water molecules so the tails pack together.

2 The non-polar fatty acid chains are attracted to each other by hydrophobic interactions.

3 Hydrogen bonds form between the phosphate groups and water.

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

10 The diagrams show three examples of different bonds.



Which bonds hold the tertiary structure of proteins together?

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

11 Which feature of collagen enables it to fulfil a structural role in skin and in tendons?

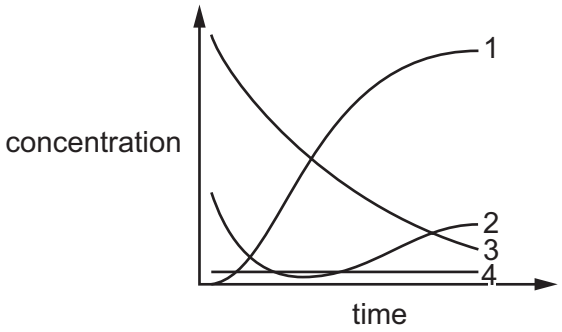
A Adjacent collagen molecules are linked by ester bonds.

B Collagen fibres form layers with the fibres in different directions.

C Collagen molecules are formed as a triple helix of polypeptide chains.

D Polypeptide chains of collagen are tightly folded into compact shapes.

12 The graph shows how the concentrations of four components, 1, 2, 3 and 4, of an enzyme-catalysed reaction change with time.



Which component is the enzyme–substrate complex?

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

13 The table shows the Michaelis–Menten constant, K_m, for three enzymes.

enzyme	K_m / mmol dm^{-3}
C	1.5×10^{-2}
P	3.0×10^{-4}
F	5.0×10^{-6}

Which interpretation of the information is correct?

A Enzyme C has a V_{max} which is half that of enzyme P.

B Enzyme C will reach V_{max} in the shortest time interval.

C Enzyme F has the greatest affinity for its substrate.

D Enzyme P has a V_{max} of 6.0×10^{-3} mmol dm^{-3}.

14 What explains how a signal molecule produced by one cell can be detected by a target cell?

A A signal molecule can bind to any type of cell surface receptor.

B A signal molecule has a complementary shape to a cell surface receptor.

C Signal molecules enter the cell by diffusion.

D Signal molecules enter the cell by endocytosis.

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15 Some enzymes are produced in the cells of the pancreas. The enzymes are secreted when required.

Which process is used to transport these enzymes out of the cells of the pancreas?

A active transport

B facilitated diffusion

C endocytosis

D exocytosis

16 Plant cells were submerged in a solution with a water potential less negative than that found inside the cells.

What describes the condition of the plant cells after 20 minutes?

A burst

B incipient plasmolysis

C plasmolysed

D turgid

17 What will be present in each chromosome at the end of the G_2 phase of the cell cycle?

A two centrioles

B two centromeres

C two molecules of DNA

D two telomeres

18 Which events listed are part of the cell cycle?

1 interphase

2 metaphase

3 cytokinesis

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

19 Which features of an organism are affected by a drug that kills cells that are dividing mitotically?

1 cell repair

2 cell replacement

3 number of stem cells

4 tissue repair

5 tumour formation

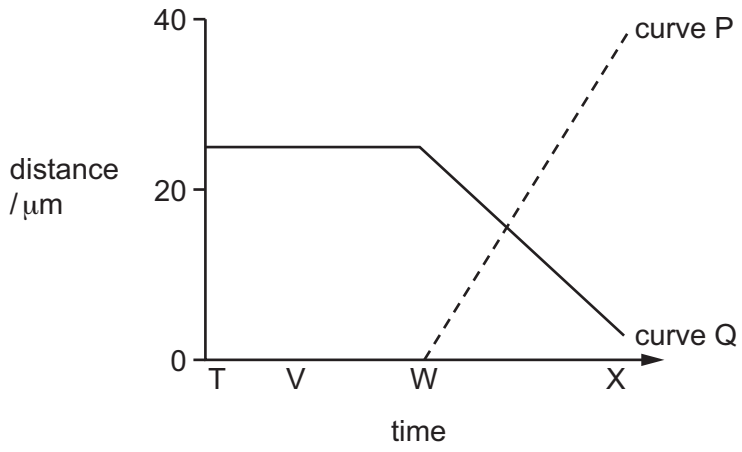
A 1, 2, 3, 4 and 5

B 1, 2 and 3 only

C 1, 4 and 5 only

D 2, 3, 4 and 5 only

20 The graph shows how the distance between sister chromatids (curve P) and the distance between chromatids and centrioles (curve Q) changes during part of mitosis.



Which statements could be correct?

1 T to V represents interphase.

2 T to W represents metaphase.

3 W to X represents anaphase.

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

21 Which statement helps to explain why the two sugar-phosphate chains in a DNA molecule are a constant distance apart?

A Adenine and thymine are held together by the same number of hydrogen bonds as cytosine and guanine.

B Each nucleotide molecule is the same size.

C Each purine base is linked to a pyrimidine base.

D The sugar-phosphate strands of the helix are held together by sulfur bridges.

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22 During DNA replication, what must happen **before** a newly added nucleotide is bonded to the next nucleotide in the strand?

1 complementary base pairing

2 hydrogen bond formation

3 phosphodiester bond formation

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

23 An antibiotic enters bacterial cells through a membrane channel protein, P.

Some bacterial cells have shown resistance to this antibiotic by acquiring a mutation which alters P. This mutation prevents the entry of the antibiotic into the cell.

Which conclusions can be drawn about how resistance to this antibiotic developed in these bacteria?

1 The mutation changed the order of the amino acids in the gene coding for P.

2 The mutation resulted in the production of P with an altered tertiary structure.

3 The antibiotic is a hydrophobic molecule and so cannot cross the phospholipid bilayer to enter the cell.

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

24 What is the correct tRNA anticodon coding for the amino acid proline?

amino acid	DNA triplet code on transcribed strand
alanine	CGT
histidine	GTG
proline	GGT

A CCA **B** CCU **C** GGT **D** GGU

25 The table shows the observations made by a student about three different cell types, P, Q and R, seen in a transverse section of a plant stem, using a light microscope.

	ratio of cell wall width to whole cell width	structures observed in cell contents
P	1 : 10	none
Q	1 : 20	regular pattern of circles in some cells
R	1 : 20	granular appearance of all cells

What type of cells are P, Q and R?

	P	Q	R
A	companion cell	phloem sieve tube element	xylem vessel element
B	companion cell	xylem vessel element	phloem sieve tube element
C	xylem vessel element	companion cell	phloem sieve tube element
D	xylem vessel element	phloem sieve tube element	companion cell

26 Water molecules are attracted to each other. This property is important in the upward movement of water in xylem.

Which term is used to describe the attraction of water molecules to each other?

A adhesion

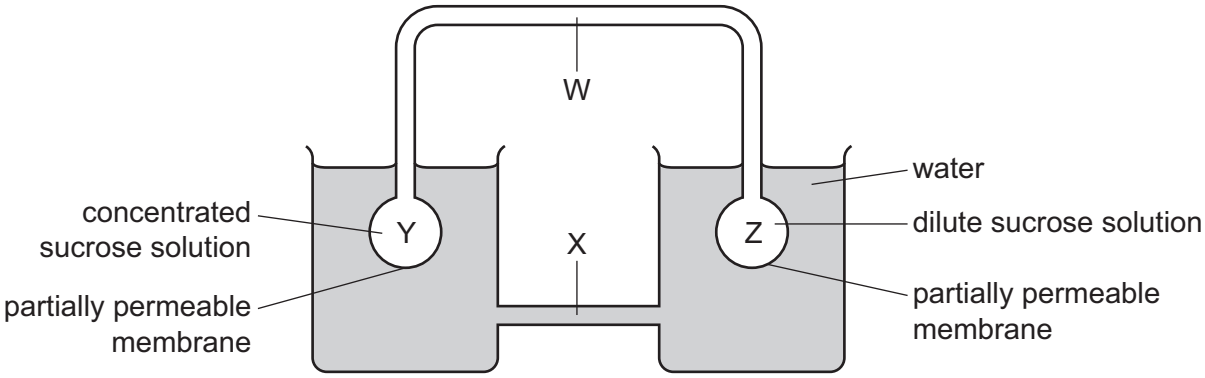
B cohesion

C hydrophilic

D polar

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27 The diagram shows a model to demonstrate mass flow.



In a plant, what are the structures W, X, Y and Z and what is the direction of flow of solution along W?

	phloem	xylem	roots	leaves	direction of flow along W
A	W	X	Y	Z	from Z to Y
B	W	X	Z	Y	from Y to Z
C	X	W	Y	Z	from Y to Z
D	X	W	Z	Y	from Z to Y

28 The parts of the heart that control heart action are listed.

- sinoatrial node (SAN)
- atrioventricular node (AVN)
- Purkyne tissue

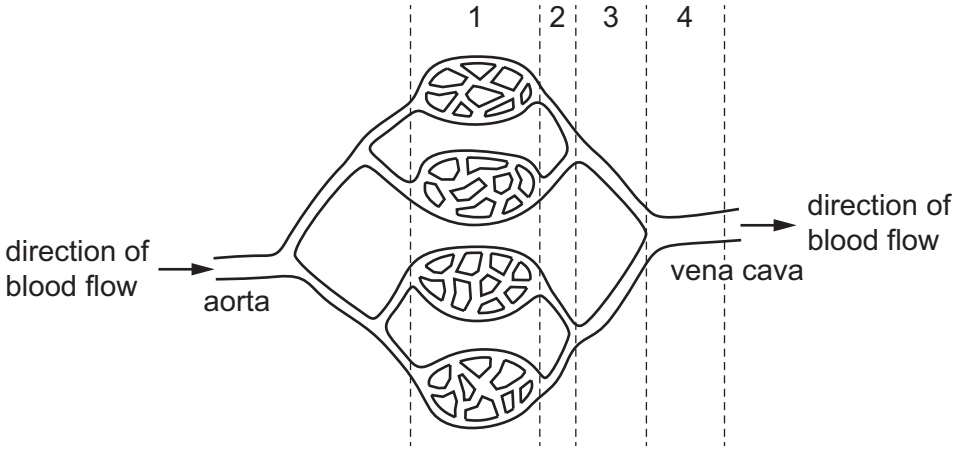
Which row is correct for atrial contraction and ventricular contraction?

	atrial contraction	ventricular contraction
A	AVN produces waves of excitation	SAN produces waves of excitation
B	Purkyne tissue carries waves of excitation	AVN produces waves of excitation
C	SAN and AVN produce waves of excitation	Purkyne tissue carries waves of excitation
D	SAN produces waves of excitation	Purkyne tissue carries waves of excitation

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[Turn over

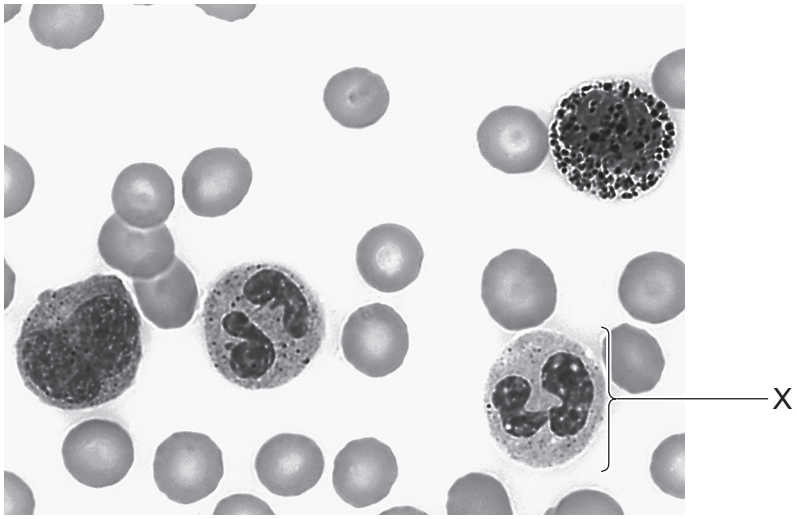
29 The diagram shows part of the circulatory system in a mammal.



Where is the blood pressure and the speed of flow the lowest?

	lowest blood pressure	lowest speed of flow
A	1	4
B	2	3
C	3	2
D	4	1

30 The photomicrograph shows human blood cells.



What type of blood cell is X?

A B-lymphocyte

B monocyte

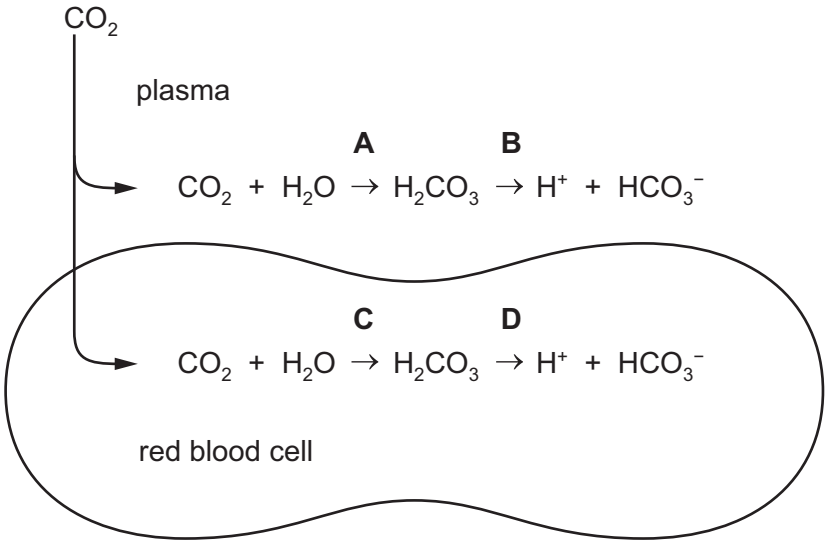
C phagocyte

D T-lymphocyte

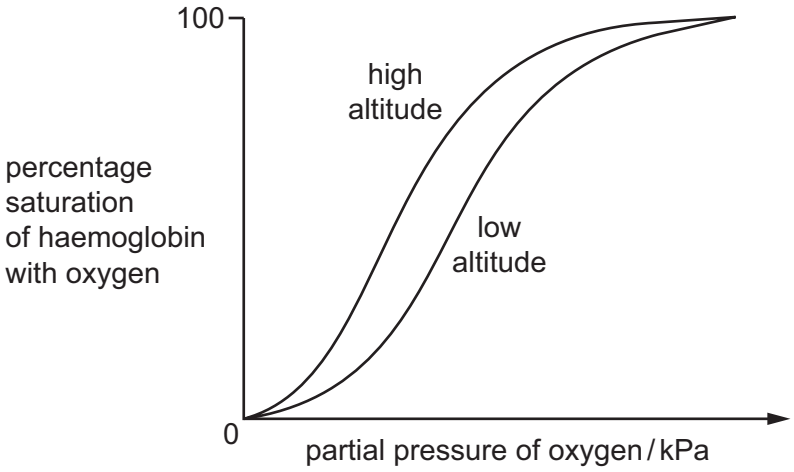
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31 The diagram shows some of the reactions of carbon dioxide when it enters the blood from cells in a metabolically active tissue.

Which reaction is catalysed by the enzyme carbonic anhydrase?



32 The graph shows the oxygen dissociation curves for haemoglobin in animals that live at high altitude and animals that live at low altitude.



What explains the oxygen dissociation curve at **high** altitude?

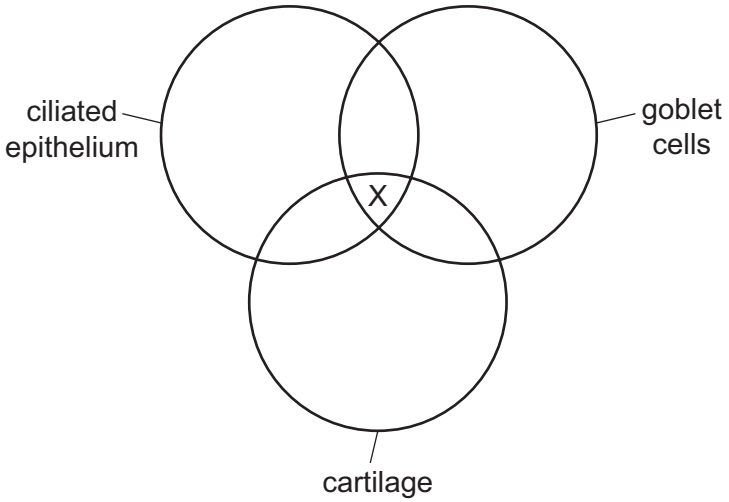
A Haemoglobin has a higher affinity for oxygen.

B Haemoglobin releases oxygen more readily.

C The change in partial pressure of carbon dioxide causes a Bohr effect.

D The decrease in percentage of carbon dioxide causes the curve to shift to the left.

33 The diagram shows three features found in the mammalian gas exchange system.



Which structures of the gas exchange system could be represented by X in the diagram?

A small bronchiole only

B small bronchiole and bronchus

C trachea only

D trachea and bronchus

34 What are short-term effects of nicotine on the cardiovascular system?

1 constriction of small arteries

2 increase in heart rate

3 increase in blood pressure

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 Some features of a disease are listed.

- It can be transmitted by animals to other animals, including humans.
- One mode of transmission is by transfusion with contaminated blood.
- The causative organism can show multiple drug resistance.
- The majority of humans who die from the disease are children.

Which disease has all these features?

A cholera

B HIV / AIDS

C malaria

D tuberculosis

36 The following advice was given to a person travelling to a country where there had been an outbreak of an infectious disease.

- Cook food well and eat it hot.
- Peel fruit and vegetables.
- Drink only cool, boiled water.
- Wash hands often with soap and cool, boiled water.

Which infectious disease would this advice help to protect against?

A cholera

B malaria

C measles

D tuberculosis

37 Which description of multiple drug resistance in bacteria is correct?

A Bacteria have DNA with resistant genes for several different types of antibiotic.

B Different species of bacteria have DNA with resistant genes for one type of antibiotic.

C Large numbers of one species of bacteria are immune to several different types of antibiotic.

D Many different species of bacteria are immune to one type of antibiotic.

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38 Which description of a T-lymphocyte is correct?

A They are only found in blood and secrete cytokines in response to infection.

B They can leave the blood and accumulate at sites of inflammation.

C They can leave the blood and secrete cytotoxins when exposed to bacteria.

D They circulate in the blood and always present antigens in response to infection.

39 Where are antibodies found during an immune response?

	on the surface of memory cells	in blood plasma
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = antibodies found

✗ = antibodies not found

40 Monoclonal antibodies are used in the diagnosis and treatment of disease. They are produced using a technique known as cell fusion.

Which two structures are fused together in this technique?

A antigens and hybridoma cells

B T-lymphocytes and cancer cells

C cancer cells and plasma cells

D hybridoma cells and antibodies

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1 A scale bar on an electron micrograph is 2 cm long and represents an actual length of 1 μm.

What is the magnification of the electron micrograph?

A ×200 **B** ×2000 **C** ×20 000 **D** ×200 000

2 The eyepiece of a microscope is fitted with an eyepiece graticule and a stage micrometer scale is placed on the microscope.

Which statements about the stage micrometer scale are correct?

1 The scale can be used to measure the actual length of cells directly.

2 The scale allows you to calibrate the eyepiece graticule.

3 Less of the scale is visible as the objective lens changes from ×10 to ×40.

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

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 mRNA passes through to the ribosome

2 organises microtubules to produce the spindle during cell division

3 synthesis of polypeptides

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

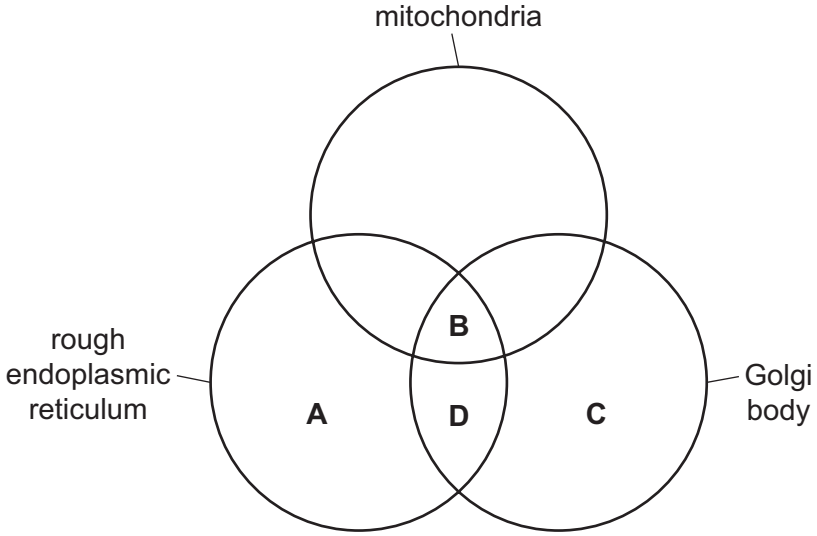
Y non-membrane bound, cylindrical structures

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	V	W	X
B	V	Y	Z
C	X	W	Z
D	X	Y	W

4 Which cell structures are required for the formation of lysosomes and the hydrolytic enzymes that they contain?



5 Which cell structures contain rRNA?

1 chloroplast

2 mitochondrion

3 nucleus

4 smooth endoplasmic reticulum

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 2 and 4 only

D 3 and 4 only

6 The single-celled organism *Thiomargarita namibiensis* measures 700 μm in diameter and is enclosed in a cell wall. The genetic material of *T. namibiensis* is located free in the cytoplasm where it occurs as thousands of copies of circular DNA. Most of the cell is taken up by a large vacuole, which stores essential chemicals for metabolism.

Which statement is correct?

A It must be a eukaryote because a diameter of 700 μm is too large for a prokaryote.

B It must be a plant because it contains a vacuole.

C It must be a plant because it is enclosed in a cell wall.

D It must be a prokaryote because its DNA is circular and located in the cytoplasm.

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7 A student carried out four tests on a sample of biological molecules.

test	observation
emulsion	cloudy
Benedict's	yellow
biuret	purple
iodine	yellow

Which conclusions made by the student are correct?

1 Fat was present.

2 Glucose was present.

3 Protein was present.

4 Starch was not present.

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1, 3 and 4 only

D 2 and 3 only

8 Which general formula is correct for monosaccharides such as fructose?

A $(CHO)_n$ **B** $(CH_2O)_n$ **C** $(CHO_2)_n$ **D** $(C_2HO)_n$

9 Which statements can be used to describe the structure of cellulose?

1 a polymer of glucose monomers linked by β-1,4 glycosidic bonds

2 a polysaccharide of hexose monomers

3 an unbranched macromolecule made of β-glucose monomers

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

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10 Complete hydrolysis of polysaccharides requires all the glycosidic bonds between the monomers to be broken.

Enzyme X only breaks α-1,4 glycosidic bonds.

Which row shows how completely enzyme X can hydrolyse molecules of glycogen and amylose?

	glycogen	amylose
A	+	++
B	++	+
C	++	–
D	–	+

key

– no hydrolysis

\+ some hydrolysis

++ most hydrolysis

11 Which molecules contain at least two double bonds?

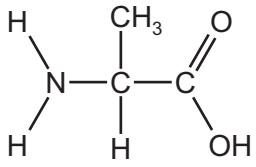
A saturated fatty acid, collagen and haemoglobin

B collagen and saturated fatty acid only

C haemoglobin and collagen only

D saturated fatty acid and haemoglobin only

12 The diagram shows an amino acid.



Which group is changed to produce different amino acids?

A OH **B** C=O **C** CH_3 **D** NH_2

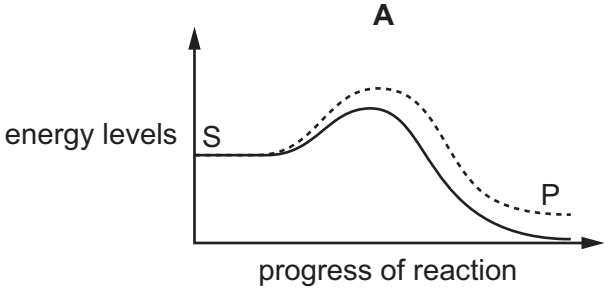
13 Which row is correct about the structure of proteins?

	primary	secondary	tertiary	quaternary
A	determined by the sequence of DNA nucleotides	occurs by hydrogen bonding between NH and C=O groups of amino acids	disulfide, ionic, hydrogen bonds and hydrophobic interactions are all involved	always formed by association of two or more polypeptides
B	the number of amino acids in each polypeptide chain	in a single polypeptide it is either an α-helix or a β-pleated sheet	the bonds are formed at specific points determined by the primary structure	always formed by two or more polypeptides held together by bonds formed between the polypeptides
C	formed by twenty different amino acids linked in a specific order	an α-helix is formed by hydrogen bonds between side chains of amino acids	only globular proteins have this level of structure	always formed by two or more different polypeptides to give the final shape
D	the sequence of amino acids in each polypeptide chain	a β-pleated sheet is the result of a folded polypeptide forming hydrogen bonds between adjacent strands	reactions between side chains of specific amino acids give a specific 3-D shape	always formed by two or more polypeptides and a metal ion

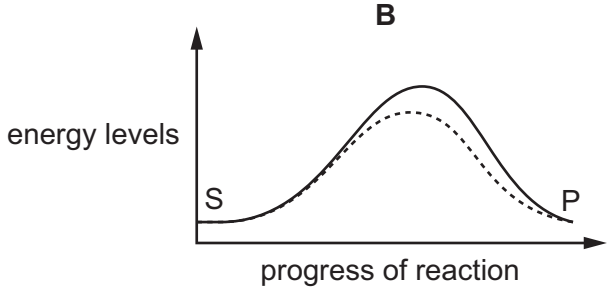
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14 Which graph correctly shows possible changes in energy levels as a chemical reaction progresses with or without an enzyme?

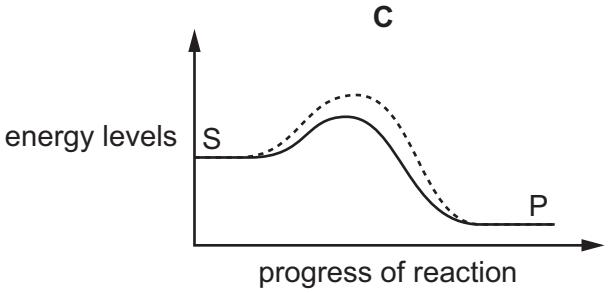
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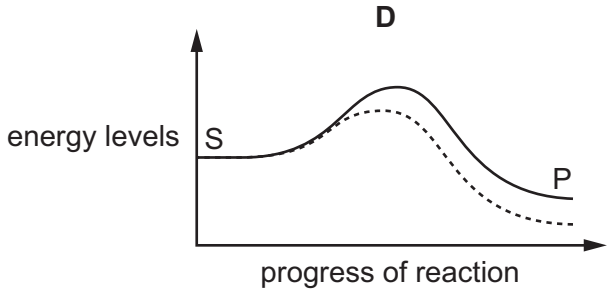
B



C



D



key

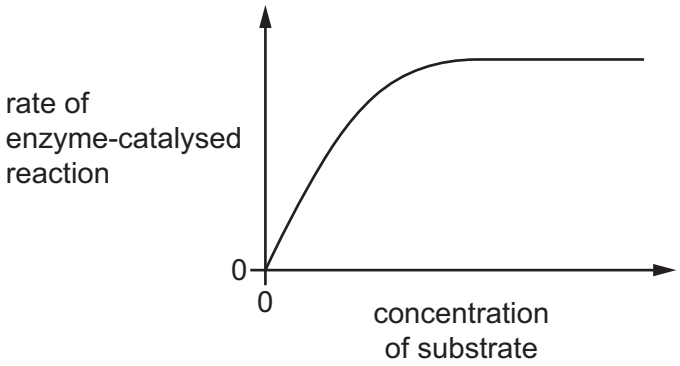
—— with enzyme

- - - - - - without enzyme

S substrate

P product

15 The graph shows the relationship between the concentration of substrate and the rate of an enzyme-catalysed reaction.



Which row shows how K_m and V_{max} for this enzyme would be affected if the same reaction was carried out in the presence of a competitive inhibitor?

	K_m	V_{max}
A	increases	decreases
B	increases	remains the same
C	remains the same	decreases
D	remains the same	remains the same

16 Liver cells contain vesicles that have proteins in their membranes which are specific for the transport of glucose.

When these cells need to take up glucose, the vesicles fuse with the cell surface membrane.

How does the uptake of glucose occur?

A exocytosis

B diffusion

C endocytosis

D facilitated diffusion

17 A student set up an experiment to investigate diffusion.

A block of agar, 1.0 cm × 1.0 cm × 1.0 cm, was stained uniformly with a water-soluble blue dye. The block of agar was put into a test-tube containing 10 cm^3 of distilled water at 20 °C.

The intensity of the blue colour of the water after five minutes was measured.

Four other experiments, **A**, **B**, **C** and **D**, were then carried out using different numbers of agar blocks, different sizes of agar blocks and different temperatures. All other variables were standardised.

Which experiment would give a lighter blue colour in the water after five minutes compared to the first experiment?

	size of each agar block / cm	number of agar blocks	temperature of distilled water / °C
A	0.5 × 0.5 × 0.5	8	30
B	0.5 × 0.5 × 0.5	2	20
C	0.5 × 1.0 × 1.0	2	30
D	2.0 × 1.0 × 1.0	1	20

18 Which description is correct?

A A centromere holds two chromatids together until the end of prophase and attaches to the microtubules of the spindle.

B A chromatid is one of two identical parts of a chromosome and is made of proteins and two molecules of DNA.

C A chromosome is a structure with two identical parts, made of DNA and proteins, found in the nucleus of a prokaryotic cell.

D A telomere is a sequence of DNA nucleotides, such as GGGTAA, repeated many times and found at the ends of each chromatid.

19 During metaphase, a scientist stains the chromosomes of a diploid animal cell with fluorescent dye to allow the telomeres to be observed.

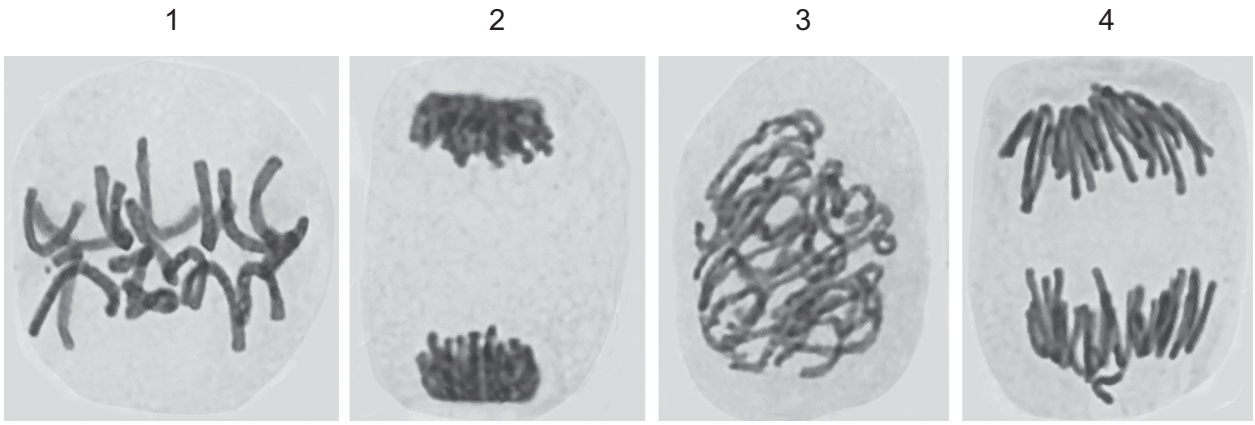
This cell has 26 chromosomes.

How many telomeres will the scientist observe?

A 26 **B** 52 **C** 78 **D** 104

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20 The photomicrographs show cells in various stages of the cell cycle.



Which cells contain twice as many DNA molecules as a cell from the same organism that has just finished a complete mitotic cell cycle ending with cytokinesis?

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 3 only

D 2 and 4 only

21 Uncontrolled cell division can result in the formation of a tumour.

Which part of the cell cycle would take less time during the formation of a tumour?

A cytokinesis

B interphase

C mitosis

D telophase

22 A piece of a DNA molecule contains 84 base pairs. The table shows the number of adenine and cytosine bases in one or both of the DNA strands in this piece of DNA molecule.

base	strand 1	strand 2
adenine	28	23
cytosine	15	

How many guanine bases are present in this piece of DNA molecule?

A 18 **B** 33 **C** 36 **D** 41

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23 The mRNA sequences of the three stop codons are shown.

UAA UAG UGA

Which mutation in the template (transcribed) strand of a DNA sequence that codes for a polypeptide would cause translation to stop prematurely?

A ATT changed to ATC

B ACT changed to ACA

C ACC changed to ATT

D ATC changed to TAG

24 Which features of companion cells are essential to their function?

1 They are connected to the sieve tube elements by plasmodesmata.

2 They have a thicker cell wall than a sieve tube element.

3 They contain a nucleus and mitochondria.

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

25 Which statements about water movement in plants are correct?

1 Water can pass through cellulose cell walls.

2 Water cannot pass through lignified cell walls.

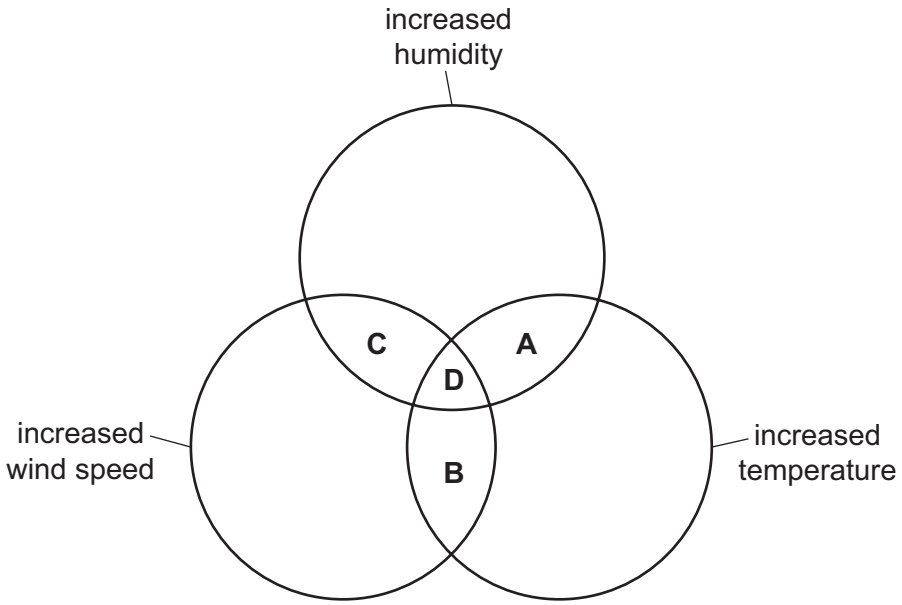
3 Water can pass through cell walls that contain suberin.

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

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26 The diameter of a tree trunk usually decreases slightly during the day.

Which changes in environmental factors during the day could cause the diameter to decrease even more?



27 Which sequence of events could lead to mass flow in a phloem sieve tube?

1 Sucrose moves into a sieve tube element.

2 Protons (H^+) and sucrose molecules move into a companion cell through a co-transporter protein.

3 A very high hydrostatic pressure is produced.

4 The water potential of the sieve tube element decreases.

5 Protons (H^+) are actively pumped out of a companion cell.

6 Water moves down a water potential gradient by osmosis.

A $1 \rightarrow 2 \rightarrow 5 \rightarrow 6 \rightarrow 4 \rightarrow 3$

B $3 \rightarrow 1 \rightarrow 2 \rightarrow 5 \rightarrow 6 \rightarrow 4$

C $3 \rightarrow 5 \rightarrow 1 \rightarrow 2 \rightarrow 4 \rightarrow 6$

D $5 \rightarrow 2 \rightarrow 1 \rightarrow 4 \rightarrow 6 \rightarrow 3$

28 What will happen as a result of the blood pressure in the right ventricle becoming higher than the blood pressure in the right atrium?

A The semilunar valve in the aorta will close.

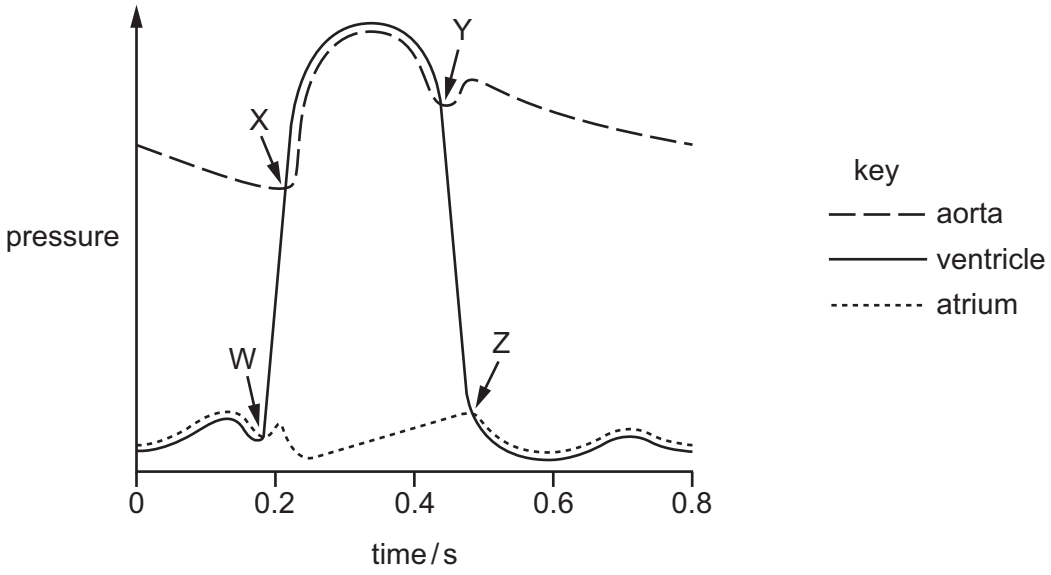
B The semilunar valve in the pulmonary artery will close.

C The left atrioventricular valve will close.

D The right atrioventricular valve will close.

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29 The graph shows pressure changes in different parts of the heart during a mammalian cardiac cycle. W, X, Y and Z indicate when a valve opens or closes.



Which row correctly identifies W, X, Y and Z?

	W	X	Y	Z
A	atrioventricular valve opens	atrioventricular valve closes	semilunar valve opens	semilunar valve closes
B	atrioventricular valve closes	semilunar valve opens	semilunar valve closes	atrioventricular valve opens
C	semilunar valve opens	semilunar valve closes	atrioventricular valve opens	atrioventricular valve closes
D	semilunar valve closes	atrioventricular valve opens	atrioventricular valve closes	semilunar valve opens

30 Which statements are correct?

1 Compared with blood, tissue fluid has less protein and no red blood cells.

2 Lymph may contain lipids, carbon dioxide and phagocytes.

3 Tissue fluid contains glucose, amino acids, urea and carbon dioxide.

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

31 Which statements about the formation of haemoglobinic acid are correct?

1 It can only occur with the dissociation of oxygen from haemoglobin.

2 It removes excess hydrogen ions, preventing blood from becoming too acidic.

3 It is linked to the action of carbonic anhydrase.

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

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32 What explains how the maximum volume of oxygen is taken up as blood passes through the capillaries of the lungs?

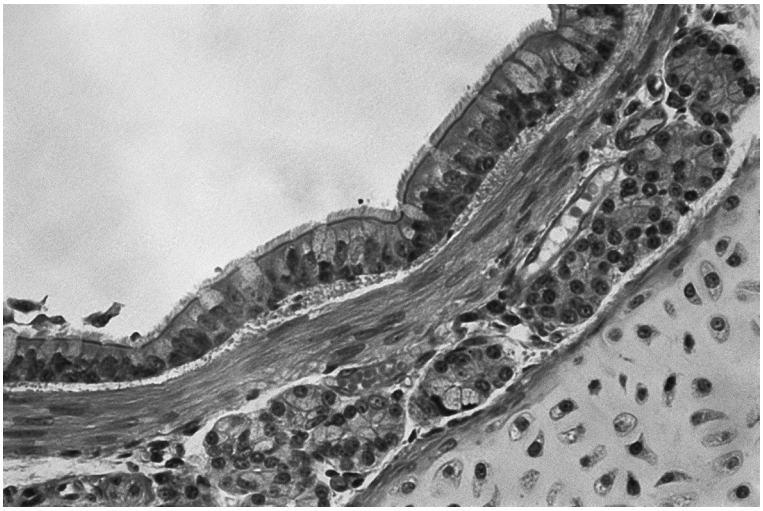
A Each haemoglobin molecule can temporarily bind to four oxygen atoms.

B The dissociation of carbon dioxide from carboxyhaemoglobin allows more haemoglobin to be available for binding oxygen.

C The binding of the first oxygen molecule to haemoglobin decreases the affinity of haemoglobin for binding other oxygen molecules.

D Oxyhaemoglobin formation increases the ability of red blood cells to transport oxygen.

33 The image shown is a photomicrograph of a transverse section of part of the gas exchange system.



What describes the image?

A a thin inner layer of ciliated epithelial cells on top of a layer containing cartilage, supported by elastic fibres

B a very thin epithelial lining with walls containing elastic fibres, surrounded by many blood vessels

C an inner layer of ciliated epithelial and goblet cells on top of elastic fibres, supported by an outer layer consisting of cartilage

D an inner layer of ciliated epithelial and goblet cells on top of loose tissue with mucous glands, supported by a continuous ring of cartilage

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34 Which row shows the tissues that are present in the wall of the trachea and the wall of the bronchus?

	smooth muscle	squamous epithelium	goblet cells
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✗

key

✓ = present

✗ = not present

35 When a person suffers an asthma attack, the tubes of the gas exchange system narrow and extra mucus is produced.

Which changes occur during an asthma attack?

1 Activity of ciliated epithelium increases.

2 Endocytosis in goblet cells increases.

3 Smooth muscles are more active.

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

36 Which flow diagram correctly describes the effect of tar entering the lungs?

A carcinogens come into contact with DNA → mutation occurs → uncontrolled cell division

B goblet cells secrete more mucus → mucus accumulates causing infection → phagocytes attracted by inflammation

C mucus accumulates causing infection → phagocytes attracted by inflammation → elastase destroys the alveolar walls

D mutation occurs → phagocytes attracted by inflammation → causes irritation and coughing

37 Which control measures would reduce the transmission of tuberculosis (TB)?

	boiling water before drinking it	antibiotics	vaccination
A	yes	no	no
B	yes	yes	yes
C	no	yes	no
D	no	yes	yes

38 Comorbidity is where an individual has two or more diseases or medical conditions at the same time. Some medical conditions are particularly likely to result in comorbidity. In one example, initial infection with one pathogen can increase the risk of developing a second disease by a factor of 15 or more. The second disease is then the major cause of death for these people.

Which description could fit this example?

A cholera infection followed by development of malaria

B cholera infection followed by development of AIDS

C HIV infection followed by development of TB

D malaria infection followed by development of TB

39 Which conditions are infectious **and** result in a high white blood cell count?

1 leukaemia

2 myasthenia gravis

3 TB

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

40 Which cell type causes the secondary immune response to be much faster than the primary immune response?

A helper T-lymphocyte

B memory cell

C phagocyte

D plasma cell

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BIOLOGY **9700/13**

Paper 1 Multiple Choice **October/November 2021**

1 hour

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.

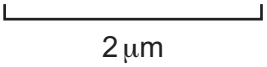
INFORMATION

- 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 A student was asked to use the scale bar shown to calculate the magnification of a cell on a photomicrograph.



Which method could the student use to calculate the magnification of the cell?

A divide the diameter of the cell by the length of the scale bar, with both measured in the same units of length

B measure the diameter of the cell in millimetres, multiply by 2000 and divide by the length of the scale bar measured in millimetres

C measure the length of the scale bar in millimetres, convert to micrometres and divide by 2

D measure the length of the scale bar in millimetres, convert to micrometres and multiply by 2

2 Which statements about light microscopy are always correct?

1 The greater the resolution of a light microscope, the greater the detail that can be seen.

2 The greater the magnification of a light microscope, the greater the detail that can be seen.

3 Increasing the magnification of a light microscope up to its limit of resolution allows more detail to be seen.

4 The shorter the wavelength of light used in a light microscope, the greater the detail that can be seen.

A 1, 2, 3 and 4

B 1, 3 and 4 only

C 1 and 2 only

D 4 only

3 What is the length of a typical prokaryote, such as the bacterium *Escherichia coli*?

A 1.5×10^{1} nm

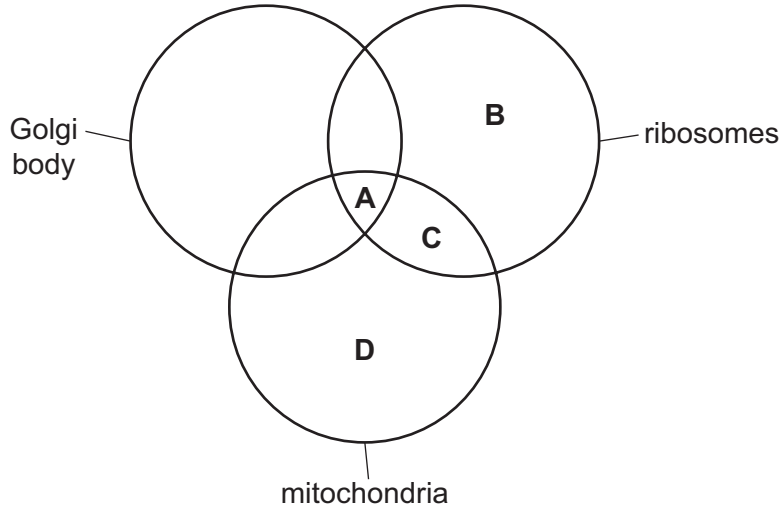
B 1.5×10^{2} nm

C 1.5×10^{0} μm

D 1.5×10^{1} μm

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4 Which cell structures are present in *Plasmodium*?



5 Which cell structures may contain nucleic acid?

1 cytoplasm

2 chloroplast

3 ribosome

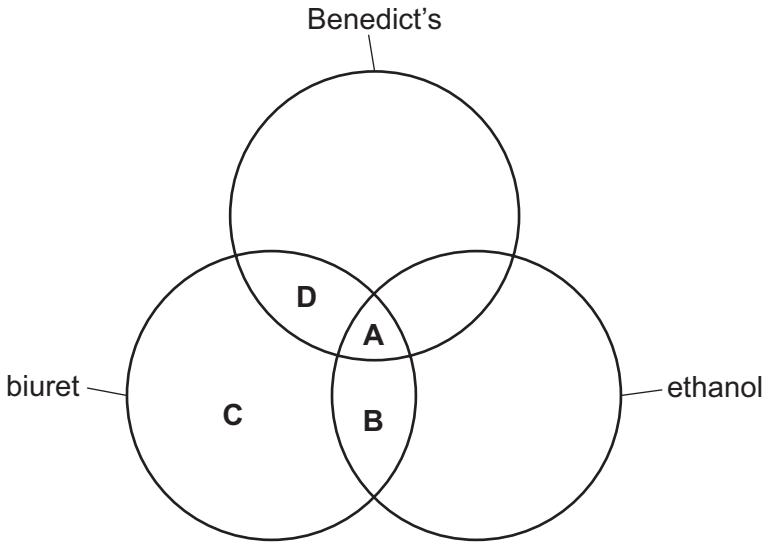
4 Golgi body

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

6 Which row shows correct features of ATP?

	carbohydrate in ATP	site of production of ATP
A	deoxyribose	mitochondria and chloroplasts
B	pentose	mitochondria and chloroplasts
C	hexose	chloroplasts only
D	ribose	mitochondria only

7 Which tests will identify biological molecules that contain monomers with a carboxyl group?



8 Which polysaccharide is correctly described?

	polysaccharide	monomer	biological role
A	amylopectin	β-glucose	storage molecule in animals
B	amylose	α-glucose	storage molecule in plants
C	cellulose	α-glucose	structural molecule in plants
D	glycogen	β-glucose	structural molecule in animals

9 Which formula represents a saturated fatty acid?

A $C_{18}H_{36}O_2$ **B** $C_{18}H_{34}O_2$ **C** $C_{18}H_{32}O_2$ **D** $C_{18}H_{30}O_2$

10 Which molecules always contain at least four double bonds?

A triglyceride, collagen and haemoglobin

B collagen and triglyceride only

C haemoglobin and collagen only

D triglyceride and haemoglobin only

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11 Which row about the structure of proteins is correct?

	primary structure	secondary structure	tertiary structure
A	the number of amino acids present in a protein	the left-handed spiral formed by the primary structure	the result of cross-bonding between specific amino acids in the primary structure
B	the order of amino acids present in a protein encoded by DNA	the coiling of a chain of amino acids to form a β-pleated sheet	the shape formed by folding of a polypeptide and held together by hydrogen bonds
C	the result of translation of an mRNA molecule by a ribosome into a chain of amino acids	occurs because of attraction between hydrogen and oxygen atoms in the side chains	the result of ionic and hydrogen bonds, disulfide bridges and hydrophobic interactions between amino acids
D	the sequence of amino acids in a protein coded by an mRNA molecule	formed by hydrogen bonding between amino acids forming the primary structure	formed as a result of interaction of the side chains of amino acids in the primary structure

12 Which statement about collagen is correct?

A A collagen fibre is made of three parallel helices with hydrogen bonds holding them in place.

B It is an insoluble fibrous protein with a quaternary structure.

C One-third of the amino acids making up collagen are valine.

D Collagen fibres are formed from several collagen molecules held together by ionic bonds.

13 Which properties of water are the result of hydrogen bonding between water molecules?

1 solvent action

2 specific heat capacity

3 latent heat of vapourisation

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

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14 Which descriptions about all enzymes are correct?

1 catalyse the breakdown of large molecules into smaller molecules

2 only function inside cells

3 form temporary bonds with the substrate

4 have a tertiary structure

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

15 The cells in the roots of beetroot plants contain a red pigment.

When pieces of root tissue are soaked in cold water, some of the red pigment leaks out of the cells into the water.

An experiment was carried out to investigate the effect of temperature on the loss of red pigment from the root cells. It was found that the higher the temperature of the water, the higher the rate of loss of red pigment from the root cells.

Which statements could explain this trend?

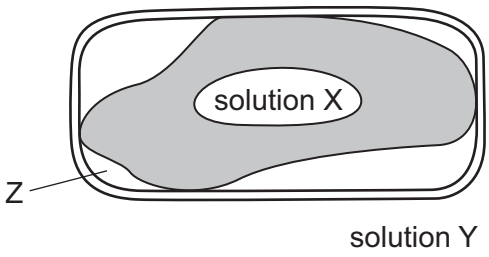
1 Enzymes in the cells denature as the temperature increases, so the pigment can no longer be used for reactions inside the cells and diffuses out.

2 As the temperature increases, the tertiary structure of protein molecules in the cell surface membrane changes, increasing the permeability of the membrane.

3 Phospholipid molecules gain kinetic energy as the temperature rises, increasing the fluidity of the phospholipid bilayer and allowing pigment molecules to diffuse out more easily.

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

16 The diagram shows a partially plasmolysed plant cell.



What is found at Z?

A air

B solution X

C solution Y

D water

17 A single-celled organism lives in freshwater. Water that enters the cytoplasm of the cell by osmosis is collected into a structure called the contractile vacuole. To remove the water the contractile vacuole fuses with the cell surface membrane.

A student counted the number of times that the contractile vacuole filled and emptied when the cell was placed in solutions with different water potentials. The results are shown in the table.

water potential of external solution / kPa	rate of contractile vacuole emptying / min^{-1}
0	31
–100	20
–200	13
–300	8
–400	6
–500	0

Which statement explains the pattern observed as the water potential of the external solution decreased?

A The water potential gradient between the cell and the solution increased, causing water to move into the cell more rapidly and the contractile vacuole to empty more frequently.

B The water potential gradient between the cell and the solution increased, causing water to move into the cell less rapidly and the contractile vacuole to empty less frequently.

C The water potential gradient between the cell and the solution decreased, causing water to move into the cell more rapidly and the contractile vacuole to empty more frequently.

D The water potential gradient between the cell and the solution decreased, causing water to move into the cell less rapidly and the contractile vacuole to empty less frequently.

18 Which row shows the correct number of each component of a single chromatid during anaphase of mitosis?

	centromeres	polynucleotide strands	telomeres
A	1	2	2
B	1	4	4
C	2	2	4
D	2	4	2

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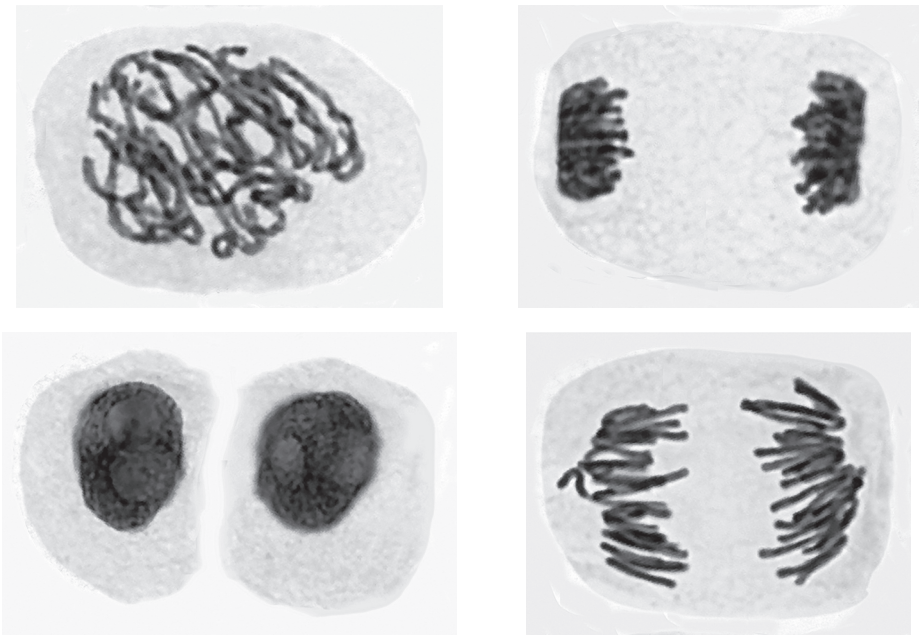
19 Some processes are listed.

- cytokinesis
- differentiation
- DNA replication
- mitosis

How many of the listed processes occur during tissue repair by stem cells?

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

20 The photomicrographs show cells in various stages of the cell cycle.



Which stage of mitosis is **not** shown?

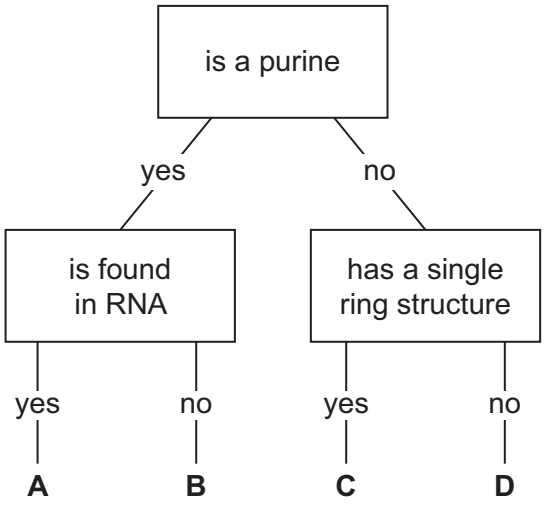
A anaphase

B prophase

C metaphase

D telophase

21 Which letter in the key describes uracil?



22 When a gene for protease is activated, which nucleic acid will be formed?

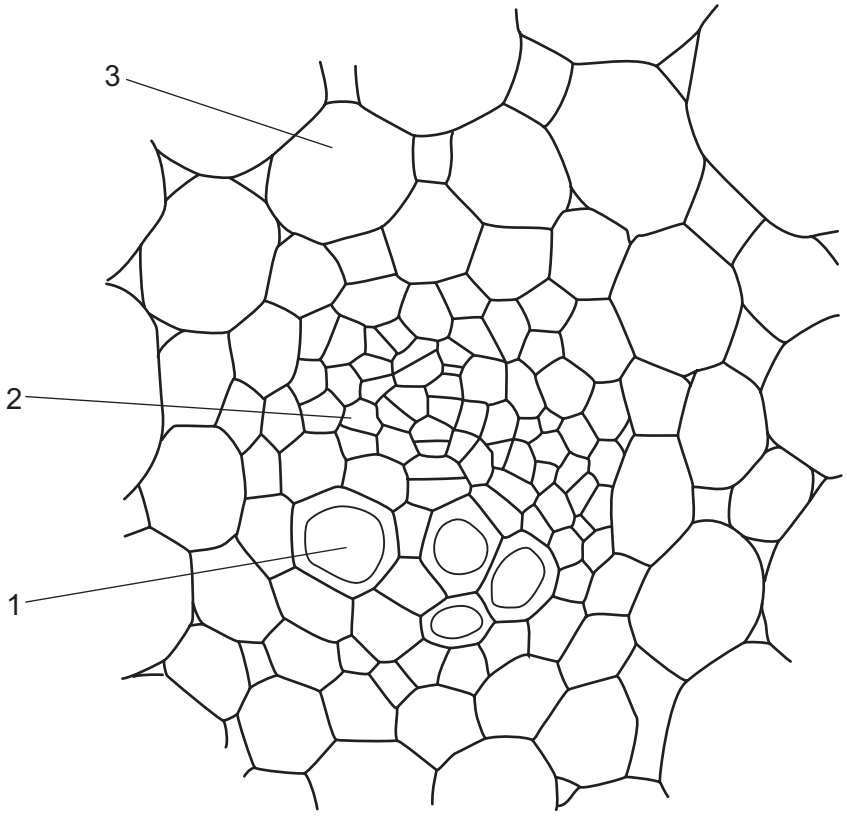
A DNA

B mRNA

C rRNA

D tRNA

23 The diagram shows a vascular bundle from the stem of a plant.



Which row describes the functions of the labelled cells?

	transports sucrose	transports mineral ions	stores starch
A	1	2	3
B	2	1	3
C	2	3	1
D	3	1	2

24 Some of the features present in the transport tissues of plants are listed.

1 lignified walls

2 cytoplasm

3 mitochondria

4 chloroplasts

5 plasmodesmata

Which features are present in sieve tube elements?

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

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25 Which statements explain why transpiration is an inevitable consequence of gas exchange in plants?

1 Hydrolysis reactions are taking place in cells.

2 ATP production is occurring.

3 Stomata must be open.

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

26 In an investigation, a leafy shoot was attached to a potometer and exposed to a variety of conditions. The time taken for the meniscus to move 50 mm along the capillary tubing was recorded for each set of conditions.

temperature / °C	humidity	air movement	time taken to move 50 mm / s
20	dry	not moving	125
20	dry	moving	71
30	dry	not moving	40
20	humid	not moving	166
20	humid	moving	83
30	humid	not moving	55

Which row shows the slowest and fastest rates of water uptake for this investigation?

	slowest rate / $mm\,s^{-1}$	fastest rate / $mm\,s^{-1}$
A	0.3	1.3
B	0.3	3.3
C	3.3	0.3
D	1.3	0.8

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27 Proton pumps (H^+ pumps) and co-transporters are used by plants when loading sucrose into a phloem sieve tube element at a source.

Which row is correct?

	proton pump	co-transporter
A	pumps protons into a companion cell raising its pH	the high concentration of protons in the companion cell allows the transporter to be used for moving sucrose out of the cell
B	pumps protons into a mesophyll cell raising its pH	the high concentration of protons in a mesophyll cell drives the transport of sucrose into the cell
C	pumps protons out of a companion cell into its cell wall	the high concentration of protons outside a companion cell drives the transport of sucrose into the cell
D	pumps protons out of a mesophyll cell into its cell wall	the low concentration of protons in a mesophyll cell allows the transporter to be used for moving sucrose out of the cell

28 The statements list some of the events in the cardiac cycle. They are not in the correct order.

1 The impulse travels through Purkyne tissue.

2 A wave of excitation sweeps across the atria.

3 The atrioventricular node delays the impulse for a fraction of a second.

4 The sinoatrial node contracts.

5 The wave of excitation sweeps upwards from the base of the ventricles.

6 The ventricles contract.

7 The atria contract.

Which statement describes the sixth of these events to occur in the cardiac cycle?

A 1 **B** 3 **C** 4 **D** 5

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29 Which tissue types are present in the walls of **all** blood vessels?

1 collagen

2 elastic

3 endothelial

4 smooth muscle

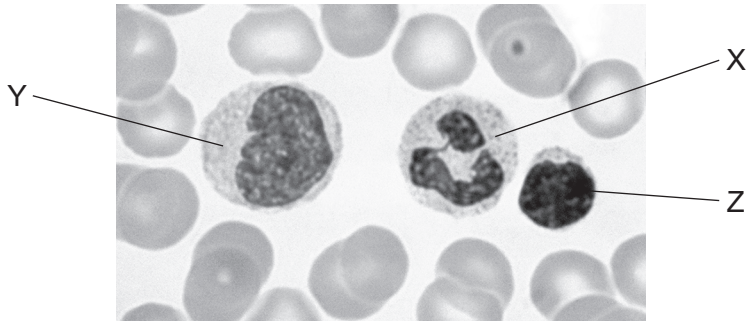
A 1, 2, 3 and 4

B 1, 2 and 4 only

C 2 and 3 only

D 3 only

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



Which row correctly identifies these cells?

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

31 When active tissues have high carbon dioxide concentrations, oxyhaemoglobin needs to release oxygen to the tissues.

How is the carbon dioxide transported away by the blood from the tissues?

1 as carboxyhaemoglobin

2 as carbaminohaemoglobin

3 as hydrogencarbonate ions

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

32 Which effect does increasing carbon dioxide concentration have on haemoglobin?

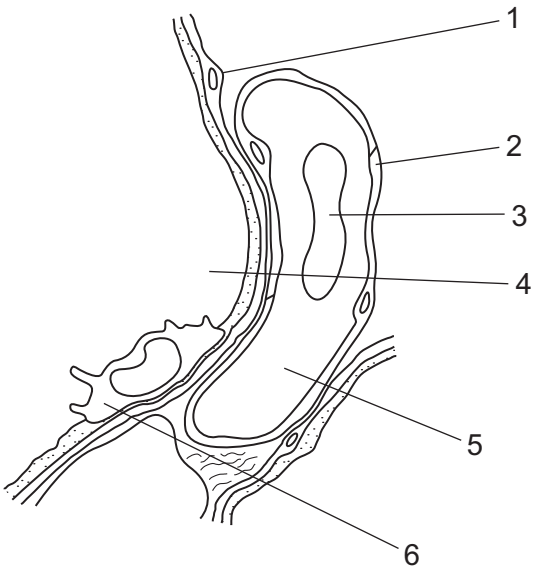
A Haemoglobin is less efficient at taking up oxygen and less efficient at releasing oxygen.

B Haemoglobin is less efficient at taking up oxygen and more efficient at releasing oxygen.

C Haemoglobin is more efficient at taking up oxygen and less efficient at releasing oxygen.

D Haemoglobin is more efficient at taking up oxygen and more efficient at releasing oxygen.

33 The diagram shows a magnified section of part of the lungs containing specialised tissues.



Which row is correct for the structures labelled 1 to 6?

	contains high proportion of		
	carbonic anhydrase	hydrogencarbonate ions	lysosomes
A	1	3	4
B	2	4	5
C	3	5	6
D	4	6	1

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34 The table shows some parts of an animal's lungs that contain different cell types.

part of lungs	cell type present		
	ciliated	goblet	smooth muscle
trachea	✓	✓	✓
bronchus	✓	✓	✓
bronchiole	✓	✗	✓
alveoli	✗	✗	✗

key
✓ = present
✗ = not present

Which parts of this animal's lungs clean inhaled air and which carry out gas exchange?

	clean inhaled air	gas exchange
A	bronchiole and alveoli	bronchus and trachea
B	bronchus and trachea only	bronchiole only
C	bronchus and trachea only	bronchiole and alveoli
D	bronchiole, bronchus, trachea	alveoli only

35 What helps to maintain a steep oxygen concentration gradient between the air in an alveolus and the blood?

1 Breathing in brings in a supply of air with a relatively high concentration of oxygen to the alveolus.

2 Blood flow brings blood with a relatively low concentration of oxygen to the alveolus.

3 The relatively low concentration of carbon dioxide in the alveolus results in the carbon dioxide leaving the red blood cell, allowing haemoglobin to combine with oxygen.

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

36 Goblet cells are found in the trachea.

Which cell structures would be found extensively in a goblet cell?

	Golgi body	mitochondria	ribosomes
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ = found extensively
✗ = not found extensively

37 In a country where malaria has successfully been eliminated, an outbreak of malaria can occur years later.

What could allow this later outbreak of malaria to occur?

1 mosquitoes become resistant to insecticides

2 migration of the population due to war

3 malarial parasites become resistant to quinine

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

38 Which row about a person with leukaemia only and about a person with measles only is correct?

	white blood cell count in a person with leukaemia only	bone marrow function in a person with leukaemia only	white blood cell count in a person with measles only
A	decreased	increased	decreased
B	decreased	decreased	increased
C	increased	normal	decreased
D	increased	increased	increased

39 What is the cause of symptoms of people with myasthenia gravis?

A antibodies block receptor molecules on the cell surface membrane of muscle cells

B it is an autoimmune disease where self-antigens attack antibodies

C the destruction of T-lymphocytes, which have receptors complementary to self-antigens

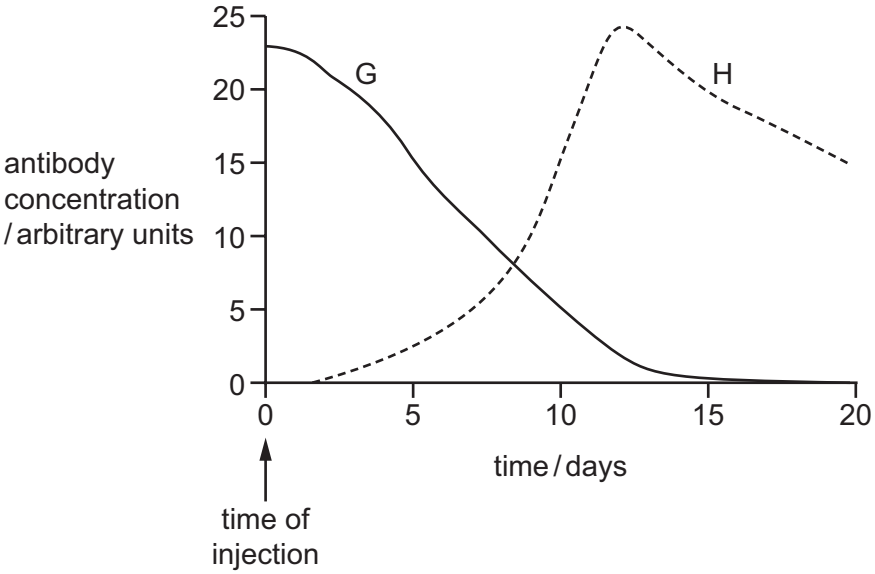
D the loss of cell surface membrane receptors in nerve cells found in the spinal cord

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40 Tetanus is a bacterial infection.

The graph shows the blood antibody concentration of two people.

On day 0, person G was injected with antibodies to the tetanus toxin and person H was injected with the vaccine for tetanus.



What could be the result if G and H were infected with the tetanus bacteria on day 20?

A Tetanus antibodies would not be produced in person G.

B Antibody production would peak after day 32 in person G.

C Antibody concentration would stay constant in person H.

D A second antibody peak would occur in person H that would be lower than the first peak.

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