



Cambridge International AS & A Level

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.

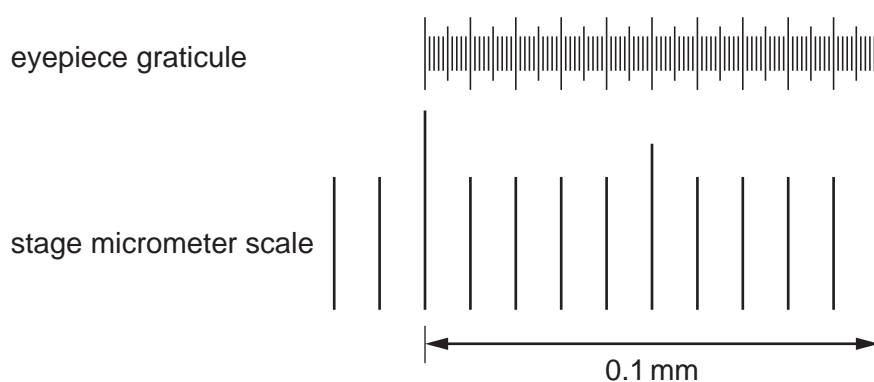


2

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 $\times 100$ 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

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.

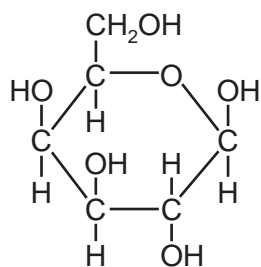
| solution | Benedict's following acid hydrolysis | Benedict's | biuret | emulsion |
|----------|--------------------------------------|------------|--------|----------|
| 1 | blue | blue | purple | cloudy |
| 2 | green | blue | purple | clear |
| 3 | red | green | purple | cloudy |
| 4 | yellow | yellow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

Which solutions contained molecules with ester bonds?

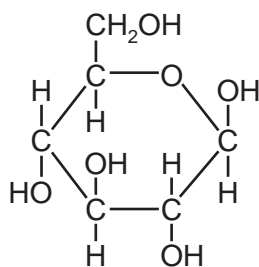
- A** 1, 2 and 3 **B** 1 and 3 only **C** 2, 3 and 4 **D** 2 and 4 only

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

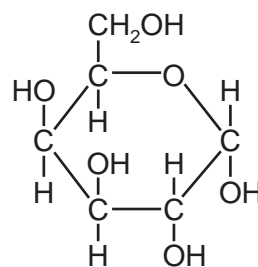
Both can exist in an alpha (α) or beta (β) form as shown.



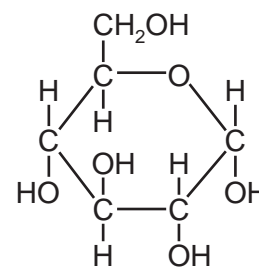
β -galactose



β -glucose

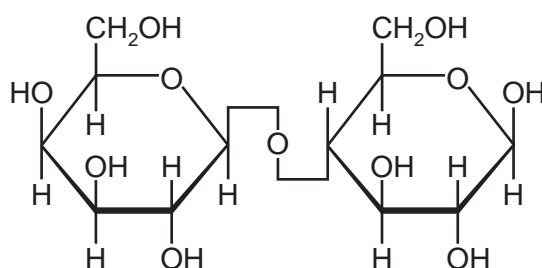


α -galactose



α -glucose

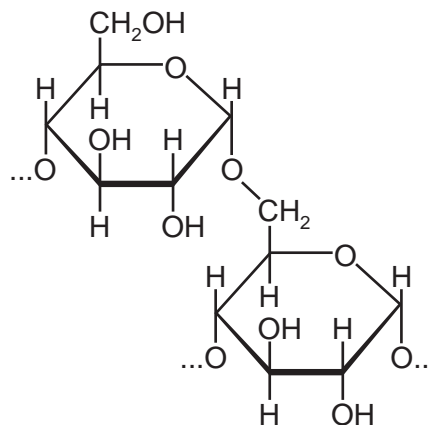
The diagram shows a lactose molecule formed by condensation between glucose and galactose.



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

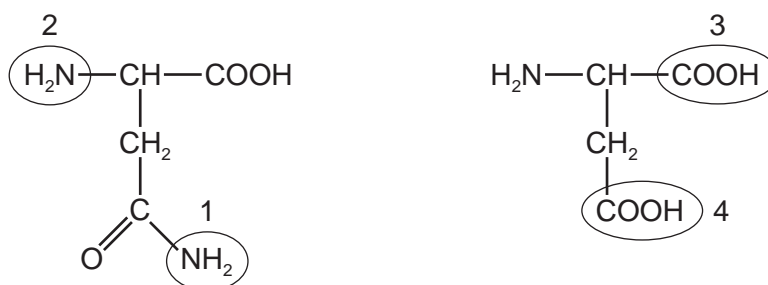
- 9 One type of covalent bond between two monomers is shown.



Which molecules contain this type of covalent bond?

- A** amylopectin, amylose, glycogen and starch
B amylopectin, amylose and glycogen only
C amylopectin, glycogen and starch only
D amylose, 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

- 12 The diagrams show the structures of two amino acids. One contains two amino ($-\text{NH}_2$) groups, labelled 1 and 2. The other contains two carboxylic ($-\text{COOH}$) 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 |

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

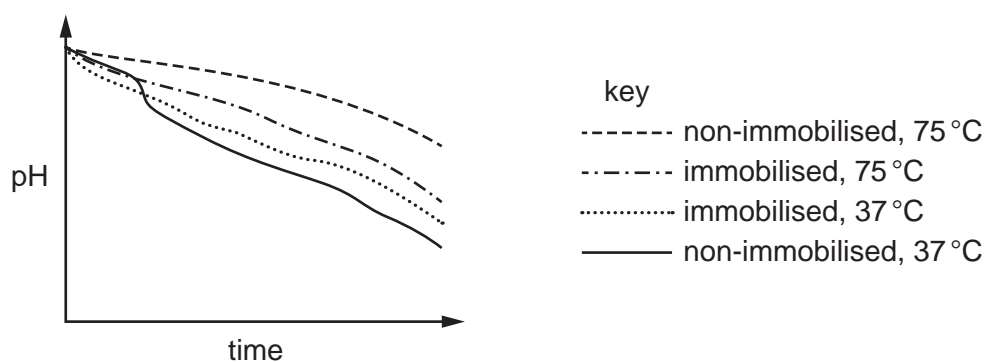
Each substrate gives a different K_m value.

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

| | substrate | $K_m / \text{mol dm}^{-3}$ |
|----------|-----------|----------------------------|
| 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

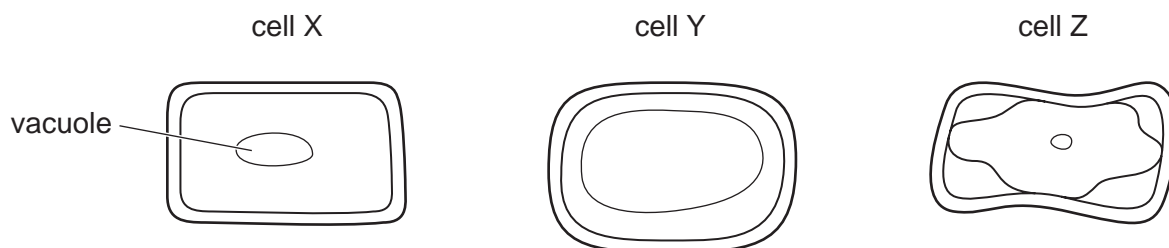
- 16 An indicator mixed with agar forms a pink colour. The pink-coloured agar becomes colourless when put in acid.

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.

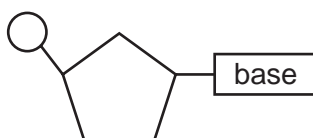


Which processes have occurred in the two hydra?

- 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

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

- 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?

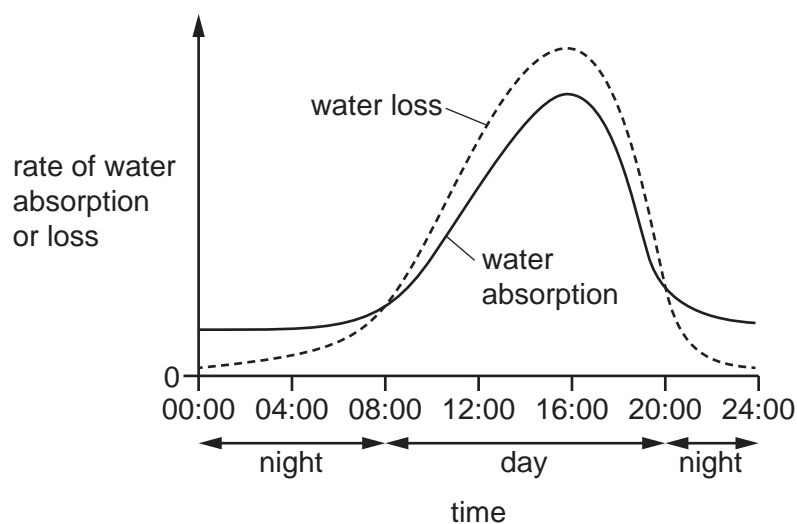
- A 1 B 2 C 4 D 8

- 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

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.

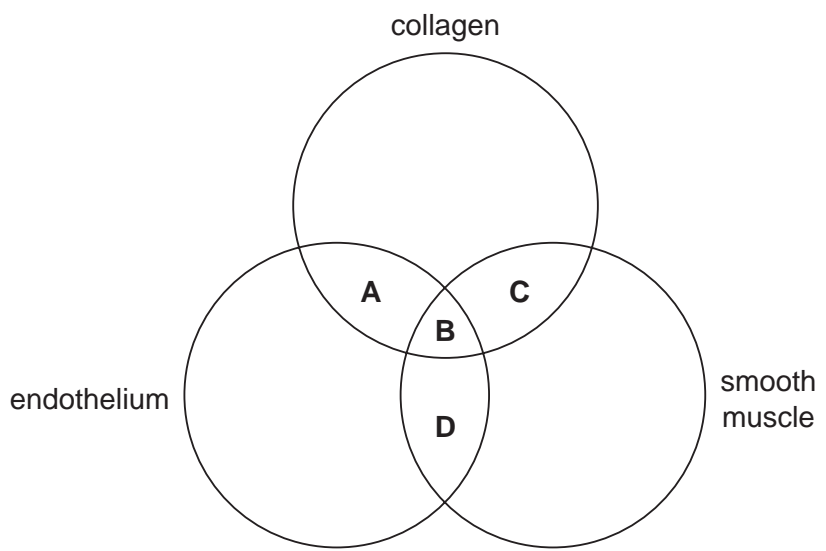
A 1 → 2 → 4 → 3

B 1 → 4 → 2 → 3

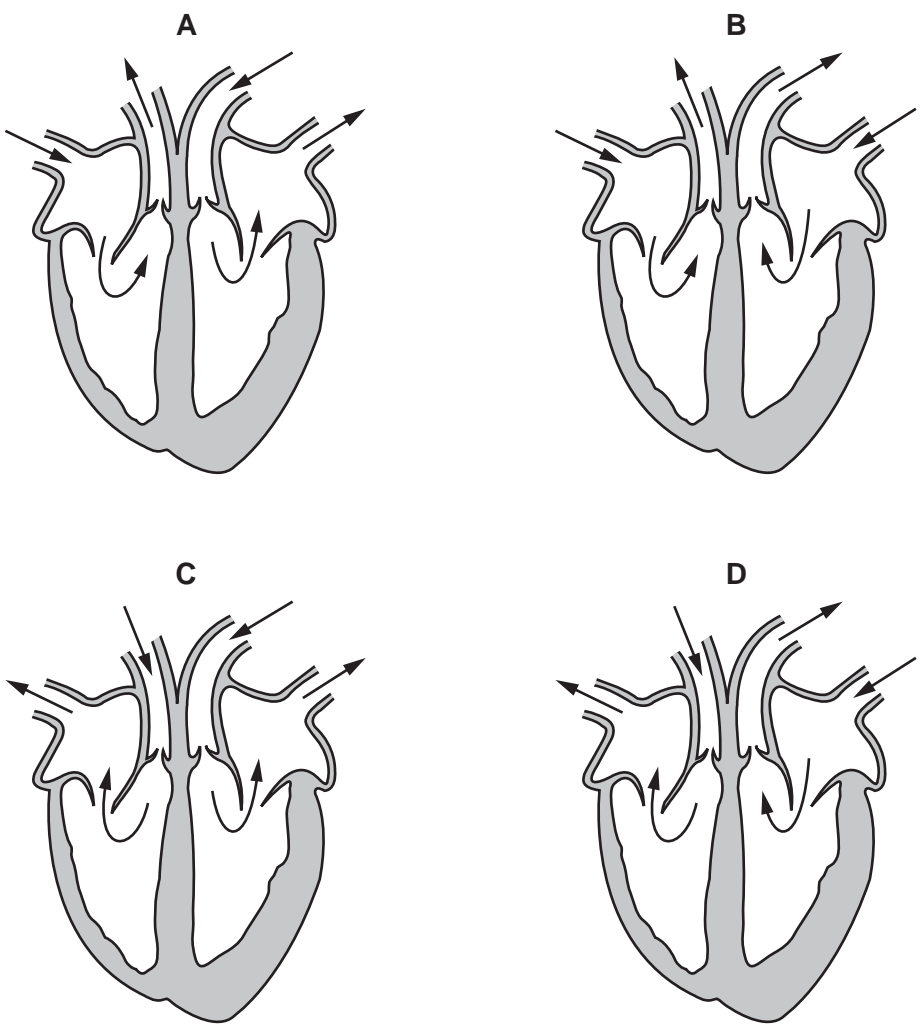
C 2 → 1 → 4 → 3

D 4 → 1 → 2 → 3

29 Which components are found in arteries?



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



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?

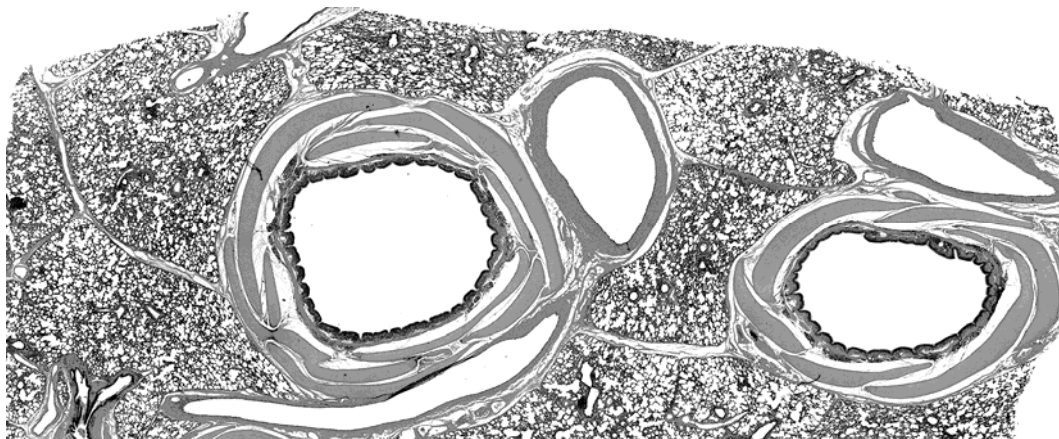
| | cartilage | cilia | smooth muscle |
|----------|-----------|-------|---------------|
| A | ✓ | ✓ | ✗ |
| B | ✓ | ✗ | ✓ |
| C | ✗ | ✓ | ✓ |
| D | ✗ | ✓ | ✗ |

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 pain when breathing loss of weight | shortness of breath difficulty breathing out 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 |

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?

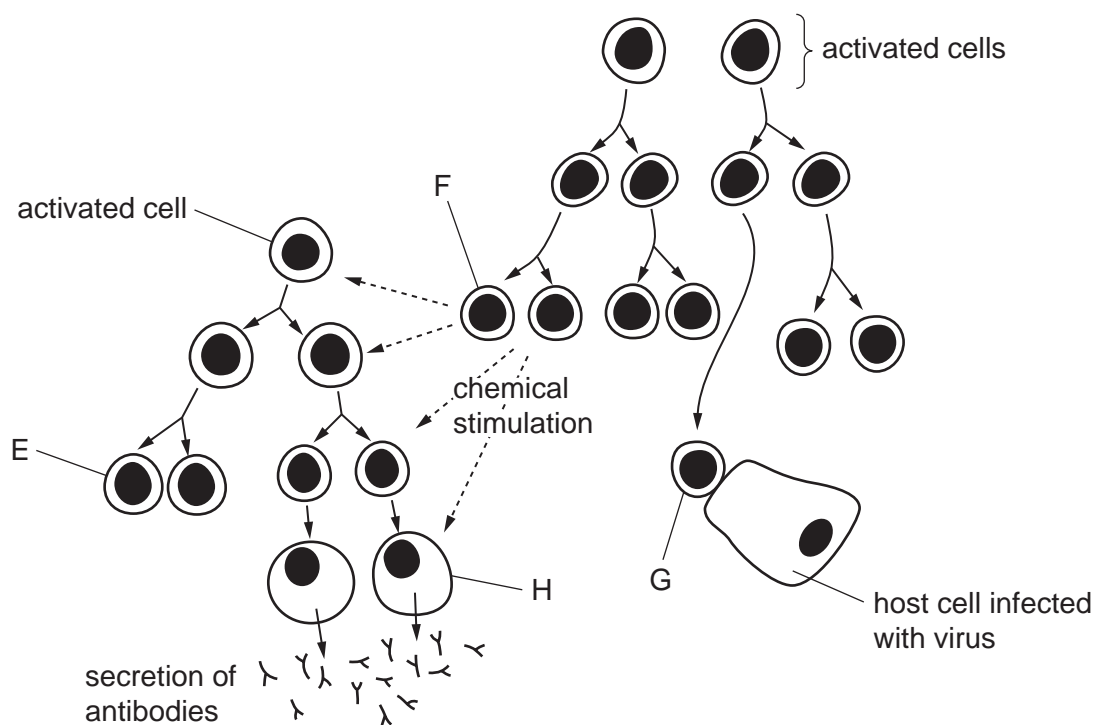
| | cell surface membrane | genes | ribosomes |
|----------|-----------------------|-------|-----------|
| A | ✓ | ✓ | ✓ |
| B | ✓ | x | x |
| C | x | ✓ | ✓ |
| D | x | ✓ | x |

key

✓ = common to all three pathogens

x = 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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