Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/11**

Paper 1 Multiple Choice **May/June 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.
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- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

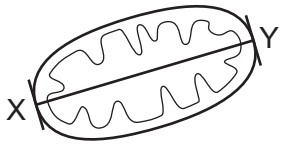
INFORMATION

- 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.

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[Turn over

1 The diagram shows a mitochondrion drawn from an electron micrograph.



The actual length of the mitochondrion, using the line X–Y, is 3000 nm.

What is the magnification of the drawing of the mitochondrion?

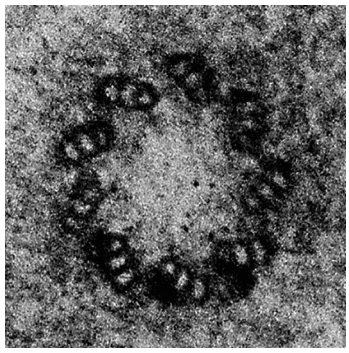
A ×100 **B** ×1000 **C** ×10 000 **D** ×100 000

2 A specimen of plant tissue is observed twice with a microscope, firstly using red light with a wavelength of 650 nm and then using green light with a wavelength of 510 nm.

What happens to the magnification and resolution when using green light compared to red light?

	magnification	resolution
A	decreases	decreases
B	increases	increases
C	remains the same	decreases
D	remains the same	increases

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



What is this cell structure?

A centriole

B lysosome

C ribosome

D vesicle

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4 Which cell structures contain nucleic acid?

1 Golgi body

2 lysosome

3 mitochondria

4 ribosomes

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

5 Which statements about mitochondria, chloroplasts or prokaryotes are correct?

1 Mitochondria and chloroplasts have a fully permeable inner membrane and a partially permeable outer membrane.

2 Prokaryotes and chloroplasts have 70S ribosomes that are the sites for translation and polypeptide synthesis.

3 Prokaryotes and mitochondria have an outer membrane and an inner, folded membrane where ATP synthesis occurs.

4 Prokaryotes and mitochondria have circular DNA where genes coding for information are located.

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

6 The very large (1000 nm) *Pandora* viruses found in Chile and Australia are considered to be viruses because they cannot replicate their own genome and cannot make proteins.

They also share essential structural features with other viruses.

What are the essential structural features of viruses?

1 non-cellular

2 protein coat

3 both DNA and RNA

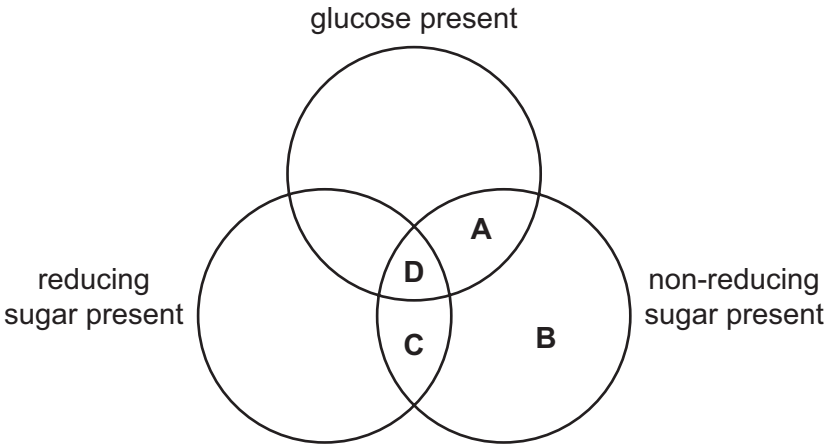
4 either DNA or RNA

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

7 A sample of food was heated with Benedict's solution which changed colour to green.

A second sample of the same food was boiled with dilute hydrochloric acid and neutralised using sodium hydrogencarbonate. It was then heated with Benedict's solution which changed colour to red.

What did these results show?



8 Which pair of molecules only includes macromolecules that can be found in animal cells?

A amylase and amylopectin

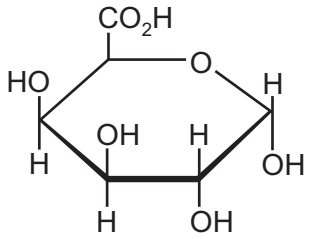
B collagen and glycogen

C deoxyribose and starch

D sucrose and haemoglobin

9 Homogalacturonan is a polysaccharide found in plant cell walls.

The diagram shows a molecule of the monomer used to form homogalacturonan.



A student studied the structure of this monomer and compared it with the structure of the monomer used to form cellulose.

Which carbon atoms in the monomer in the diagram have hydroxyl groups arranged in different positions to those found in the cellulose monomer?

A carbon one and carbon four

B carbon one only

C carbon three and carbon four

D carbon three only

10 Which statement is correct for triglycerides and phospholipids?

A A phosphate group is joined to a glycerol molecule.

B Hydrocarbon chains may be saturated or unsaturated.

C They are polar molecules.

D They contain three ester bonds.

11 Which description of collagen is correct?

A A collagen molecule consists of three polypeptide chains, each in the shape of a helix. The three chains are wound together into a triple helix called a fibre.

B A collagen molecule consists of three polypeptide chains, each of which is an α-helix. The three chains are wound tightly together into a triple helix. Many of these triple helices bind together as a fibre.

C A collagen molecule consists of three polypeptide chains wound tightly into a triple helix called a fibre.

D A collagen molecule consists of three polypeptide chains in which every third amino acid is glycine. The three polypeptides are wound tightly together into a triple helix. Many of these helices form a fibre.

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12 In a healthy human, the mean value for the number of haemoglobin molecules in one red blood cell is 260 million.

How many α-globin chains does one red blood cell contain in a healthy human?

A 1.3×10^8 **B** 2.6×10^8 **C** 5.2×10^8 **D** 1.04×10^9

13 Which statements about a peptide bond are correct?

1 It joins two monomers which are always identical to each other.

2 It contains four different atoms.

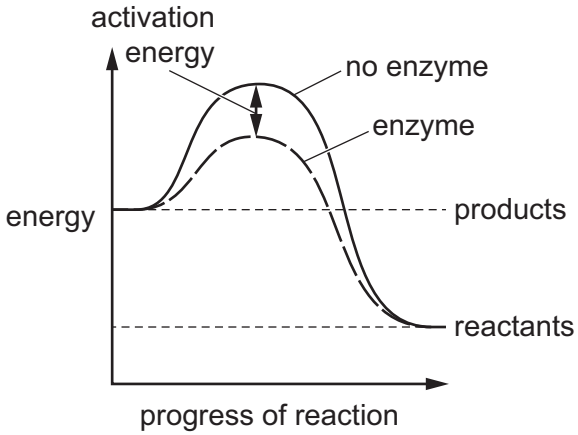
3 It can be broken by the addition of water at room temperature.

4 It is important in the primary structure of proteins.

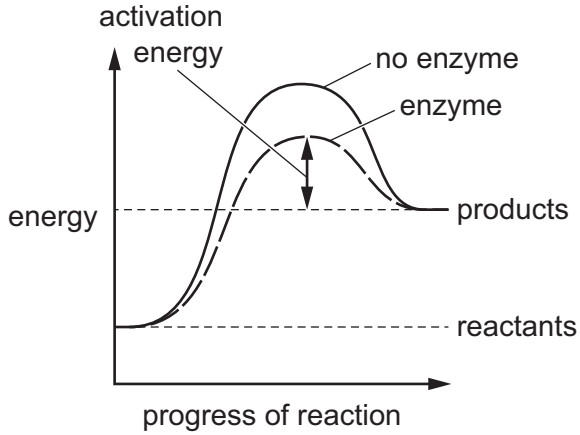
A 1, 2 and 3 **B** 1 and 3 only **C** 2, 3 and 4 **D** 2 and 4 only

14 Which graph correctly shows the activation energy of a reaction when an enzyme is added?

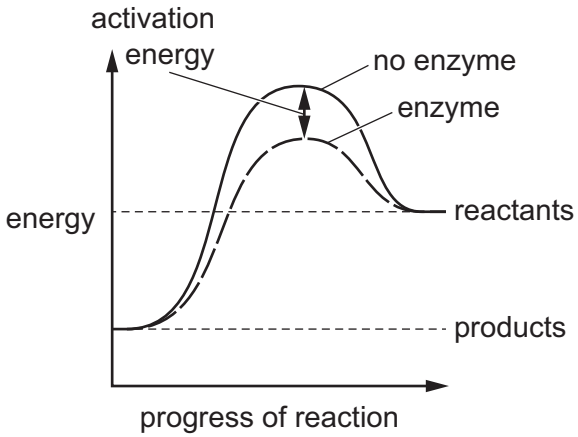
A



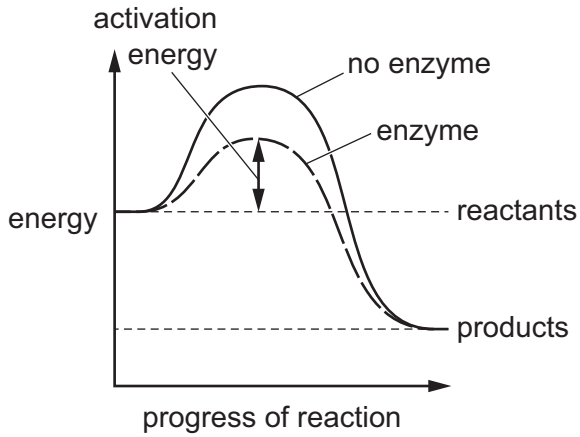
B



C



D



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15 The enzyme lactase is found in the membranes of epithelial cells lining the small intestine.

The enzyme is formed by a single polypeptide that folds to give three regions.

- an active site with the free amino group outside the cell
- a short section inside the membrane
- a short section inside the cell

What type of amino acid would be found in each of the three regions?

	outside the cell	inside the membrane	inside the cell
A	hydrophilic	hydrophobic	hydrophilic
B	hydrophilic	hydrophobic	hydrophobic
C	hydrophobic	hydrophilic	hydrophobic
D	hydrophobic	hydrophobic	hydrophilic

16 A student wrote three statements about cell signalling.

1 A signal chemical always has the same shape as a protein receptor on a target cell.

2 An increase in temperature may decrease the effect of cell to cell signalling.

3 A mutation may decrease production of active protein receptors for the cell surface membrane.

Which statements are correct?

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

17 At which stages of mitosis are chromosomes composed of two chromatids that are held together by a centromere?

A anaphase and telophase

B anaphase and prophase

C metaphase and prophase

D metaphase and telophase

18 The jellyfish, *Turritopsis dohrnii*, is described as being immortal. If *T. dohrnii* is not eaten by predators or diseased, it seems to be able to live forever. There is no way to determine the biological age of a *T. dohrnii* individual.

Which feature of the cells in *T. dohrnii* could explain these observations?

A very long G phases in the cell cycle

B a very short S phase in the cell cycle

C an ability to restore telomeres to their original length

D fewer chromosomes than other eukaryotic organisms

19 Some chemicals, used to stop tumour growth, work by preventing the DNA double helix from uncoiling and separating.

During which stage of the cell cycle would they act?

A anaphase

B interphase

C metaphase

D prophase

20 Four nucleotides, **A**, **B**, **C** and **D**, each consist of three phosphate groups, a nitrogenous base and a pentose sugar. Characteristics of the base and sugar components before they are joined to form each nucleotide are shown in the table.

Which nucleotide could pair with an adenine base during DNA replication?

	ring structure of nitrogenous base	ratio of carbon to oxygen atoms in pentose sugar
A	double	1 : 1
B	double	5 : 4
C	single	1 : 1
D	single	5 : 4

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21 The statements describe the process of translation.

1 A peptide bond forms between adjacent amino acids.

2 Hydrogen bonds form between the anticodon and the codon.

3 mRNA binds to the ribosome.

4 tRNA enters the ribosome carrying a specific amino acid.

In which order does this process take place?

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

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

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

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

22 The sequence of amino acids in a section of a polypeptide is:

… histidine–proline–aspartic acid–leucine...

amino acid	possible DNA triplet codes	
aspartic acid	CTA	CTG
histidine	GTA	GTG
leucine	GAT	GAC
proline	GGA	GGG

What is a correct sequence of mRNA codons for this polypeptide section?

A …CAC CCC GAA CUG…

B …CAU CCU GAC CUA…

C …GTA CCA CTG GAT…

D …GUA GGA CUG GAU…

23 What contributes to the upward movement of water in a xylem vessel of a plant?

1 cohesion of water molecules by hydrogen bonding

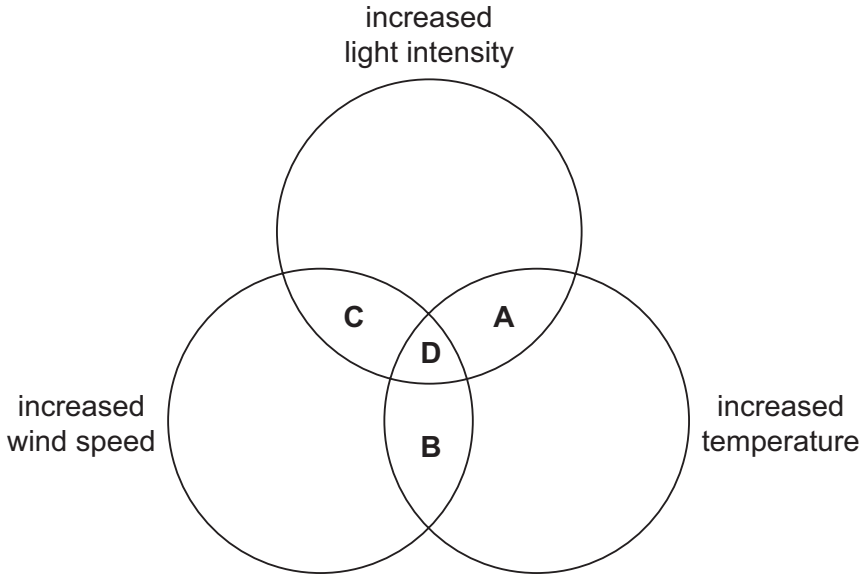
2 adhesion of water molecules to the cellulose walls of xylem vessels by hydrogen bonding

3 removal of water from xylem vessels in a leaf reduces the hydrostatic pressure in the xylem

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

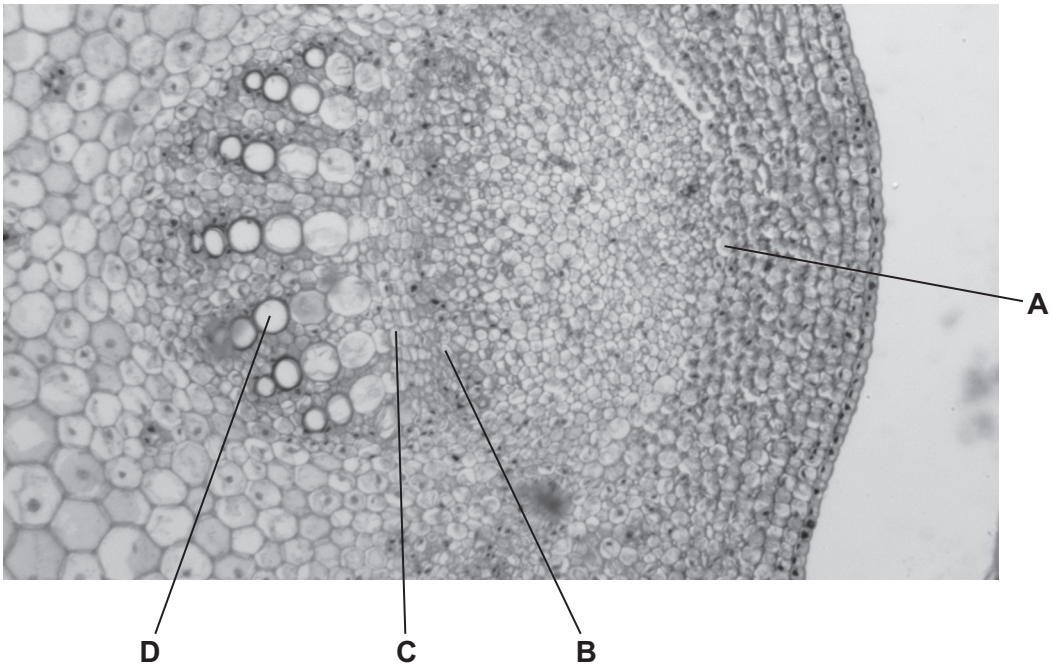
24 The diameter of a tree trunk usually decreases slightly during the day.

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

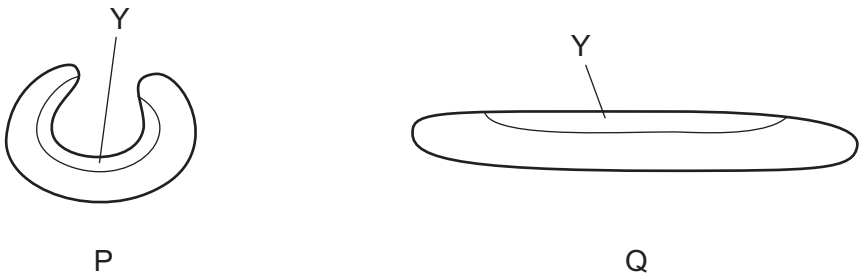


25 The diagram shows a transverse section of a stem.

Which area is the phloem?



26 The diagram shows a xerophytic leaf in different conditions, P and Q.



Which statements describe the difference between the cells in layer Y in conditions P and Q?

1 more negative water potential in P than Q

2 more cells plasmolysed in P

3 cells less turgid in Q

4 water potential becomes zero in Q

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

27 Different substances, such as sucrose and amino acids, can move in different directions in the phloem sieve tube elements.

Which statement explains this?

A Active transport occurs in some phloem sieve tube elements and mass flow occurs in other sieve tube elements.

B Both active transport and mass flow occur in each individual phloem sieve tube element.

C Mass flow occurs in both directions at the same time in each individual phloem sieve tube element.

D Mass flow occurs in different directions in different phloem sieve tube elements at the same time.

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

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

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.

A 1 **B** 3 **C** 4 **D** 7

29 Which row correctly identifies components of **both** lymph and tissue fluid?

	antibodies	red blood cells	sodium ions	white blood cells
A	✓	✓	✓	✓
B	✓	✗	✓	✓
C	✗	✓	✗	✗
D	✗	✗	✓	✓

key

✓ = component present

✗ = component not present

30 Which row is correct for the mean blood pressure in different parts of the human circulatory system?

	mean blood pressure				key
	right atrium	artery in arm	vein in arm	capillary in arm	
A	+	++++	++	+++	++++
B	++	++++	+++	+	+++
C	+++	++	++++	+	++
D	++++	+++	+	++	+

highest mean blood pressure

↓

lowest mean blood pressure

31 Which mechanism accounts for the way most of the carbon dioxide is transported in blood?

A Carbon dioxide dissolves in plasma and is carried in solution.

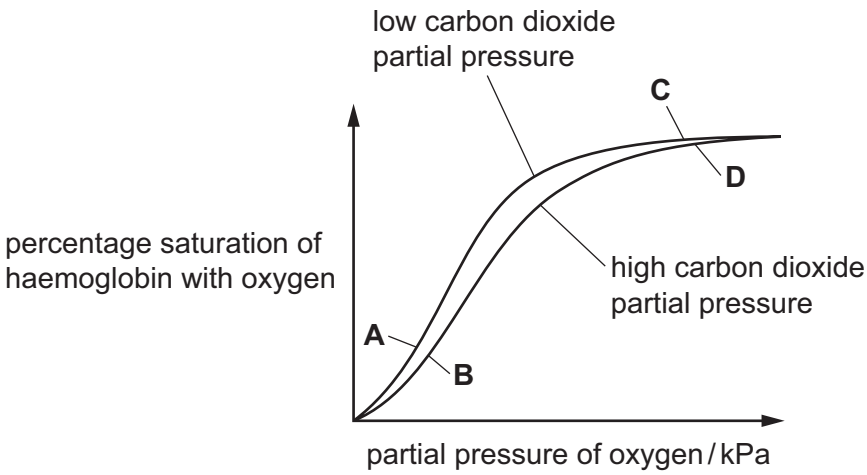
B Carbon dioxide is converted to carbaminohaemoglobin inside red blood cells.

C Carbon dioxide is converted to carboxyhaemoglobin inside red blood cells.

D Carbon dioxide is converted to hydrogencarbonate ions inside red blood cells.

32 The graph shows the dissociation curves for haemoglobin at two different partial pressures of carbon dioxide.

At which position on the graph, **A**, **B**, **C**, or **D**, is the concentration of haemoglobinic acid lowest in red blood cells?



33 The table shows the partial pressure of carbon dioxide and oxygen in two blood vessels.

	partial pressure of gas in pulmonary artery / kPa	partial pressure of gas in pulmonary vein / kPa
carbon dioxide	6	5
oxygen	5	15

What explains the difference in the partial pressures of oxygen in the pulmonary artery and pulmonary vein?

A Oxygen diffuses from the alveoli into the blood in the capillaries.

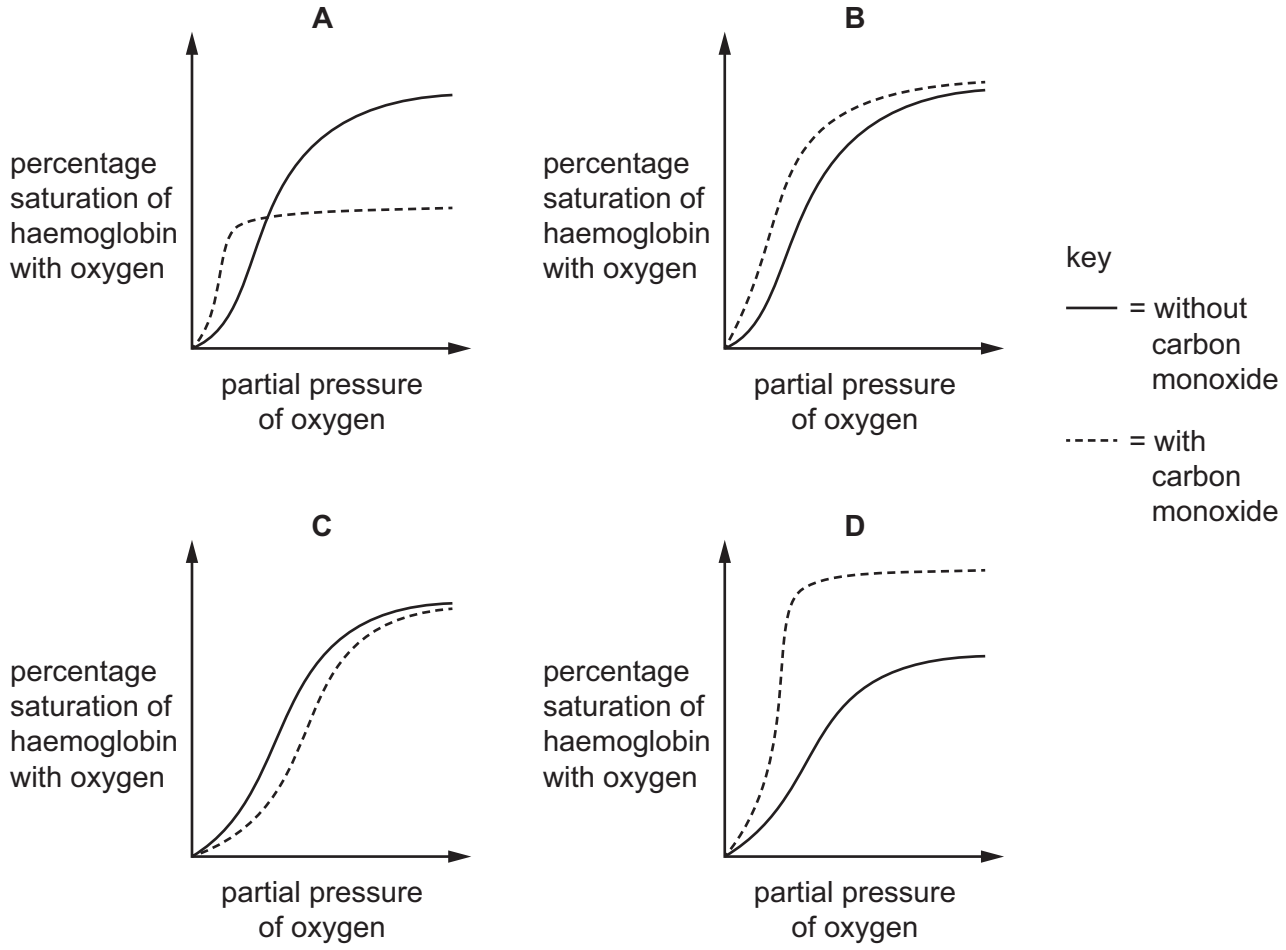
B Carbon dioxide diffuses into the alveoli from the blood in the capillaries.

C Oxygen diffuses from the body cells into the blood in the capillaries.

D Carbon dioxide diffuses into the body cells from the blood in the capillaries.

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34 Which graph shows the effect of carbon monoxide on the percentage saturation of haemoglobin with oxygen?



35 Which row shows the correct methods of transmission of the named pathogens?

	method of transmission		
	airborne droplets	insect vector	water
A	*Morbillivirus*	*Mycobacterium*	*Vibrio*
B	*Mycobacterium*	*Plasmodium*	*Vibrio*
C	*Plasmodium*	*Vibrio*	*Morbillivirus*
D	*Vibrio*	*Plasmodium*	*Mycobacterium*

36 Which disease is caused by a eukaryote?

A cholera

B malaria

C measles

D smallpox

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37 What is the initial mechanism by which bacteria become resistant to antibiotics?

A genetic mutation

B overuse of antibiotics

C natural selection

D patients not finishing a course of antibiotics

38 What are functions of T-lymphocytes?

1 production of cytokines

2 production of toxins

3 recognition of an antigen bound to an antigen-presenting cell

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

39 What is correct about the role of memory cells in long-term immunity?

1 They divide to form plasma cells and memory cells when the pathogen enters the body a second time.

2 They produce a fast response so that the person infected with the pathogen does not become ill again.

3 They produce more antibodies than were produced during the primary immune response.

4 They remain in the blood and lymphatic system after the pathogen has been destroyed.

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

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40 Which events result in a person developing actively acquired immunity?

1 becoming infected by TB bacteria

2 drinking breast milk

3 receiving an injection of antigens

4 receiving an injection of antibodies

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

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BIOLOGY **9700/12**

Paper 1 Multiple Choice **May/June 2021**

1 hour

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INFORMATION

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This document has **16** pages. Any blank pages are indicated.

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1 Which row describes the membranes surrounding each cell structure?

	chloroplast	mitochondrion	nucleus
A	single	single	double
B	double	single	single
C	single	double	single
D	double	double	double

2 The mean width of mitochondria in an electron micrograph is 6 mm.

The magnification of the electron micrograph is ×9600.

What is the actual mean width of the mitochondria?

A 6×10^{-3} mm **B** 6×10^{-4} mm **C** 6×10^{-2} μm **D** 6×10^{3} μm

3 Which sequence shows the correct order of some of the stages in the production and secretion of an enzyme?

A Golgi body → ribosome → rough endoplasmic reticulum → mRNA

B mRNA → smooth endoplasmic reticulum → Golgi body → vesicle

C ribosome → rough endoplasmic reticulum → vesicle → Golgi body

D smooth endoplasmic reticulum → mRNA → vesicle → ribosome

4 Different antibiotics function in different ways. Ideally, the antibiotic kills the bacteria, but does not harm the infected human.

One type of antibiotic, tetracycline, can affect the way in which human mitochondria function.

What explains the effect of tetracycline on human mitochondria?

1 The antibiotic prevents the synthesis of peptidoglycan cell walls.

2 The antibiotic prevents synthesis of linear DNA.

3 The antibiotic prevents translation by binding to 70S ribosomes.

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

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5 A prokaryotic cell is 5.0 μm in length.

A virus particle is 300 nm in length.

How many times larger is the prokaryotic cell compared to the virus particle?

A 2 **B** 17 **C** 60 **D** 167

6 A student carries out a semi-quantitative test with Benedict's solution.

Which statement about this procedure is correct?

A It detects only the presence or absence of glucose.

B It provides an indication of relative reducing sugar concentrations.

C The precipitate needs to be filtered, dried and weighed to give the reducing sugar concentration.

D A colorimeter needs to be used to determine the glucose concentration.

7 Which row is correct for carbohydrates?

	macromolecule	monomer	polymer
A	sucrose	starch	α-glucose
B	glycogen	sucrose	starch
C	α-glucose	glycogen	sucrose
D	starch	α-glucose	glycogen

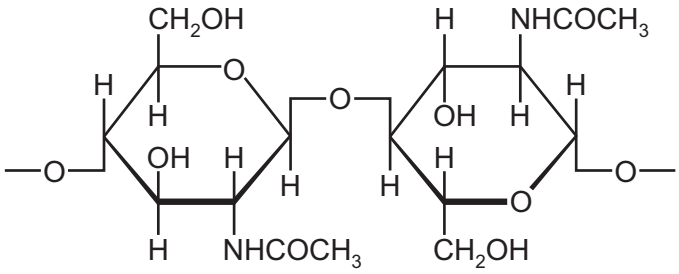
8 Which shows the correct general formula for glycogen?

A $(C_5H_{10}O_5)_n$ **B** $(C_5H_{10}O_6)_n$ **C** $(C_6H_{10}O_5)_n$ **D** $(C_6H_{12}O_6)_n$

9 Chitin is a structural polysaccharide found in the hard, outer shells of animals such as crabs.

Chitin is made of chains of amino sugars that contain NH groups.

The diagram shows two sugars in the chain of a chitin molecule.



Which polysaccharide is most like chitin?

A amylopectin

B amylose

C cellulose

D glycogen

10 Four fatty acids and their formulae are listed.

caprylic acid	$CH_3(CH_2)_6COOH$
lauric acid	$CH_3(CH_2)_{10}COOH$
oleic acid	$CH_3(CH_2)_7CH{=}CH(CH_2)_7COOH$
palmitoleic acid	$CH_3(CH_2)_5CH{=}CH(CH_2)_7COOH$

Which fatty acids are saturated?

A caprylic acid and lauric acid

B caprylic acid and oleic acid

C lauric acid and palmitoleic acid

D oleic acid and palmitoleic acid

11 Which molecule contains the smallest number of hydrogen atoms?

A α-glucose

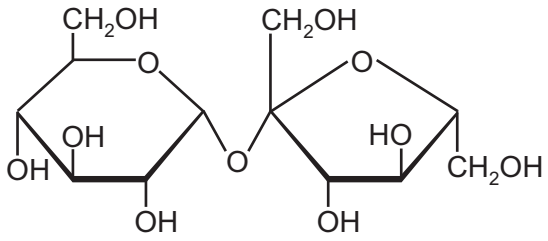
B glycine, an amino acid in which the R group is H

C glycerol

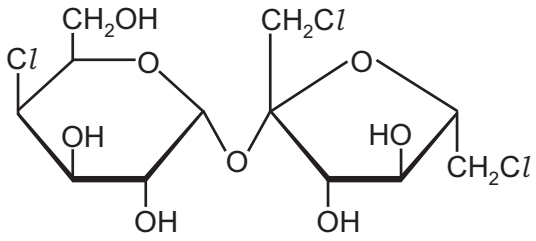
D a saturated fatty acid containing eight carbon atoms

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12 The diagram shows sucrose and sucralose.



sucrose



sucralose

The enzyme sucrase breaks down sucrose but cannot break down sucralose. Four students were asked to suggest why sucrase can break down sucrose but not sucralose.

Three of the students gave correct suggestions.

Which suggestion **cannot** be correct?

A The C*l* atoms change the shape of the sucralose molecule so it is not the same shape as the active site of sucrase.

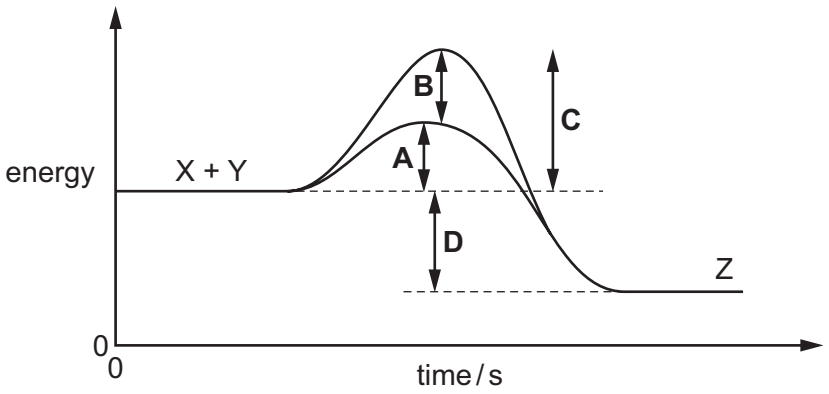
B The C*l* atoms of the modified fructose cannot bind to the active site of sucrase.

C The C*l* atoms cannot cause an induced fit, so sucralose does not enter the active site of sucrase.

D The C*l* atoms cause fewer temporary hydrogen bonds between sucralose and the active site of sucrase.

13 The graph shows the energy levels involved in an enzyme-catalysed reaction. Substrate molecules X and Y combine to give product Z.

Which arrow shows the reduction in activation energy due to the enzyme?



14 Which roles of the cell surface membrane result from 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

15 Which factors can be changed to affect the rate of facilitated diffusion across a cell surface membrane?

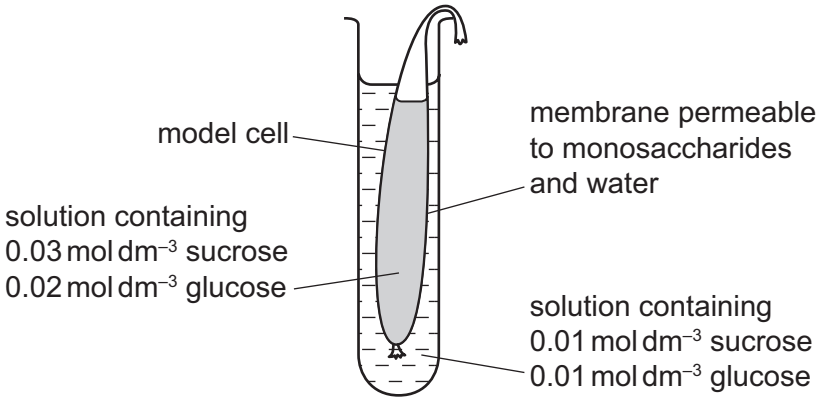
1 the surface area of the membrane

2 the concentration gradient

3 the number of specific protein channels

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

16 The diagram shows an experiment using a model cell to investigate the movement of substances.



Which statements are correct?

1 There is net movement of sucrose out of the model cell.

2 There is net movement of glucose out of the model cell.

3 There is net movement of water into the model 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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17 Human chromosomes have different parts. Some parts are more numerous than others.

Which parts are listed in order from **most** numerous to **least** numerous in a human white blood cell?

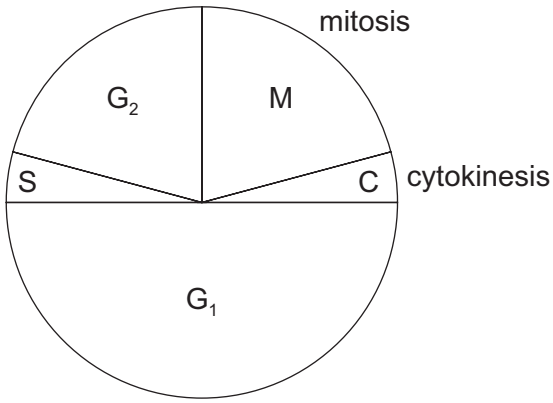
A centromere → nucleotide → histone protein

B DNA molecule → telomere → centromere

C histone protein → telomere → DNA molecule

D telomere → centromere → nucleotide

18 The diagram represents the cell cycle of a human cell. During the cell cycle the number of chromatids changes.



Which row is correct for the number of chromatids in M, G_1, and G_2?

	M	G_1	G_2
A	46	46	92
B	46	92	92
C	92	46	92
D	92	92	92

19 A single skin cell was isolated and transferred to growth medium in a sterile Petri dish. The Petri dish was incubated for 16 days. During this time, the number of skin cells multiplied as a result of repeated mitotic divisions.

One of the chromosomes in the nucleus of each skin cell has a telomere that contains many repeats of the base sequence TTAGGG. On each of days 4, 8, 12 and 16 of the incubation period, a single cell was removed from the Petri dish. The total number of bases in the telomere of this chromosome was determined for each cell. Each of the four cells had a different total number of telomere bases for this chromosome: 5548, 5580, 5645 and 5700.

What was the total number of telomere bases in the chromosome from the cell that had undergone the most mitotic divisions?

A 5548 **B** 5580 **C** 5645 **D** 5700

20 A short piece of DNA, 18 base pairs long, was analysed to find the number of nucleotide bases in each of the polynucleotide strands.

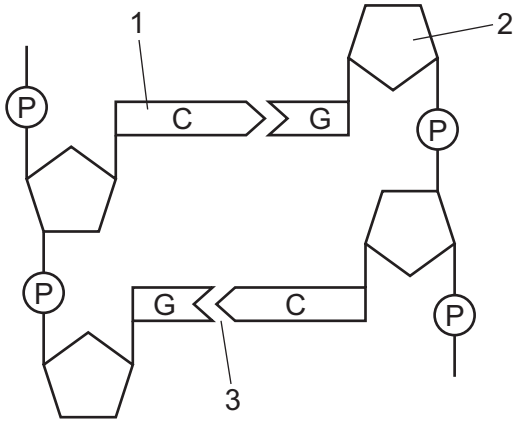
Some of the results are shown in the table.

	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

21 The diagram shows a strand of DNA and mRNA during transcription.



Which row correctly identifies 1, 2 and 3?

	1	2	3
A	purine	deoxyribose	two hydrogen bonds
B	purine	ribose	three hydrogen bonds
C	pyrimidine	deoxyribose	two hydrogen bonds
D	pyrimidine	ribose	three hydrogen bonds

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22 Two students were discussing the involvement of DNA and RNA in transcription and translation.

- Student 1 always stated correct facts.
- Student 2 gave further information, which was sometimes correct.

	correct facts given by student 1	further information given by student 2
1	A length of mRNA is 747 nucleotides long, including stop and start codons.	This mRNA can produce a polypeptide that is 249 amino acids long.
2	Adjacent mRNA codons of AAU and CUG bind to complementary tRNA anticodons.	There is a total of 14 hydrogen bonds formed between these two codons and their anticodons.
3	RNA polymerase catalyses the formation of the mRNA from the template strand of DNA.	During translation, an RNA adenine nucleotide will pair with a DNA thymine nucleotide.
4	A DNA adenine nucleotide is structurally different to an RNA adenine nucleotide.	The difference is in the hexose sugars; DNA is deoxyribose and RNA is ribose.

Which further information, given by student 2, is correct?

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

23 Which descriptions of the adaptations of xylem vessel elements to their function are correct?

1 They have pits between vessels allowing water to pass from one vessel to another.

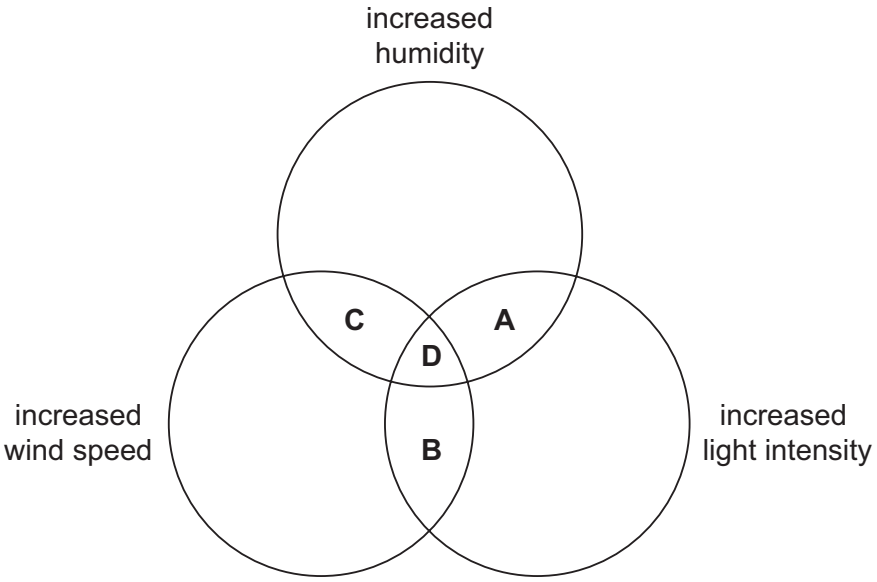
2 They are thickened with lignin to stop them collapsing when the column of water is under tension.

3 They form a continuous hollow tube through the plant providing little resistance to water movement.

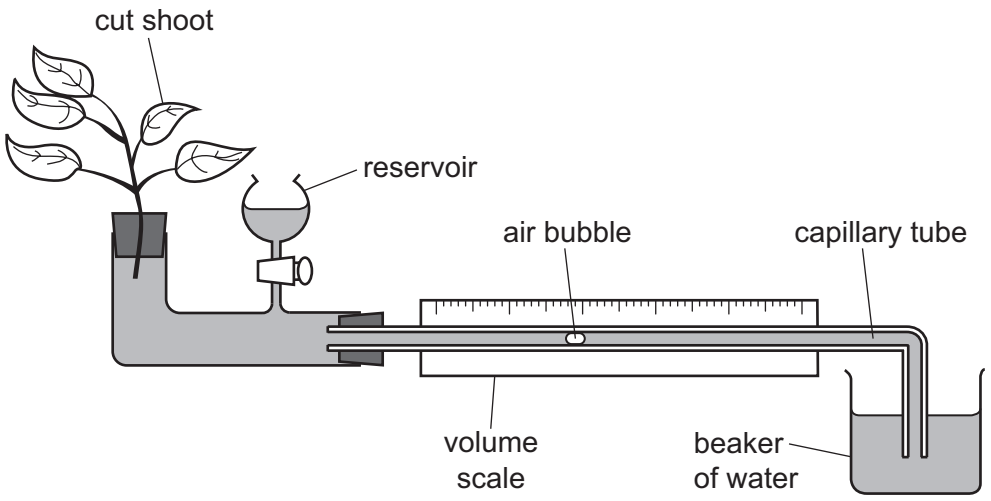
A 1, 2 and 3 **B** 1 and 3 only **C** 2 only **D** 2 and 3 only

24 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?



25 A student wanted to find out the rate of transpiration using a potometer as shown.



The student was told to work out a value for transpiration using the units mm^3, m^{-2} and $hour^{-1}$.

Which measurements would the student need to take?

A volume of water in the reservoir, length of the capillary tubing, temperature and how many leaves are on the shoot

B volume of water in the reservoir, radius of the capillary tubing, time and surface area of the leaves

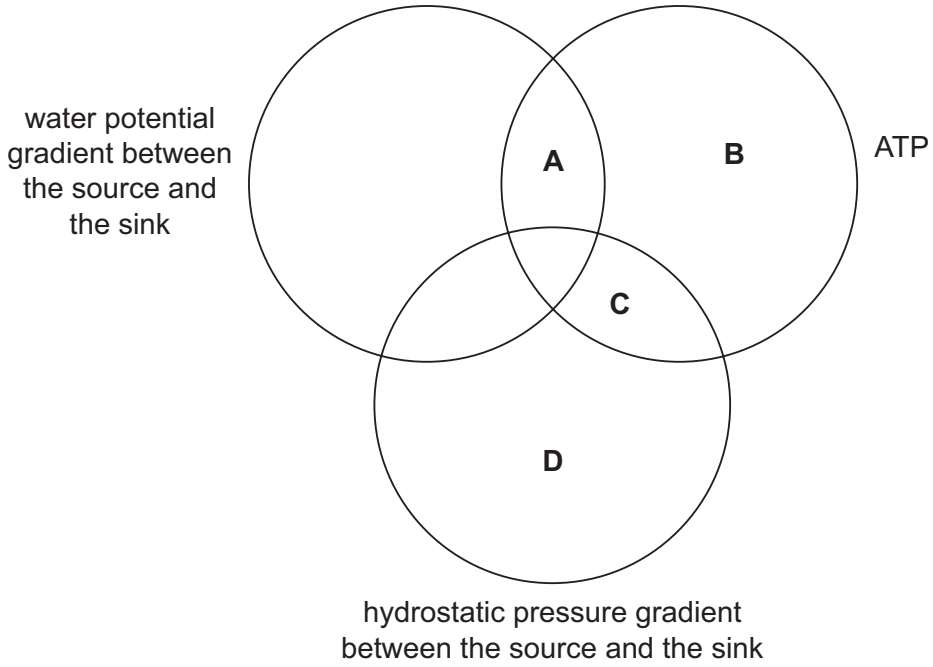
C distance air bubble moves, radius of the capillary tubing, time and surface area of the leaves

D distance air bubble moves, length of the capillary tubing, temperature and how many leaves are on the shoot

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26 In plants, assimilates such as sucrose are loaded from source cells into sieve tube elements. The assimilates are then transported from source to sink.

What is needed to transport sucrose from source cells through phloem tissue to sink cells?



27 The sinoatrial node initiates the cardiac cycle.

What is the correct order in which the chambers of the heart contract?

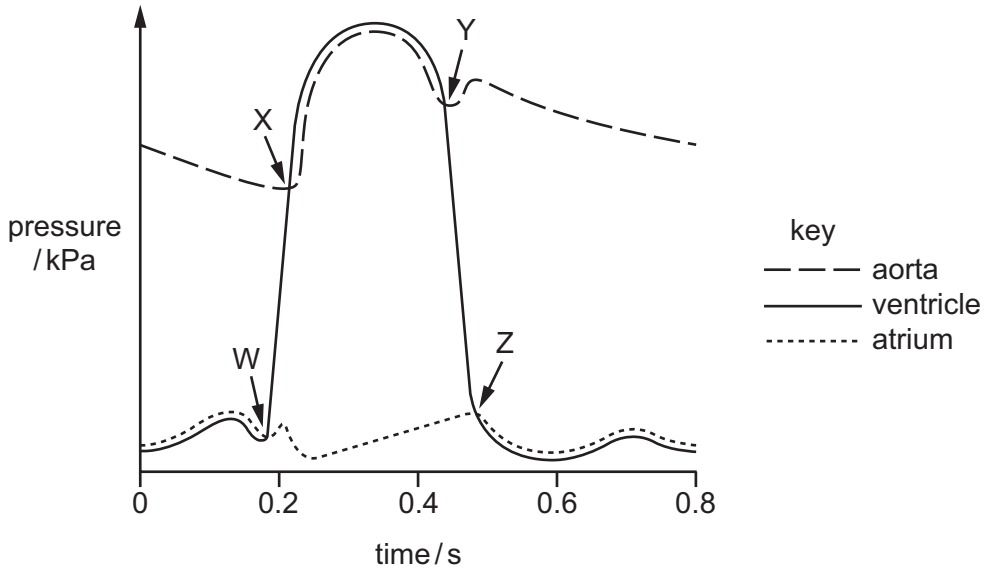
A atria and ventricles at the same time

B both atria then both ventricles

C left atrium, then left ventricle, then right atrium, then right ventricle

D right atrium, then right ventricle, then left atrium, then left ventricle

28 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 is correct?

	W	X	Y	Z
A	opens	closes	closes	opens
B	opens	opens	closes	opens
C	closes	opens	closes	opens
D	closes	closes	opens	opens

29 What can combine with the haem group of a haemoglobin molecule?

1 oxygen

2 carbon dioxide

3 carbon monoxide

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

30 What is the main reaction occurring in blood capillaries at the gas exchange surface in a human lung?

A Carbonic acid dissociates into carbon dioxide and hydrogen ions.

B Carbonic anhydrase converts carbon dioxide into hydrogencarbonate ions.

C Carbon dioxide combines with haemoglobin to form carbaminohaemoglobin.

D Carbon dioxide is produced from hydrogencarbonate ions by carbonic anhydrase.

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31 Which reactions take place in blood that is passing through active tissues?

1 $HbO_8 \rightarrow Hb + 4O_2$

2 $HbO_8 + H^+ \rightarrow HHb + 4O_2$

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

4 $H_2O + CO_2 \rightarrow H_2CO_3$

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1, 3 and 4 only

D 2 and 3 only

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

	cartilage	squamous epithelium	goblet cells
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✗

key

✓ = present

✗ = not present

33 In some cases where a person has lung disease, the partial pressure of oxygen in the pulmonary veins is less than the partial pressure of oxygen in the alveoli.

What could explain the difference in partial pressure of oxygen?

1 A high proportion of alveoli are collapsed and do not have enough alveolar capillaries.

2 The partial pressure of oxygen in the pulmonary arteries is lower than in the alveolar air.

3 The rate of diffusion of oxygen from the alveolar air to the surrounding alveolar capillaries is too slow.

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

34 How many times must a molecule of carbon dioxide pass through a cell surface membrane as it diffuses from the plasma, through a cell in the capillary wall, into an alveolus?

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

35 Which disease is spread by a vector?

A AIDS / HIV

B cholera

C malaria

D measles

36 Which statement explains why a one-dose vaccination programme for measles has not yet eliminated the disease?

A Many infants under the age of eight months have passive immunity.

B Some children need several booster doses to develop full immunity.

C The one-dose measles vaccine has a success rate of 93%.

D The virus does not often change its antibodies.

37 What has contributed to the increase in antibiotic resistance in bacteria?

1 increased use of vaccines for animal diseases

2 mutations in bacterial DNA

3 patients not completing their antibiotic treatment

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

38 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 secrete a type of antigen that binds to a specific antibody.

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

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39 Which statements correctly describe lymphocytes?

1 Each B-lymphocyte has the ability to make several types of antibody molecules.

2 Some B-lymphocytes and T-lymphocytes become memory cells.

3 Plasma cells secrete antibodies into the blood plasma.

4 Some T-lymphocytes stimulate macrophages to kill infected cells.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 4 only

D 2, 3 and 4 only

40 A country introduced a measles vaccination during a measles epidemic.

Later, it was realised that vaccinated children were more likely to survive childhood than unvaccinated children, even when there were no measles epidemics.

The vaccine had given the children some protection against other pathogenic infections.

Which statement could account for this extra protection?

A B-lymphocytes produced memory cells which gave the children passive immunity to these infections.

B Memory cells produced plasma cells which secreted anti-measles antibodies that bound to antigens that closely resembled measles antigens.

C Memory cells produced plasma cells which secreted anti-measles antibodies that bound to any antigen.

D T-lymphocytes produced memory cells which gave the children natural immunity against these other infections.

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BIOLOGY **9700/13**

Paper 1 Multiple Choice **May/June 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.

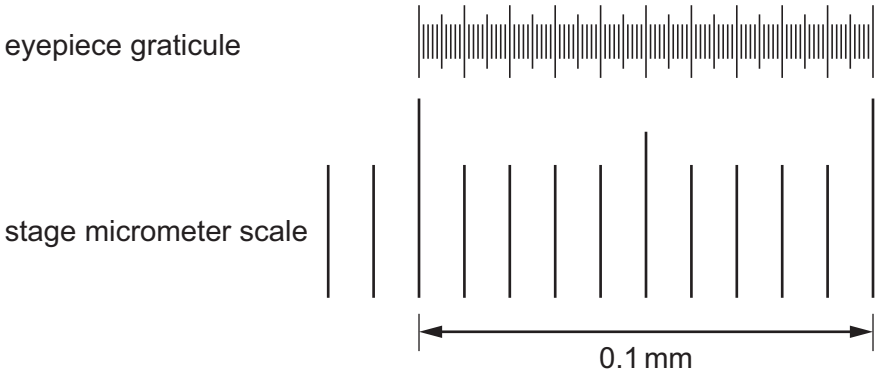
This document has **20** pages. Any blank pages are indicated.

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1 Which set of measurements is correct?

	diameter of capillary	diameter of red blood cell	thickness of cell surface membrane of red blood cell
A	7 μm	7 μm	7 nm
B	7 μm	7 nm	7 nm
C	0.7 mm	7 μm	7 nm
D	0.7 mm	0.7 mm	7 μm

2 The diagram shows an eyepiece graticule and part of a stage micrometer scale as seen using ×100 magnification.



Which is the correct method for calculating the value of one eyepiece graticule unit in micrometres (μm)?

A divide 100 by 0.1 then multiply by 1000

B divide 100 by 0.1 then multiply by 1000 divided by 100

C multiply 0.1 by 1000 then divide by 100

D multiply 0.1 by 1000 then divide by 100 then divide again by 100

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

What is the diameter as shown in the electron micrograph?

A 0.5 mm **B** 5 mm **C** 50 mm **D** 500 mm

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4 Which cell structures contain DNA?

1 mitochondria

2 chloroplasts

3 centrioles

4 nucleolus

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

5 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 synthesis of polypeptides

3 synthesis of lipids

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

6 Which row is correct for structures found in eukaryotic cells?

	circular DNA	70S ribosomes	80S ribosomes
A	present	present	present
B	present	present	absent
C	present	absent	present
D	absent	present	absent

7 Four solutions were tested for the presence of four different biological molecules. The appearance of the solutions after each test are shown in the table.

solution	Benedict's following acid hydrolysis	Benedict's	biuret	emulsion
1	blue	blue	purple	cloudy
2	green	blue	purple	clear
3	red	green	purple	cloudy
4	yellow	yellow	blue	clear

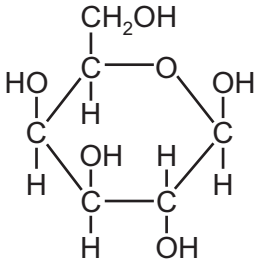
Which solutions contained molecules with ester bonds?

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

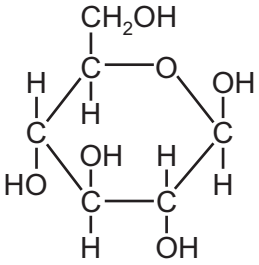
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8 The diagrams represent two monosaccharides with the same molecular formula ($C_6H_{12}O_6$).

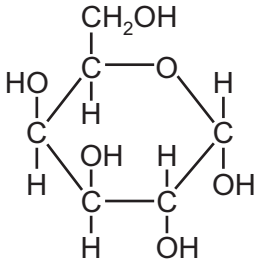
Both can exist in an alpha (α) or beta (β) form as shown.



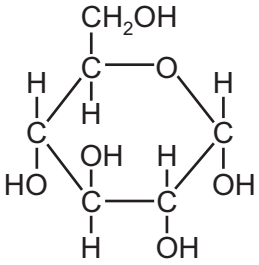
β-galactose



β-glucose

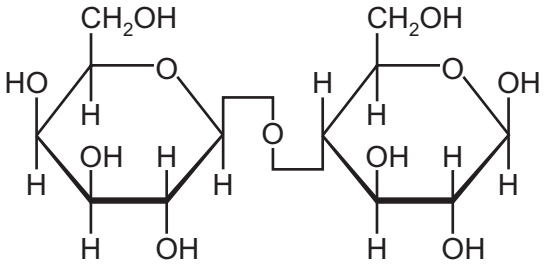


α-galactose



α-glucose

The diagram shows a lactose molecule formed by condensation between glucose and galactose.



Which molecules have condensed to form lactose?

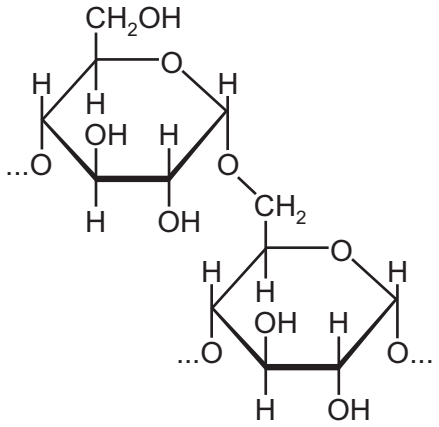
A α-glucose and α-galactose

B α-glucose and β-galactose

C β-glucose and α-galactose

D β-glucose and β-galactose

9 One type of covalent bond between two monomers is shown.



Which molecules contain this type of covalent bond?

A amylopectin, amylase, glycogen and starch

B amylopectin, amylase and glycogen only

C amylopectin, glycogen and starch only

D amylase, glycogen and starch only

10 Which statements about carbohydrates **and** triglycerides are correct?

1 They form polymers.

2 They contain carbon, hydrogen and oxygen.

3 They are used as energy stores.

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

11 Which molecules contain at least three double bonds?

A saturated fatty acid, collagen and haemoglobin

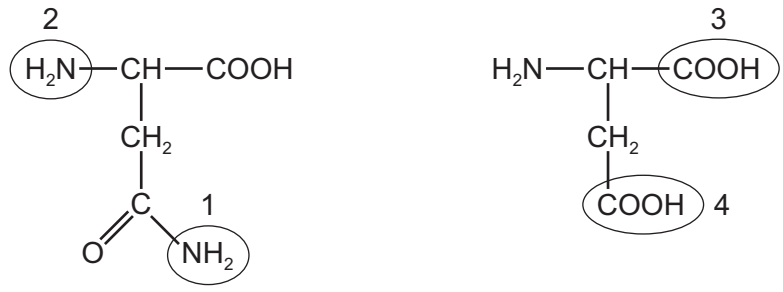
B collagen and saturated fatty acid

C haemoglobin and collagen

D saturated fatty acid and haemoglobin

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12 The diagrams show the structures of two amino acids. One contains two amino ($-NH_2$) groups, labelled 1 and 2. The other contains two carboxylic (–COOH) groups, labelled 3 and 4.



A peptide bond is formed between the two amino acids.

Which groups form the peptide bond?

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

13 Which row about the structure of proteins is correct?

	primary structure	secondary structure	tertiary structure	quaternary structure
A	is the number of amino acids present in a protein	is the right-handed spiral formed by the primary structure	is the result of cross-bonding between specific amino acids in the primary structure	is the sub-unit polypeptides that link together to form a protein
B	is the order of amino acids present in a protein encoded by DNA	is the coiling of a chain of amino acids to form a β-pleated sheet or an α-helix	is the shape formed by the folding of a polypeptide and is held together by hydrogen bonds	contains two types of polypeptide that interact forming the shape of a protein
C	is the result of translation of an mRNA molecule by a ribosome into a chain of amino acids	occurs because of an attraction between hydrogen and oxygen atoms in the peptide bonds	is the result of ionic and hydrogen bonds, disulfide bridges and hydrophobic interactions between amino acids	is formed by four polypeptides and an additional reactive group attached to the protein
D	is the sequence of amino acids in a protein coded by an mRNA molecule	is formed by hydrogen bonding between amino acids forming the primary structure	is formed as a result of interaction of the side chains of amino acids in the primary structure	is formed by the linking together of more than one polypeptide to form a protein

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14 The enzyme β-galactosidase can catalyse the hydrolysis of four substrates with similar structures.

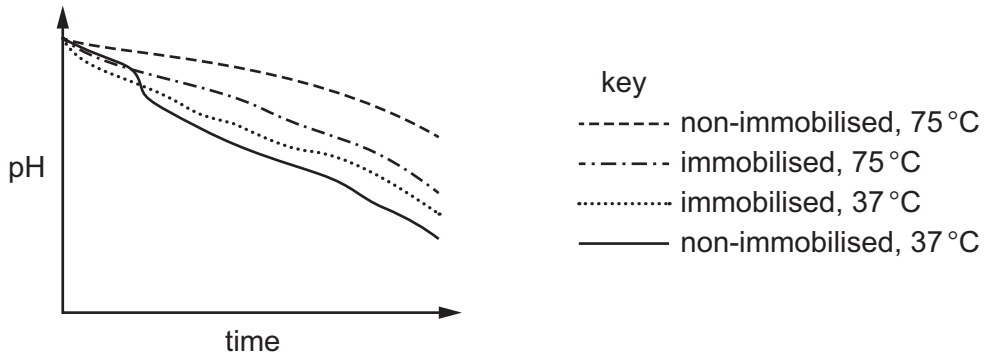
Each substrate gives a different K_m value.

For which substrate does β-galactosidase have the **highest** affinity?

	substrate	K_m / mol dm^{-3}
A	1	4×10^{-3}
B	2	1×10^{-3}
C	3	2×10^{-4}
D	4	1×10^{-4}

15 An investigation was carried out on the effect of temperature on the activity of an enzyme when it is immobilised and when it is non-immobilised (free in solution). The product of the enzyme-catalysed reaction causes a decrease in pH.

The graph shows the results of the investigation.



Which would give the highest yield of product?

A immobilised, 37 °C

B immobilised, 75 °C

C non-immobilised, 37 °C

D non-immobilised, 75 °C

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16 An indicator mixed with agar forms a pink colour. The pink-coloured agar becomes colourless when put in acid.

Blocks of pink-coloured agar are cut to different sizes and put in acid. All other variables are kept constant.

Which block becomes colourless most quickly?

A 3 mm × 30 mm × 30 mm

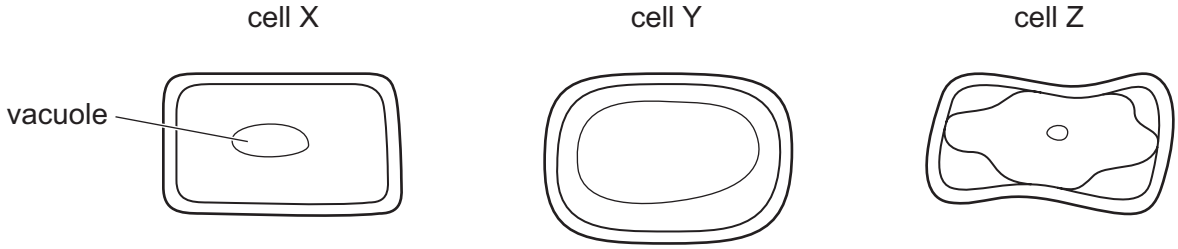
B 6 mm × 6 mm × 6 mm

C 6 mm × 12 mm × 12 mm

D 12 mm × 12 mm × 12 mm

17 Three identical plant cells were put into one of three different concentrations of sugar solution, 10%, 5% and 2.5%.

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



Which statement is **not** correct?

A Cell X has the same water potential as the sugar solution it was put into.

B Cell Y is turgid and cell Z is plasmolysed.

C Cell Y was put into the 2.5% sugar solution.

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

18 How many copies of each different DNA molecule are found in a cell at the start of each of these stages of the mitotic cell cycle?

	G_2 of interphase	prophase	cytokinesis
A	1	1	2
B	1	2	1
C	2	1	2
D	2	2	2

19 Hydra are simple animals which can reproduce asexually.

The photomicrograph shows an adult hydra with a new hydra developing while attached to the side of the adult animal.



Which processes have occurred in the two hydra?

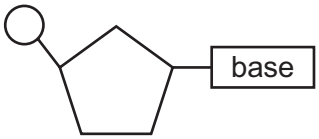
1 DNA replication

2 growth

3 mitosis

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

20 The diagram represents a nucleotide containing thymine.



Which statements about this nucleotide are correct?

1 Thymine is a pyrimidine.

2 Base pairing occurs with two hydrogen bonds.

3 The carbohydrate can be ribose or deoxyribose.

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

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21 Some of the events that occur during transcription are listed.

1 Bonds break between complementary bases.

2 Bonds form between complementary bases.

3 Sugar-phosphate bonds form.

4 Free nucleotides pair with complementary nucleotides.

Before the mRNA molecule leaves the nucleus, which events occur twice during transcription?

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

22 The table shows the DNA triplet codes for some amino acids.

amino acid	DNA triplet code	amino acid	DNA triplet code
arginine	GCA	glycine	CCA
arginine	GCC	glycine	CCG
arginine	GCG	glycine	CCT
asparagine	TTA	lysine	TTC
asparagine	TTG	lysine	TTT
cysteine	ACA	proline	GGA
cysteine	ACG	proline	GGC
STOP	ATC	valine	CAC

The base sequence on the DNA template strand coding for part of a polypeptide is shown.

CCA TTC ACG GCG TTA GCA

Two mutations occur in this sequence during DNA replication.

Which mutated DNA would result in a polypeptide with one different amino acid?

A CCA ATC ACG GCG TTG GCA

B CCA TTC ACA GCA TTA GCA

C CCA TTC ACG CCG TTA GCC

D CCT TTC ACG GCG TTA GCC

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23 A gene codes for the sequence of amino acids in a single polypeptide. Haemoglobin consists of two α-globins and two β-globins.

How many genes are needed to code for a single haemoglobin molecule?

A 1 **B** 2 **C** 4 **D** 8

24 Which properties of water molecules are important in the upward flow of water through the xylem?

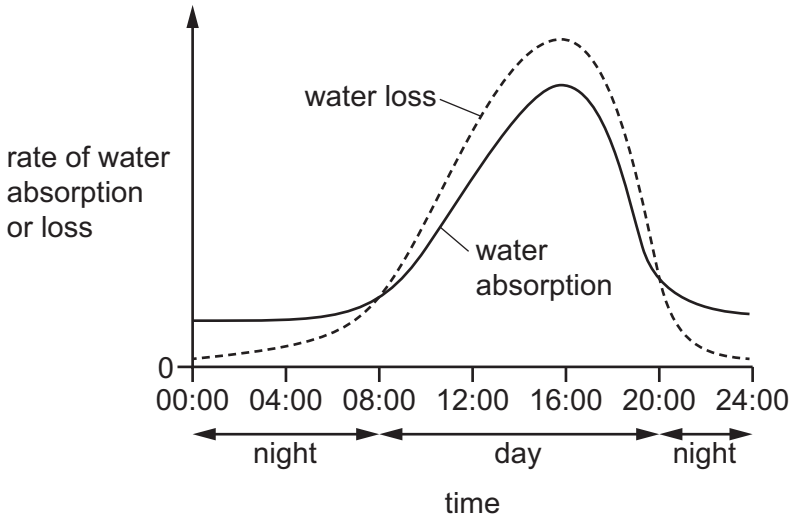
1 Water molecules are attracted to each other by hydrogen bonding.

2 Water molecules are attracted to cellulose by adhesion.

3 Water molecules have high cohesion in water columns.

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

25 The graph shows the rate of water absorption and the rate of water loss by a plant during one 24-hour period. The plant was growing in natural conditions.



What may be concluded from the graph?

1 The rate of water absorption and the rate of water loss peak at 16:00.

2 The rate of water loss is greater than the rate of water absorption for 12 hours.

3 The rate of water absorption is greater than the rate of water loss at night.

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 Which statements explain why a stem is cut under water and connected to a potometer under water?

1 to prevent plasmolysis of xylem vessel elements

2 to prevent the collapse of xylem vessel elements

3 to prevent air entering xylem vessel elements

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

27 Sucrose moves into an actively dividing shoot tip from a phloem sieve tube element.

Which changes to the water potential and the volume of liquid in the phloem sieve tube element are correct?

	water potential becomes	volume of liquid
A	less negative	decreases
B	less negative	increases
C	more negative	decreases
D	more negative	increases

28 Sucrose is loaded into phloem sieve tubes from companion cells.

What is the correct order of statements that explains this mechanism?

1 Hydrogen ions diffuse into companion cells through co-transporter proteins.

2 Hydrogen ions are pumped out of companion cells by active transport.

3 Sucrose diffuses into phloem sieve tubes via plasmodesmata.

4 Sucrose is co-transported along with hydrogen ions.

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

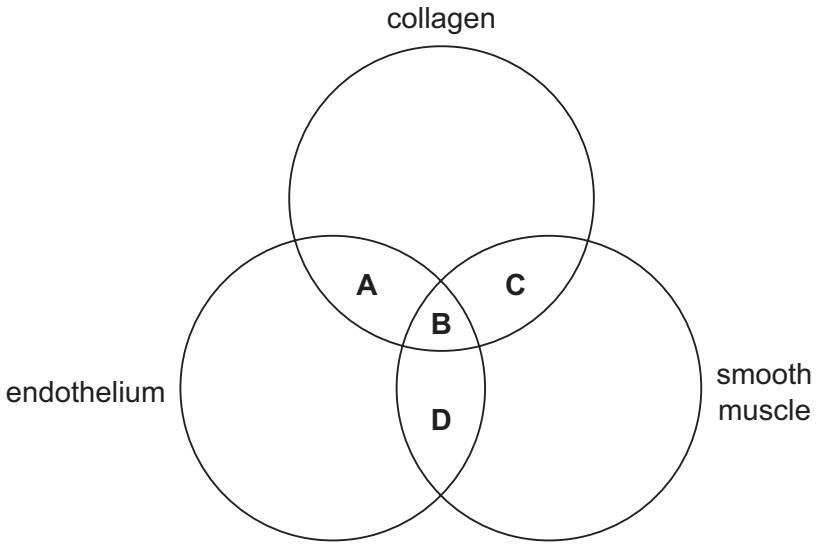
B $1 \rightarrow 4 \rightarrow 2 \rightarrow 3$

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

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

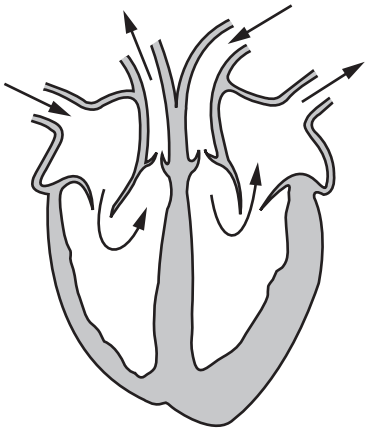
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29 Which components are found in arteries?

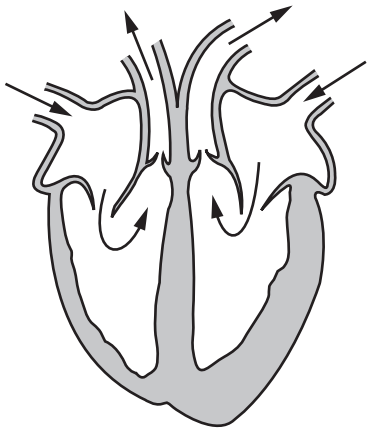


30 Which diagram correctly shows the direction of the flow of blood through the heart?

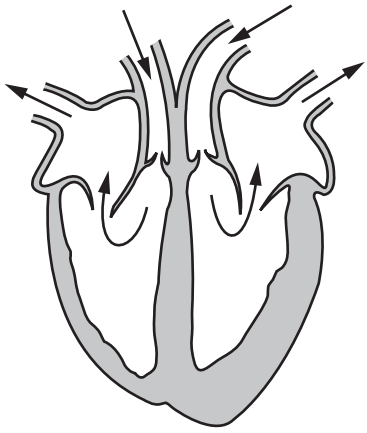
A



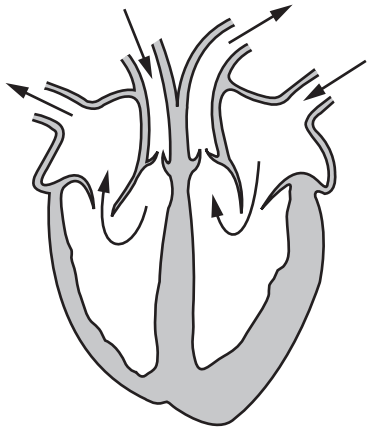
B



C



D



31 Which row correctly identifies the pulmonary artery?

	thickness of blood vessel wall / mm	oxygen content of blood inside vessel	blood pressure / mmHg
A	1.30	deoxygenated	15–30
B	2.10	oxygenated	80–120
C	0.15	oxygenated	5–15
D	0.20	deoxygenated	3–8

32 What is found in **all** blood vessels, lymph and tissue fluid?

1 carbon dioxide

2 glucose

3 white blood cells

4 antibodies

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 3 and 4 only

D 2 and 4 only

33 At high altitudes, the oxygen content of the air may be a third of that at sea level.

As a person slowly climbs a mountain, their body gradually adjusts to the high altitude.

What is increased during this period of adjustment?

A the concentration of haemoglobin in the red blood cells

B the oxygen-carrying capacity of the haemoglobin

C the number of red blood cells per mm^3 of blood

D the rate at which haemoglobin releases oxygen into the tissues

34 Which row correctly shows features present in terminal bronchioles?

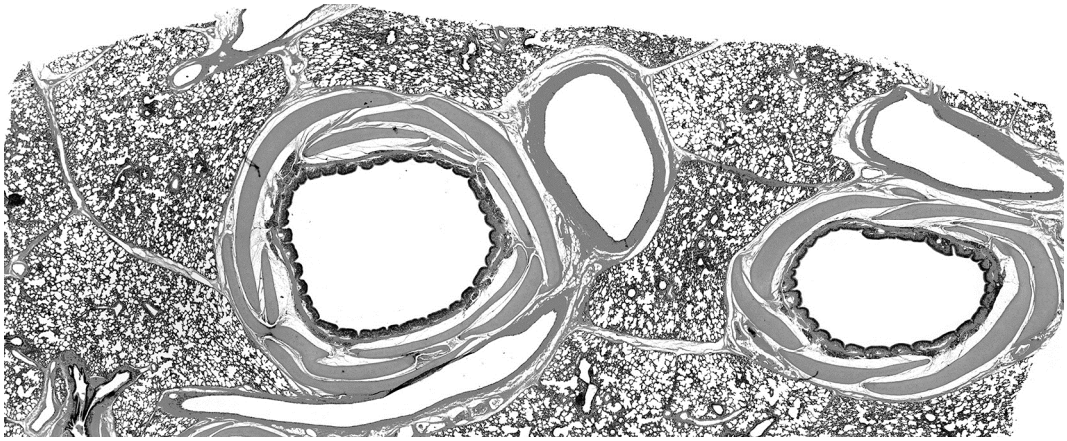
	cartilage	cilia	smooth muscle
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✓
D	✗	✓	✗

key

✓ = present

✗ = not present

35 The photomicrograph shows a section through lung tissue.



Which structures are present in this photomicrograph?

	artery	vein	bronchus	trachea
A	✓	✓	✓	✗
B	✓	✗	✗	✓
C	✗	✓	✗	✓
D	✗	✗	✓	✓

key

✓ = present

✗ = not present

36 The symptoms of two diseases are listed.

disease 1	disease 2
coughing up blood	shortness of breath
pain when breathing	difficulty breathing out
loss of weight	fatigue

Which row identifies diseases 1 and 2?

	disease 1	disease 2
A	chronic bronchitis	emphysema
B	emphysema	lung cancer
C	lung cancer	chronic bronchitis
D	lung cancer	emphysema

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37 Disease transmission can be reduced in different ways.

- antibiotic therapy for sufferers
- vaccination for non-sufferers
- more living space per person

The transmission of which disease can be reduced by all of these methods?

A cholera

B TB

C malaria

D measles

38 What do pathogens of HIV / AIDS, malaria and TB have in common?

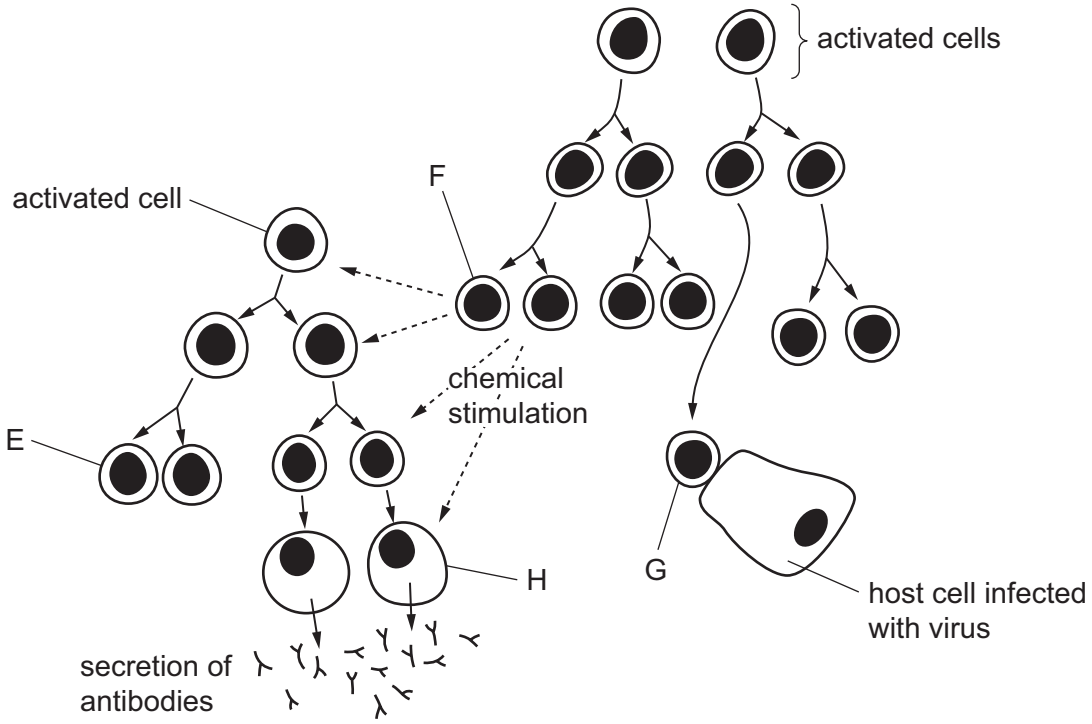
	cell surface membrane	genes	ribosomes
A	✓	✓	✓
B	✓	✗	✗
C	✗	✓	✓
D	✗	✓	✗

key

✓ = common to all three pathogens

✗ = not common to all three pathogens

39 The diagram shows the immune response following infection by a virus.



Which row identifies the cells labelled E, F, G and H?

	E	F	G	H
A	B-memory cell	T-helper cell	T-killer cell	plasma cell
B	B-memory cell	T-memory cell	macrophage	plasma cell
C	plasma cell	T-memory cell	T-helper cell	B-memory cell
D	T-killer cell	B-memory cell	macrophage	T-helper cell

40 Monoclonal antibodies are used to test for the presence of the hormone HCG in the urine of a human female during early pregnancy.

Which statements describe how the monoclonal antibodies used in this test are produced?

1 HCG is injected into a mouse, and plasma cells in the mouse produce antibodies specific to HCG.

2 Antibodies are extracted from the mouse and then fused with cancer cells to produce hybridoma cells.

3 Single hybridoma cells are cultured and they divide by mitosis to produce a clone of hybridoma cells.

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

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