Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/12**

Paper 1 Multiple Choice **May/June 2023**

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.

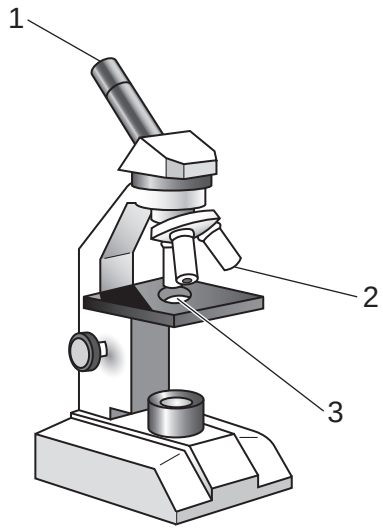
INFORMATION

- 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.

This document has **20** pages.

© UCLES 2023

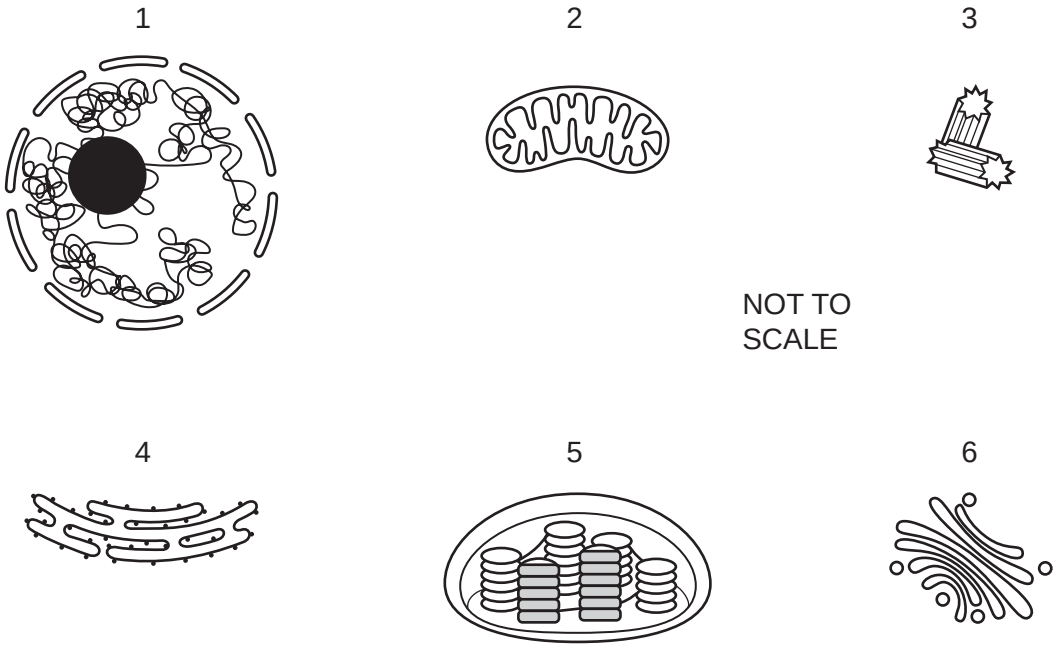
1 A graticule and a micrometer scale can be used to measure the size of biological structures that are viewed with a microscope.



Which row shows the correct locations for the placement of a graticule and a micrometer scale on the microscope shown?

	graticule	micrometer scale
A	1	2
B	1	3
C	2	3
D	3	1

2 Six organelles found in eukaryotic cells are shown.



Which organelles are involved in the synthesis and secretion of a glycoprotein?

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

3 Which cell structures can have mRNA inside them?

1 chloroplast

2 mitochondrion

3 nucleus

4 rough endoplasmic reticulum

A 1, 2, 3 and 4

B 1, 2 and 3 only

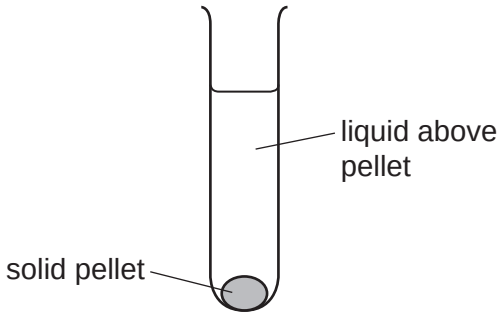
C 2, 3 and 4 only

D 3 and 4 only

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

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

The extracted mixture was filtered and then spun in a centrifuge at a high speed to separate the heaviest type of organelle. These sank to the bottom, forming solid pellet 1.



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

This procedure was repeated twice more to obtain pellet 3 and pellet 4, each containing a single type of organelle.

What is the main function of the type of organelle extracted in pellet 2?

A digestion of old organelles

B production of ATP

C production of mRNA

D synthesis of protein

5 Which structures are found in palisade mesophyll cells **and** photosynthetic prokaryotes?

1 cell surface membrane

2 cellulose wall

3 ribosomes

4 chloroplasts

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 3 only

D 2 and 4 only

© UCLES 2023

6 Which polymers are present in all viruses **and** all prokaryotes?

1 polynucleotides

2 polypeptides

3 polysaccharides

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

7 Which set of steps is the best method for conducting the emulsion test for lipids?

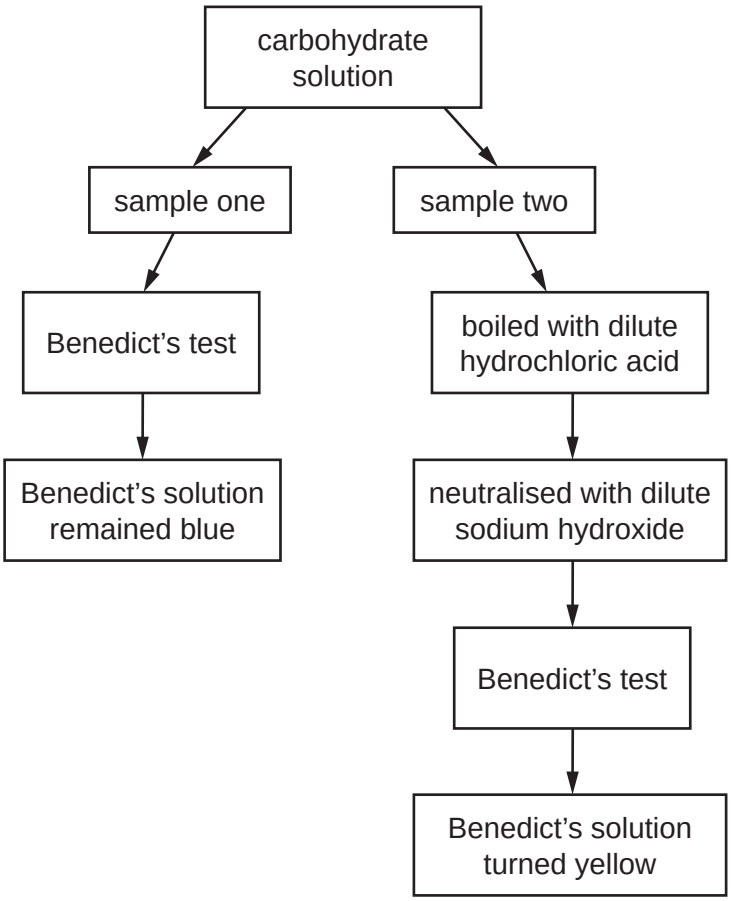
A Add 2 cm^3 of water to the sample.
Pour the water into a test-tube containing 2 cm^3 of ethanol.
Lipids are present if the mixture becomes cloudy.

B Add 2 cm^3 of ethanol to the sample and shake.
Pour the ethanol into a test-tube containing 2 cm^3 of water and boil.
Lipids are present if the mixture becomes clear.

C Add 2 cm^3 of water to the sample and shake.
Pour the water into a test-tube containing 2 cm^3 of ethanol and boil.
Lipids are present if the mixture becomes cloudy.

D Add 2 cm^3 of ethanol to the sample and shake.
Pour the ethanol into a test-tube containing 2 cm^3 of water and shake again.
Lipids are present if the mixture becomes cloudy.

8 A student was provided with a solution of carbohydrate. They removed two samples from the solution and performed tests on each sample, as shown.



Which statement explains the results?

A Condensation reactions occur in sample two to release reducing sugar.

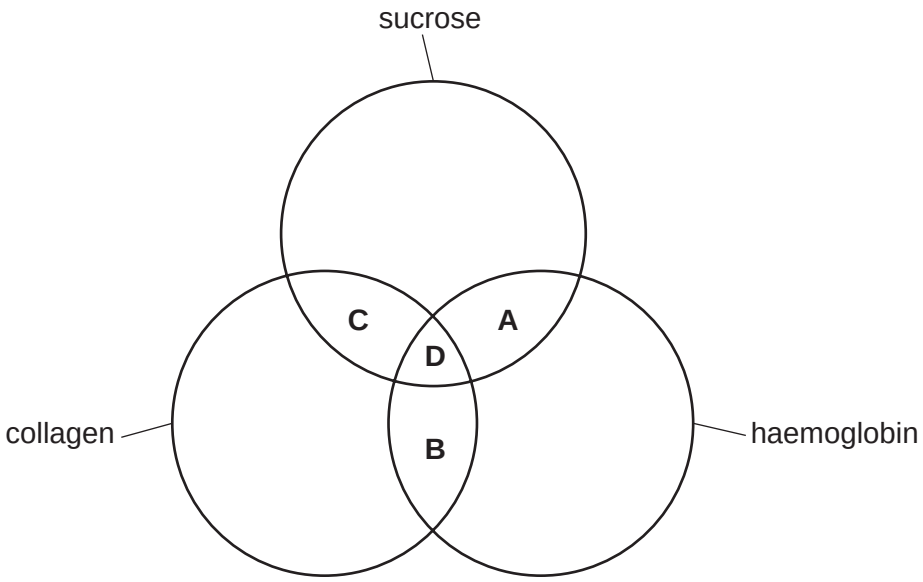
B Glycosidic bonds in a polysaccharide have been broken to release reducing sugar.

C Sample one shows that sucrose is present in the carbohydrate solution.

D The change in colour to a yellow solution shows that glucose is present.

© UCLES 2023

9 Which molecules contain at least two double bonds?



10 What describes cellulose?

A a branched chain of 1-4 α-glucose

B a branched chain of 1-4 β-glucose

C an unreactive linear chain of 1-4 α-glucose

D an unreactive linear chain of 1-4 β-glucose

11 Which part of the structure of haemoglobin carries oxygen?

A four polypeptide chains

B haem groups

C hydrogen bonds

D hydrophilic R groups

12 What is the maximum number of hydrogen bonds that can form between two single water molecules?

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

13 CYP3A4 is an important enzyme in the human digestive system where it is needed to break down a range of different toxins. The activity of CYP3A4 has been shown to be reduced by substances called furanocoumarins. Furanocoumarins are found in some fruits and so dangerous concentrations of toxins may develop in the human digestive system when fruits containing furanocoumarins are eaten.

From the information provided, what can be concluded about molecules of the enzyme CYP3A4?

A They lower the activation energy of the toxin breakdown reactions.

B They bind specifically through the active site to a substrate found in some fruits.

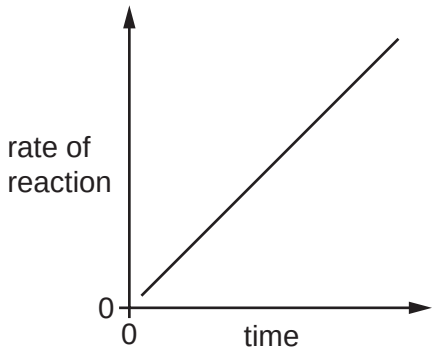
C They change permanently when acted upon by furanocoumarin molecules.

D They resume normal activity when concentrations of furanocoumarins decrease.

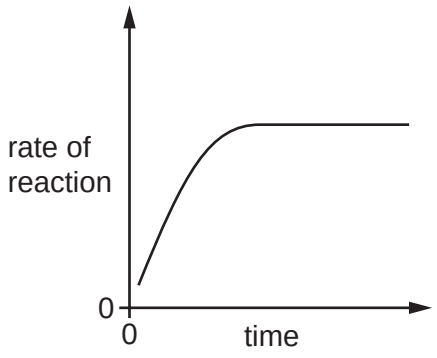
14 A fixed volume and concentration of substrate and enzyme were mixed. All other variables were kept constant. The enzyme-catalysed reaction was left until it was complete.

Which graph shows how the rate of reaction changes with time?

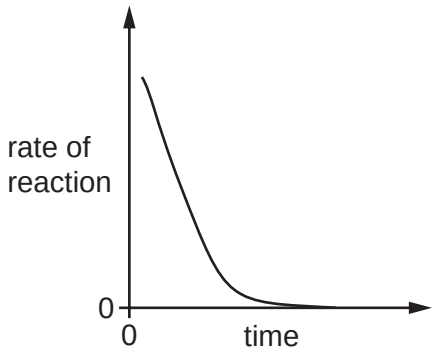
A



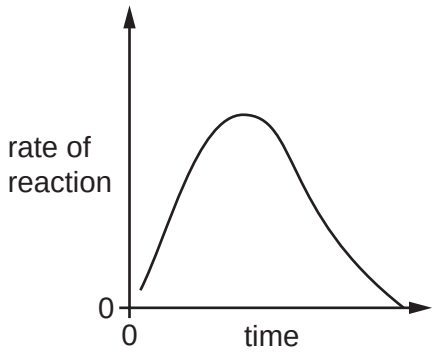
B



C



D



15 Which molecules in cell surface membranes are typically involved in cell recognition?

	cholesterol	glycolipids	glycoproteins	phospholipids
A	✓	✓	✗	✗
B	✓	✗	✗	✓
C	✗	✓	✓	✗
D	✗	✗	✓	✓

key

✓ = involved

✗ = not involved

16 What can increase the fluidity of the cell surface membrane?

1 single bonds between carbon atoms in the fatty acid chains

2 cholesterol

3 longer-chained fatty acids

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

17 The three main factors that affect the rate of diffusion across a membrane can be expressed by the relationship shown.

$$\text{rate of diffusion is proportional to } \frac{\text{surface area} \times \text{concentration difference}}{\text{thickness of membrane}}$$

Which changes in the factors would result in the rate of diffusion doubling?

1 Surface area has doubled.

2 Concentration difference has halved.

3 Thickness of membrane has doubled.

4 Thickness of membrane has halved.

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

18 A student measured the time taken for complete diffusion of a dye into agar blocks of different sizes which were suspended in the dye.

The results are shown.

size of agar block / mm × mm × mm	time for diffusion / s
5 × 5 × 5	6.2
10 × 10 × 10	16.1
15 × 15 × 15	34.5
5 × 10 × 15	

What is the predicted time for complete diffusion of the dye into the agar block measuring 5 mm × 10 mm × 15 mm?

A 6.2 s

B 16.1 s

C 34.5 s

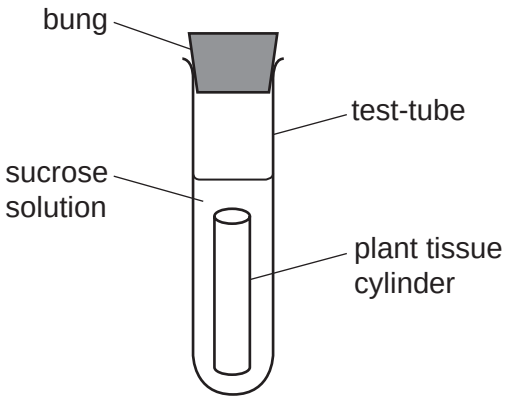
D more than 34.5 s

© UCLES 2023

19 An experiment was carried out to investigate the effect of concentration of sucrose solution on cells in a plant tissue.

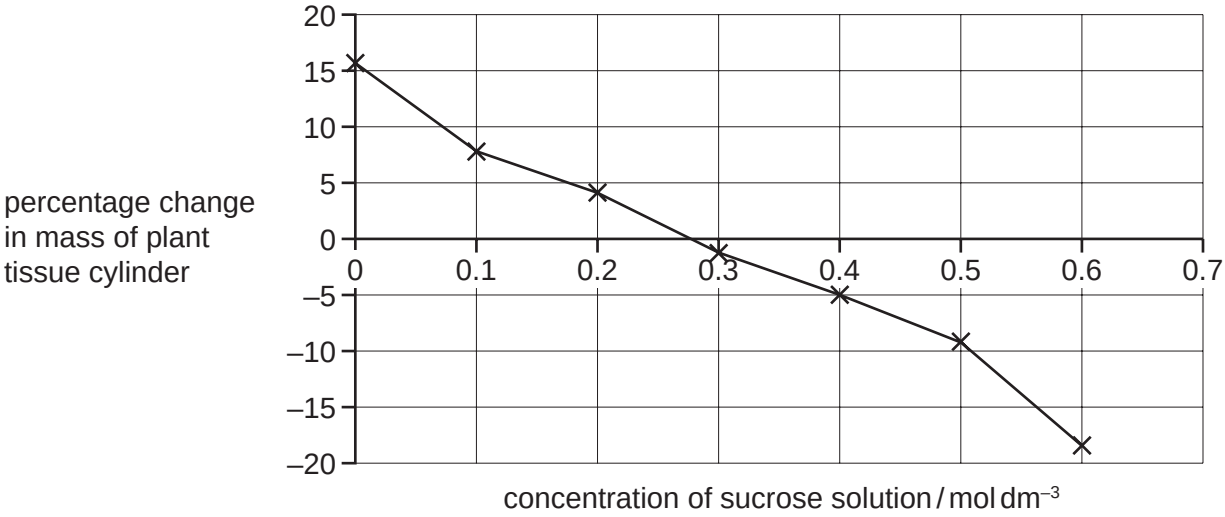
A sample of plant tissue was cut into seven cylinders of equal length and diameter. The mass of each cylinder was recorded.

Each of the seven cylinders was put into a different sucrose solution concentration.



After two hours, the cylinders were removed, blotted dry and reweighed. The percentage change in mass of each cylinder was recorded.

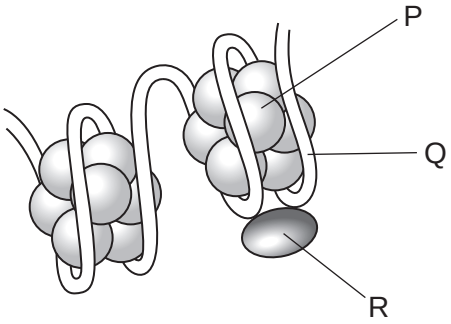
The graph shows the results of this investigation.



Which row explains the results if plant tissue cells were put in a sucrose solution of 0.45 mol dm^{-3}?

	water potential of the cytoplasm of the cells at the start of the experiment compared with the water potential of 0.45 mol dm^{-3} sucrose solution	change in volume of the vacuoles of the cells at the end of the experiment, that were initially placed in 0.45 mol dm^{-3} sucrose solution
A	less negative	decreased
B	less negative	increased
C	more negative	decreased
D	more negative	increased

20 The diagram shows part of the organisation of a section of a DNA molecule and the associated histones, P and R, in prophase of mitosis.



Which statement about the features labelled P, Q and R during prophase of mitosis is correct?

A The coiled DNA molecule forms Q and wraps around histone R to form small clusters held in place by histone P.

B The groups of histones, P, and its associated DNA, Q, move closer together as the chromosome condenses around R.

C The histones P and R are made of protein around which the DNA molecule, Q, is wrapped so that the DNA molecule can fit inside the nucleus.

D The linked groups of histones P and R and the associated DNA, Q, form strands that fold and twist together to form a chromatid.

21 How many copies of each DNA molecule will be found in a cell at the **start** of the stages of the mitotic cell cycle shown?

	G_1 of interphase	cytokinesis
A	1	1
B	1	2
C	2	1
D	2	2

22 One characteristic of DNA is that it is a universal genetic code.

What is meant by a universal genetic code?

A All living organisms use the same triplet code for amino acids.

B All DNA triplets code for a different amino acid.

C Not all DNA triplets code for an amino acid.

D All living organisms contain the same four nucleic acids.

© UCLES 2023

23 Which statement about mRNA is correct?

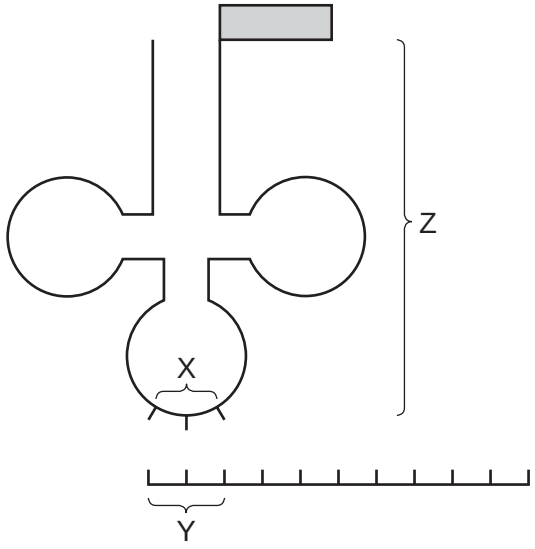
A It is a polymer made of nucleotides all joined with hydrogen bonds.

B Each nucleotide subunit contains the sugar ribose.

C It always has an equal proportion of adenine and uracil.

D The mRNA sequence is identical to the template strand of DNA.

24 The diagram shows part of the process of translation.



What are the names of the structures labelled X, Y and Z?

	X	Y	Z
A	anticodon	codon	mRNA
B	anticodon	codon	tRNA
C	codon	anticodon	mRNA
D	codon	anticodon	tRNA

25 The DNA triplets of genes are translated as amino acids or stop signals during protein synthesis. The table shows some of these triplets.

DNA triplet	name of amino acid
ATA	tyrosine
ATG	tyrosine
ACA	cysteine
ACG	cysteine
ATC	*stop signal*
ACC	tryptophan

What could be the effects of **one** substitution mutation in a triplet coding for tyrosine?

1 The triplet is translated as cysteine.

2 The triplet is translated as tryptophan.

3 The triplet is translated as tyrosine.

4 Translation stops at this triplet.

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

26 Which row identifies cells with plasmodesmata?

	phloem sieve tube element	companion cell	xylem vessel element
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = plasmodesmata present

✗ = plasmodesmata not present

27 Which statements about the apoplast and symplast pathways are correct?

1 In the apoplast pathway, water molecules move through free spaces in the cellulose cell walls of plant roots.

2 In the symplast pathway, water molecules diffuse through the cytoplasm and plasmodesmata of cells.

3 Water molecules travelling through plant tissue move by mass flow along the apoplast pathway.

4 The Casparian strip blocks the symplast pathway and forces all water molecules to enter the cytoplasm of endodermis cells.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 2 only

D 3 and 4 only

28 Where does water evaporate from during transpiration?

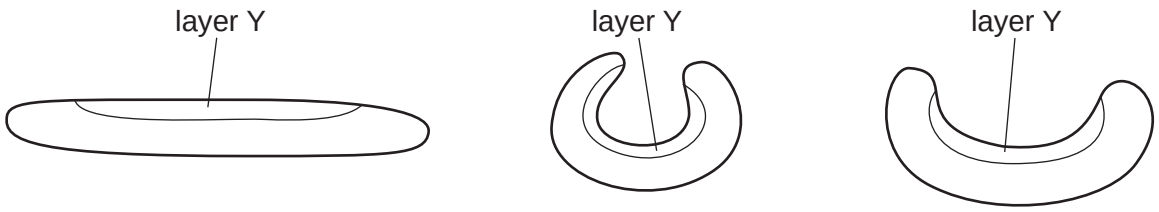
A intercellular spaces

B leaf surface

C mesophyll cell walls

D stomatal pores

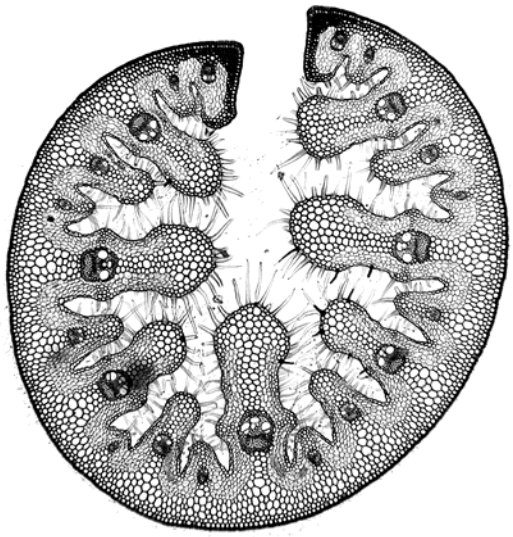
29 The diagram shows the outline of three xerophytic leaves of the same type in three different conditions, P, R and S.



Which description of the water potential of the cells in layer Y is correct?

	water potential of cells in layer Y		
	P	R	S
A	higher than R and S	lower than P and S	lower than P
B	higher than S	lower than P	higher than P
C	lower than R	higher than S	higher than R
D	lower than R and S	higher than P	lower than P

30 The photomicrograph shows a transverse section of the leaf of a species of grass.



The grass is specially adapted to grow in a dry habitat.

Which row correctly explains how the features help the grass to grow in this habitat?

	hair-like structures	leaf shape
A	increase internal humidity	decrease external humidity
B	decrease external humidity	increase internal humidity
C	increase internal humidity	increase internal humidity
D	decrease external humidity	decrease external humidity

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

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

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

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

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

32 Which properties of water are essential for its role in the transport of blood in mammals?

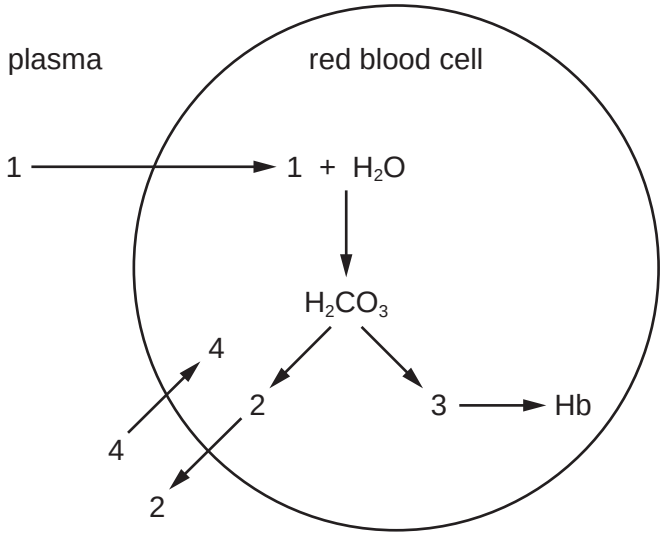
	high latent heat of vaporisation	solvent for polar substances
A	✓	✗
B	✗	✓
C	✓	✓
D	✗	✗

key

✓ = essential

✗ = not essential

33 The diagram shows some of the events that happen between the plasma and the red blood cells in the circulatory system.



What do the numbers 1, 2, 3 and 4 represent?

	1	2	3	4
A	Cl^-	HCO_3^-	H^+	CO_2
B	CO_2	HCO_3^-	H^+	Cl^-
C	HCO_3^-	Cl^-	CO_2	H^+
D	CO_2	H^+	HCO_3^-	Cl^-

34 The diagrams show the valves in the heart when viewed in cross-section from above at different stages in the cardiac cycle.

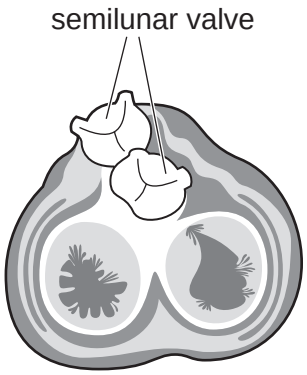


diagram 1

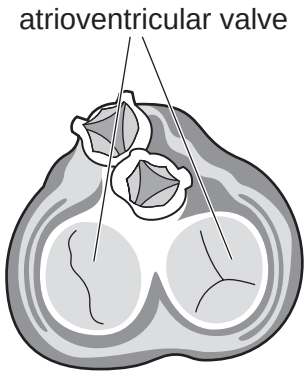


diagram 2

Which stages in the cardiac cycle are shown?

	diagram 1	diagram 2
A	diastole	ventricular systole
B	atrial systole	diastole
C	ventricular systole	diastole
D	diastole	atrial systole

35 Where are squamous epithelial cells found in the human gas exchange system?

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

key

✓ = found

✗ = not found

36 Which statement about gas exchange between air in the alveoli and blood in the pulmonary capillaries is correct?

A The oxygen concentration in the capillaries leaving the pulmonary artery is higher than the oxygen concentration in the alveoli.

B Gases must diffuse across the endothelium of the pulmonary capillaries and the endothelium of the alveoli.

C The elastic fibres in the alveoli walls allow the alveoli to expand to increase the surface area available for diffusion into the pulmonary capillaries.

D Breathing out reduces the carbon dioxide concentration gradient between the blood in the pulmonary capillaries and the air in the alveoli.

© UCLES 2023

37 The average thicknesses for some structures in the human respiratory system are shown.

structure	average thickness of structure / nm
human cell membrane	5
cytoplasm of alveolar wall cells	190
cytoplasm of capillary wall cells	90
tissues between alveolar wall and capillary wall	300

A molecule of oxygen is in the alveolar air space next to the wall of the alveolus.

What is the shortest distance that the molecule needs to diffuse from its current position to the haemoglobin that completely fills a red blood cell in the nearest capillary?

(Assume that the red blood cells touch the walls of a capillary.)

A 595 nm **B** 600 nm **C** 605 nm **D** 610 nm

38 The statements refer to the disease tuberculosis (TB).

1 The pathogen is **not** accessible to the immune system.

2 The bacterial pathogen reproduces slowly.

3 The pathogen is **not** very sensitive to antibiotics.

Which statements explain why antibiotic treatment for TB takes a long time?

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

TURN OVER FOR QUESTIONS 39 AND 40.

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

39 The average sizes of some pathogens are shown.

pathogen	average size / nm
HIV particle	100
Mycobacterium tuberculosis	3 000
Plasmodium	20 000
Vibrio cholerae	1 500

One type of air filter has been shown to be effective at preventing any pathogens of 1 µm or larger from entering the air system of a room.

Based on their size **and** mode of transmission, which diseases would the air filter prevent from entering the air system of a room?

	HIV infection	TB	malaria	cholera
A	✗	✓	✓	✓
B	✗	✗	✓	✓
C	✓	✗	✗	✗
D	✗	✓	✗	✗

key

✓ = prevented

✗ = not prevented

40 A successful vaccination programme provides a level of immunity where the majority of a population is protected.

There are several factors that can affect the success of a vaccination programme.

Which row correctly shows the factors that can affect the success of a vaccination programme?

	frequent mutation of the pathogen	vaccination from eight weeks old	pathogen is able to invade T-cells	booster vaccinations needed frequently
A	✓	✓	✗	✓
B	✓	✗	✓	✓
C	✗	✓	✓	✗
D	✓	✗	✓	✗

key

✓ = affects

✗ = does not affect