Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/11**

Paper 1 Multiple Choice **May/June 2016**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

2740917736

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
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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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
Electronic calculators may be used.

This document consists of **16** printed pages.

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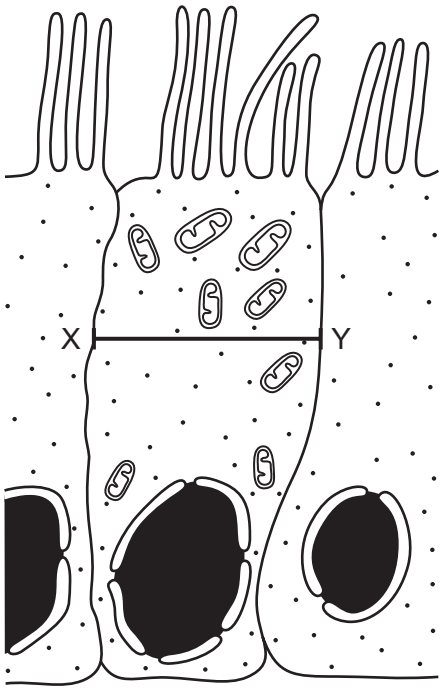
1 Which of the cell organelles will be clearly visible under the high power (×400) of the light microscope?

	lysosomes	endoplasmic reticulum	mitochondria	chloroplasts
A	✓	✓	✗	✗
B	✓	✗	✓	✗
C	✗	✓	✓	✓
D	✗	✗	✗	✓

key
✓ = clearly visible
✗ = not clearly visible

2 The drawing from an electron micrograph shows a ciliated epithelial cell, magnified ×1500, which is found in the trachea.

Line X-Y shows the widest dimension of the cell.



What is the number of these cells that could be found along a 1 cm length of the trachea?

A 5 **B** 50 **C** 500 **D** 5000

3 What are correct locations of ribosomes in the typical eukaryotic cell?

1 free in the cytoplasm

2 attached to the outside of the endoplasmic reticulum

3 attached to the inside of the endoplasmic reticulum

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

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4 Visking tubing is an artificial partially permeable membrane used to demonstrate diffusion. Glucose molecules can pass through the pores in the membrane which are approximately 2.4 nm in diameter.

Which of the following could pass through the pores?

1 bacteria

2 haemoglobin

3 ribosomes

4 glycogen

A 1 and 3 **B** 2 and 4 **C** 2 only **D** none of the above

5 What are found in both chloroplasts and typical prokaryotic cells?

A 70S ribosomes and circular DNA

B 70S ribosomes only

C 80S ribosomes and circular DNA

D circular DNA only

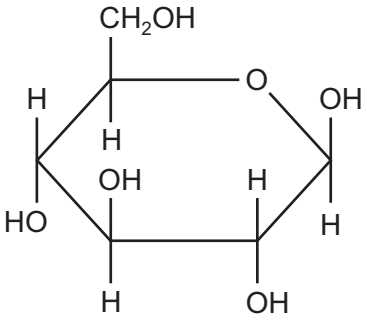
6 Two solutions, 1 and 2, one containing starch and sucrose, and the other containing glucose and protein, were tested with a variety of reagents to confirm their identity.

The table shows the conclusions from the results recorded for the various tests.

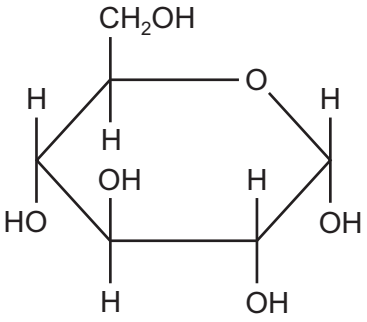
Which row identifies the two solutions?

	add iodine solution		boil with Benedict's solution		boil with Benedict's solution after acid hydrolysis		add biuret solution		
	1	2	1	2	1	2	1	2	key
A	+	–	+	–	–	+	–	+	+ = biological molecule present
B	–	+	+	–	+	–	–	+	– = biological molecule absent
C	+	–	–	+	+	–	–	+	
D	–	+	+	–	+	+	+	–	

7 X and Y are two monomers found in biological polymers.



X



Y

Which monomer is found in each of cellulose, glycogen, amylopectin and amylose?

	cellulose	glycogen	amylopectin	amylose
A	X	Y	X	Y
B	X	Y	Y	Y
C	Y	X	X	X
D	Y	X	Y	X

8 Chitin is a polysaccharide consisting of long straight chains of the monosaccharide acetylglucosamine, linked by 1,4 glycosidic bonds.

Acetylglucosamine is similar in structure to glucose, but contains nitrogen, allowing hydrogen bonds to form between adjacent chains of chitin when they lie parallel to each other.

Which polysaccharide is most similar in structure to chitin?

A amylopectin

B amylose

C cellulose

D glycogen

9 Which statement about triglycerides is correct?

A They are made up of three fatty acids combined with glycogen.

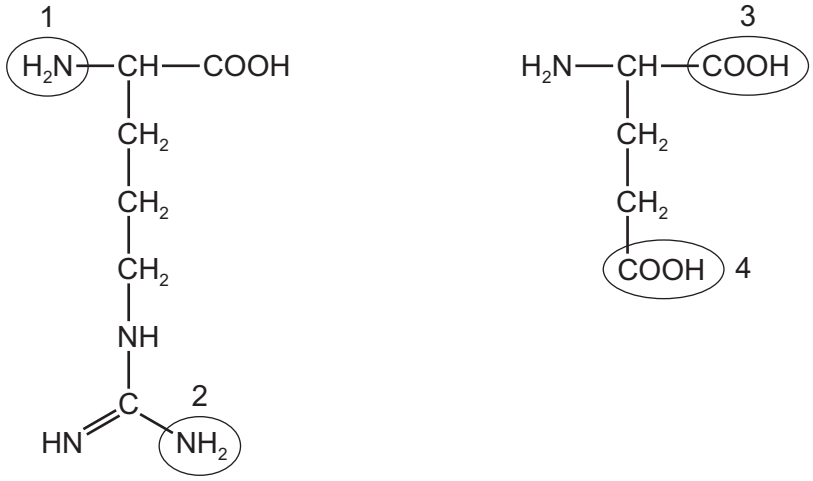
B They are more saturated with hydrogen compared with phospholipids.

C They form a bilayer in the cell surface membranes of cells.

D They have a lower ratio of oxygen to carbon compared with carbohydrates.

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10 The diagrams show the structures of two amino acids, one of which has two amine ($–NH_2$) groups and the other has two carboxylic (–COOH) groups.

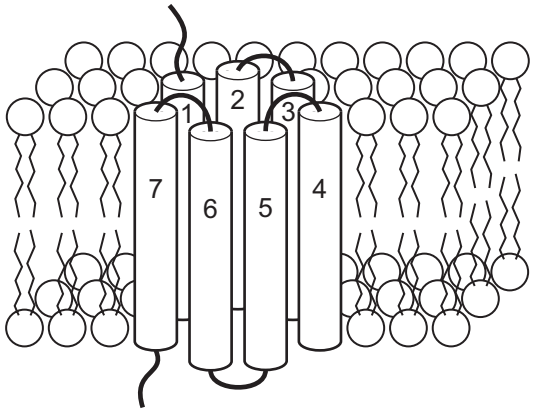


A peptide bond is formed between the two amino acids.

Which groups form the peptide bond?

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

11 Proteins which transport sugars out of cells have been identified. These proteins are called SWEETs. Each SWEET has seven coiled, cylindrical regions which together make up a pore through the cell surface membrane bilayer, as shown in the diagram.



What describes each of the seven coiled regions (1-7) of a SWEET shown in the diagram?

A primary structure held in its shape by bonds such as hydrogen bonds

B primary structure held in its shape by peptide bonds

C secondary structure held in its shape by bonds such as hydrogen bonds

D secondary structure held in its shape by peptide bonds

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

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

1 The active site must have a complementary shape to the substrate for them to bind together.

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

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

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

13 Which row about competitive inhibitors of enzymes is correct?

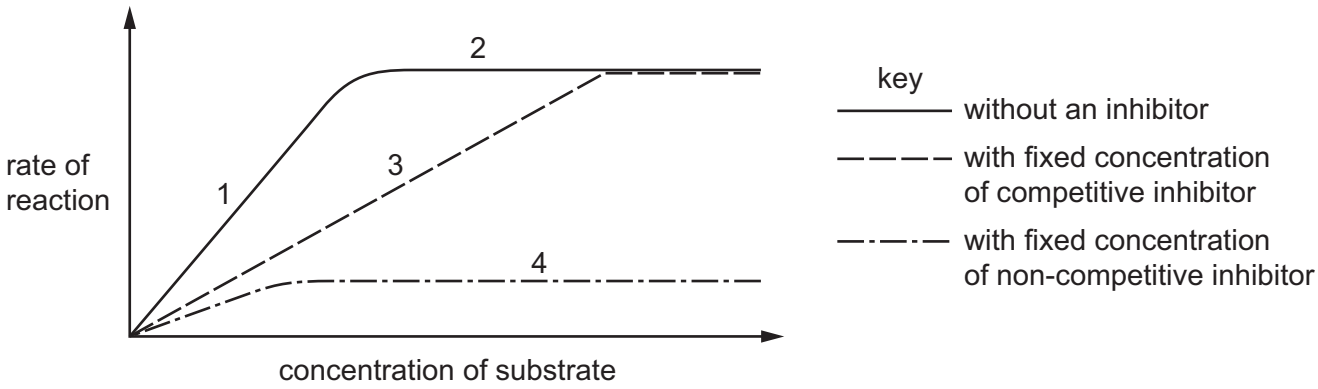
	bind to a site other than the active site	lower the activation energy needed for a reaction to occur
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = true

✗ = false

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



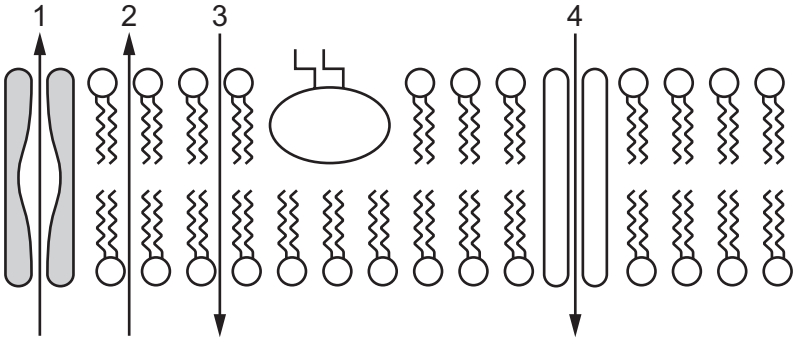
What is limiting the rate of the enzyme-catalysed reaction at 1, 2, 3 and 4 on the graph?

	1	2	3	4
A	enzyme concentration	substrate concentration	competitive inhibitor	non-competitive inhibitor
B	enzyme concentration	substrate concentration	non-competitive inhibitor	competitive inhibitor
C	substrate concentration	enzyme concentration	competitive inhibitor	non-competitive inhibitor
D	substrate concentration	enzyme concentration	non-competitive inhibitor	competitive inhibitor

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[Turn over

15 The diagram represents a cell surface membrane of a metabolically active cell and the direction of movement of some molecules through the membrane.



Which row shows a process by which the molecules may be moving through the membrane at each of the points 1, 2, 3 and 4?

	1	2	3	4
A	carbon dioxide by diffusion	water by osmosis	glucose by diffusion	sodium ions by active transport
B	fatty acids by diffusion	oxygen by diffusion	carbon dioxide by diffusion	water by osmosis
C	sodium ions by active transport	carbon dioxide by diffusion	water by osmosis	glucose by facilitated diffusion
D	water by osmosis	oxygen by diffusion	fatty acids by diffusion	glucose by active transport

16 Batrachotoxin is a poison found in frogs in the Columbian jungle. The poison is used by Native Indians to produce poison darts.

The poison works by increasing the permeability of some cell surface membranes to sodium ions, which move out of the cells.

Which statements are correct for cells affected by batrachotoxin?

1 The intracellular fluid has a less negative water potential than the extracellular fluid.

2 The extracellular fluid has a less negative water potential than the intracellular fluid.

3 Water leaves the cells by osmosis, causing the cells to shrink.

4 Water enters the cells by osmosis, causing the cells to swell.

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

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17 Which processes occur during prophase of the mitotic cell cycle in an animal cell?

	centrioles replicate	chromosomes condense	spindle fibres form
A	✓	✓	✗
B	✓	✗	✗
C	✗	✓	✓
D	✗	✗	✓

key

✓ = true

✗ = false

18 The protein p53 is produced in a cell in response to DNA damage. This protein stops the cell cycle for a short time just before the DNA is replicated, so that the DNA can be repaired.

At which phase of the cell cycle will this stop occur?

A M **B** G1 **C** S **D** G2

19 Which feature of stem cells enables them to replace cells in tissues such as the skin?

A They are undifferentiated cells that are present at birth.

B They differentiate to form skin cells.

C They divide by mitosis to supply some cells that can differentiate.

D They have the full number of chromosomes.

20 DNA contains the ……X…… base ……Y…… which is joined to adenine with ……Z…… hydrogen bonds.

Which row correctly completes the statement about DNA?

	X	Y	Z
A	purine	thymine	three
B	purine	uracil	three
C	pyrimidine	thymine	two
D	pyrimidine	uracil	two

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21 The diagram shows the nucleotide sequence of a small section of a gene which is transcribed.

CGCCGCACGCGC

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 order 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

22 The statements describe the features of some nucleic acids.

1 carry an amino acid to a ribosome

2 carry a genetic code sequence out of the nucleus

3 carry a genetic code sequence to a ribosome

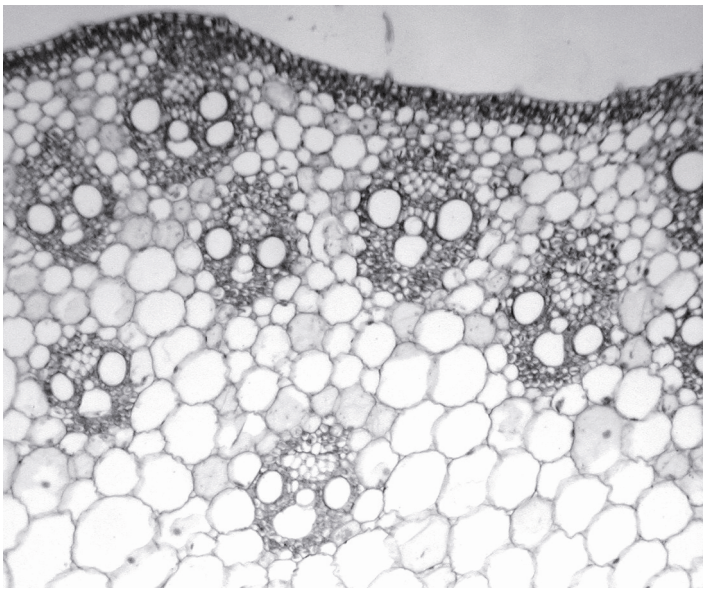
4 hold amino acids in position for translation

Which functions are carried out by tRNA?

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

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23 A student was asked to draw a plan diagram of the plant tissue shown in the photomicrograph and to annotate two observable features.



What are correct annotations?

A epidermis darkly stained layer of cells, xylem hollow vessels

B epidermis formed of a single layer of cells, xylem strengthened by lignin

C phloem small cells, xylem empty cells to transport water

D vascular bundles arranged in a regular pattern, xylem large dead cells

24 Water that is present inside a root hair cell may leave the cell and pass to the vascular tissue.

Through which route **must** the water travel?

A apoplast

B plasmodesmata

C symplast

D vacuoles

25 What is a correct definition of the term transpiration?

A diffusion of water from intercellular air spaces to the atmosphere where it evaporates

B evaporation of water from the leaf surface of a plant via the stomata

C loss of water vapour from the aerial parts of a plant to the atmosphere

D movement of water from the xylem to the atmosphere through the cell walls only

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26 Which changes to the water potential and the volume of liquid in the phloem sieve tube element occur when sucrose is moved from a photosynthesising leaf into the phloem sieve tube element?

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

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

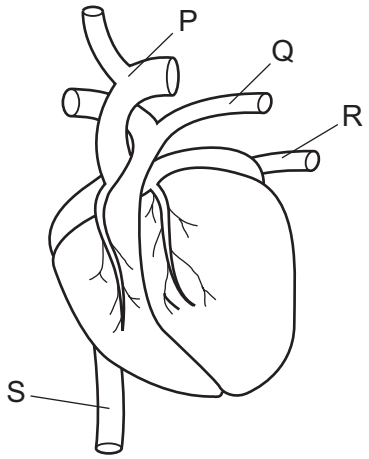
A The pH decreases in the cell wall of the companion cells compared to the cytoplasm.

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

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

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

28 The diagram is an external view of the mammalian heart and the associated blood vessels.



Which statement about the blood vessels associated with a normal, healthy heart is correct?

A P and Q carry blood with more oxyhaemoglobin than haemoglobin.

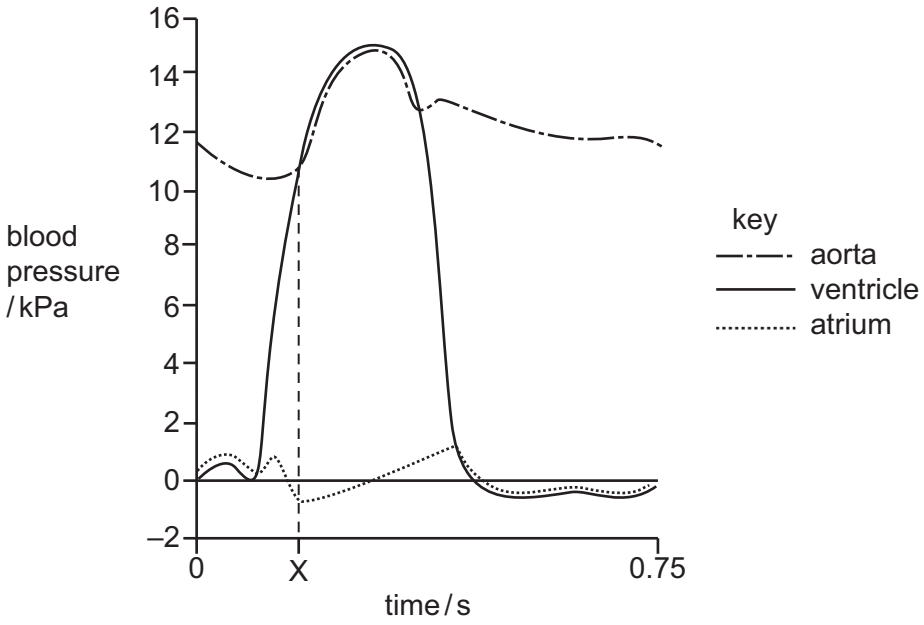
B P and R carry blood that is saturated with oxygen.

C S and P carry blood with a low oxygen concentration.

D S and R carry blood with more haemoglobin than oxyhaemoglobin.

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29 The graph shows changes in blood pressure during one cardiac cycle.



What is happening at time X?

	aortic semilunar valve	atrium
A	closing	emptying
B	closing	filling
C	opening	emptying
D	opening	filling

30 Which does **not** occur when a red blood cell arrives at the alveolus?

A Carbaminohaemoglobin releases carbon dioxide from the α-globin and β-globin polypeptide chains.

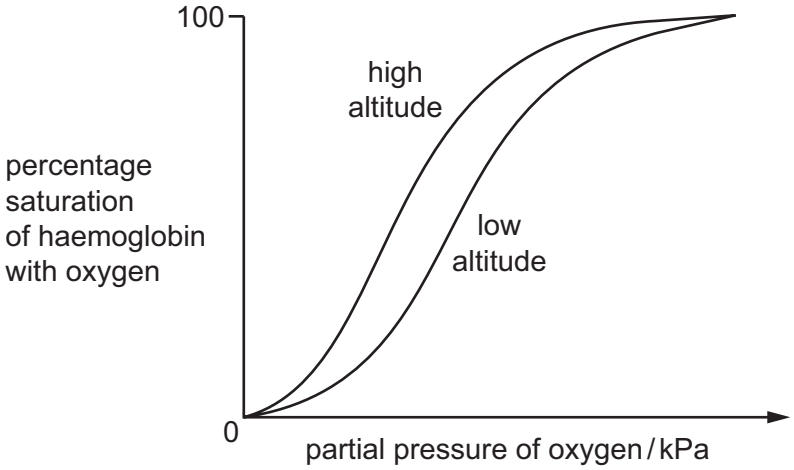
B Carbonic acid in the red blood cell forms carbon dioxide and water.

C Hydrogencarbonate ions diffuse from the plasma into the red blood cell.

D Hydrogen ions are released from haemoglobinic acid and diffuse out of the red blood cell.

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31 The graph shows the oxygen dissociation curves for haemoglobin of 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.

32 Which statement concerning events that occur in the heart is correct?

A As the wave of excitation passes through the atrioventricular node there is a time delay before it passes down the conducting fibres in the septum to the ventricles; this allows the atria to fill before ventricular systole.

B Contraction of the ventricle muscles following atrial systole causes the ventricular blood pressure to rise above the blood pressure in the atria, closing the atrioventricular valve and preventing backflow.

C The band of non-conducting fibres between the atria and ventricles prevents the wave of excitation from the atria reaching the ventricles directly; the wave of excitation passes to the Purkyne fibres and then to the atrioventricular node.

D The primary pacemaker, the sinoatrial node in the left atrium, sends out a wave of excitation that spreads across the walls of the atria, resulting in the movement of blood from the atria into the ventricles.

33 What would be seen in an electron micrograph of a bronchus wall?

1 cartilage cells

2 ciliated cells

3 exocytotic vesicles

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

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34 Which parts of the human gas exchange system may typically contain macrophages?

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

✓ = may contain macrophages

✗ = may not contain macrophages

35 An oxygen molecule diffuses from the air in an alveolus through cells to haemoglobin in a red blood cell.

What is the minimum number of cell surface membranes through which this molecule must pass?

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

36 Which short-term effects of smoking are caused by carbon monoxide?

1 formation of carboxyhaemoglobin

2 increased risk of blood clotting

3 narrowing the lumen of arteries

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

37 A person whose immune system is suppressed may become more susceptible to certain diseases.

Which disease will this person **not** become more susceptible to?

A cholera

B measles

C sickle cell anaemia

D TB

38 Which disease is treated with drugs that have a similar molecular structure to DNA nucleotides?

A cholera

B HIV / AIDS

C malaria

D TB

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39 Rabies is a viral disease which can be spread to humans by a bite from an infected animal.

One method of treatment is to inject the patient with antibodies specific to the rabies virus.

Which statements about this treatment are correct?

1 The patient will have natural passive immunity to rabies.

2 The injected antibodies will be broken down by the patient.

3 The patient's memory cells will be able to produce this antibody more rapidly in the future.

4 The immunity provided will only be of short duration.

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

40 What are the functions of T-lymphocytes during an immune response?

1 destroy infected body cells

2 differentiate into memory cells

3 secrete antibodies

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

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BIOLOGY **9700/12**

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1 hour

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1 A student was presented with a photomicrograph of a cell organelle. The magnification of the photomicrograph is known.

Which calculation of the actual length of the organelle in μm is correct?

A actual size in cm × 100 divided by the magnification

B actual size in mm × 100 divided by the magnification

C image size in cm × 1000 divided by the magnification

D image size in mm × 1000 divided by the magnification

2 Which statements about **both** mitochondria and chloroplasts are correct?

1 They contain 80S ribosomes.

2 They contain circular DNA molecules.

3 They produce ATP.

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

3 Which range of sizes would include most eukaryotic cells?

A 1×10^2 nm to 1 μm

B 1 μm to 1×10^1 μm

C 1×10^1 μm to 1×10^2 μm

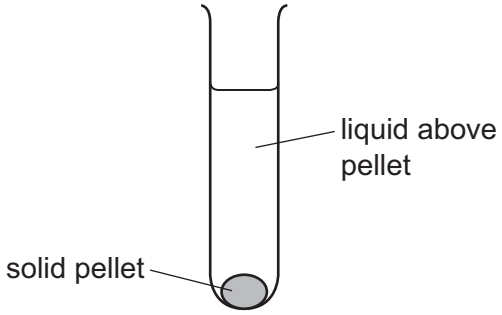
D 1×10^2 μm to 1×10^3 μm

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

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

The extracted mixture was filtered and then spun in a centrifuge at a speed that separates the heaviest organelle. This organelle sank to the bottom, forming a solid pellet, 1.



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

He repeated this procedure twice more to obtain pellet 3 and pellet 4, each containing a single organelle.

What is the function of the organelle extracted in pellet 4?

A digestion of old organelles

B production of ATP

C production of mRNA

D synthesis of protein

5 Which row shows the monomer and type of bond that form the polymer?

	monomer	type of bond	polymer
A	α-glucose	1,4 only	starch
B	α-glucose	1,4 and 1,6	amylopectin
C	β-glucose	1,4 only	glycogen
D	β-glucose	1,4 and 1,6	cellulose

6 Which biological molecules **always** contain the element nitrogen?

A amino acids, cellulose, mRNA

B amino acids, DNA, lipids

C enzymes, mRNA, tRNA

D membrane proteins, starch, tRNA

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7 Which statement about the quaternary structure of proteins is correct?

A consists of four subunits

B depends on the presence of metal ions

C depends on the primary structure of the subunits

D is made of α and β subunits

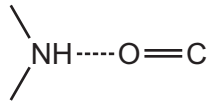
8 Which set of statements correctly describes haemoglobin?

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

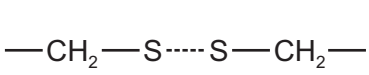
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9 The diagrams show different types of bond found in biological molecules.

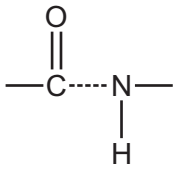
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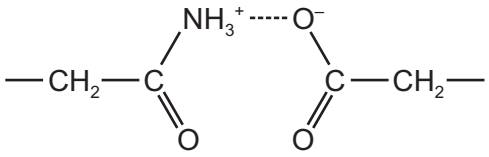
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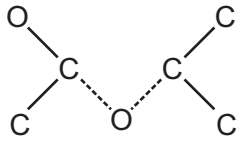
3



4



5



Which bonds are found in proteins with a tertiary structure?

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

10 In two investigations, the rate of an enzyme-catalysed reaction was measured in the presence of either a competitive inhibitor or a non-competitive inhibitor.

What could be the effect of increasing the substrate concentration on each rate of reaction?

	rate of reaction	
	with competitive inhibitor	with non-competitive inhibitor
A	decreases	no change
B	increases	decreases
C	increases	no change
D	no change	decreases

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11 Two enzymes, X and Y, were used in an experiment.

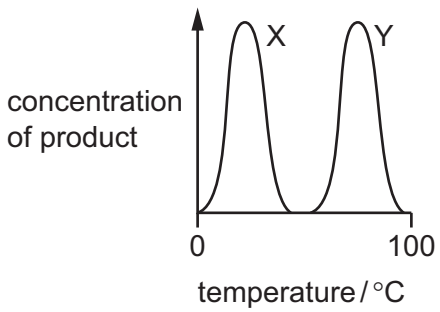
Enzyme X was from bacteria that live in rivers and lakes at temperatures from 5 °C to 20 °C.

Enzyme Y was from bacteria that live in hot water springs at temperatures from 40 °C to 85 °C.

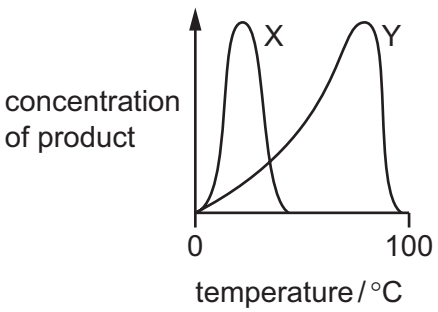
The experiment measured the concentration of product produced by each enzyme at temperatures between 0 °C and 100 °C after 5 minutes.

Which graph shows the results?

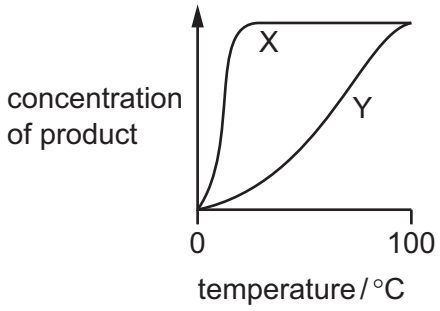
A



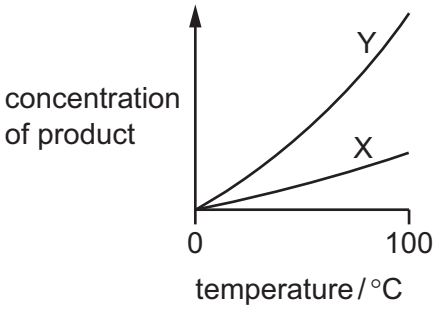
B



C



D



12 What is a function of the cholesterol in a cell surface membrane?

A acting as a membrane-bound receptor

B controlling active transport

C helping cells join together

D regulating the flexibility of the membrane

13 Which roles of the cell surface membrane are a result of the properties of the phospholipids?

1 to allow cytokinesis to occur in mitotic cell division

2 to allow entry and exit of oxygen and carbon dioxide

3 to allow the phagocytosis of a bacterium into a cell

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

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14 Which statements about active transport are **always** correct?

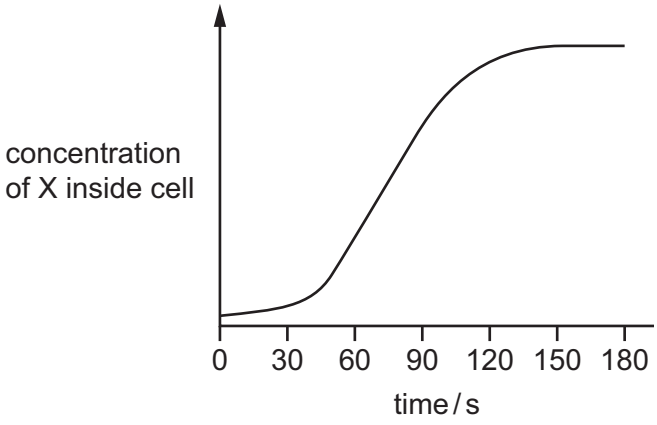
1 It does not require a membrane.

2 It occurs against the concentration gradient.

3 It moves oxygen molecules.

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

15 There is a high concentration of molecule X outside the cell which enters the cell by facilitated diffusion. The results of measuring the concentration of X inside the cell at 30 s intervals are shown by the graph.



Why does the concentration of X inside the cell remain constant after 150 s?

1 There is no more of X outside the cell.

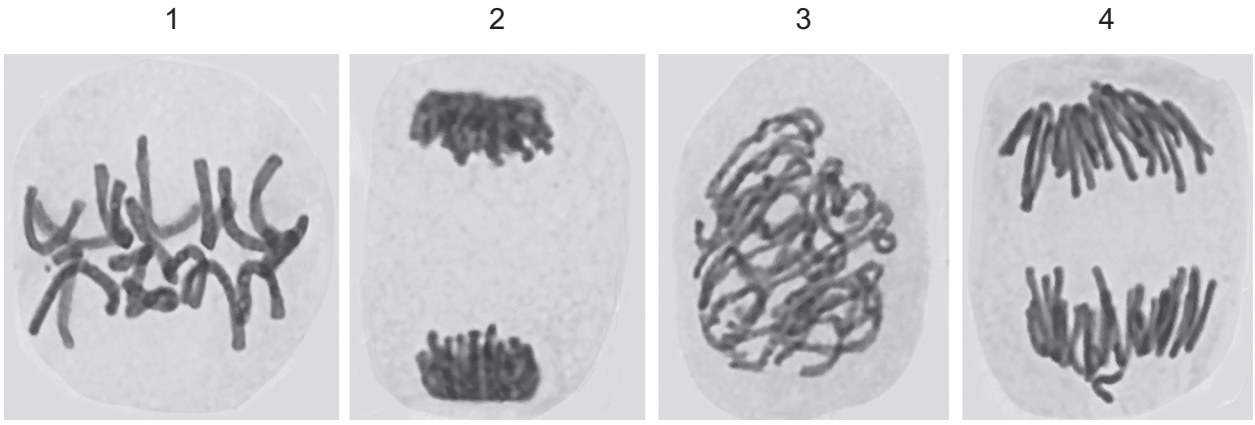
2 The number of carrier proteins is limiting.

3 There is no net movement of X.

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

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16 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 after cytokinesis?

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 3 only

D 2 and 4 only

17 A group of chemicals used to treat cancer prevents the formation of the spindle during mitosis.

Which phase of mitosis is the **first** to be affected?

A anaphase

B metaphase

C prophase

D telophase

18 Mitosis is an important process for organisms.

Which features of mitosis are important for single-celled organisms?

1 asexual reproduction

2 growth

3 production of genetically identical cells

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

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19 Which statements about complementary base pairing are correct?

1 Cytosine forms three hydrogen bonds with guanine.

2 Purines and pyrimidines are different sizes.

3 It allows transcription to occur.

4 The base pairs are of different lengths.

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

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

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

What is the composition of this DNA?

A 25% hybrid DNA

B 50% hybrid DNA

C 75% hybrid DNA

D 100% hybrid DNA

21 Which statements about tRNA are correct?

1 It contains base pairing.

2 It contains hydrogen bonds.

3 It contains uracil.

4 It is single stranded.

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

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

TTCTTCCCGTTC

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 order of the four amino acids in the polypeptide translated from this small section of a gene?

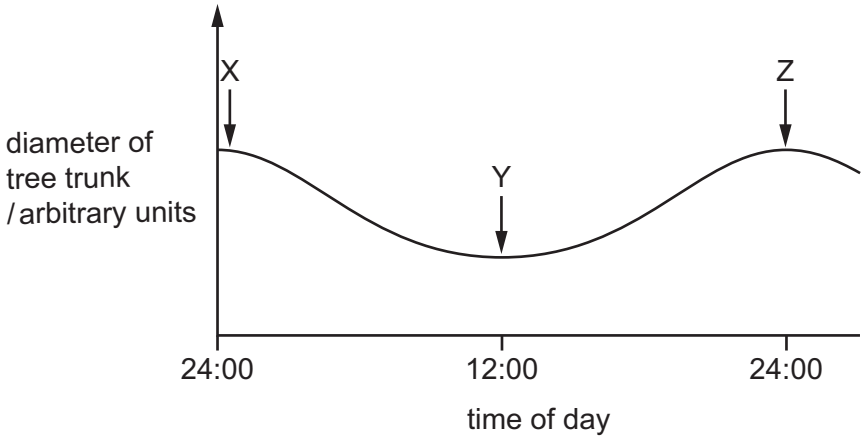
A Cys-Cys-Gly-Cys

B Lys-Lys-Gly-Lys

C Lys-Lys-Pro-Lys

D Thr-Thr-Pro-Thr

23 The graph shows the diameter of a tree trunk at different times.



Which statement is correct?

A X shows the expansion of the trunk as water fills the xylem during transpiration.

B Y shows a reduction in diameter of trunk as water is lost from the xylem due to transpiration.

C Y shows a reduction in diameter of trunk due to water held in tension in the xylem.

D Z shows the expansion of the trunk as the phloem tissue acts as a sink at night.

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24 Some plant species can take up toxic heavy metal ions that are dissolved in water in the soil. These ions accumulate in the aerial parts of the plant, which can be harvested and disposed of safely.

An investigation was carried out into the ability of a plant species to remove a heavy metal ion from soil. This produced the following observations:

- some heavy metal ions accumulated in the cells of the root cortex
- within these cells, most of these ions were in the vacuole
- in the roots and leaves, the ions were transported dissolved in water.

Which suggestions about the transport and accumulation of heavy metals are valid?

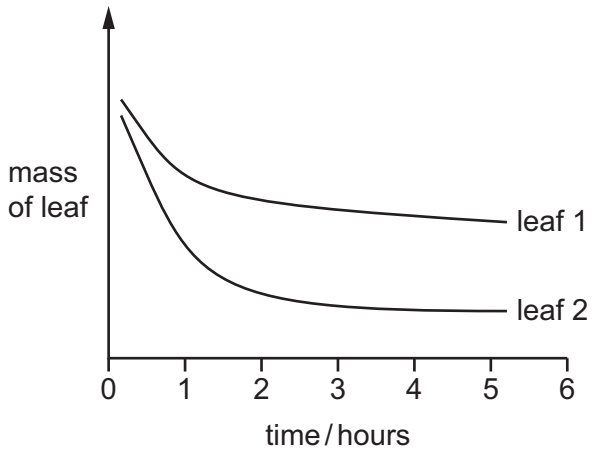
1 After initial entry into the root, some of the ions can pass through the tonoplast.

2 In the roots and leaves, the ions pass through a symplastic or apoplastic pathway but at the endodermis they must take a symplastic pathway.

3 In xylem vessels, the ions pass through an apoplastic pathway only.

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

25 The diagram shows the results of an experiment on transpiration using two different leaves. Each leaf was left on a balance in daylight in a closed room and its mass recorded at 1 hour intervals.



Which conclusions could be correct?

1 The loss of mass is mainly due to evaporation of water.

2 Most stomata close in both leaves after 1 hour.

3 Leaf 1 has a larger surface area than leaf 2.

4 Leaf 1 has a thicker cuticle than leaf 2.

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 2 and 3 only

D 3 and 4 only

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26 Which statement about the transport of sucrose is correct?

A ATP synthesised by mitochondria of companion cells provides the energy to move sucrose from phloem sieve tube elements in leaves to sinks.

B Sucrose moves through plasmodesmata by passive diffusion from mesophyll cells through companion cells to phloem sieve tube elements.

C The water potential in phloem sieve tube elements becomes more negative following the entry of sucrose.

D Water enters companion cells and hydrostatic pressure builds up to push sucrose into phloem sieve tube elements by mass flow.

27 Which of the tissue types below 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

28 Which components of blood are present in tissue fluid?

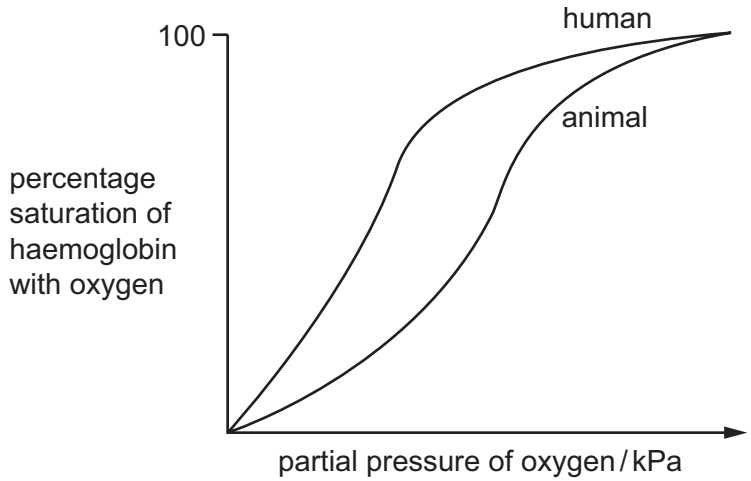
	phagocytes	proteins	sodium ions
A	✓	✓	✓
B	✓	✗	✗
C	✗	✓	✓
D	✗	✓	✗

key

✓ = present

✗ = absent

29 The graph shows changes in percentage saturation of haemoglobin with oxygen in the blood of a human and of another animal. The partial pressure of carbon dioxide remains constant at 1.0 kPa and the temperature is constant at 25 °C.



Which conclusion is supported by the graph?

A At 25 °C the affinity of haemoglobin for oxygen increases more in humans than in the animal.

B Haemoglobin in the animal carries less oxygen than haemoglobin in the human.

C Oxygen is more easily released from haemoglobin in animal muscle than in human muscle.

D The Bohr effect in the haemoglobin of the animal is greater than in human haemoglobin.

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

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

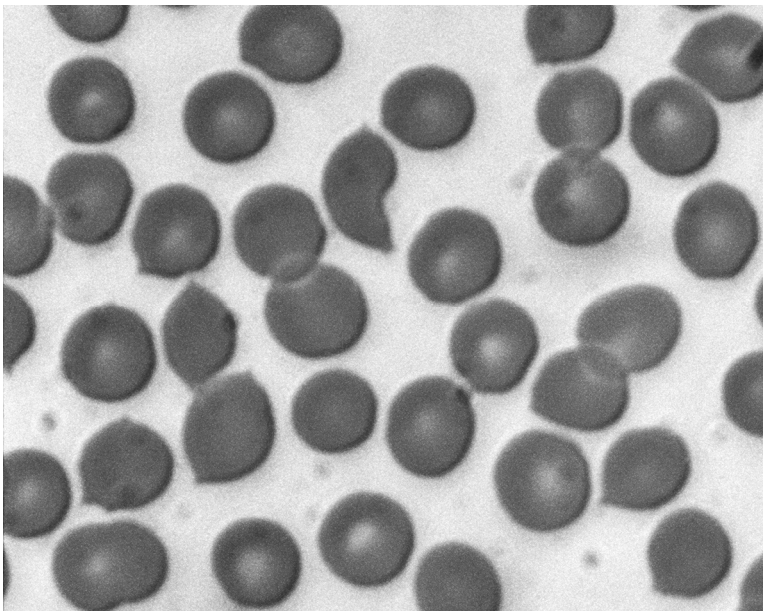
2 It acts to prevent excess hydrogen ions causing acidity in blood.

3 It depends on the release of hydrogen ions by the action of carbonic anhydrase.

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

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31 The photograph shows a type of blood cell.



Which statements about these cells are correct?

1 Oxygen diffuses through the phospholipid bilayer.

2 Sodium ions diffuse through the phospholipid bilayer.

3 Water passes in and out of these cells by osmosis.

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

32 A student was asked to describe the differences between four microscope slides of sections taken from different parts of the gas exchange system.

slide 1 not present: cartilage, glands
present: few goblet cells, ciliated epithelial cells, smooth muscle

slide 2 present: incomplete cartilage rings, glands, goblet cells, ciliated epithelial cells, smooth muscle

slide 3 not present: cartilage, glands, goblet cells, smooth muscle
present: squamous epithelial cells

slide 4 present: plates of cartilage, glands, goblet cells, ciliated epithelial cells, smooth muscle

Which is the correct identification of the parts of the gas exchange system?

	slide 1	slide 2	slide 3	slide 4
A	alveolus	bronchiole	bronchus	trachea
B	bronchiole	bronchus	alveolus	trachea
C	bronchiole	trachea	alveolus	bronchus
D	bronchus	trachea	bronchiole	alveolus

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33 Which components of the human gas exchange system help to reduce the effects of carcinogens in tar?

A cilia and goblet cells only

B cilia and mucous glands only

C mucous glands and goblet cells only

D mucous glands, goblet cells and cilia

34 What is correct about the affinity between haemoglobin and the gases carbon dioxide, carbon monoxide and oxygen?

	highest affinity → lowest affinity		
A	carbon monoxide	carbon dioxide	oxygen
B	carbon monoxide	oxygen	carbon dioxide
C	oxygen	carbon dioxide	carbon monoxide
D	oxygen	carbon monoxide	carbon dioxide

35 The table shows the names of five pathogens.

Which row matches the pathogens with the diseases they cause?

	Morbillivirus	*Mycobacterium*	*Plasmodium*	*Variola*	*Vibrio*
A	cholera	measles	TB	malaria	smallpox
B	malaria	smallpox	cholera	measles	TB
C	measles	TB	malaria	smallpox	cholera
D	TB	malaria	smallpox	cholera	measles

36 Which disease exhibits all the following features?

- 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.

A cholera

B HIV / AIDS

C malaria

D tuberculosis

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37 The proportion of the local population who have malaria in area R is higher than the proportion in area S.

Which factor causes this difference?

A Area R has a more humid climate than area S.

B Area R is nearer the equator than area S.

C There is a higher population in area R than area S.

D There is less sewage treatment in area R than area S.

38 Which statement describes how passive natural immunity is obtained?

A A vaccination containing dead microorganisms is given.

B An immunisation containing specific antigens is given.

C Antibodies are passed from mother to developing baby.

D Antibodies from another individual are injected.

39 What describes a non-specific immune response?

A activation of killer T-lymphocytes by infected cells

B cloning of B-lymphocytes to form plasma cells

C ingestion of a bacterial cell by a neutrophil

D presentation of antigens on the cell surface of macrophages

40 What explains why monoclonal antibodies can be used to target cancer cells?

A Cancer cells have different antigens from normal body cells.

B Specific cancer drugs can be attached to the monoclonal antibody.

C They are one type of a specific antibody that binds to an antigen.

D They are secreted by hybridomas of cancer cells and B-lymphocytes.

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BIOLOGY **9700/13**

Paper 1 Multiple Choice **May/June 2016**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

7827360565

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
Electronic calculators may be used.

This document consists of **14** printed pages and **2** blank pages.

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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 For which cell component would nanometres be the most appropriate unit of measurement?

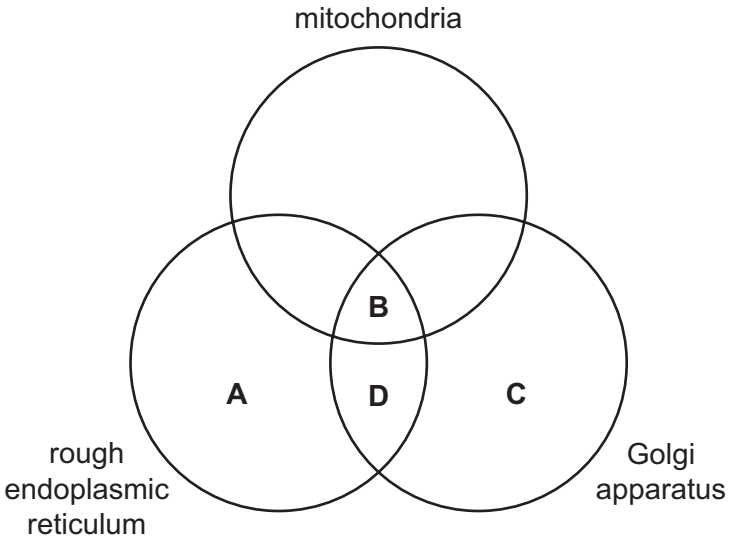
A a cell surface membrane

B a chloroplast

C a mitochondrion

D a nucleolus

3 Which organelles are required for the formation of lysosomes containing hydrolytic enzymes?



4 What are found in **both** chloroplasts and mitochondria?

A 70S ribosomes only

B 70S ribosomes and circular DNA

C 80S ribosomes and circular DNA

D circular DNA only

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5 Which types of RNA are found in **both** prokaryotic and eukaryotic cells?

	mRNA	rRNA	tRNA
A	✓	✓	✓
B	✓	✓	✗
C	✗	✓	✓
D	✗	✓	✗

key
✓ = present
✗ = absent

6 A sample of milk was tested with Benedict's solution and a yellow colour was observed.

Which conclusion is correct?

A No non-reducing sugars are present.

B Reducing sugars are present.

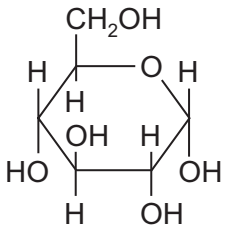
C There is a high concentration of glucose.

D There is a high concentration of sucrose.

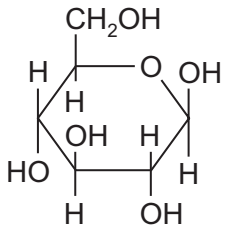
7 The diagrams show four monosaccharides with the formula $C_6H_{12}O_6$.

Which diagram shows β-glucose?

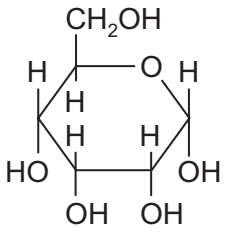
A



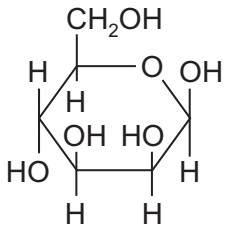
B



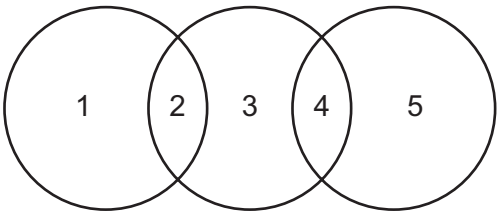
C



D



8 The diagram shows the relationship between different polysaccharides and the glycosidic bonds formed between the monomers.



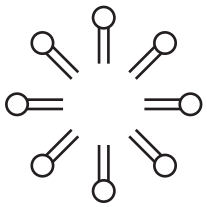
Which row is correct?

	1	2	3	4	5
A	amylopectin	α-1,-6	glycogen	α-1,-4	amylopectin
B	amylose	α-1,-4	cellulose	β-1,-4	glycogen
C	cellulose	α-1,-4	amylose	α-1,-4	glycogen
D	glycogen	β-1,-6	amylopectin	α-1,-4	amylose

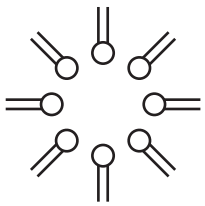
9 When a small quantity of phospholipid is added to a test-tube of water and then shaken vigorously, an emulsion is formed by small droplets called liposomes.

Which diagram shows the arrangement of phospholipid molecules in a cross-section of a liposome?

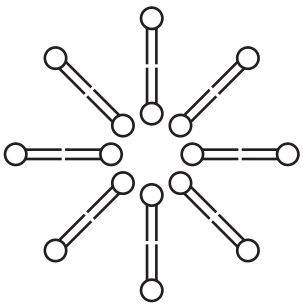
A



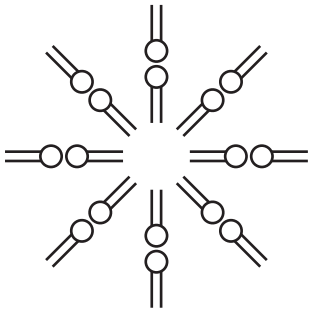
B



C



D



10 Which of the bonds will be last to break as the temperature of an enzyme is increased?

A hydrogen

B hydrophobic interactions

C ionic

D peptide

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11 Which statement is **only** true for the induced fit theory of enzyme action?

A A few amino acids give the active site a specific shape.

B An enzyme has a substrate with a specific shape.

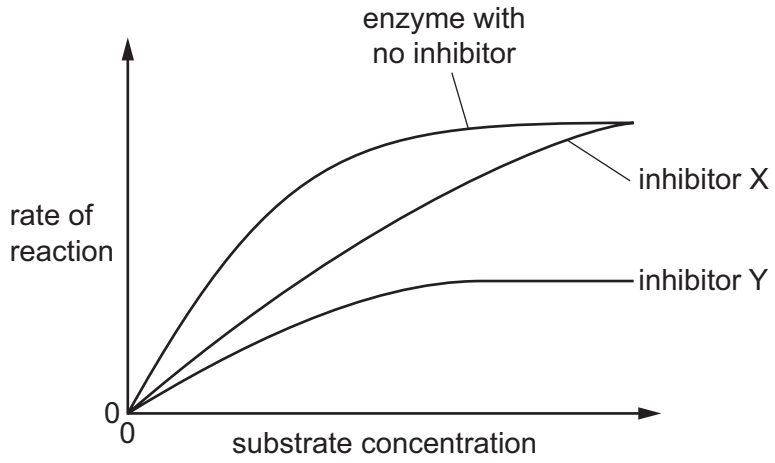
C The enzyme changes shape in the presence of the substrate.

D The substrate molecules are complementary to the active site.

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

- with no inhibitor
- with inhibitor X
- with inhibitor Y.

The graph shows the results.



Which statement is correct?

A X is a competitive inhibitor which binds away from the active site of the enzyme.

B X is a non-competitive inhibitor which has a similar shape to the substrate.

C Y is a competitive inhibitor which has a similar shape to the substrate.

D Y is a non-competitive inhibitor which binds away from the active site of the enzyme.

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[Turn over

13 The list includes some of the molecules found in a cell surface membrane.

1 glycolipid

2 surface protein

3 glycoprotein

4 trans-membrane protein

Which molecules are involved in cell signalling?

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

14 Which statements about fatty acids are correct?

1 form part of cell membranes

2 form storage droplets

3 are synthesised by the Golgi body

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

15 Which substances can pass directly through cell surface membranes **without** using a carrier protein or channel protein?

1 Ca^{2+} and Na^{+}

2 O_2

3 $C_6H_{12}O_6$

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

16 Which statements about endocytosis are correct?

1 It is a process requiring energy in the form of ATP.

2 Phagocytosis is a form of endocytosis.

3 Substances brought into a cell by endocytosis are enclosed in a small vacuole.

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

17 Which process occurs during prophase of the mitotic cell cycle in an animal cell?

A division of centromeres

B formation of chromosomes

C replication of DNA

D separation of centrioles

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18 Which processes occur in bone marrow cells that are in a mitotic cell cycle?

1 phosphate groups bind to ADP molecules to form ATP

2 bonds form between nucleotides in a DNA strand

3 tRNA anticodons hydrogen bond with codons on mRNA

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

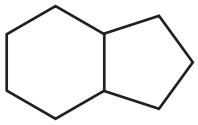
19 Which diagram shows a correct ring structure and named nucleic acid base?

A



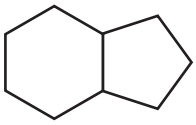
adenine

B



cytosine

C



thymine

D



uracil

20 Which statements are correct?

1 Adenine and cytosine are both purines.

2 The DNA nucleotide containing adenine is different from the RNA nucleotide containing adenine.

3 Purines only form base pairs with pyrimidines.

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

21 A short piece of DNA 18 base pairs long was analysed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown below.

	number of nucleotide bases			
	adenine	cytosine	guanine	thymine
strand 1		4		7
strand 2		5		

How many nucleotides containing thymine were present in strand 2?

A 2 **B** 4 **C** 5 **D** 7

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

CGGGCCCCGCGG

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 order 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 During transpiration, what is the site of evaporation of water in the leaves?

A air spaces

B guard cell walls

C mesophyll cell walls

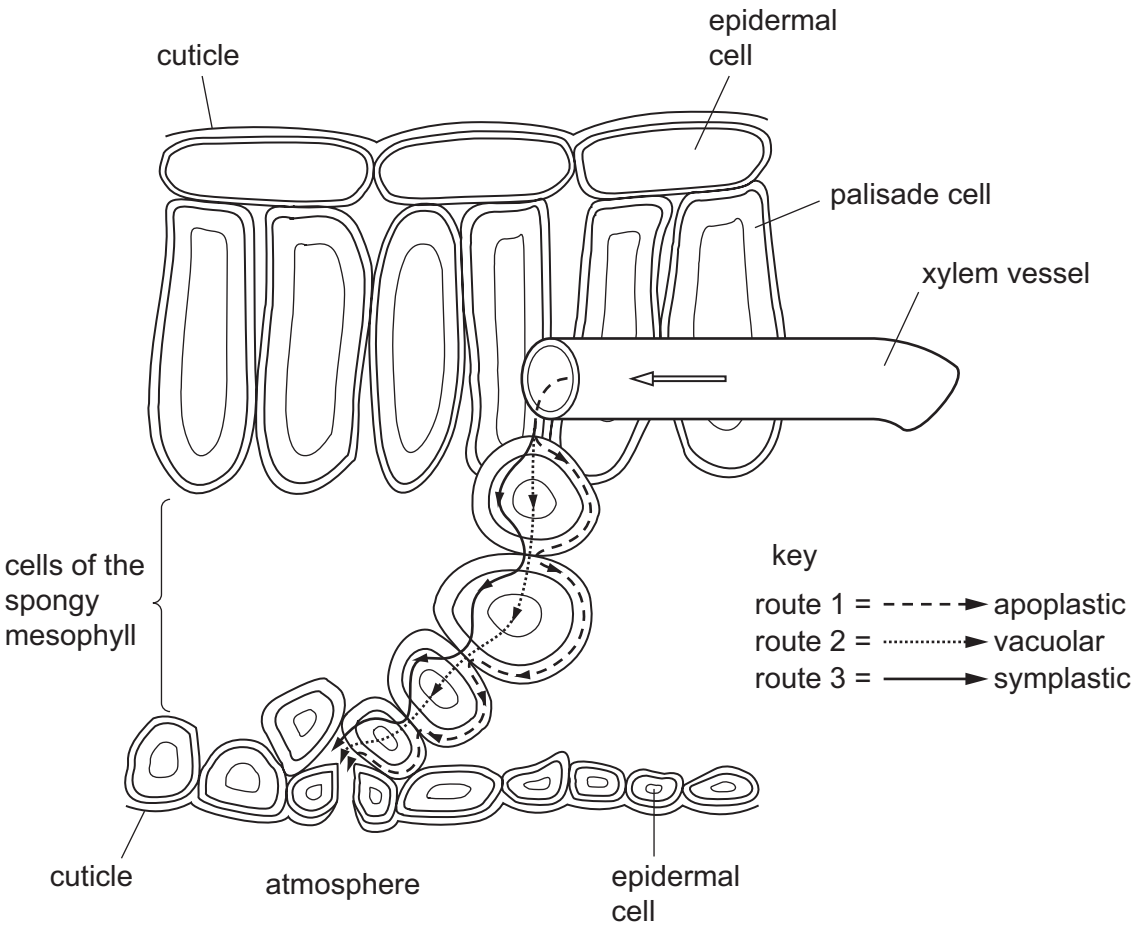
D stomata

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24 Water passes across leaf tissues by different routes as a result of:

- differences in water potential
- the pull transmitted by cohesive forces between water molecules.

The diagram shows three routes by which water can travel.



Which row correctly identifies why water passes across leaf tissues by the different routes?

	differences in water potential	pull transmitted by cohesive forces
A	route 1	routes 2 and 3
B	routes 1 and 3	route 2
C	route 2	routes 1 and 3
D	routes 2 and 3	route 1

25 Which factors contribute to the increase in transpiration rate when the temperature rises?

1 concentration of water molecules increases in air spaces due to evaporation

2 increased rate of diffusion as water molecules have more kinetic energy

3 increased hydrogen bonding between water molecules in air spaces

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

26 ATP is used in companion cells to provide the energy for loading a sieve tube element with sucrose.

How does the co-transporter mechanism use this energy?

A to pump protons into the sieve tube element

B to pump protons out of the companion cell

C to pump sucrose into the sieve tube element

D to pump sucrose out of the companion cell

27 Which changes to the water potential and the volume of liquid in the phloem sieve tube element occur when sucrose is moved from the phloem sieve tube element to an actively dividing shoot tip?

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

28 Which events occur during ventricular systole?

1 atrioventricular valves close

2 muscle in ventricle walls relaxes

3 semilunar valves open

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

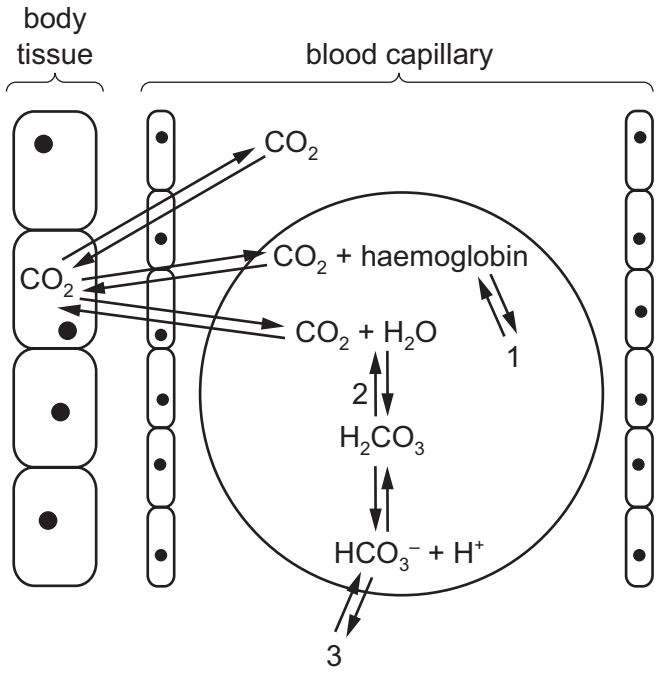
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29 Which components of blood are present in lymph?

	white blood cells	proteins	sodium ions
A	✓	✓	✓
B	✓	✗	✓
C	✗	✓	✓
D	✗	✓	✗

key
✓ = present
✗ = absent

30 Which row gives the correct labels for the diagram shown?



	1	2	3
A	carbaminohaemoglobin	carbonic anhydrase	hydrogencarbonate
B	carbonic anhydrase	carbaminohaemoglobin	carbon dioxide
C	carbonic anhydrase	carbaminohaemoglobin	hydrogencarbonate
D	hydrogencarbonate	carbon dioxide	carbonic anhydrase

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[Turn over

31 An increase in carbon dioxide in human blood shifts the oxyhaemoglobin dissociation curve to the right.

What is the explanation for this effect?

A An increase in carbon dioxide concentration increases the breathing rate.

B Carbon dioxide is more soluble than oxygen and displaces it.

C Diffusion of carbon dioxide between the alveoli and the blood is more rapid.

D Increasing the H^+ concentration decreases haemoglobin affinity for oxygen.

32 A person has two blood tests one month apart. The number of each type of cell in a fixed sample size is counted.

type of cell	first test	after one month
red blood cells	normal	higher
lymphocytes	normal	higher

What could this suggest about the person based on the results after one month?

	body temperature higher	moved to higher altitude	ATP synthesis in cells is higher
A	no	no	yes
B	no	yes	no
C	yes	no	no
D	yes	yes	yes

33 Goblet cells are found in the trachea.

Which organelles would be found in large numbers in a goblet cell?

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

key

✓ = present in large numbers

✗ = not present in large numbers

34 What is the minimum number of layers of phospholipids that a molecule of oxygen passes through when diffusing from the alveoli, through cells, to haemoglobin in the red blood cells?

A 4 **B** 6 **C** 8 **D** 10

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35 Which symptoms may be seen in a person affected by chronic obstructive pulmonary disease (COPD)?

1 persistent cough

2 less elastic alveoli

3 increased risk of lung infection

4 shortness of breath

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 2, 3 and 4 only

D 1 and 4 only

36 More people are exposed to the risk of contracting malaria due to an increase in the distribution of *Anopheles* mosquitoes.

What could be the cause of this increase?

A drug resistance in *Plasmodium*

B global warming

C insecticide resistance

D no effective vaccine

37 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 selectively permeable.

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

38 Which of these pathogens can be transmitted by air?

1 *Plasmodium*

2 *Morbillivirus*

3 *Mycobacterium*

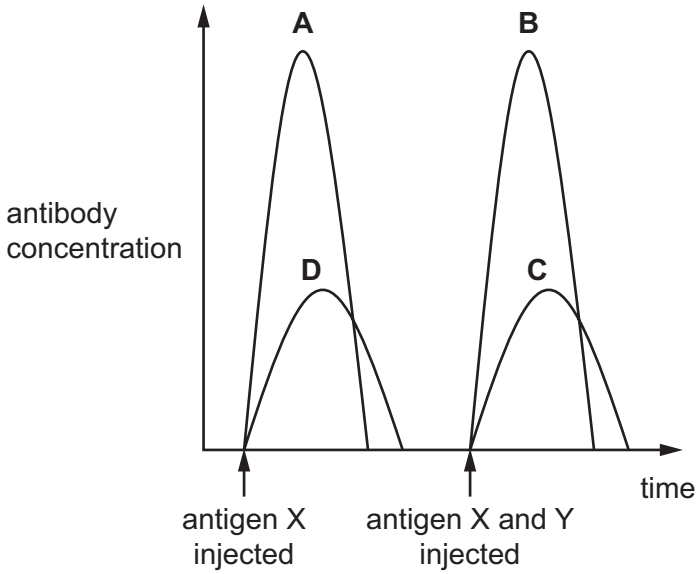
4 *Vibrio*

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

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39 The graph shows the antibody response when a person is injected first with antigen X and later with antigens X and Y.

Which curve shows the primary response to antigen Y?



40 Which row describes passive immunity?

	triggered by an antigen	involves an immune response	memory cells produced	permanent protection
A	✓	✓	✓	✓
B	✓	✓	✗	✗
C	✗	✗	✓	✓
D	✗	✗	✗	✗

key
✓ = true
✗ = false

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