Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/11**

Paper 1 Multiple Choice **May/June 2022**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
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- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

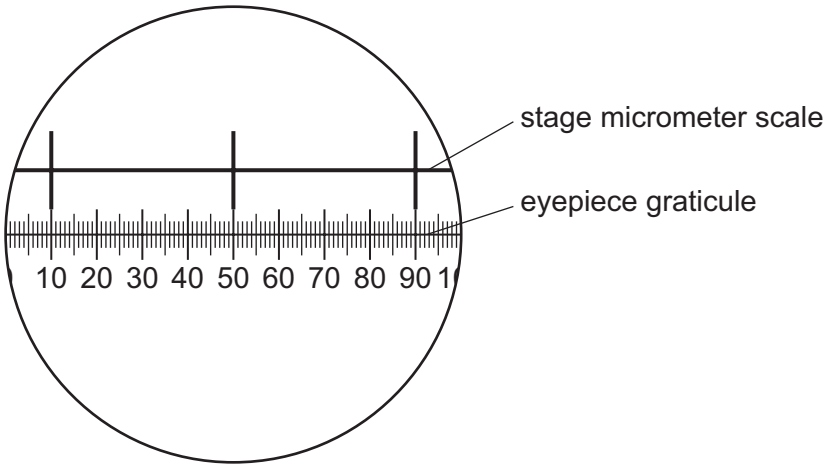
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

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

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1 A student used a stage micrometer scale to calibrate an eyepiece graticule.

The diagram shows the view of both the stage micrometer scale and the eyepiece graticule seen by the student. The divisions on the stage micrometer scale are 0.1 mm apart.



The student removed the stage micrometer scale and viewed a slide with blood cells on it. The same lenses were used so that the magnification remained unchanged.

The student measured the diameter of one of the white blood cells on the slide using the eyepiece graticule and recorded that it was 8 eyepiece units.

What is the correct diameter of this white blood cell in micrometers?

A 0.2 **B** 0.8 **C** 20 **D** 800

2 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 produces the mitotic spindle during cell division

3 packaging of hydrolytic enzymes that will remain in the cell

The appearances were listed by letter.

V membranes which surround an enclosed inner cavity

W non-membrane-bound, spherical structures

X a double membrane interspersed with pores

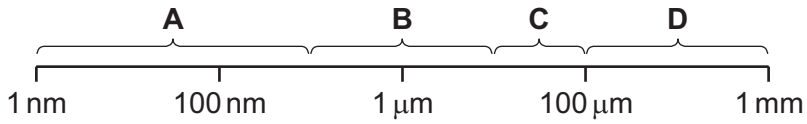
Y non-membrane-bound, cylindrical structures

Z membrane-bound sacs, arranged as a flattened stack

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

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

3 Which size range would include most prokaryotic cells?



4 What is present in a typical prokaryotic cell **and** a typical eukaryotic cell?

A 70S ribosomes

B centrioles

C circular DNA in the cytoplasm

D starch granules

5 Which statement about viruses is correct?

A They all have a capsid made of protein.

B They all contain RNA.

C They all have an outer envelope made of phospholipids.

D They all contain 80S ribosomes.

6 Samples of glucose, sucrose, and a mixture of glucose and sucrose were divided into two halves **M** and **N**.

M was then tested with Benedict's solution.

N was boiled with dilute hydrochloric acid, neutralised and then tested with Benedict's solution.

The colour of the solution was compared to colour standards.

Which table identifies the correct colour changes for these samples?

A

sample	**M**	**N**
glucose	blue	blue
sucrose	blue	yellow
mixture	blue	yellow

B

sample	**M**	**N**
glucose	yellow	yellow
sucrose	blue	yellow
mixture	blue	yellow

C

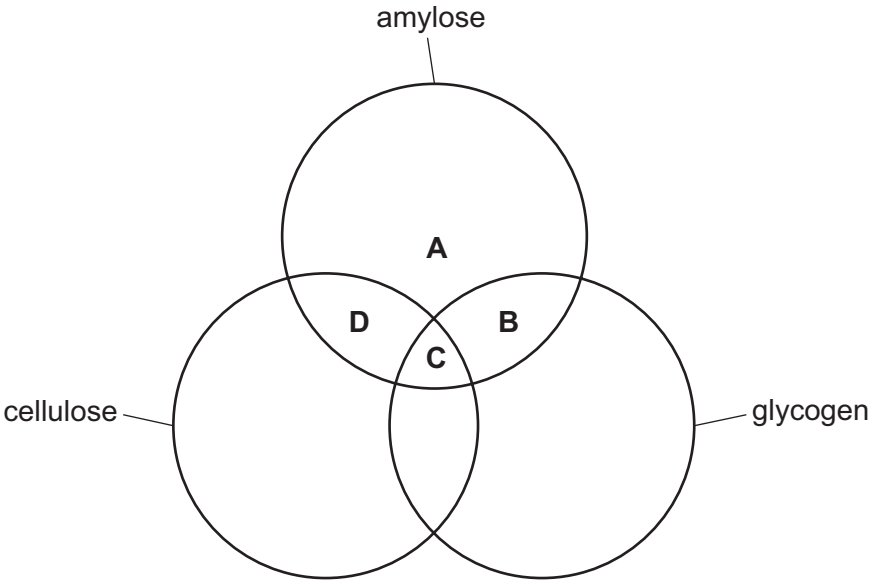
sample	**M**	**N**
glucose	yellow	yellow
sucrose	blue	yellow
mixture	yellow	red

D

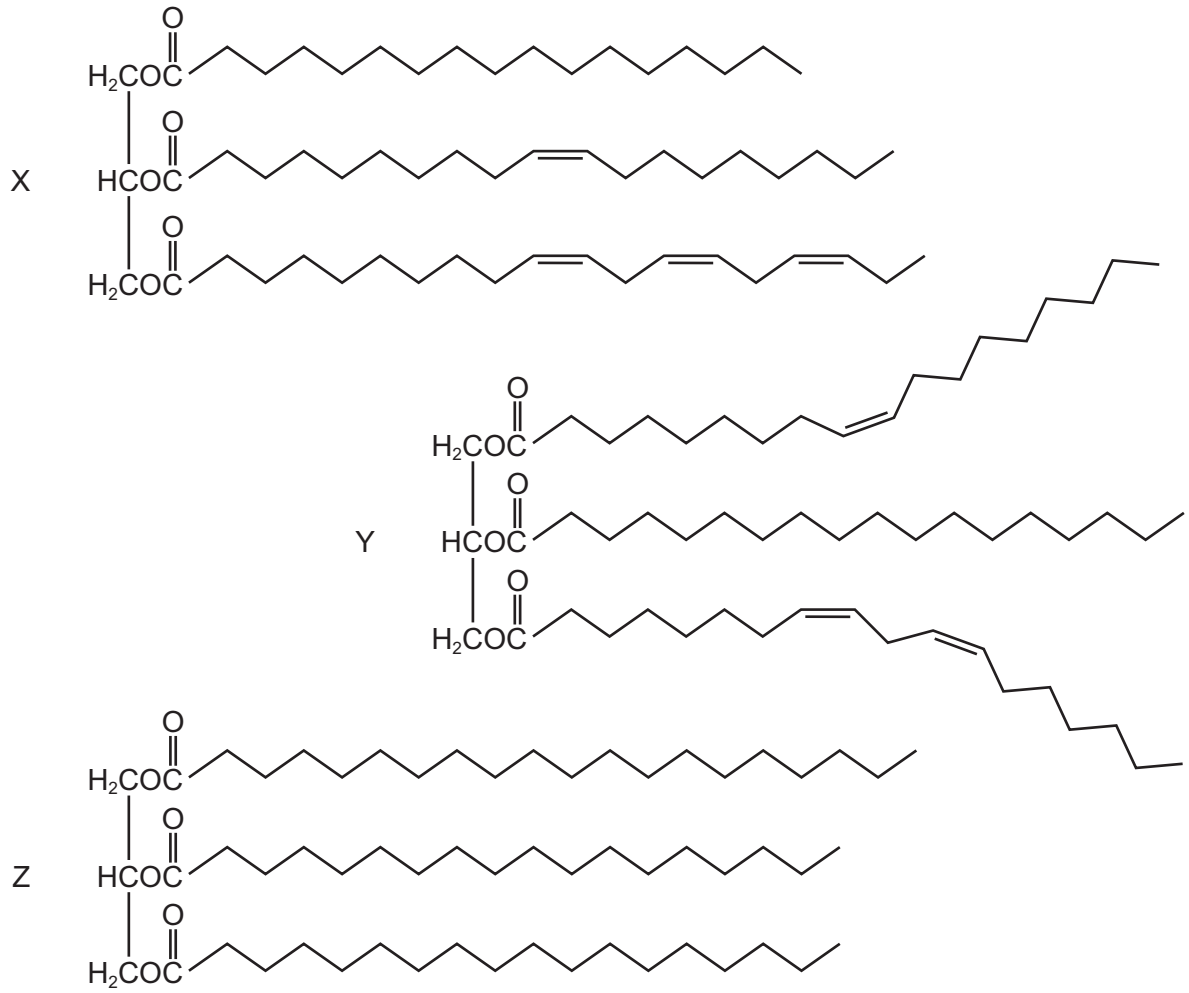
sample	**M**	**N**
glucose	yellow	red
sucrose	blue	red
mixture	yellow	red

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7 Which molecules contain 1,4-glycosidic bonds?



8 The diagram shows three triglycerides, X, Y and Z.



Which row is correct for these triglycerides?

	contains saturated fatty acids	contains unsaturated fatty acids	contains more than two different fatty acids
A	X, Y and Z	X and Y	X and Y
B	X, Y and Z	Z	X and Y
C	X and Y	X, Y and Z	X, Y and Z
D	Z	X and Y	X, Y and Z

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9 Some foods contain hydrogenated vegetable fats. These are unsaturated fats that have been converted to saturated fats.

Which property of the fats will have changed?

A Their hydrocarbon chains will fit together more closely.

B Their solubility in water will increase.

C They will have more double bonds in their molecules.

D They will remain liquid at room temperature.

10 A polypeptide contains a specific number of amino acids, n.

How many peptide bonds are present in this polypeptide?

A n – 1 **B** n **C** n + 1 **D** n + 2

11 Which statement is correct?

A Amylase, ribose and phospholipid are all macromolecules.

B Cellulose, glucose and catalase are all polymers.

C Deoxyribose, fructose and ribose are all monosaccharides.

D Sucrose, deoxyribose and amylopectin are all polysaccharides.

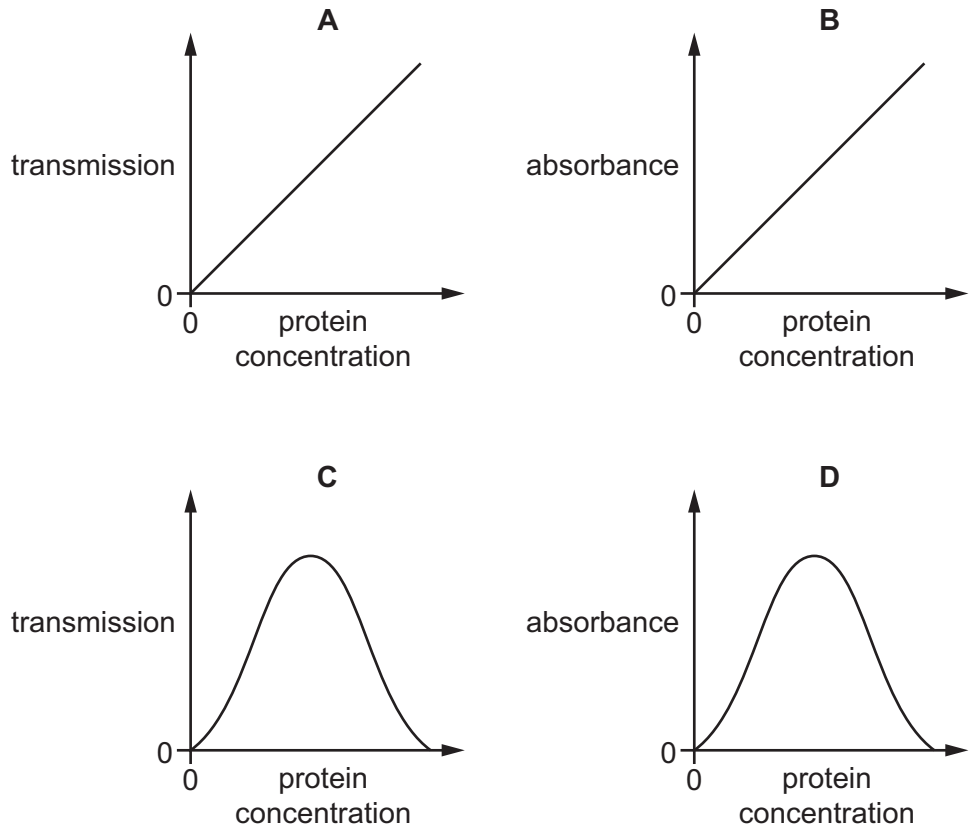
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12 A student used colorimetry to monitor the hydrolysis of a protein by a protease enzyme.

The student used biuret solution to determine the concentration of protein in the hydrolysis reaction.

The student produced a calibration curve using known concentrations of protein.

Which diagram shows the calibration curve?



13 A student completed an experiment to measure how increasing concentrations of substrate affects the rate of an enzyme-controlled reaction.

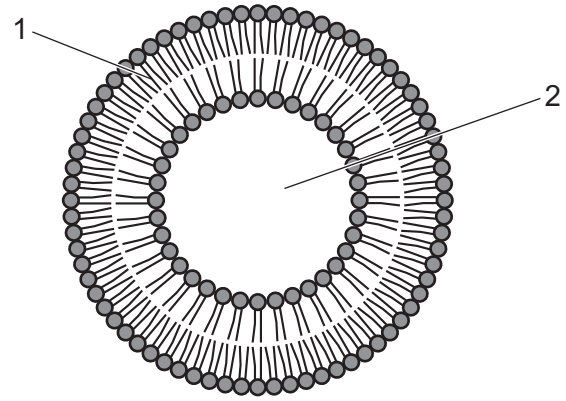
The student then repeated the experiment after adding a fixed quantity of a reversible competitive inhibitor.

Which row describes the effect of a reversible competitive inhibitor on enzyme activity?

	attachment of inhibitor at active site	effect of increasing substrate concentration on rate of enzyme-controlled reaction
A	no	little effect on the rate
B	yes	rate increases
C	no	rate increases
D	yes	little effect on the rate

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14 The diagram shows a liposome.



Liposomes can be used to move therapeutic drugs into cells of the body to treat conditions such as cancer.

Which row shows the property of a drug that could be transported in the sections of the liposome labelled 1 and 2?

	property of drug transported in location 1	property of drug transported in location 2
A	hydrophilic	hydrophilic
B	hydrophilic	hydrophobic
C	hydrophobic	hydrophilic
D	hydrophobic	hydrophobic

15 Some processes occurring in cells are listed.

1 endocytosis of water into cells

2 exocytosis of enzymes from cells

3 facilitated diffusion of glucose into red blood cells

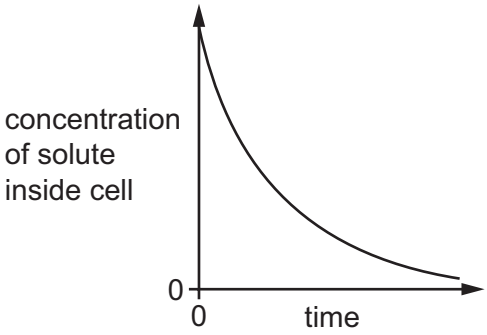
4 phagocytosis of dead cells by macrophages

Which processes use ATP?

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

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16 The graph shows changes in the concentration of a solute inside a cell.



What explains this change in concentration?

1 diffusion

2 endocytosis

3 exocytosis

4 osmosis

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

17 The indicator cresol red, changes from red to yellow when put into acid.

Four blocks of agar containing cresol red were cut to different sizes measured in millimetres. The blocks were submerged in acid. All other variables were kept constant. The time taken for each of the blocks to completely turn yellow was recorded.

Which of the four blocks became completely yellow most quickly?

A $3 \times 30 \times 30$ **B** $6 \times 6 \times 6$ **C** $6 \times 12 \times 12$ **D** $12 \times 12 \times 12$

18 Which processes require mitosis?

1 the cloning of T-lymphocytes

2 the repair of cell structures by protein synthesis

3 the growth of multicellular organisms from a single cell

4 the reproduction of a unicellular eukaryote

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

19 Which events listed are part of the cell cycle?

1 interphase

2 prophase

3 cytokinesis

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

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20 Telomerase is an enzyme that adds nucleotides to telomeres.

Which statement about telomerase is correct?

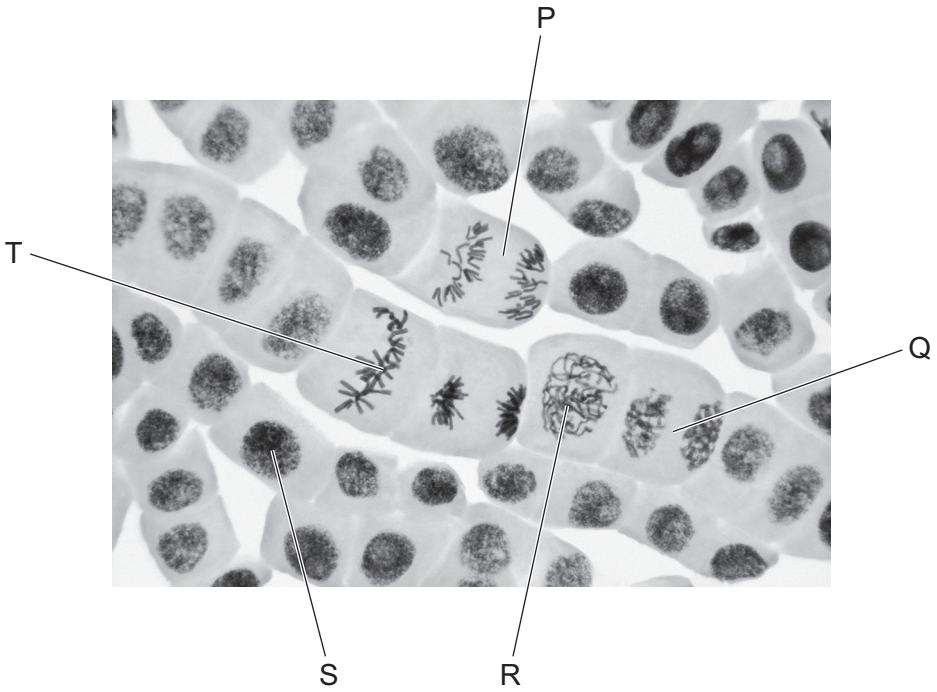
A A high concentration of telomerase in a cell damages genes during DNA replication.

B A high concentration of telomerase in cancerous cells limits the rate of tumour growth.

C The low concentration of telomerase in stem cells means that these cells can divide an unlimited number of times.

D The low concentration of telomerase in body cells means that these cells can divide a limited number of times.

21 The photomicrograph shows cells at different stages of mitosis.



A student wrote four statements about the photomicrograph.

1 Cell P shows anaphase.

2 Spindle formation is occurring in cell Q.

3 The amount of DNA in cell R is the same as in cell T.

4 The correct order for the stages is S → R → T → P → Q.

Which statements are correct?

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

22 Bacterial cells with DNA containing only the 'heavy' isotope of nitrogen (^{15}N) are allowed to reproduce for three generations in a culture medium containing the normal isotope of nitrogen (^{14}N).

Which percentage of the DNA molecules produced contain strands with the heavy isotope of nitrogen?

	first generation %	second generation %	third generation %
A	50	25	12.5
B	75	50	25
C	100	50	25
D	100	75	50

23 A bacterial circular DNA molecule is 2 600 150 base pairs long. 26% of the bases are adenine.

How many cytosine bases would be in the DNA molecule?

A 624 036 **B** 676 039 **C** 1 248 072 **D** 1 352 078

24 Which statement relating to the structure of DNA is correct?

A Two DNA strands are joined to each other by phosphodiester bonds.

B The alignment of bases to form a double helix is only achieved between antiparallel strands.

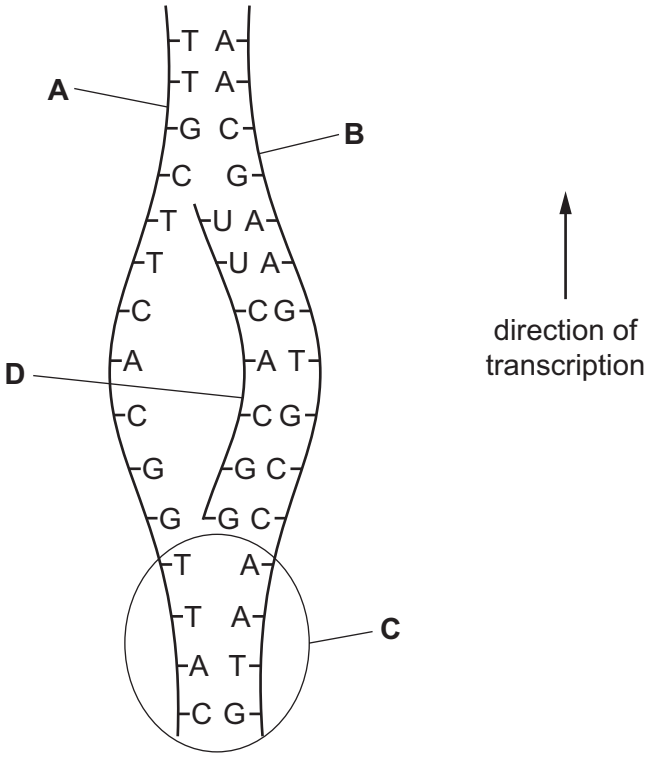
C Three hydrogen bonds are formed between all base pairs containing purines.

D The number of cytosine bases always equals the number of thymine bases.

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25 A student sketched a diagram to represent the process of transcription.

Which part of their diagram shows the non-transcribed strand?



26 Which row is correct for the movement of water in a root?

	pathway	molecule present in Casparian strip
A	apoplast pathway through intercellular spaces	suberin
B	apoplast pathway through plasmodesmata	lignin
C	symplast pathway through plasmodesmata	lignin
D	symplast pathway through intercellular spaces	suberin

27 The table contains some information about uptake and movement of water and of mineral ions in plants.

	water	mineral ions
mechanism for uptake	osmosis	diffusion, active transport
site of uptake	root hair cells	root hair cells
mechanism of release	evaporation, diffusion	diffusion, active transport
site of release	stomata	plant cells

Using the information provided, which factors will affect the uptake and movement of water or of mineral ions in plants?

1 humidity

2 surface area of root hair cell

3 oxygen concentration

4 temperature

A 1, 2, 3 and 4

B 1, 3 and 4 only

C 1 and 3 only

D 4 only

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

	water potential in the phloem sieve tube becomes	volume of solution in the phloem sieve tube
A	higher	decreases
B	higher	increases
C	lower	decreases
D	lower	increases

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29 A student wrote the following statements about a possible mechanism for loading sucrose from a source.

1 When energy is released from ATP, the released energy is used to move sucrose through a co-transporter protein in the companion cell membrane.

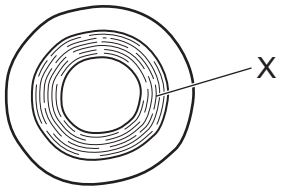
2 As sucrose is moved into a companion cell the pH in the cell wall of the companion cell decreases.

3 Proton pumps in the cell membrane of a companion cell move sucrose into the phloem sieve tube element.

Which statements are correct?

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

30 The diagram shows a transverse section through an artery.



Which tissues are present in layer X?

A collagen and smooth muscle only

B elastic fibres and collagen only

C elastic fibres and smooth muscle only

D elastic fibres, collagen and smooth muscle

31 What is systolic blood pressure?

A the blood pressure in the arteries when the heart is relaxing

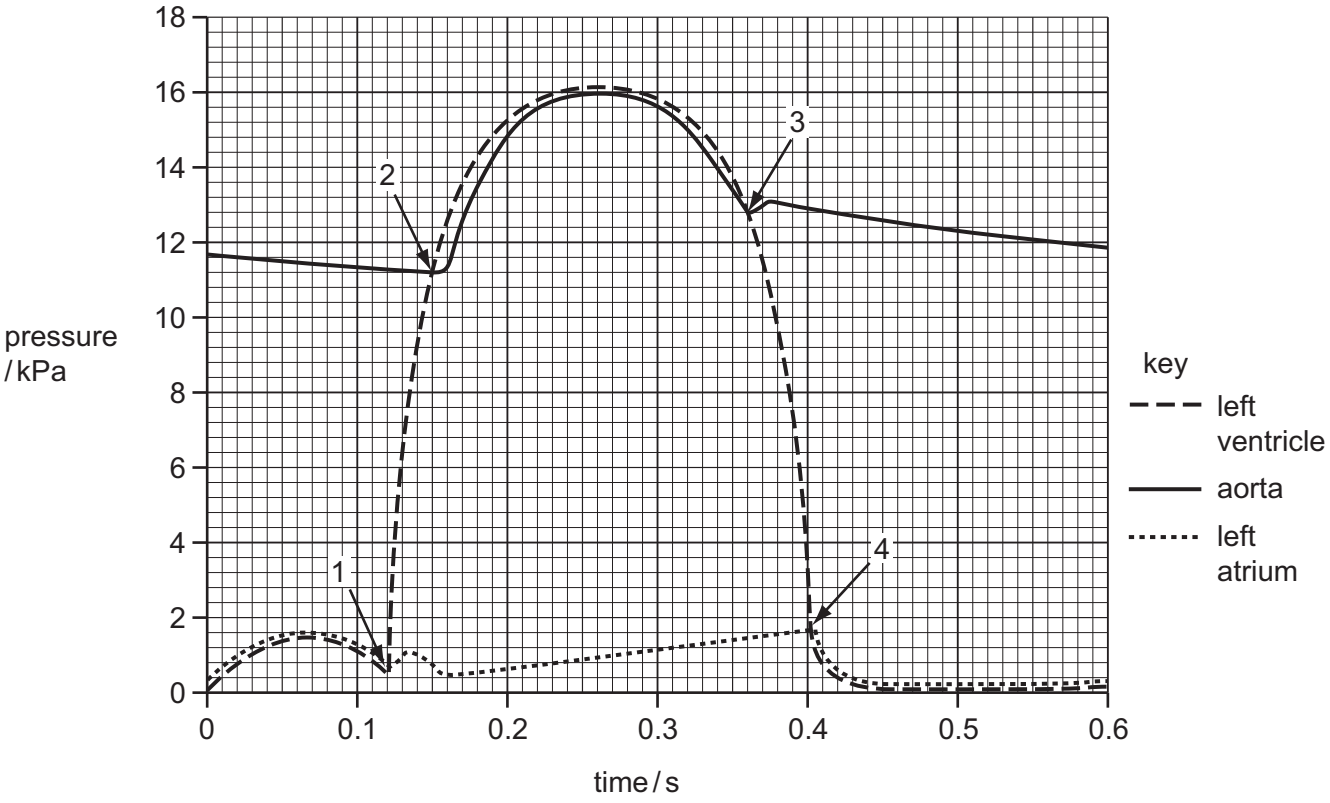
B the blood pressure in the left ventricle at the start of a contraction

C the maximum blood pressure in the arteries

D the maximum blood pressure in the right ventricle

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32 The diagram shows pressure changes in the left side of the heart and aorta over time. The length of this cardiac cycle is 0.6 s. Points 1, 2, 3 and 4 indicate when atrioventricular valves and semilunar valves either open or close.



What is the total time during one cardiac cycle that the atrioventricular valves and the semilunar valves are both closed at the same time?

A 0.03 s **B** 0.04 s **C** 0.07 s **D** 0.21 s

33 Which reactions take place in the capillaries surrounding an alveolus?

1 carbon dioxide + water → carbonic acid

2 carbon dioxide + haemoglobin → carbaminohaemoglobin

3 haemoglobinic acid → haemoglobin + hydrogen ions

4 hydrogencarbonate ions + hydrogen ions → carbonic acid → carbon dioxide + water

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

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34 Which statement explains the importance of the chloride shift in red blood cells (RBC)?

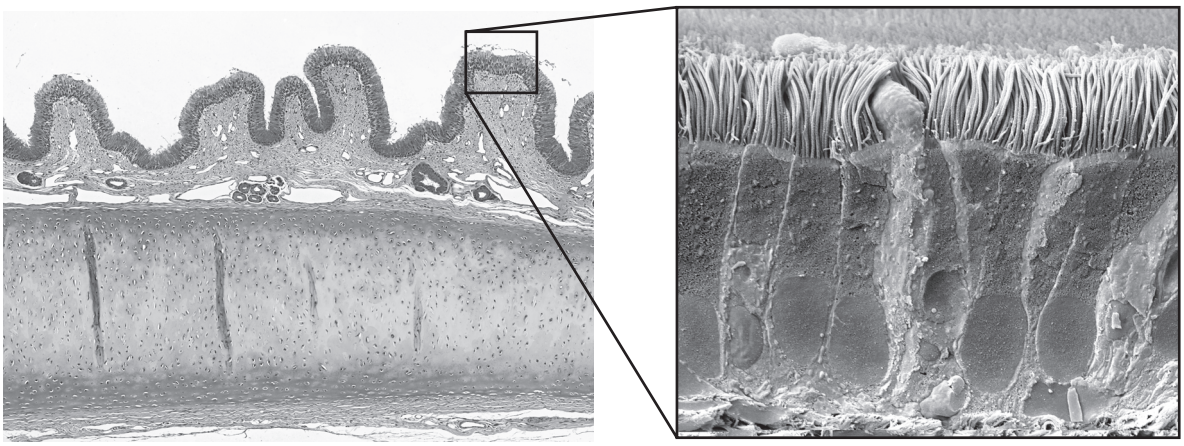
A Carbon dioxide diffuses from blood plasma into RBC and chloride ions diffuse out of RBC to maintain a balance of positive and negative ions.

B Hydrogencarbonate ions diffuse into plasma from RBC and chloride ions diffuse into RBC to maintain a balance of positive and negative ions.

C Carbon dioxide in RBC together with chloride ions stimulate the release of oxygen from haemoglobin to allow increased levels of respiration.

D Hydrogencarbonate ions diffuse into RBC from plasma and chloride ions diffuse into plasma to maintain a balance of positive and negative ions.

35 The photomicrographs show a cross-section through the lining of part of the respiratory system.



Which statements about the photomicrographs are correct?

1 Goblet cells are visible between squamous epithelium cells.

2 Smooth muscle is visible.

3 The section cannot be from a bronchiole as cartilage is visible.

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

36 The surface tension of the layer of liquid lining the alveoli tends to pull the walls inwards so alveoli could collapse.

Which statements could explain how this is prevented?

1 Alveolar fluid is moved around by cilia.

2 Elastic fibres keep the alveoli open.

3 Epithelial cells secrete a chemical that reduces the cohesion in water.

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

37 What will reduce the rate at which bacteria become resistant to antibiotics?

1 prescribing two antibiotics with different modes of action

2 prescribing different antibiotics for the same bacterium

3 finishing a prescribed course of antibiotics

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

38 T-lymphocytes have a protein, PD-1, on their surface. Some cancer cells have a receptor molecule on their surface which binds with PD-1, inactivating the T-lymphocyte.

A monoclonal antibody, lambrolizumab, has been produced against this receptor.

Trials showed that in 54 of 135 people with advanced skin cancer who were given lambrolizumab the tumours more than halved in volume. In six of the 57 people who were given the highest dose the tumours disappeared.

What may be correctly concluded from this information?

1 Lambrolizumab binds with a receptor on the surface of skin cancer cells.

2 Cancer cells to which lambrolizumab is bound cannot inactivate T-lymphocytes.

3 Lambrolizumab targets and kills skin cancer cells.

4 Lambrolizumab allows a patient's own immune system to kill cancer cells.

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 3 only

D 2, 3 and 4 only

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39 A person's blood group is determined by antigens present on the red blood cells.

The table shows the antigens and antibodies in the blood of people with different blood groups.

blood group	presence of A or B antigens on red blood cells	presence of antibodies to A or B in plasma
A	A only	anti-B only
B	B only	anti-A only
AB	A and B	neither
O	neither	anti-A and anti-B

During a blood transfusion, it is essential that the person receiving the blood does not have antibodies to the donor's blood.

Which blood groups can be given to a person with blood group AB?

A AB only

B O only

C A and B only

D A, B, AB and O

40 Which types of cell are stimulated to divide by the cytokines produced by T-helper cells?

A macrophages

B B-lymphocytes only

C T-killer cells only

D B-lymphocytes and T-killer cells

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Cambridge International AS & A Level

BIOLOGY **9700/12**

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1 hour 15 minutes

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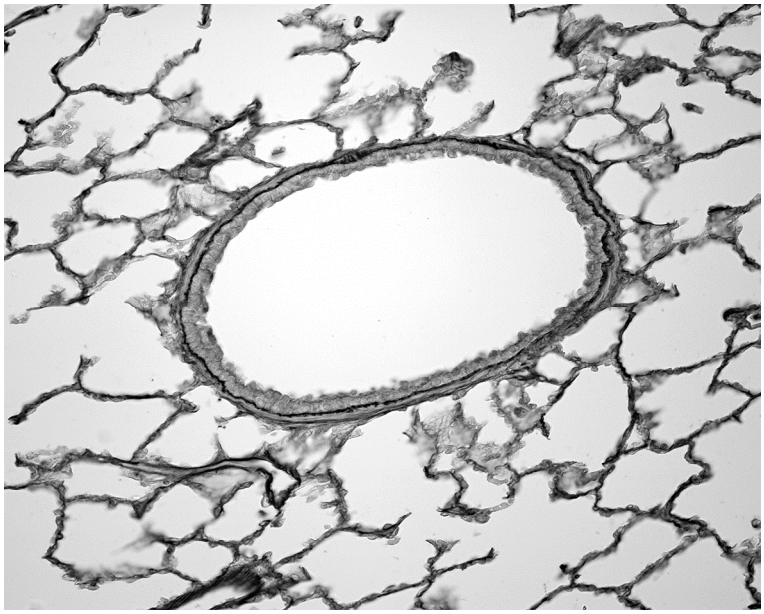
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1 The photomicrograph shows a bronchiole and alveoli.



The magnification of the image is ×360.

What is the maximum diameter of the bronchiole lumen?

A 14 μm **B** 80 μm **C** 140 μm **D** 170 μm

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

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

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

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

The functions were listed by number.

1 produces the mitotic spindle during cell division

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 functions with the appearance of the cell structure?

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

4 What is found in 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 feature is correct for all known viruses?

A capsid made of lipid and protein

B DNA core

C outer envelope of phospholipid

D non-cellular structure

6 Four extracts from different plant materials were made and tested with Benedict's solution.

The extracts were boiled with Benedict's solution for 240 seconds and the final colour was recorded.

extract	colour produced after 240 seconds
1	red
2	yellow
3	blue
4	green

Which sequence of plant extracts represents an increasing quantity of reducing sugar?

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

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

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

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

7 Which have properties that are dependent on hydrogen bonds?

1 cellulose

2 a molecule of haemoglobin

3 water

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

8 Which statement is correct?

A Cellulose, glycogen and amylopectin are all polymers.

B Ribose, amylase and phospholipid are all macromolecules.

C Starch, glucose and amylose are all monomers.

D Sucrose, deoxyribose and amylopectin are all polysaccharides.

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9 The diagram shows two amino acids. Some of the hydrogen atoms are numbered 1 to 6.



Which two numbered hydrogen atoms could contribute to the production of a molecule of water when a peptide bond forms between these two amino acids?

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

10 A student wrote four statements about water.

1 Water has a high specific heat capacity which maintains the temperature of water within cells.

2 Mammals rely on water having a relatively low latent heat of vaporisation to keep them cool.

3 When a negatively charged ion is added to water, the δ^+ charge on the hydrogen atom is attracted to the ion.

4 When surrounded by water, non-polar molecules tend to be pushed apart from one another.

Which statements are correct?

	1	2	3	4
A	✓	✗	✓	✓
B	✓	✗	✓	✗
C	✗	✓	✗	✓
D	✗	✓	✗	✗

key

✓ = correct

✗ = not correct

11 Typical enzymes are large globular proteins with a specific tertiary shape.

Which molecular interactions are directly involved in maintaining the tertiary shape?

1 hydrogen bonding

2 disulfide bridges

3 hydrophobic interactions

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

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12 Which statement about the Michaelis–Menten constant (K_m) is correct for an enzyme with a low affinity for its substrate?

A It has a high K_m and reaches V_{max} at a high substrate concentration.

B It has a high K_m and reaches V_{max} at a low substrate concentration.

C It has a low K_m and reaches V_{max} at a high substrate concentration.

D It has a low K_m and reaches V_{max} at a low substrate concentration.

13 Long chain, saturated fatty acids change from solid to liquid at higher temperatures compared with short chain, unsaturated fatty acids.

Which fatty acids would be more likely to form triglycerides in mammals that live in cold climates?

A long chain saturated

B long chain unsaturated

C short chain saturated

D short chain unsaturated

14 When animal cells are cultured, salt solution is added to keep the cells alive.

What is the purpose of the salt solution?

A to allow facilitated diffusion of salts into the cells

B to prevent diffusion of other ions in or out of the cells

C to prevent net movement of water into or out of the cells

D to provide a source of energy for active transport

15 The following are all processes that allow movement into cells.

1 phagocytosis

2 active transport

3 facilitated diffusion

Which processes require ATP?

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

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16 Which features are required to allow for efficient diffusion?

1 a large surface area

2 a short diffusion pathway

3 maintenance of a constant diffusion gradient

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

17 What is a role of mitosis?

A growth of organisms

B production of genetically different cells

C repair of cells

D replacement of cancerous tissue

18 Telomeres prevent the loss of genes from the ends of chromosomes during DNA replication, but they become shorter each time they are copied.

In cancer cells and stem cells, the telomeres remain the same length.

Which statement is correct for **all** human cells?

A If telomeres become too short, a cell may stop dividing.

B Adding telomeres could increase the rate of ageing of cells.

C Telomeres are repaired by the enzyme RNA polymerase.

D Telomeres prevent all damage occurring to DNA molecules.

19 The nucleus of a mouse body cell in G_1 phase of the cell cycle has 1.2×10^{-12} g of DNA.

What will be the mass of DNA in the nucleus of the cell at the end of S phase and at the end of G_2 phase of the cell cycle?

	end of S phase	end of G_2 phase
A	1.2×10^{-12} g	1.2×10^{-12} g
B	1.2×10^{-12} g	2.4×10^{-12} g
C	2.4×10^{-12} g	1.2×10^{-12} g
D	2.4×10^{-12} g	2.4×10^{-12} g

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20 What occurs during prophase in animal cells?

1 fragmentation of the nuclear envelope

2 nucleolus disappears

3 stained chromosomes become visible

4 centrioles replicate

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 2 and 3 only

D 1 and 4 only

21 Which statement describes the structure of ATP?

A It is a DNA nucleotide with two extra phosphates.

B It is a DNA nucleotide with three extra phosphates.

C It is an RNA nucleotide with two extra phosphates.

D It is an RNA nucleotide with three extra phosphates.

22 Rifampicin is an antibiotic used to treat tuberculosis.

It works by inhibiting RNA polymerase in bacteria.

Which processes are directly inhibited by this antibiotic?

1 DNA replication

2 enzyme synthesis

3 ATP synthesis

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

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23 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 template DNA strand coding for part of a polypeptide is shown.

CCA ACG GCG TTA TTC GCA

Two mutations occur in this sequence during DNA replication.

Which mutated template DNA strand would result in a shorter polypeptide?

A CCA ACA GCA TTA TTC GCA

B CCA ACG CCG TTA TTC GCC

C CCA ACG GCG TTG ATC GCA

D CCT ACG GCG TTA TTC GGA

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

1 lignified walls

2 cytoplasm

3 mitochondria

4 pits

5 plasmodesmata

Which features are present in xylem vessel elements?

A 1, 2, 3 and 4

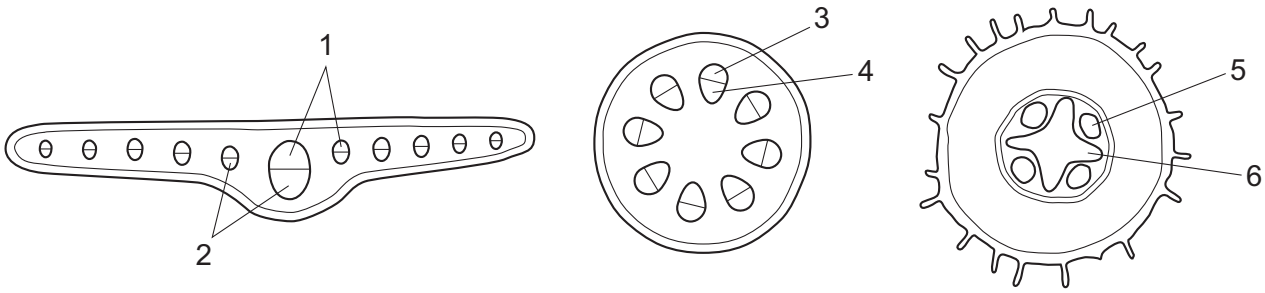
B 1, 4 and 5

C 1 and 4 only

D 2, 3 and 5

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25 The diagrams show transverse sections through parts of plants.



Which row is correct?

	contains lignin	transports organic solutes
A	1, 4, 5	2, 3, 6
B	1, 4, 6	2, 3, 5
C	2, 3, 5	1, 4, 6
D	2, 4, 6	1, 3, 5

26 Which molecules form hydrogen bonds with water during transpiration?

1 cellulose in the xylem wall

2 suberin in the xylem wall

3 other water molecules in the xylem

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

27 Some plant species can take up heavy metal contaminants that are dissolved in soil water and then transport them within the plant. Within plant cells, the heavy metals accumulate mainly in the vacuole.

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

1 After initial entry into the root, some of the heavy metals can pass through the tonoplast to be stored in the vacuole of cells in the cortex.

2 The heavy metals take an apoplastic pathway in the xylem but at the endodermis must take a symplastic pathway.

3 The rate of accumulation of the heavy metals in leaf cells will be faster at night, when photosynthesis is not occurring, than during the day.

4 The presence of heavy metals causes the transpiration stream to slow down and reduce the rate of transpiration.

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

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28 What is the correct route for the movement of water from cell to cell in the apoplast pathway?

A through adjacent cell surface membranes

B through intercellular spaces

C through plasmodesmata

D through the Casparian strip

29 Which row shows the correct sequence for the movement of sucrose into phloem sieve tubes?

	first	second	third
A	diffusion of sucrose into the companion cell cytoplasm	active transport of protons into the companion cell cytoplasm	cotransport of protons and sucrose into the sieve tubes
B	cotransport of protons and sucrose into the companion cell cytoplasm	active transport of protons out of the companion cell cytoplasm	diffusion of sucrose into the sieve tubes
C	active transport of protons into the companion cell cytoplasm	diffusion of sucrose into the companion cell cytoplasm	cotransport of protons and sucrose into the sieve tubes
D	active transport of protons out of the companion cell cytoplasm	cotransport of protons and sucrose into the companion cell cytoplasm	diffusion of sucrose into the sieve tubes

30 What occurs during ventricular systole in a mammalian heart?

1 Aortic pressure increases.

2 Atrial pressure does not change.

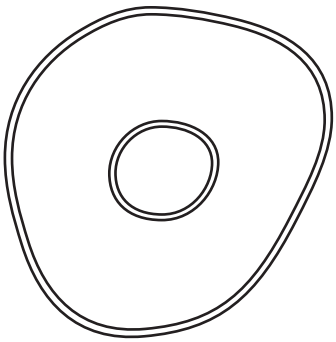
3 Ventricular pressure increases.

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

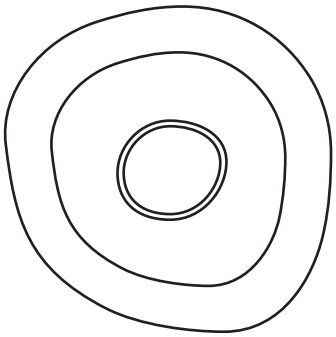
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31 Which plan diagram represents the tissues in a major vein?

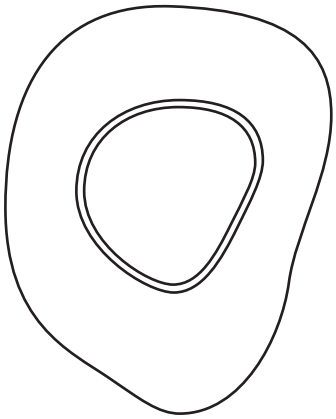
A



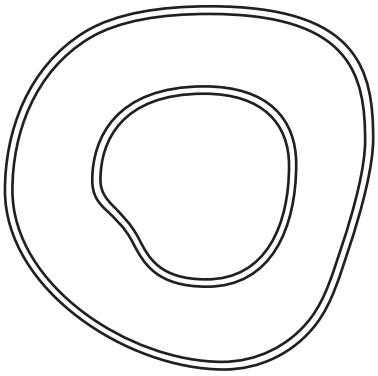
B



C

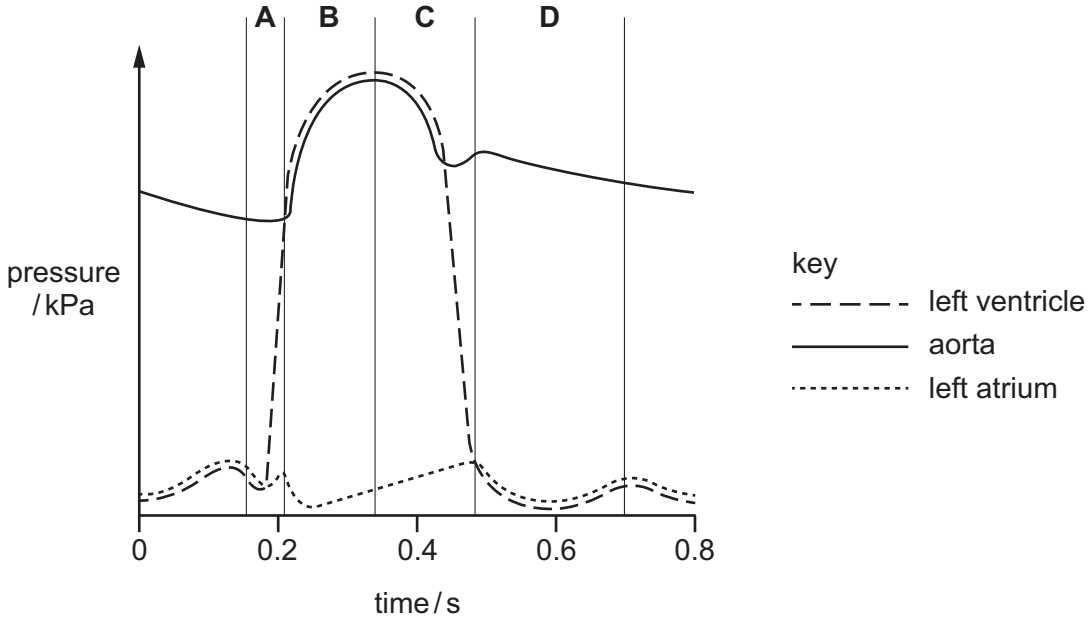


D



32 The diagram shows the pressure changes in various structures of the left side of the heart during the cardiac cycle.

At the end of which period is the ventricle full of blood?



33 Which description of movement of substances during tissue fluid formation is correct?

A Low hydrostatic pressure forces substances out of the capillary at the arterial end allowing small substances to enter the fluid that bathes the cells.

B Tissue fluid moves back into the venule due to a net hydrostatic pressure change in the capillary.

C Movement of water in tissue fluid into the capillary by osmosis is due to the low water potential and low hydrostatic pressure inside the capillary.

D A high water potential of the surrounding tissue fluid causes substances to leave the capillaries at the arterial end.

34 Which row shows the change in concentration of some substances in red blood cells when carbon dioxide diffuses from active cells?

	carbonic anhydrase	hydrogencarbonate ions	hydrogen ions
A	decreases	no change	no change
B	increases	increases	increases
C	no change	decreases	increases
D	no change	increases	increases

35 Which statements about the human gas exchange system are correct?

1 The absence of cartilage in small bronchioles allows them to expand.

2 The walls of the alveoli are made of cuboidal epithelium.

3 Alveoli secrete a substance which reduces surface tension.

4 The trachea and bronchi are supported by rings of cartilage.

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

36 Four types of cell in the gas exchange system are listed.

J alveolus epithelium cell

K ciliated cell

L goblet cell

M smooth muscle cell

The ticks (✓) in the table show specialised features of three of these types of cell.

	many mitochondria	lots of endoplasmic reticulum	many Golgi bodies
1	✓		
2	✓		
3	✓	✓	✓

Which row correctly matches the specialised feature with the correct cell?

	1	2	3
A	J	M	K
B	K	J	M
C	K	M	L
D	M	L	J

37 Why is it difficult to control the spread of tuberculosis?

1 Global air travel for commerce and tourism has increased.

2 The bacterium that causes tuberculosis has evolved resistance to some antibiotics.

3 The bacterium that causes tuberculosis shows great antigenic variability.

4 Civil unrest and poverty result in overcrowded living conditions.

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

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38 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 last a short time.

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

39 A person's blood group is determined by antigens present on the red blood cells. The table shows the antigens and antibodies in the blood of people with different blood groups.

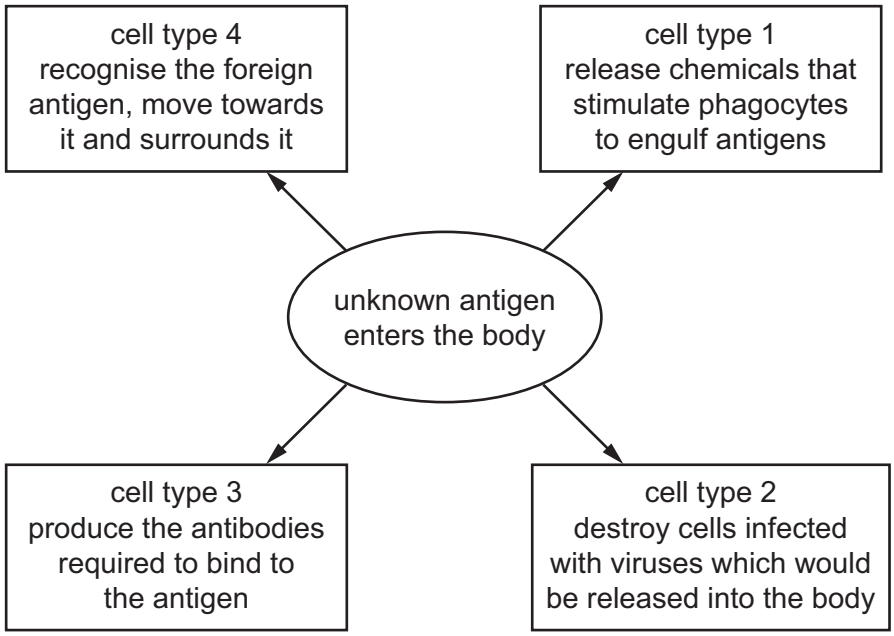
blood group	presence of A or B antigens on red blood cells	presence of antibodies to A or B in plasma
A	A only	anti-B only
B	B only	anti-A only
AB	A and B	neither
O	neither	anti-A and anti-B

During a blood transfusion, it is essential that the person who receives the blood does **not** have antibodies to the donor's blood.

Which blood groups can be given to a person with blood group B?

A A and B **B** AB and B **C** AB and O **D** B and O

40 A student used a diagram to show four types of cells involved in the primary immune response.



Which row is correct?

	cell 1	cell 2	cell 3	cell 4
A	B-lymphocyte	macrophage	T-killer cell	T-helper cell
B	macrophage	B-lymphocyte	T-helper cell	T-killer cell
C	T-helper cell	T-killer cell	B-lymphocyte	macrophage
D	T-killer cell	T-helper cell	B-lymphocyte	macrophage

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BIOLOGY **9700/13**

Paper 1 Multiple Choice **May/June 2022**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

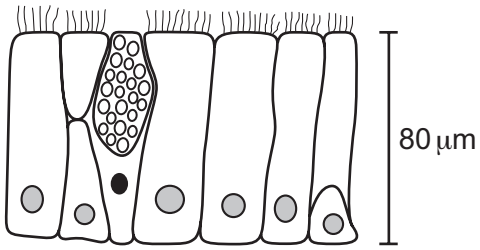
- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

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

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1 The diagram shows a section through epithelium found in part of the respiratory system.



What is the magnification of the diagram?

A ×35 **B** ×350 **C** ×3500 **D** ×35 000

2 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 packaging of hydrolytic enzymes that will remain in the cell

The appearances were listed by letter.

V membranes which surround an enclosed inner cavity

W non-membrane-bound, spherical structures

X a double membrane interspersed with pores

Y non-membrane-bound, cylindrical structures

Z membrane-bound sacs, arranged as a flattened stack

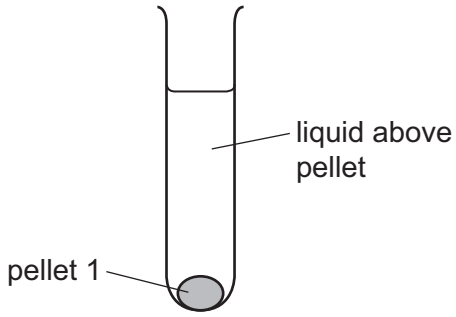
Which student correctly matched the numbered functions with the appearance of the cell structure?

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

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3 An experiment was carried out to separate the cell structures in an animal cell.

The cells were broken open. The extract was filtered and put into a centrifuge tube. This tube was then spun so that the heaviest cell structure sank to the bottom first, forming pellet 1, as shown.



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

This procedure was repeated twice to obtain pellet 3 and pellet 4, each containing a single cell structure.

What is a function of the cell structure extracted in pellet 1?

A digestion of old organelles

B production of ATP

C production of mRNA

D synthesis of protein

4 ATP molecules are synthesised in mitochondria.

Which sugar is found in these ATP molecules?

A deoxyribose

B fructose

C glucose

D pentose

5 Which row shows a comparison that is **not** correct between a typical prokaryotic cell and a typical eukaryotic plant cell?

	prokaryotic cell	eukaryotic plant cell
A	DNA not associated with histones	DNA associated with histones
B	no endoplasmic reticulum present	endoplasmic reticulum present
C	peptidoglycan cell walls	cellulose cell walls
D	all ribosomes approximately 18 nm in diameter	all ribosomes approximately 22 nm in diameter

6 It is suggested that primitive prokaryotic cells may be ancestors of certain organelles in eukaryotic cells.

Which organelle is most similar in composition to a typical prokaryote?

A Golgi bodies

B lysosomes

C mitochondria

D nucleoli

7 The concentration of reducing sugar in a solution can be found if an observational measurement is compared to a standard.

Which observational measurement could be used to estimate the concentration of reducing sugar in an unknown solution?

1 the colour of the solution after 20 minutes

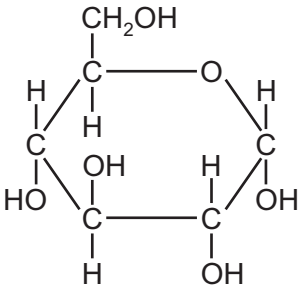
2 the time for the first colour change to occur

3 the rate of formation of solid particles

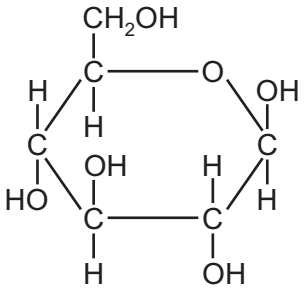
A 1, 2 and 3 **B** 1 and 2 only **C** 2 only **D** 3 only

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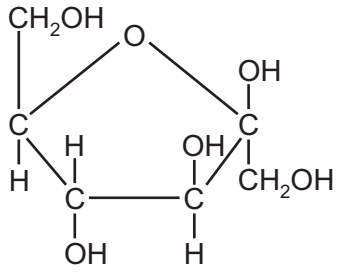
8 The diagram shows three hexose sugars.



1



2



3

Which row correctly shows examples of carbohydrates in which these three hexose sugars occur?

	sucrose	cellulose	amylopectin
A	1	2	3
B	1	3	2
C	2	3	1
D	3	2	1

9 Trehalose is a sugar that gives a negative result when tested with Benedict's solution.

A molecule of trehalose forms two α-glucose molecules when it is hydrolysed.

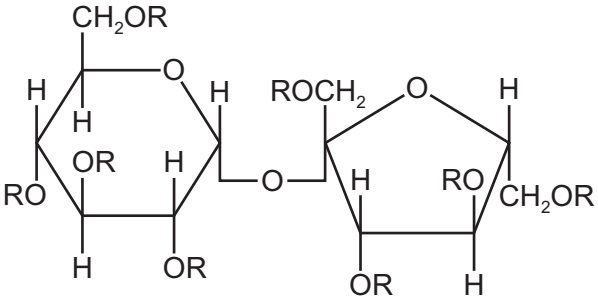
Which row is correct?

	formula of trehalose	sugar that gives the same result with Benedict's as trehalose
A	$C_{12}H_{22}O_{11}$	fructose
B	$C_{12}H_{22}O_{11}$	sucrose
C	$C_{12}H_{24}O_{12}$	fructose
D	$C_{12}H_{24}O_{12}$	sucrose

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10 Olestra is an artificial lipid. It is made by attaching fatty acids, by condensation, to a sucrose molecule.

A simplified diagram of olestra is shown. R represents the position where fatty acids would be attached.



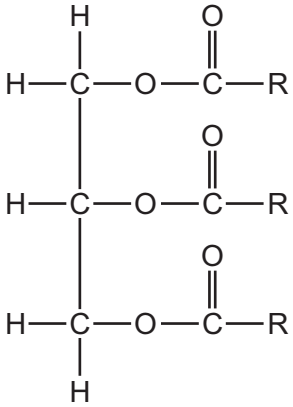
Humans cannot hydrolyse olestra. However, other animals may be able to do so.

How many molecules of water would be needed to hydrolyse one molecule of olestra into fatty acids, fructose and glucose?

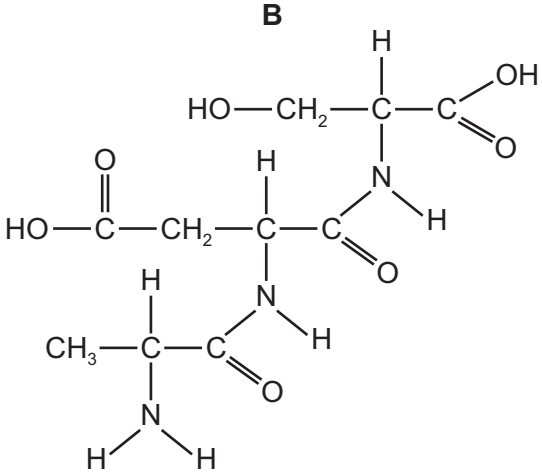
A 11 **B** 10 **C** 9 **D** 8

11 Which molecule contains at least one peptide bond?

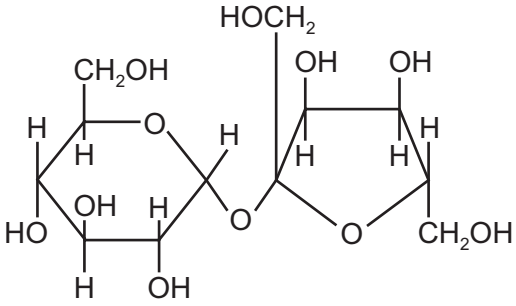
A



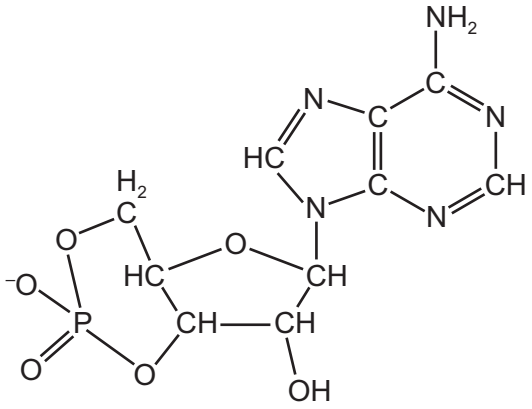
B



C



D



12 RNA polymerase and peptidyl transferase are both enzymes involved in protein synthesis.

Which statements describe similarities between these two enzymes?

1 They are both globular proteins.

2 They both have the same tertiary structure.

3 They are both intracellular enzymes.

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

13 What is a feature of competitive enzyme inhibition?

A The inhibitor binds permanently to the active site.

B Inhibition can be reversed by increasing the concentration of the substrate.

C The inhibitor molecule changes the secondary structure of the enzyme.

D The substrate and the inhibitor are the same shape.

14 Batrachotoxin is a poison found in frogs in the Colombian jungle. The poison is used to produce poison darts.

The poison works by increasing the permeability of the cell surface membrane of nerve and muscle cells to sodium ions, which move out of the cells.

Four students made statements about how the poison affects the cells.

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

2 Water enters the cells by osmosis, causing the cells to burst.

3 When the sodium ions move out of the cells the intracellular fluid has a more positive water potential than the extracellular fluid.

4 When the sodium ions move out of the cells the extracellular fluid has a more positive water potential than the intracellular fluid.

Which statements are correct for the cells affected by batrachotoxin?

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

15 Which processes use energy in the form of ATP?

1 endocytosis

2 exocytosis

3 facilitated diffusion

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

16 An indicator is colourless in acid and pink in alkali.

In an experiment a petri dish of agar was prepared using an acidic solution of this indicator.

A disc of agar 1 cm in diameter was removed from the centre to create a well.

A white card showing circular marker lines 1 cm apart was placed underneath the petri dish.

1 cm^3 alkali solution was put into the well in the agar and a stop-watch was started.

A circular disc of pink colour appeared and spread through the agar. It reached the first marker line in a short time but took longer to reach the second marker line and a very long time to reach the third marker line.

What explains these observations?

A facilitated diffusion of alkali solution

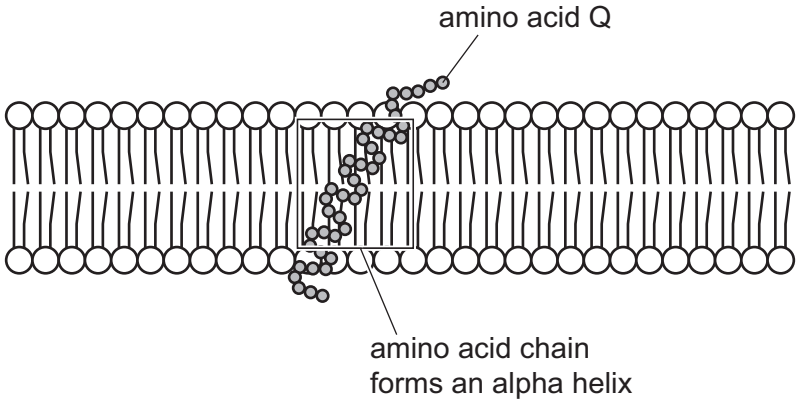
B facilitated diffusion of the indicator

C simple diffusion of alkali solution

D simple diffusion of the indicator

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17 The diagram shows a section of a glycoprotein molecule found embedded in a cell surface membrane. Each of the amino acids is represented by a small shaded circle.



Which row shows a property of the amino acids found in the alpha helix and a property of amino acid Q?

	property of amino acids found in the alpha helix	property of amino acid Q
A	non-polar	polar
B	non-polar	non-polar
C	polar	polar
D	polar	non-polar

18 Some cells are listed.

1 bacterial cells

2 cancer cells

3 lymphocytes

4 mature red blood cells

5 stem cells

Which cells can divide by mitosis?

A 1, 2, 4 and 5

B 1, 2 and 3

C 2, 3 and 5

D 3, 4 and 5

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19 Which statements about mitosis are correct?

1 At the end of telophase, two nuclei are formed.

2 Centrioles attach chromosomes to the spindle during metaphase.

3 Chromatids are pulled apart during anaphase.

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

20 Which statement about telomeres is correct?

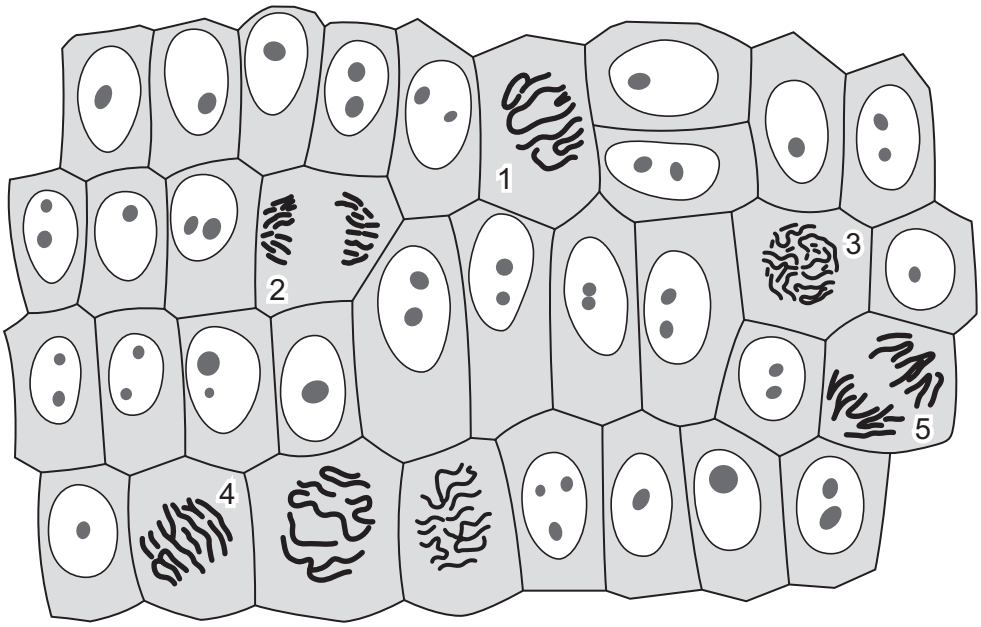
A They allow cells in culture from any age of donor to divide a fixed number of times.

B They are genes which are present on the 5′ end of every chromosome.

C They are unpaired regions of DNA on the 3′ end of every chromosome.

D They prevent introns and exons being lost from genes during cell division.

21 The diagram shows stages of mitosis.



What is the correct sequence of the stages of mitosis numbered on the diagram?

A 1 → 3 → 4 → 2 → 5

B 1 → 3 → 4 → 5 → 2

C 3 → 1 → 4 → 5 → 2

D 3 → 4 → 1 → 2 → 5

22 Which statement about the transcription and translation of a gene is correct?

A The non-transcribed strand of DNA has a base sequence that is identical to the mRNA produced in transcription.

B The template strand of DNA has a base sequence that is identical to the mRNA produced in transcription.

C The non-transcribed strand of DNA has a base sequence that is complementary to the tRNA molecules required in translation.

D The template strand of DNA has a base sequence that is complementary to the tRNA molecules required in translation.

23 Which statement about mRNA is correct?

A The primary transcript becomes modified by the joining of introns to become mRNA.

B The primary transcript is synthesised and then modified to mRNA in the nucleus.

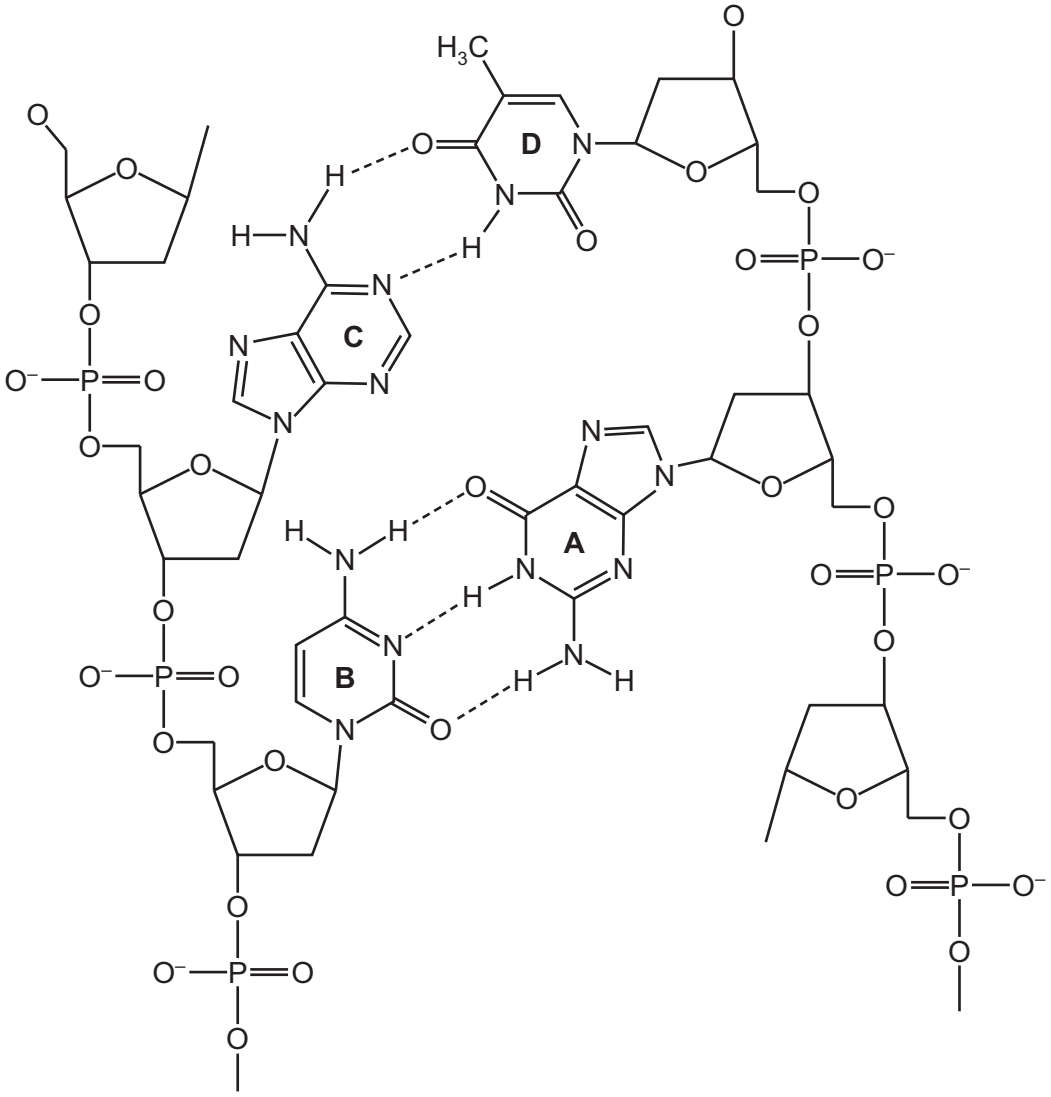
C mRNA contains nucleotides containing the sugar deoxyribose.

D The bases in mRNA are held together by covalent bonds.

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[Turn over

24 The diagram shows part of a DNA molecule.



Which label is correct?

A adenine

B guanine

C cytosine

D thymine

25 The sequence of bases in DNA coding for the first eight amino acids in the β-polypeptide of adult haemoglobin is:

CAC GTG GAC TGA GGA CTC CTC TTC

However, in haemoglobin C, which is a cause of haemolytic anaemia, it becomes:

CAC GTG GAC TGA GGA TTC CTC TTC

Some of the DNA triplets that code for the amino acids are listed in the table.

amino acid	DNA triplet
Glu	CTC
His	GTG
Leu	GAG
Lys	TTC
Pro	GGA
Thr	TGA

Which change occurs to the amino acid sequence of normal haemoglobin to make it haemoglobin C?

A Glutamic acid is changed to lysine.

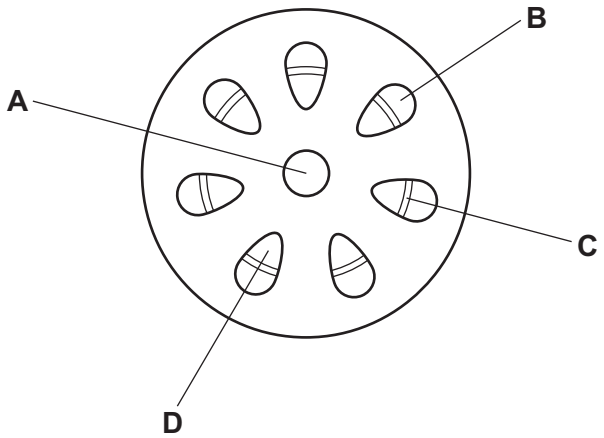
B Histidine is changed to leucine.

C Leucine is changed to lysine.

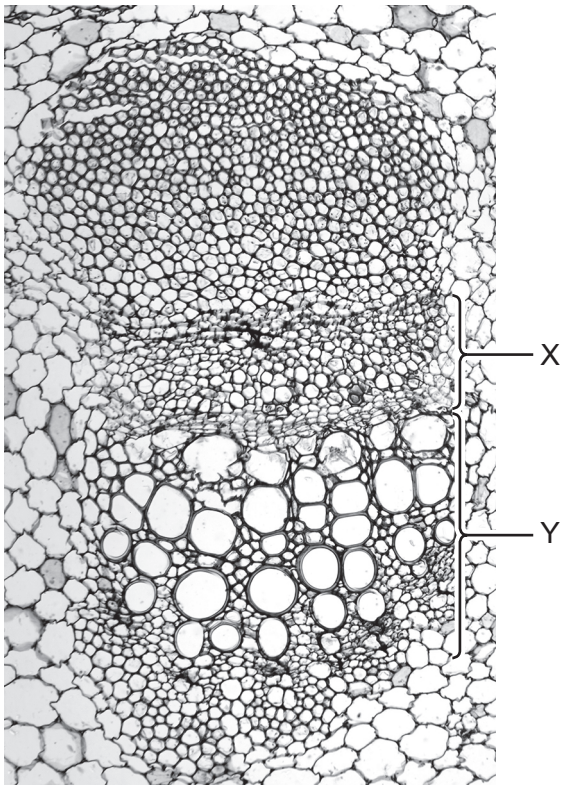
D Proline is changed to threonine.

26 The diagram shows a plant organ.

Which letter correctly labels the xylem?



27 The photomicrograph shows a vascular bundle found in a plant organ.



Which statements about this vascular bundle are correct?

1 The vascular bundle is part of the structure of a root.

2 Some of the cells in region X have very large numbers of mitochondria.

3 Region Y is made up of a number of different cell types.

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

28 Which changes to the water potential and the volume of solution 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 becomes	volume of solution in phloem sieve tube element
A	higher	decreases
B	higher	increases
C	lower	decreases
D	lower	increases

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29 Which processes occur during the loading of sucrose into phloem sieve tubes?

1 Protons are pumped out of the cytoplasm of the companion cell into its cell wall.

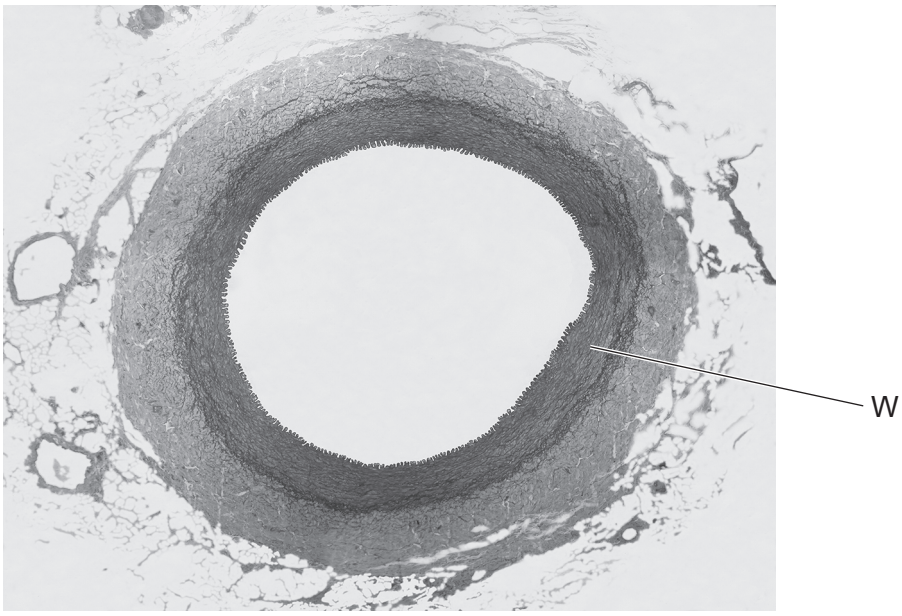
2 There is a higher concentration of protons in the symplastic pathway outside the companion cell.

3 Protons are unable to move back into the companion cell.

4 A co-transporter molecule acts as a carrier for protons and sucrose.

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

30 The photomicrograph shows a section through a structure found in mammals viewed using a light microscope.



×60

What are the main components of layer W?

A collagen fibres only

B elastic fibres and collagen fibres

C smooth muscle and elastic fibres

D squamous epithelial cells forming an endothelium

31 Which statement correctly links muscular or elastic arteries to their function?

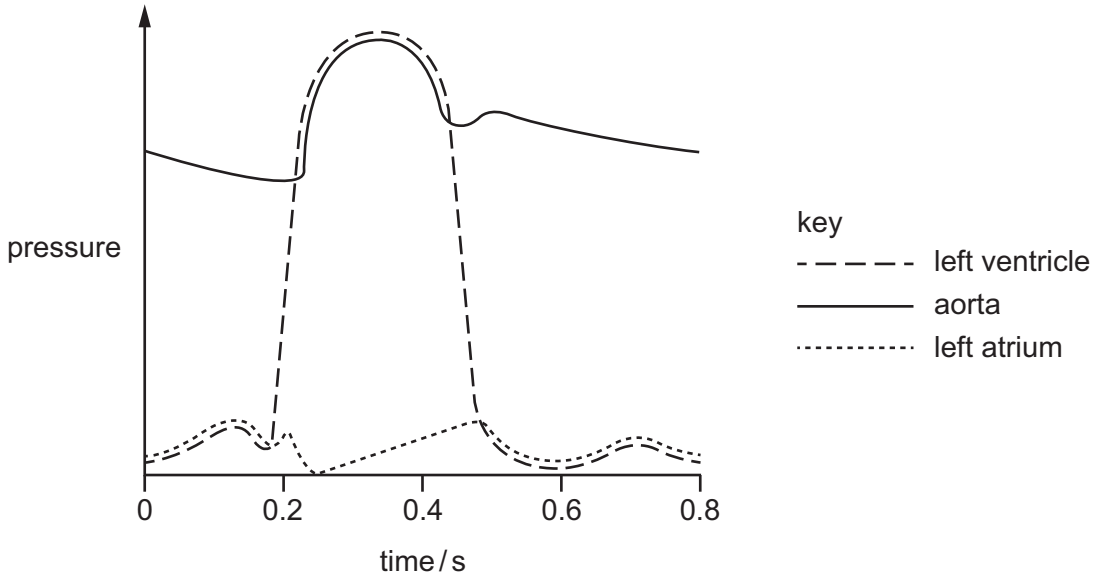
A The aorta is an example of a muscular artery as it transports blood from the left ventricle of the heart.

B Arteries further away from the heart are muscular arteries as they transport blood at high pressure.

C Elastic arteries expand when the heart contracts and then recoil as the heart relaxes to maintain pressure.

D Muscular arteries facilitate smoother blood flow than elastic arteries as their walls expand and recoil.

32 The graph shows the changes in pressure that occur in the left side of the heart during one cardiac cycle.



What is the heart rate in beats per minute?

A 75 **B** 80 **C** 120 **D** 150

33 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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34 Which reactions take place in a capillary in the lungs?

1 Carbonic acid is formed from carbon dioxide and water.

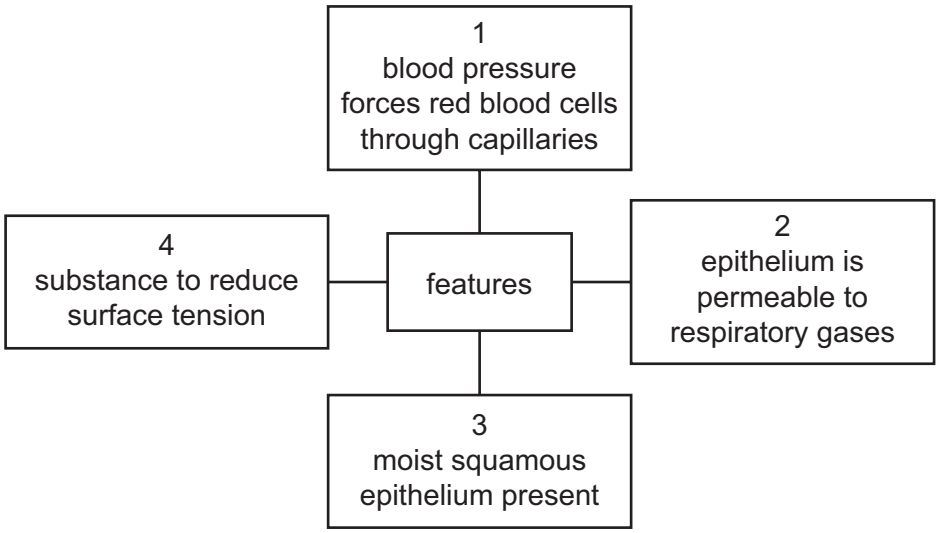
2 Carbaminohaemoglobin is formed from carbon dioxide and haemoglobin.

3 Haemoglobinic acid is formed from haemoglobin and hydrogen ions.

4 Carbon dioxide and water are formed from hydrogencarbonate ions and hydrogen ions.

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

35 Which features are important for the process of diffusion of oxygen out of an alveolus?



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

36 A student viewed three slides at both low magnification and high magnification. Each slide was a section through a different airway of the gas exchange system.

The student observed three features in each slide.

slide	three features observed by student
1	irregular arrangement of cartilage highly folded inner layer cilia on epithelial cells
2	very few goblet cells cilia on epithelial cells thick layer of smooth muscle relative to wall thickness
3	smooth muscle tissue blood vessels many goblet cells

Which row correctly identifies the three slides?

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

37 Which terms can be used to describe the role of mosquitoes in the transmission of malaria?

1 malarial parasite

2 pathogen

3 vector

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

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38 Rheumatoid arthritis is a disease which causes the body's immune system to attack its own cells. The disease can be treated using monoclonal antibodies.

The table shows how five different monoclonal antibodies can work.

monoclonal antibody	mode of action
1	binding to proteins on cell surfaces and triggering the immune system
2	blocking molecules on cell surfaces that inhibit T-lymphocytes
3	blocking cell signalling receptors that trigger cell division
4	binding to antigens on cell surfaces and releasing a drug
5	blocking cell signalling receptors that trigger the immune response

Inflammation and swelling of joints are symptoms of rheumatoid arthritis. The cytokine, TNFalpha, activates cells in the immune system leading to death of cells in the joint.

Which types of monoclonal antibody could be used to treat rheumatoid arthritis?

A 1, 2, 3, 4 and 5

B 1, 2, 3 and 4 only

C 2, 3 and 5 only

D 4 and 5 only

39 A person's blood group is determined by antigens present on the red blood cells. Antibodies in the plasma of the person who receives the blood can make some blood transfusions unsafe.

The table shows the antigens and antibodies in the blood of people with different blood groups.

blood group	presence of A or B antigens on red blood cells	presence of antibodies to A or B in plasma
A	A only	anti-B only
B	B only	anti-A only
AB	A and B	neither
O	neither	anti-A and anti-B

Which blood groups can be given to a person with blood group A?

A A and AB **B** A and O **C** B and O **D** AB only

40 Some of the events during the primary immune response are listed.

1 phagocytosis of a foreign microbe by a macrophage and antigen presentation

2 some T-lymphocytes will become T-killer cells which kill infected body cells

3 the T-helper cell divides by mitosis to produce T-lymphocyte clones

4 a T-helper cell with the complementary receptor binds to the antigens being presented

What is the correct sequence of events during the primary immune response?

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

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

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

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

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