Cambridge International AS & A Level

**Cambridge International Examinations**
Cambridge International Advanced Subsidiary and Advanced Level

**BIOLOGY** **9700/11**

Paper 1 Multiple Choice **October/November 2017**

**1 hour**

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

*5026880790*

**READ THESE INSTRUCTIONS FIRST**

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

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

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

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


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**1** Which row is correct for a typical plant cell?

| | cell wall | cell diameter | ribosomes |
|---|---|---|---|
| **A** | cellulose | 1-5 μm | 80S |
| **B** | cellulose | 5-40 μm | 70S and 80S |
| **C** | peptidoglycan | 1-5 μm | 70S |
| **D** | peptidoglycan | 5-40 μm | 70S and 80S |

**2** An electron micrograph of a cell shows large quantities of rough endoplasmic reticulum and many Golgi bodies.

What type of cell is being viewed?

**A** bacterium

**B** guard cell

**C** lymphocyte

**D** mesophyll

**3** Which cell structures can form vesicles?

| | cell structure | | |
|---|---|---|---|
| | cell surface membrane | endoplasmic reticulum | Golgi body |
| **A** | ✓ | ✓ | ✓ |
| **B** | ✓ | ✓ | ✗ |
| **C** | ✓ | ✗ | ✓ |
| **D** | ✗ | ✓ | ✓ |

key

✓ = can form vesicles

✗ = cannot form vesicles

**4** 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 |

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**5** The size of the measles virus is approximately 150 nm.

The *Mimivirus* is approximately 4.5 times larger than the measles virus, whilst the *Pandoravirus* is approximately 1.5 times larger than the *Mimivirus*.

Which viruses can be seen using **both** a light microscope with a maximum resolution of 0.25 μm **and** an electron microscope?

| | measles virus | *Mimivirus* | *Pandoravirus* |
|---|---|---|---|
| **A** | ✓ | ✓ | ✓ |
| **B** | ✗ | ✓ | ✓ |
| **C** | ✗ | ✗ | ✓ |
| **D** | ✗ | ✗ | ✗ |

key
✓ = can be seen
✗ = cannot be seen

**6** Which carbohydrate gives a brick red colour when boiled with Benedict's solution?

**A** cellulose

**B** fructose

**C** glycogen

**D** sucrose

**7** Which two polysaccharides both have 1,6 glycosidic bonds **and** are branched?

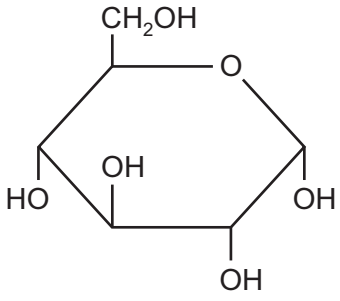
**A** amylopectin and amylose

**B** amylopectin and glycogen

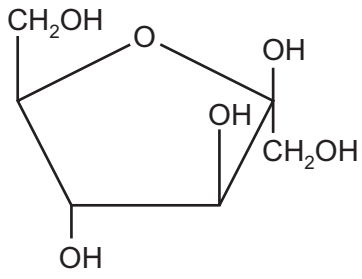
**C** amylose and glycogen

**D** glycogen and cellulose

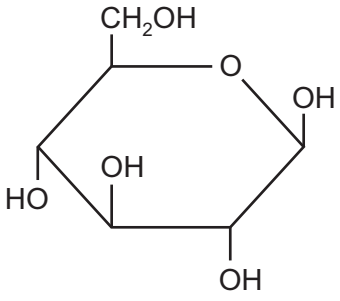
**8** Three carbohydrate molecules are shown.




1




2

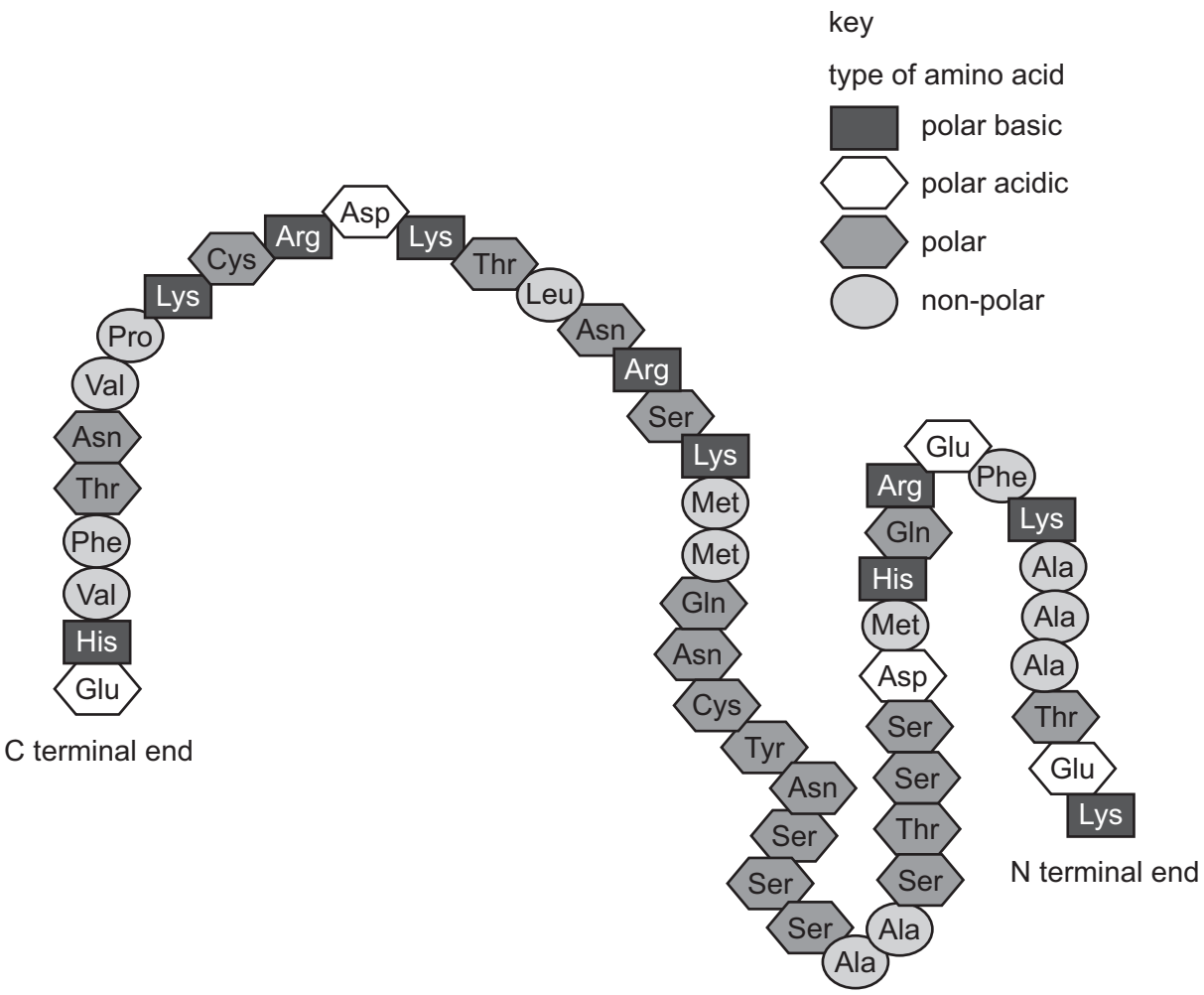



3

Which two molecules combine to form a molecule of sucrose?

**A** 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** two of molecule 1

**9** The diagram shows the amino acids in a polypeptide.




An enzyme catalyses the hydrolysis of bonds between polar basic amino acids and non-polar amino acids.

How many peptides (chains of amino acids) will be formed as the result of the hydrolysis of this polypeptide?

**A** 5 **B** 6 **C** 8 **D** 13

**10** Lysozyme is an enzyme found in tears and saliva.

Which statement refers only to the tertiary structure of lysozyme?

**A** A section of the molecule consists of an $\alpha$-helix.

**B** It consists of a single polypeptide.

**C** It is 129 amino acids long.

**D** The 35th and 52nd amino acids help form the active site.

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**11** Some RNA molecules, called ribozymes, can catalyse reactions in a similar way to protein enzymes.

Most of these ribozymes have other RNA molecules as their substrates and catalyse reactions that break specific sugar phosphate bonds in the substrate molecules.

Which statements about these ribozymes are correct?

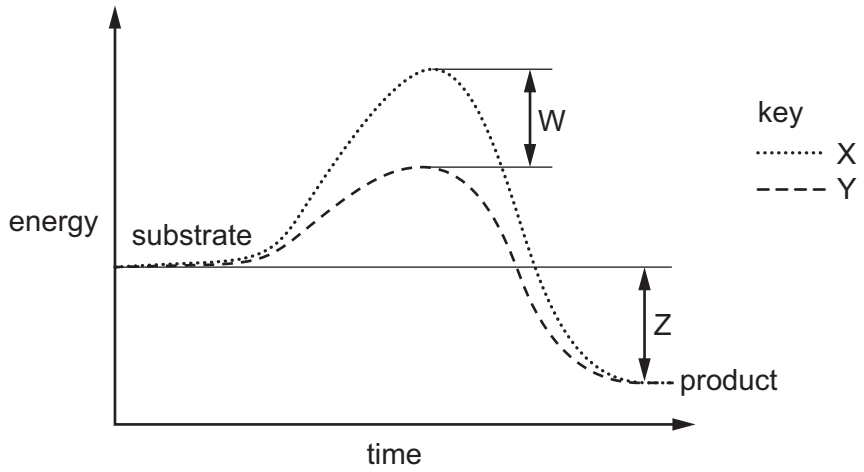
1 Hydrogen, ionic and disulfide bonds will be involved in the ribozyme structure.

2 The active site of a ribozyme is formed from a specific sequence of nucleotides.

3 Ribozymes can form because RNA can have a specific secondary and tertiary structure.

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

**12** The graph shows the effect of an enzyme on a reaction.




Which labels are correct?

**A** X is the reaction without the enzyme, W is the activation energy.

**B** X is the reaction with the enzyme, Z is the overall energy change.

**C** Y is the reaction with the enzyme, W is the difference in activation energy.

**D** Z is the energy gained by the product, W is the activation energy with the enzyme.

**13** Which statements about non-competitive enzyme inhibitors are correct?

1 The inhibitor can bind to the enzyme whether or not the enzyme has its substrate bound in the active site.

2 The inhibitor may bind at an allosteric site.

3 The inhibitor may not prevent substrate binding at the active site, but will prevent product formation.

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

**14** 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

**15** The fluidity of the cell surface membrane can be changed by a number of factors.

As the fluidity of cell surface membranes decreases, which process would be **least** affected?

**A** active transport

**B** diffusion

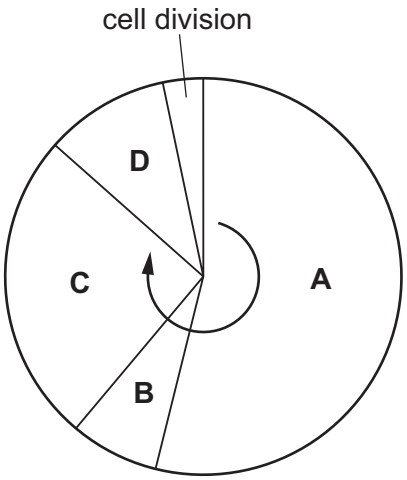
**C** endocytosis

**D** osmosis

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**16** The diagram shows the cell cycle.

During which phase do chromosomes condense and become visible?




**17** Colchicine is a chemical that stops chromatids from separating during mitosis.

A cell is treated with colchicine.

Which stage of mitosis will this cell reach but not complete?

**A** anaphase

**B** metaphase

**C** prophase

**D** telophase

**18** The following statements describe the process of translation.

1 A peptide bond forms between adjacent amino acids.

2 Hydrogen bonds form between the anticodon and the codon.

3 mRNA binds to the ribosome.

4 tRNA enters the ribosome carrying a specific amino acid.

In which order does this process take place?

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

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

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

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

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**19** Which row represents the correct features of the nitrogenous base adenine?

| | has a single ring structure | is a purine | joins its complementary base by three hydrogen bonds | pairs with thymine |
|---|---|---|---|---|
| **A** | ✓ | ✓ | ✗ | ✗ |
| **B** | ✓ | ✗ | ✓ | ✗ |
| **C** | ✗ | ✓ | ✗ | ✓ |
| **D** | ✗ | ✗ | ✗ | ✓ |

key
✓ = true
✗ = false

**20** The codons UGU and UGC code for the amino acid cysteine, which can form disulfide bonds in a polypeptide.

The codon UGG codes for the amino acid tryptophan, which does not contain a sulfur atom.

The codon UGA is a stop signal.

The DNA triplet code for the 10th amino acid in a particular polypeptide is ACA.

Which single base substitutions in this triplet code will result in **no** disulfide bond being formed with the 10th amino acid in the polypeptide?

**A** ACC and ACG

**B** ACG and ACT

**C** ACT and ACC

**D** ACT only

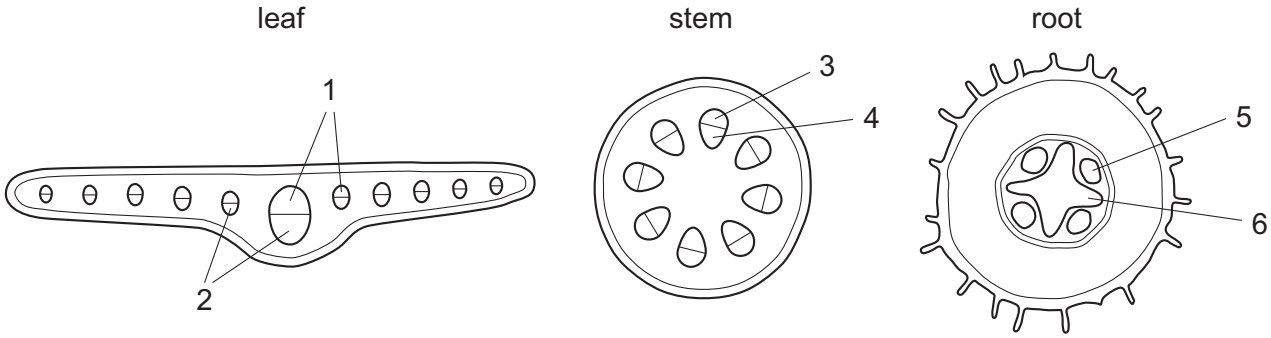
**21** A student produced a table of differences between RNA and DNA. The table contains one mistake.

Which row has the mistake?

| | RNA | DNA |
|---|---|---|
| **A** | contains ribose | contains deoxyribose |
| **B** | contains uracil | contains thymine |
| **C** | found throughout cell | found only in nucleus |
| **D** | single polynucleotide per molecule | two polynucleotides per molecule |

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**22** The diagrams show transverse sections of parts of a plant with some transport tissues labelled 1–6.




Which tissues mainly transport water and which tissues mainly transport sucrose?

**A** 1 water 5 — 4 sucrose 6

**B** 2 water 3 — 4 sucrose 5

**C** 3 water 5 — 2 sucrose 6

**D** 1 water 6 — 2 sucrose 3

**23** Transpiration is the consequence of which feature of plants?

**A** the presence of symplast and apoplast pathways

**B** the requirement for a transport system in plants

**C** the requirement for leaves to exchange gases

**D** the thin waxy cuticle on the lower epidermis of leaves

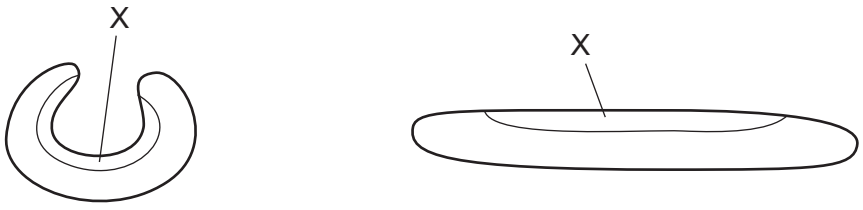
**24** Mass flow is the bulk movement of materials from one place to another.

How many of the vessels listed carry fluids by mass flow?

- artery
- phloem sieve tube
- vein
- xylem vessel

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

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




P Q

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

1 more negative water potential in P than Q

2 more cells plasmolysed in P

3 cells less turgid in Q

4 water potential becomes zero in Q

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

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**26** What could increase the rate of transpiration?

**A** increasing the humidity

**B** increasing the light intensity

**C** decreasing the temperature

**D** decreasing the wind speed

**27** What happens during ventricular systole in a mammalian heart?

**A** aortic pressure increases

**B** atrioventricular valves open

**C** semilunar valves close

**D** ventricular pressure decreases

**28** Which substances could displace oxygen from oxyhaemoglobin?

1 carbon dioxide

2 carbon monoxide

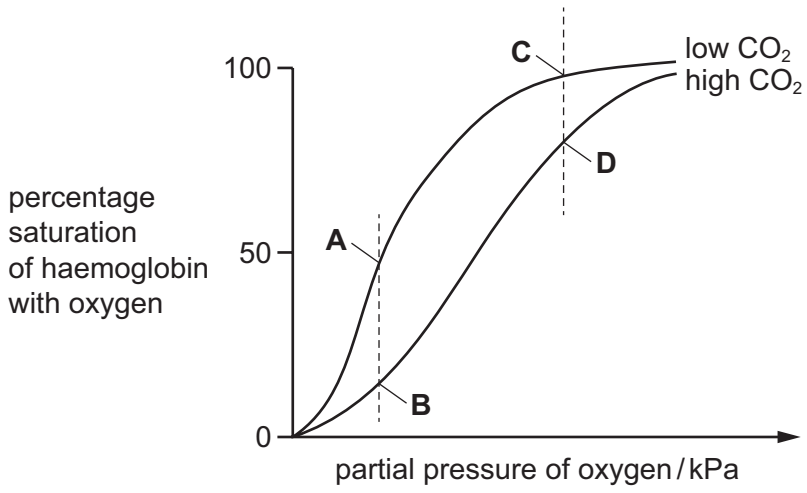
3 hydrogencarbonate ions

4 hydrogen ions

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

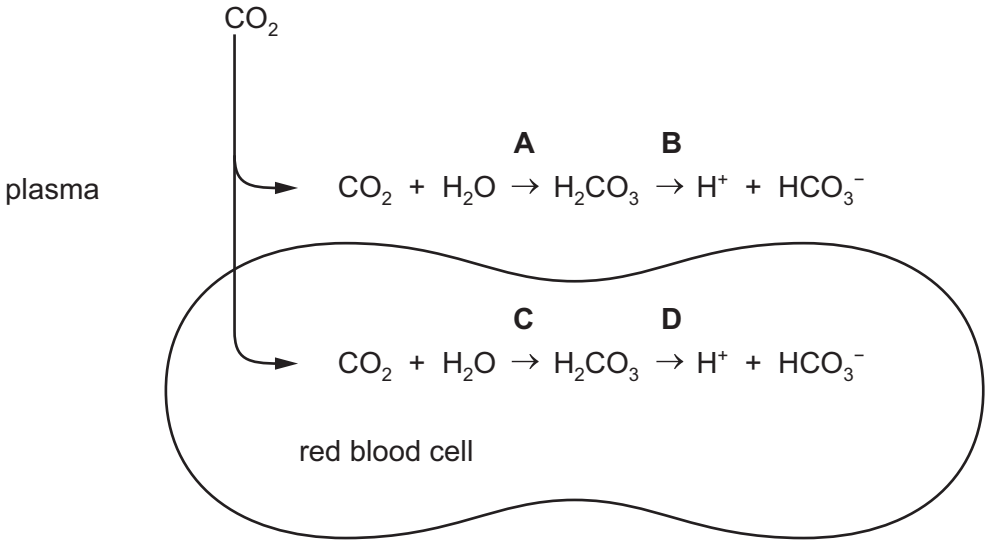
**29** The graph shows the affinity of haemoglobin for oxygen at two different concentrations of carbon dioxide.

Which point on the graph shows the percentage saturation of haemoglobin entering the pulmonary artery?



**30** The diagram shows some of the reactions of carbon dioxide when it enters the blood from cells in a metabolically active tissue.

Which reaction is catalysed by the enzyme carbonic anhydrase?




**31** How many phospholipid bilayers does oxygen pass through in diffusing from an alveolar air space to form oxyhaemoglobin in a red blood cell in a mammalian lung?

**A** 3 **B** 5 **C** 6 **D** 9

**32** 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 surfactant which reduces surface tension in the lungs.

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

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

**33** A disease damages alveoli walls, causing the alveoli to burst.

What effect does this have on the gas exchange system?

| | surface area for gas exchange | maximum volume of air breathed out |
|---|---|---|
| **A** | decreases | decreases |
| **B** | decreases | increases |
| **C** | decreases | no change |
| **D** | no change | no change |

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**34** What are short-term effects of nicotine on the cardiovascular system?

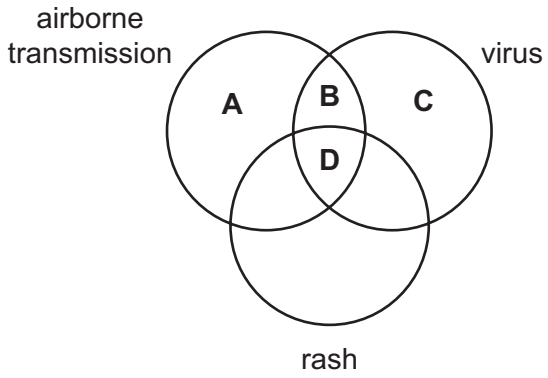
1 constriction of small arteries

2 increase in heart rate

3 increase in blood pressure

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

**35** What is correct for tuberculosis (TB)?




**36** Which factors contribute to outbreaks of measles after natural disasters?

1 contamination of drinking water with untreated sewage

2 lack of effective vaccination coverage in the population before the disaster

3 people living in overcrowded accommodation

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

**37** Which of these statements explain why some vaccines can be taken by mouth but tuberculosis (TB) vaccine has to be injected?

1 Macrophages present antigens in vaccines to stimulate an immune response.

2 The TB antigens necessary to produce an immune response are proteins which would be digested in the stomach and small intestine.

3 There are no B-lymphocytes and T-lymphocytes in the stomach.

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

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**38** Which method of gaining immunity can be described as natural active immunity?

**A** feeding on colostrum

**B** inhaling the chicken pox virus

**C** injection with antibodies

**D** through the placenta

**39** Which statements about endocytosis are correct?

1 It is part of phagocytosis.

2 It is a passive process.

3 Materials are taken into the cell.

4 Vesicles form within the cytoplasm.

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

**40** The statements refer to vaccination programmes for each of the diseases cholera, measles, smallpox and tuberculosis (TB).

Which statement is correct for TB?

**A** Most children are vaccinated before their first birthday.

**B** The pathogen has not mutated or changed its antigens.

**C** The pathogen lives in the intestine where antibodies cannot get to it.

**D** The vaccine is not effective against some strains of the pathogen.

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**BIOLOGY** **9700/12**

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**1 hour**

Additional Materials: Multiple Choice Answer Sheet
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*5635932162*

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Electronic calculators may be used.

This document consists of **17** printed pages and **3** blank pages.


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**1** Which equation for calculating the actual size of a specimen, A, or image size, I, or magnification, M, is correct?

**A** $A = M \div I$ **B** $A = I \times M$ **C** $I = M \div A$ **D** $M = I \div A$

**2** One of the smallest viruses is the polio virus, which has a diameter of approximately 30 nm.

In 2003, the *Mimivirus* was discovered which has a diameter of approximately 680 nm.

In 2013, the *Pandoravirus* was discovered which has a diameter of approximately 1000 nm.

Which row correctly matches a cell structure with a virus that has a similar approximate size?

| | polio virus | *Mimivirus* | *Pandoravirus* |
|---|---|---|---|
| **A** | lysosome | nucleolus | nucleus |
| **B** | nucleolus | lysosome | mitochondrion |
| **C** | nucleolus | mitochondrion | lysosome |
| **D** | ribosome | lysosome | mitochondrion |

**3** Which cell components are present in **all** prokaryotic cells?

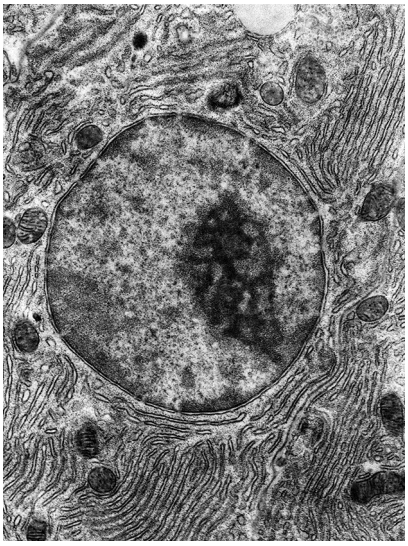
| | cell surface membrane | cell wall | endoplasmic reticulum | flagellum |
|---|---|---|---|---|
| **A** | ✓ | ✓ | ✗ | ✓ |
| **B** | ✓ | ✓ | ✗ | ✗ |
| **C** | ✓ | ✗ | ✓ | ✗ |
| **D** | ✗ | ✓ | ✓ | ✓ |

key

✓ = present

✗ = not present

**4** The electron micrograph shows part of an animal cell.



What will be synthesised in large quantities in this cell?

1 ATP

2 glucose

3 RNA

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

**5** Mitochondria are thought to have evolved from prokaryotic cells that were ingested by an ancestral cell.

Which feature have the prokaryotes lost during their evolution into mitochondria?

**A** cell wall

**B** circular chromosome

**C** endoplasmic reticulum

**D** ribosomes

**6** Which statement is correct?

**A** A virus is composed of a protein coat which may surround RNA or DNA.

**B** Eukaryotic plant cell walls contain peptidoglycans in addition to cellulose.

**C** Plasmodesmata and centrioles are found in all plant cells.

**D** Prokaryotic cells contain 80S ribosomes which they use to manufacture proteins.

**7** A student carried out four tests for biological molecules on a sample of milk.

The tests and their results were as follows.

- Heating to 80 °C with Benedict's solution gave a brick red colour.
- Adding Biuret solution gave a purple colour.
- Adding iodine solution gave an orange colour.
- Boiling with acid, followed by neutralisation, then heating to 80 °C with Benedict's solution gave a brick red colour.

Which biological molecules **must** be present in the milk?

1 non-reducing sugars

2 protein

3 reducing sugars

4 starch

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

**8** Which features adapt a cellulose molecule for its function?

1 Long chains of glucose molecules coil into a helix.

2 Many hydrogen bonds form between adjacent chains.

3 It is insoluble in water.

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

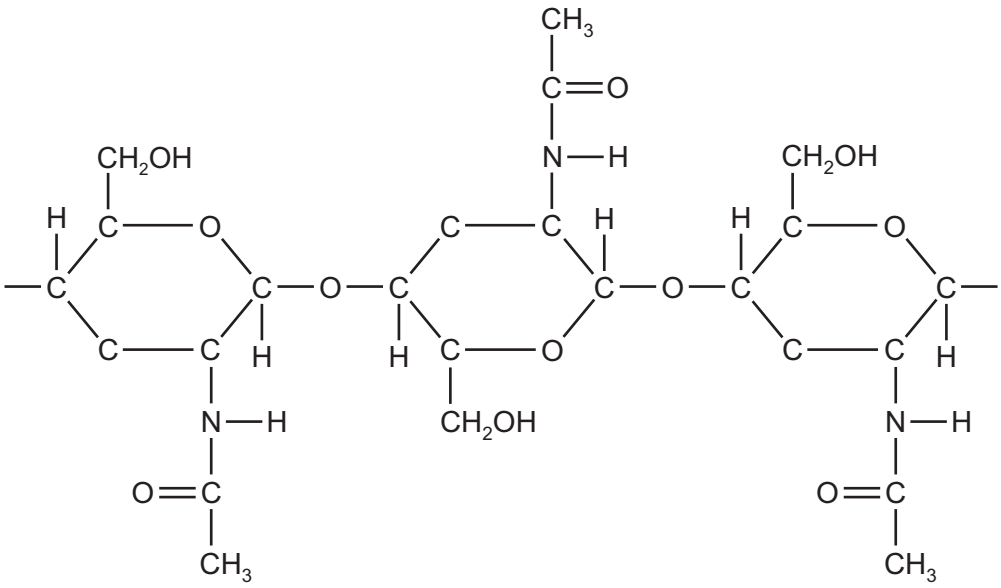
**9** Two disaccharides are maltose and sucrose. Maltose is formed from two molecules of glucose, whilst sucrose is formed from fructose and glucose.

Which row shows the molecular formulae of the two disaccharides?

| | maltose | sucrose |
|---|---|---|
| **A** | $C_{12}H_{22}O_{11}$ | $C_{12}H_{22}O_{11}$ |
| **B** | $C_{12}H_{22}O_{11}$ | $C_{12}H_{24}O_{12}$ |
| **C** | $C_{12}H_{24}O_{12}$ | $C_{12}H_{22}O_{11}$ |
| **D** | $C_{12}H_{24}O_{12}$ | $C_{12}H_{24}O_{12}$ |

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**10** The diagram shows the structure of the polysaccharide chitin which is found in the cell wall of fungi.



Which statements are correct for chitin **and** for cellulose?

1 The monomers are joined by 1,4 glycosidic bonds.

2 Every second monosaccharide in the polysaccharide chain is rotated by 180°.

3 The polysaccharide contains the elements carbon, hydrogen, oxygen and nitrogen.

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

**11** Which row correctly matches the functional and structural features of cellulose, collagen, glycogen or triglyceride?

| | molecule | function | structure | | |
|---|---|---|---|---|---|
| | | | fibrous | molecules held together by hydrogen bonds | branched chains |
| **A** | cellulose<br>triglyceride | support<br>energy source | ✓<br>✗ | ✓<br>✗ | ✗<br>✗ |
| **B** | collagen<br>cellulose | strengthening<br>support | ✓<br>✓ | ✓<br>✗ | ✗<br>✓ |
| **C** | collagen<br>glycogen | strengthening<br>storage | ✓<br>✗ | ✓<br>✗ | ✓<br>✓ |
| **D** | glycogen<br>triglyceride | storage<br>energy source | ✗<br>✗ | ✓<br>✓ | ✓<br>✗ |

key ✓ = true ✗ = false

**12** A polypeptide has a number of amino acids (*n*).

How many peptide bonds and R groups (side chains) does this polypeptide have?

**A** *n* – 1 peptide bonds and *n* – 1 R groups

**B** *n* – 1 peptide bonds and *n* R groups

**C** *n* peptide bonds and *n* – 1 R groups

**D** *n* peptide bonds and *n* R groups

**13** What are the features of triglycerides?

| | polar | less dense than water | lower proportion of hydrogen than in carbohydrates |
|---|---|---|---|
| **A** | ✓ | ✓ | ✗ |
| **B** | ✓ | ✗ | ✓ |
| **C** | ✗ | ✓ | ✗ |
| **D** | ✗ | ✗ | ✓ |

key

✓ = yes

✗ = no

**14** Which of these statements describe the action of an extracellular enzyme?

1 synthesis of a polynucleotide in the nucleus during DNA replication

2 digestion of macromolecules in the lumen of the small intestine

3 synthesis of ATP molecules in the mitochondria

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

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**15** An experiment was carried out in which the enzyme lipase was used to hydrolyse a triglyceride.

The pH was recorded at regular intervals during the reaction.

The results are shown in the table.

| time / minutes | pH |
|---|---|
| 0 | 7.0 |
| 2 | 6.2 |
| 4 | 5.6 |
| 6 | 5.1 |
| 8 | 4.7 |
| 10 | 4.6 |
| 12 | 4.6 |
| 14 | 4.6 |

At 14 minutes unreacted triglyceride was still present.

What explains the results after 10 minutes?

**A** The end-products acted as competitive inhibitors.

**B** The end-products acted as non-competitive inhibitors.

**C** The enzyme reaction had reached $V_{max}$.

**D** The tertiary structure of the enzyme had been lost.

**16** Which statement about the effect of substrate concentration on the activity of an enzyme is correct?

**A** Above a certain concentration of substrate an enzyme reaches its maximum rate of reaction.

**B** At high concentration of competitive inhibitor increasing the substrate concentration has no effect.

**C** At high substrate concentration a non-competitive inhibitor no longer affects the enzyme activity.

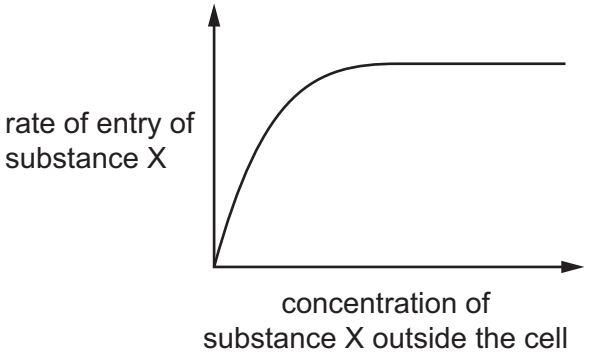
**D** The higher the concentration of substrate the faster an enzyme can catalyse a reaction.

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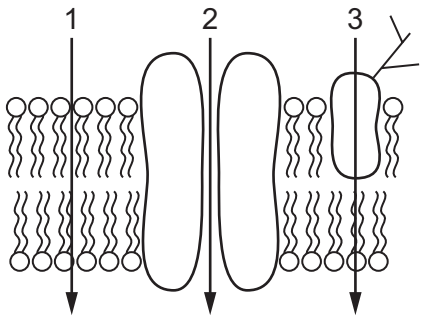
**17** Which row shows a correct function of the components of the cell surface membrane?

| | phospholipids | cholesterol | proteins | glycoproteins |
|---|---|---|---|---|
| **A** | prevent the entry of non-polar molecules | regulates permeability of the membrane | allow exchange of ions between the cell and its environment | allow cell-to-cell communication |
| **B** | prevent the entry of polar molecules | stabilises the membrane by binding to water molecules | allow cell-to-cell communication | provide sites of attachment for hormones |
| **C** | regulate the flexibility of the cell membrane | prevents the entry of protons | allow exchange of gases between the cell and its environment | stabilise the membrane by binding to water molecules |
| **D** | regulate the fluidity of the cell membrane | stabilises the membrane over a range of temperatures | form channels for polar molecules | allow cell-to-cell recognition |

**18** The graph shows how the rate of entry of substance X into a cell changes as the concentration of substance X outside the cell increases.




The diagram shows part of a cell surface membrane.



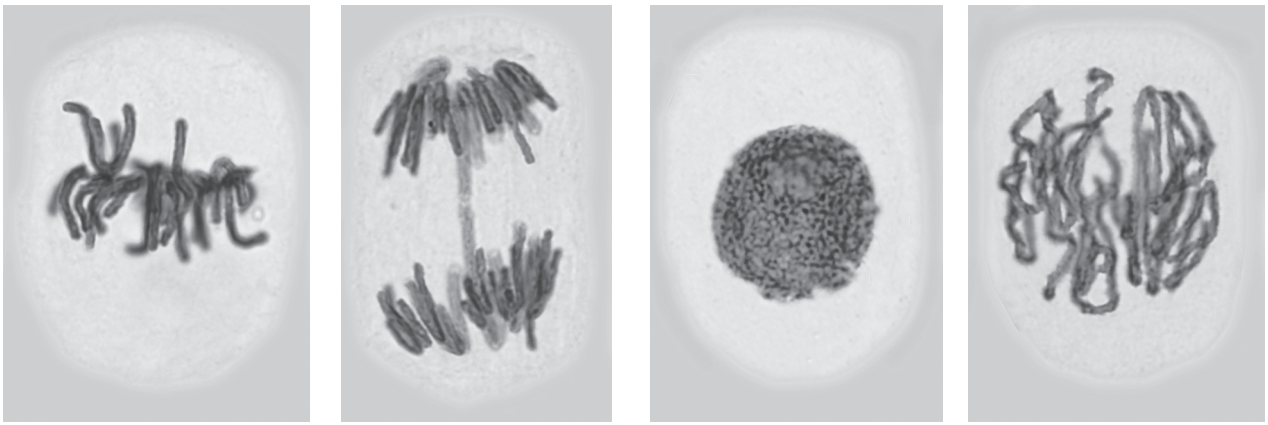

Which pathways could substance X use to enter the cell?

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

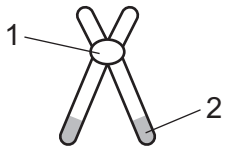
**19** The photomicrographs show cells in various stages of the cell cycle.

In which stage does semi-conservative replication of DNA take place?

**A** **B** **C** **D**



**20** The diagram shows the structure of one chromosome.




Which row is correct?

| | 1 | 2 | number of DNA strands |
|---|---|---|---|
| **A** | centromere | chromatid | 2 |
| **B** | centromere | telomere | 4 |
| **C** | chromatid | telomere | 2 |
| **D** | telomere | chromatid | 4 |

**21** Cancer cells may divide by far more divisions than other cells found in humans.

Which statement about cancer cells is correct?

**A** They are able to synthesise the enzyme telomerase.

**B** They have a mutation in the telomeres so DNA is not hydrolysed.

**C** They have DNA polymerase so can replicate their DNA without telomere loss.

**D** They increase the number of copies of repeated DNA sequences in the telomeres.

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**22** What is the **maximum** number of hydrogen bonds in a length of DNA containing 700 nucleotides?

**A** 350 **B** 700 **C** 1050 **D** 2100

**23** Which statements concerning DNA and RNA are correct?

1 Adenine and guanine are bases that have a double ring structure; cytosine, thymine and uracil are bases with a single ring structure.

2 An adenine nucleotide from DNA is the same as an adenine nucleotide from RNA; DNA adenine pairs with thymine and RNA adenine pairs with uracil.

3 The base pairing that occurs in a double DNA helix and when RNA is synthesised during transcription is always according to the rule that a purine pairs with a pyrimidine.

4 The two polynucleotides on a DNA molecule run in opposite directions so that the double helix formed has two strands that are parallel to each other.

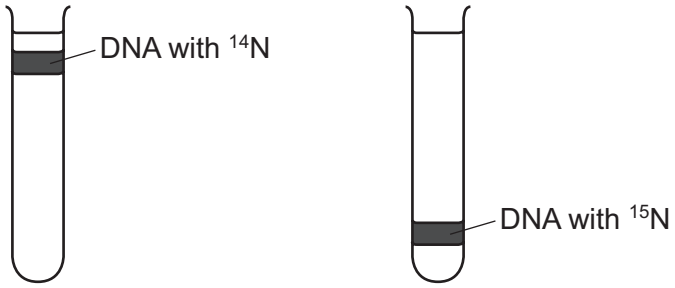
**A** 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

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**24** Two sets of bacteria were grown using different types of nitrogen-containing growth media.

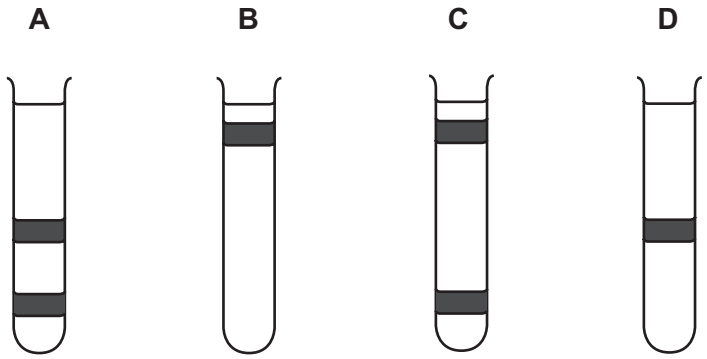
One set was grown in a medium containing the 'heavy' isotope of nitrogen, $^{15}N$, until all the DNA was labelled. The other set was grown in a medium containing the 'light' isotope of nitrogen, $^{14}N$, until all the DNA was labelled.

The DNA from each set of bacteria was extracted and centrifuged. The diagram shows the position in the centrifuge tubes of this DNA.




Bacteria with $^{15}N$ labelled DNA were transferred to a medium containing $^{14}N$ and allowed to reproduce once. The DNA of the new generation of bacteria was extracted and centrifuged.

Which tube shows the position of DNA from this new generation of bacteria?



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

GCGCGCGGCGCG

The table shows the amino acids coded for by 10 mRNA codons.

| mRNA codon | amino acid |
|---|---|
| AAG | Lys |
| ACG | Thr |
| CGG CGC CGU | Arg |
| CCG | Pro |
| GCC GCG | Ala |
| GGC | Gly |
| UGC | Cys |

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

**A** Ala-Ala-Cys-Ala

**B** Ala-Arg-Gly-Ala

**C** Arg-Ala-Pro-Arg

**D** Arg-Arg-Thr-Arg

**26** What contributes to the movement of water through the xylem vessel elements?

**A** cohesion of water molecules through hydrogen bonding

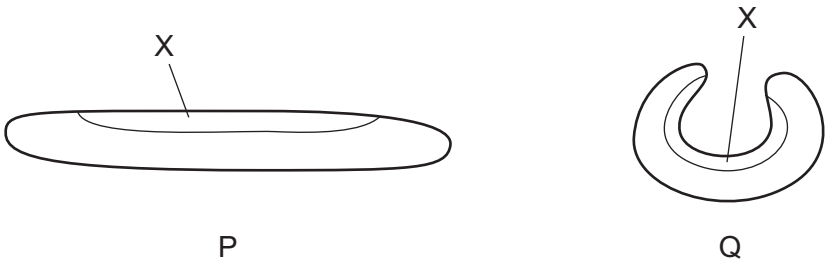
**B** ion movement followed by passive osmosis

**C** negative water potential in the xylem

**D** surface tension at the top of the plant

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




Which statements about the cells in layer X of the leaf in each of the conditions P and Q are correct?

1 less negative water potential in P than Q

2 cells may be turgid in P and plasmolysed in Q

3 cells less turgid in P than Q

4 no net diffusion of water into X in either P or Q

**A** 1, 2, 3 and 4

**B** 1, 2 and 4 only

**C** 1 and 4 only

**D** 2 and 3 only

**28** What are features that adapt root hair cells for efficient uptake of mineral ions?

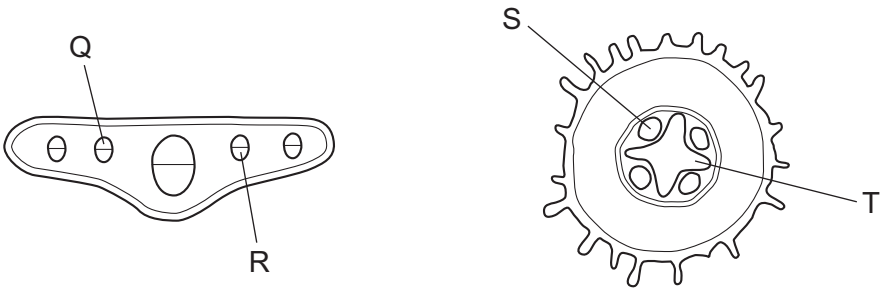
1 a large number of mitochondria

2 a large number of protein carriers in the cell surface membrane

3 a large surface area to volume ratio

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

**29** The transverse sections of two plant organs are shown.




Which pair of tissues contains proton pumps?

**A** Q and S **B** Q and T **C** R and S **D** R and T

**30** Measurements of the stem of a young tree showed that the diameter varied slightly. It decreased during the day and increased during the night.

Which statement explains these observations?

**A** During the day, cohesion between water molecules and lignin in the walls of the xylem vessels pulls the walls of the vessels inwards.

**B** During the day, the tension developed in a moving column of water molecules reduces the pressure inside the xylem vessels, so that their walls move inwards.

**C** During the night, the adhesion of water molecules to the lignin in the walls of the xylem vessels pushes the walls of the vessels outwards.

**D** During the night, the pressure of the column of water molecules adhering to one another increases and pushes the walls of the xylem vessels outwards.

**31** Which statement about the human circulatory system is correct?

**A** Blood passes twice through the heart in one complete circulation.

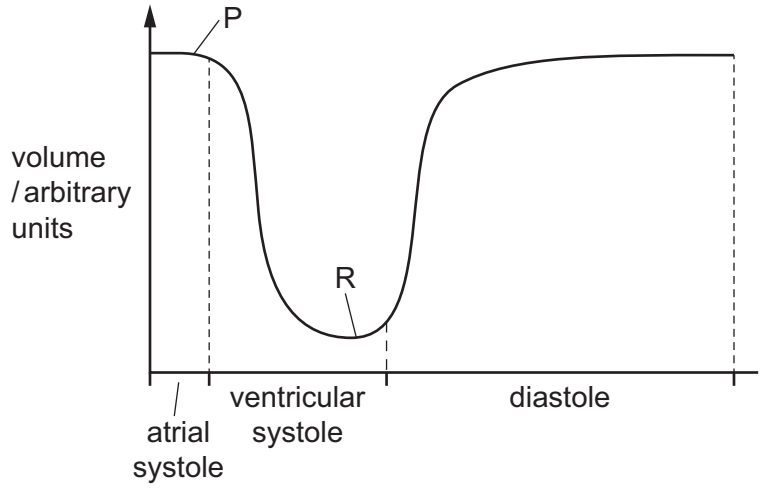
**B** Blood, tissue fluid and lymph are all parts of the circulatory system.

**C** Capillaries have the lowest blood pressure.

**D** Veins in the circulatory system all carry deoxygenated blood.

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**32** The graph shows changes in the volume of the ventricles during the cardiac cycle.




stages of the cardiac cycle

Which valves open and close at P and R?

| | atrioventricular valve at P | semilunar valve at R |
|---|---|---|
| **A** | closes | closes |
| **B** | closes | opens |
| **C** | opens | closes |
| **D** | opens | opens |

**33** Haemoglobin can bind to carbon dioxide, carbon monoxide and oxygen.

1 carbon dioxide

2 carbon monoxide

3 oxygen

Which gases share a binding site?

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

**34** A good gas exchange system maintains a steep diffusion gradient, has a large total surface area and a short diffusion distance.

Which feature of the human gas exchange system helps to maintain a steep diffusion gradient?

**A** A large number of alveoli are present in each lung.

**B** Alveoli walls contain elastic fibres allowing expansion.

**C** The air brought into the alveoli by ventilation is high in oxygen.

**D** The endothelium of the capillary wall is made of flattened cells.

**35** Which statement about bronchioles is correct?

**A** They have cartilage and ciliated cells.

**B** They have cartilage and elastic tissue.

**C** They have cartilage and muscle tissue.

**D** They have elastic tissue and ciliated cells.

**36** In which regions of the human gas exchange system is the function of some types of cell **directly** affected by tar in cigarette smoke?

**A** bronchioles and alveoli only

**B** trachea, bronchus, bronchioles, alveoli

**C** trachea and bronchus only

**D** trachea, bronchus and bronchioles only

**37** What is the causative agent and method of transmission of smallpox?

| | causative agent | method of transmission |
|---|---|---|
| **A** | *Morbillivirus* | direct contact |
| **B** | *Morbillivirus* | waterborne |
| **C** | *Variola* | direct contact |
| **D** | *Variola* | waterborne |

**38** A scientist investigated the effect of an antibiotic on the treatment of cholera.

320 people suffering with cholera were split into two groups. One group was treated with an antibiotic while the other group was not given antibiotics. Both groups were given fluids containing sugars and mineral salts (oral rehydration therapy).

The scientist recorded the number of days that each person suffered from diarrhoea.

The table shows the results.

| treatment | mean time person had diarrhoea / days |
|---|---|
| antibiotic and oral rehydration therapy | 3.2 |
| oral rehydration therapy | 5.3 |

What is the percentage decrease in the mean time that a person suffered from diarrhoea when they were treated with the antibiotic?

**A** 39.6% **B** 60.4% **C** 165.6% **D** 252.4%

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**39** Which sequence of events occurs during an immune response?

1 development of plasma cells

2 mitosis of B-lymphocytes

3 recognition of non-self antigens

4 secretion of antibodies

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

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

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

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

**40** An influenza vaccine can be made by growing the viruses in chicken eggs.

The viruses are extracted in liquid from the eggs and inactivated. The purified egg extract containing the viruses is then used as the vaccine.

What is a side-effect of using this vaccine in some people?

**A** An auto-immune condition could occur.

**B** An immune response to egg antigens could occur.

**C** The egg antigens could cause infections.

**D** The influenza viruses could cause infections.

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**BIOLOGY** **9700/13**

Paper 1 Multiple Choice **October/November 2017**

**1 hour**

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

*7462309111*

**READ THESE INSTRUCTIONS FIRST**

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

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

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

This document consists of **17** printed pages and **3** blank pages.


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**1** Which statement about the light microscope is correct?

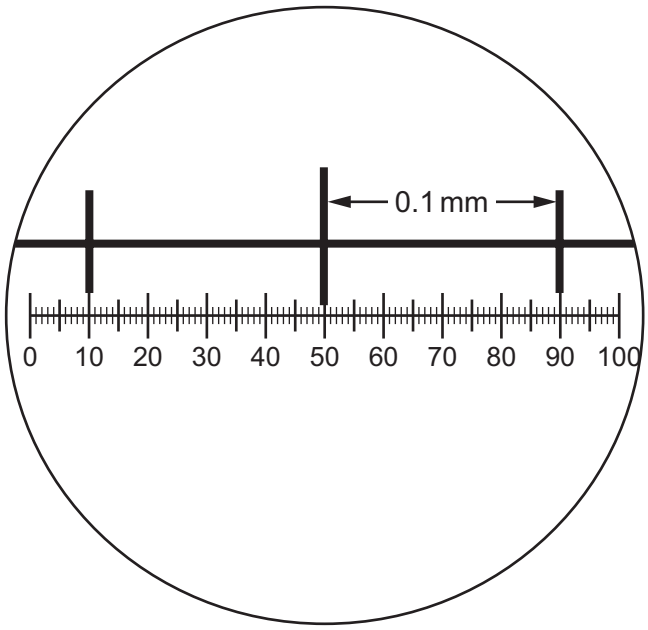
**A** As the smallest distance to see two points as distinct separate points decreases, the resolution also decreases.

**B** If the resolution is 220 nm, then a bacterium 0.2 μm in diameter will not be visible.

**C** If the wavelength of light is 600 nm, then two membranes 300 nm apart will be visible as two distinct membranes.

**D** Using visible light of a longer wavelength, such as red light, will improve the resolution.

**2** The diagram shows a stage micrometer scale viewed with an eyepiece graticule, using a magnification of ×200.




Using the same magnification, a chloroplast is measured as 4 eyepiece graticule divisions long.

How long is the chloroplast?

**A** $1.0 \times 10^{1}$ μm

**B** $4.0 \times 10^{2}$ μm

**C** $2.5 \times 10^{-1}$ μm

**D** $2.5 \times 10^{-2}$ μm

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**3** A cell was supplied with cytosine labelled with radioactive carbon.

In which cell structure would radioactivity be detected first?

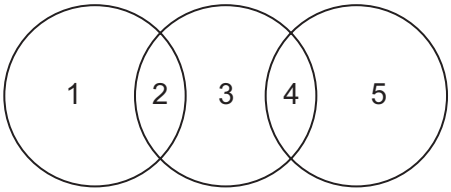
**A** endoplasmic reticulum

**B** Golgi body

**C** nucleus

**D** ribosome

**4** The diagram shows some similarities between chloroplasts, mitochondria and typical prokaryotes.




Which row is correct?

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **A** | chloroplasts | circular DNA | mitochondria | 80S ribosomes | prokaryotes |
| **B** | chloroplasts | 80S ribosomes | mitochondria | circular DNA | prokaryotes |
| **C** | prokaryotes | circular DNA | mitochondria | circular DNA | chloroplasts |
| **D** | prokaryotes | 70S ribosomes | chloroplasts | 80S ribosomes | mitochondria |

**5** Which statement supports the fact that mature plant cells can carry out the same role as lysosomes?

**A** A range of hydrolytic enzymes can be found within mature plant vacuoles.

**B** Glycogen, found within vesicles, can be hydrolysed to glucose molecules.

**C** Single membrane-bound vesicles are formed from plant Golgi bodies.

**D** Vesicles, formed from smooth endoplasmic reticulum, contain enzymes.

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**6** A student carried out four tests for biological molecules on a sample of milk.

The tests and their results were as follows.

- Heating to 80 °C with Benedict's solution gave a green colour.
- Adding Biuret solution gave a purple colour.
- Adding iodine solution gave an orange colour.
- Boiling with acid, followed by neutralisation, then heating to 80 °C with Benedict's solution gave a brick red colour.

Which conclusion about these results is correct?

**A** only protein and reducing sugar present

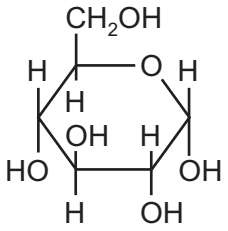
**B** only protein and non-reducing sugar present

**C** only protein, reducing sugar and non-reducing sugar present

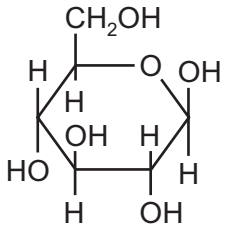
**D** only starch, protein and sugar present

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

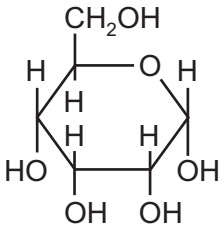
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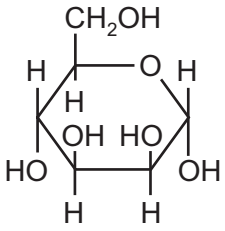

2




3




4




Which diagrams show glucose molecules?

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

**8** Which bonds will be broken when a molecule of glycogen is broken down?

1 $\alpha$-1, 4

2 $\beta$-1, 4

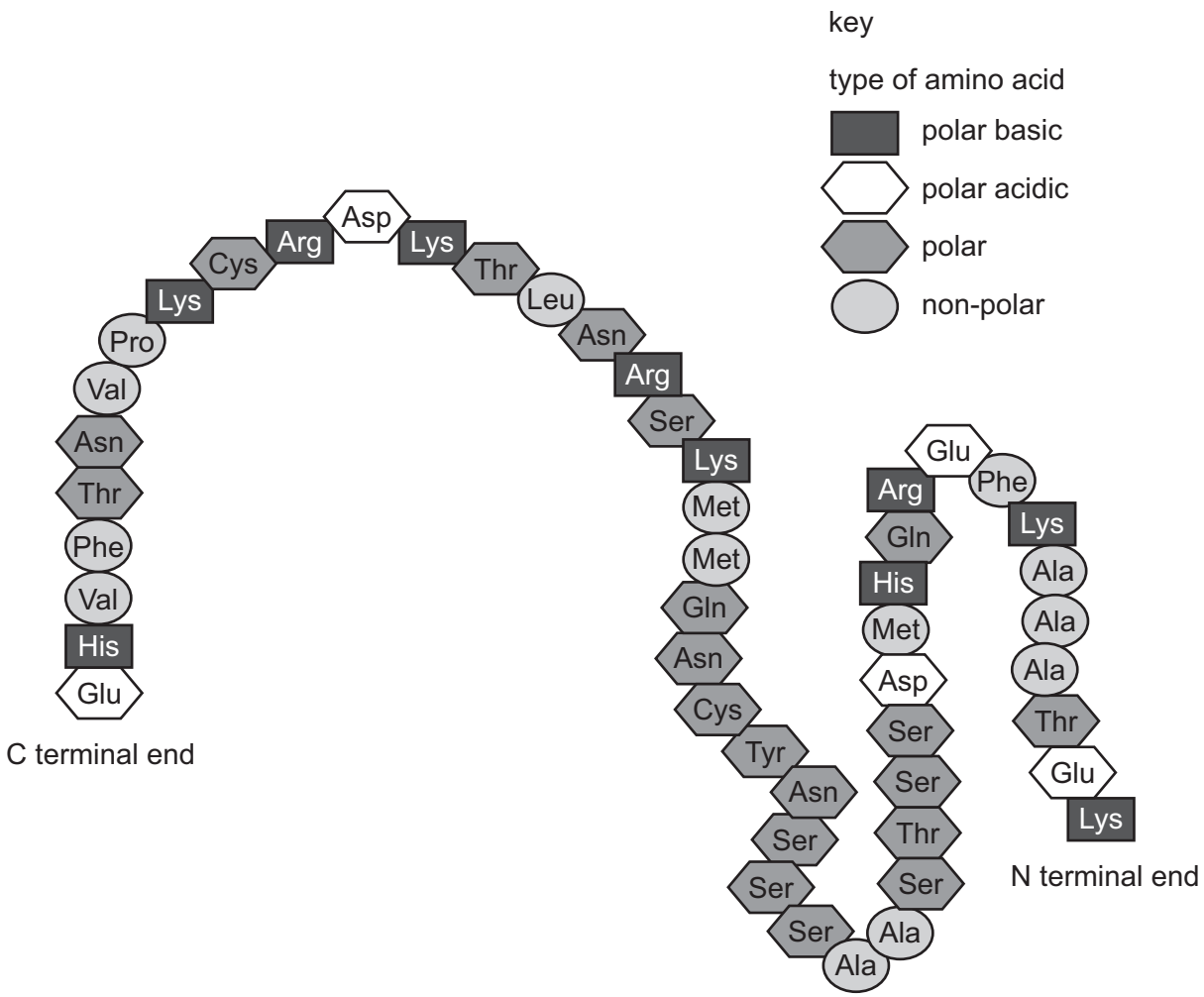
3 $\alpha$-1, 6

4 $\beta$-1, 6

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

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**9** The diagram shows the amino acids in a polypeptide.




An enzyme catalyses the hydrolysis of **any** peptide bond between a non-polar amino acid **and** any polar amino acid.

How many small peptides and single amino acids will be formed by the action of this enzyme?

| | small peptides | single amino acids |
|---|---|---|
| **A** | 6 | 1 |
| **B** | 8 | 1 |
| **C** | 12 | 3 |
| **D** | 13 | 4 |

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**[Turn over**

**10** A person with diabetes is unable to make enough of the protein insulin.

Some forms of diabetes can be treated by using insulin produced by animals. Scientists have compared the amino acids in insulin produced by animals to human insulin.

Which level of protein structure were the scientists studying?

**A** primary

**B** secondary

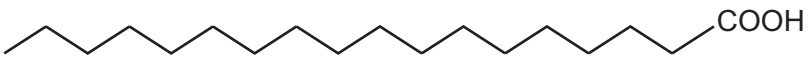
**C** tertiary

**D** quaternary

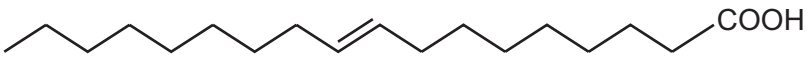
**11** The diagrams show four fatty acids, each with a chain of 18 carbon atoms.

Which fatty acid, as part of a phospholipid molecule, would contribute most to the fluidity of a cell surface membrane?

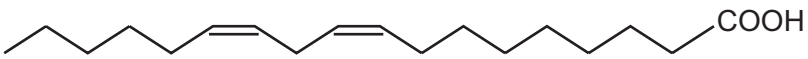
**A**



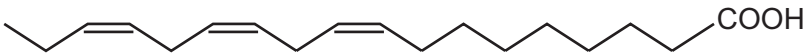

**B**




**C**




**D**




**12** Which levels of protein structure are maintained by disulfide bonds?

**A** secondary, tertiary and quaternary

**B** tertiary and quaternary only

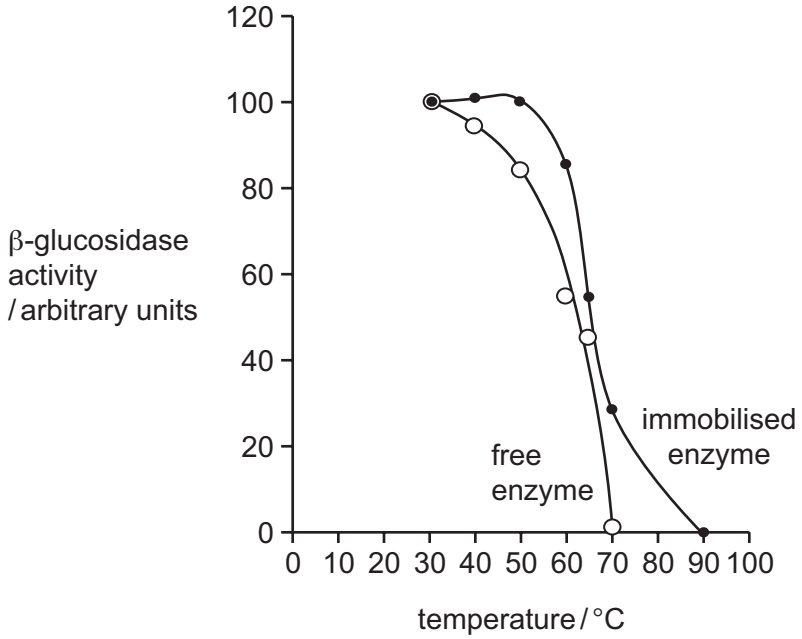
**C** quaternary only

**D** tertiary only

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**13** An experiment was conducted to investigate the effect of temperature on the activity of the enzyme β-glucosidase. The enzyme was tested when in solution (free) and when immobilised in alginate beads.

The results are shown in the graph below.




Which statement about the effect of immobilisation of β-glucosidase is correct?

**A** It increases the kinetic energy of the enzyme.

**B** It inhibits the activity of the enzyme.

**C** It reduces the optimum temperature of the enzyme.

**D** It stabilises the enzyme against denaturation.

**14** An investigation was carried out into the effect of an increasing concentration of substrate molecules on the rate of an enzyme-catalysed reaction. All other variables were standardised.

Which statement is correct?

**A** The rate increases to a maximum and then levels off.

**B** The rate increases to an optimum and then decreases.

**C** The value of $K_m$ will increase.

**D** The $V_{max}$ will never be reached.

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**15** Which features are correct for a competitive inhibitor of an enzyme-catalysed reaction?

| | binds to active site | changes shape of enzyme | similar shape to substrate | rate of reaction affected by concentration of inhibitor |
|---|---|---|---|---|
| **A** | ✓ | ✗ | ✓ | ✓ |
| **B** | ✓ | ✗ | ✗ | ✓ |
| **C** | ✗ | ✓ | ✓ | ✗ |
| **D** | ✗ | ✓ | ✗ | ✗ |

key

✓ = correct

✗ = incorrect

**16** Liver cells contain membrane-bound organelles called peroxisomes, which contain the enzyme catalase. This enzyme hydrolyses hydrogen peroxide into water and oxygen gas.

A student cut two identical sized pieces of liver and placed one in a refrigerator at 5 °C and the other in a freezer at –18 °C.

After 12 hours both pieces were raised to room temperature and placed in equal volumes of hydrogen peroxide.

The liver that had been at –18°C produced bubbles of oxygen more rapidly than the liver that had been at 5 °C.

Which statement explains why the liver that had been at –18 °C produced bubbles of oxygen more rapidly than the liver that had been at 5 °C?

**A** At 5 °C the cell surface membrane allowed water to enter cells and dilute the catalase.

**B** Freezing at –18 °C made the cell walls more permeable to hydrogen peroxide.

**C** Ice crystals damaged the cell membranes of the liver cells at –18 °C.

**D** The higher temperature had denatured some of the catalase.

**17** Which of these processes allow movement in both directions across cell surface membranes?

1 active transport

2 diffusion

3 facilitated diffusion

4 osmosis

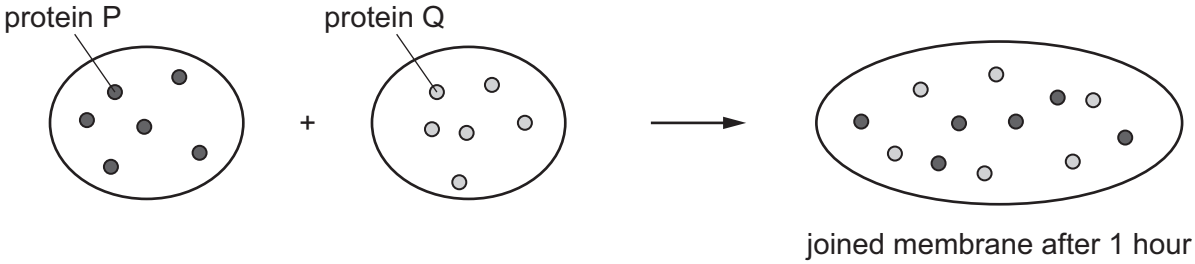
**A** 1, 2, 3 and 4 **B** 1 and 4 only **C** 2 and 3 only **D** 2 only

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**18** The diagram shows an experiment in which two different cell surface membranes were joined to form a single large membrane.

The outer surface of one membrane contained molecules of protein P and the outer surface of the other membrane contained molecules of protein Q.

The positions of the two proteins in each membrane were observed just before they were joined together and 1 hour after they were joined.




Which statements are correct?

1 This provides evidence for the fluid mosaic model of cell membranes.

2 This shows that proteins can move freely in cell membranes.

3 This shows that the membrane is fluid but the proteins are not.

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

**19** Which row describes osmosis across a cell surface membrane?

| | molecule moved | uses energy from ATP | moves molecule down a concentration gradient |
|---|---|---|---|
| **A** | solute | ✓ | ✓ |
| **B** | solute | ✓ | ✗ |
| **C** | solvent | ✗ | ✓ |
| **D** | solvent | ✗ | ✗ |

key
✓ = correct
✗ = incorrect

**20** What describes a telomere?

**A** a cell structure composed mainly of protein and involved in cell division

**B** a protein that associates with DNA to help condense it

**C** a region of DNA that links two sister chromatids together

**D** a region of repetitive nucleotide sequences at the end of a chromatid

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**21** Uncontrolled cell division can form tumours.

Which statement is correct for tumour cells **only**?

**A** Metaphase does not take place.

**B** Cytokinesis does not occur.

**C** Interphase takes less time.

**D** They have mutated DNA.

**22** Which of these events are part of mitosis?

1 interphase

2 anaphase

3 cytokinesis

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

**23** Rifampicin is an antibiotic used to treat tuberculosis.

It works by inhibiting RNA polymerase in bacteria.

Which of these processes are prevented by this antibiotic?

1 DNA replication

2 transcription

3 translation

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

**24** A gene codes for the sequence of amino acids in a single polypeptide. Haemoglobin consists of two $\alpha$-globins and two $\beta$-globins.

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

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

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**25** A single substitution in an allele of the gene coding for haemoglobin results in sickle cell haemoglobin.

The mRNA sequence for three amino acids for normal haemoglobin is shown.

CCUGAAGAG

The mRNA sequence for sickle cell haemoglobin is shown.

CCUGUAGAG

The table shows some of the triplet codes for two amino acids.

| DNA triplet codes | amino acid |
|---|---|
| CTC | Glu |
| CTT | Glu |
| CAT | Val |
| CAC | Val |

Which row is correct for the substituted DNA nucleotide of the allele and the substituted amino acid of the protein?

| | DNA nucleotide | new amino acid |
|---|---|---|
| **A** | A | Glu |
| **B** | A | Val |
| **C** | T | Glu |
| **D** | T | Val |

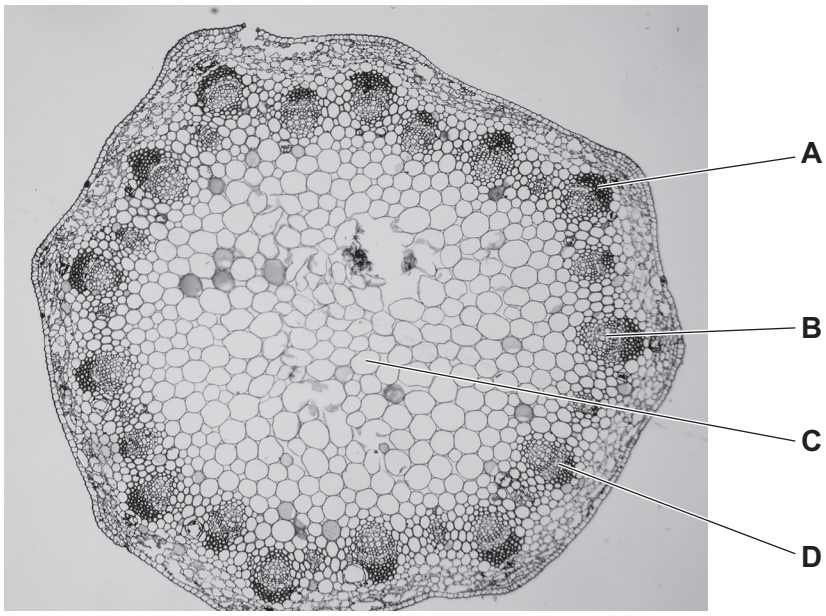
**26** What is the **minimum** number of hydrogen bonds in a length of DNA containing 700 base pairs?

**A** 350 **B** 700 **C** 1400 **D** 2100

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**27** The photomicrograph is a section through a plant organ.

Which label identifies the xylem vessels?




**28** Which of these statements correctly describe transport pathways in dicotyledonous plants?

1 In the apoplast pathway, water may move through plasmodesmata.

2 In the symplast pathway, water may move through intercellular spaces.

3 The apoplast pathway may be blocked by the Casparian strip.

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

**29** Mass flow is the bulk movement of materials from one place to another.

Which vessels carry fluids by mass flow?

1 artery

2 phloem sieve tube

3 vein

4 xylem vessel

**A** 1, 2, 3 and 4

**B** 1, 2 and 3 only

**C** 1 and 3 only

**D** 2 and 4 only

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**30** Amino acids move from a phloem sieve tube element into a root cell.

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

| | water potential | volume of liquid |
|---|---|---|
| **A** | becomes higher | decreases |
| **B** | becomes higher | increases |
| **C** | becomes lower | decreases |
| **D** | becomes lower | increases |

**31** The table shows the volume of water taken up over a 10 minute period for two species of plant, X and Y.

| time / minutes | water uptake / $mm^3$ | |
|---|---|---|
| | X | Y |
| 2 | 4.2 | 1.2 |
| 4 | 7.8 | 2.3 |
| 6 | 10.9 | 3.7 |
| 8 | 13.3 | 4.4 |
| 10 | 16.9 | 4.9 |

Both plants were tested at the same time, in the same room and using identical potometers. A student concluded that Y was a xerophyte so lost less water.

What feature of the experiment could bring this conclusion into doubt?

**A** The student did not control air flow or temperature surrounding the plants.

**B** The student did not leave the plants to acclimatise to their surroundings.

**C** The student did not take measurements at 0 minutes.

**D** The student did not take account of the area of leaves.

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**[Turn over**

**32** What happens during left ventricular systole?

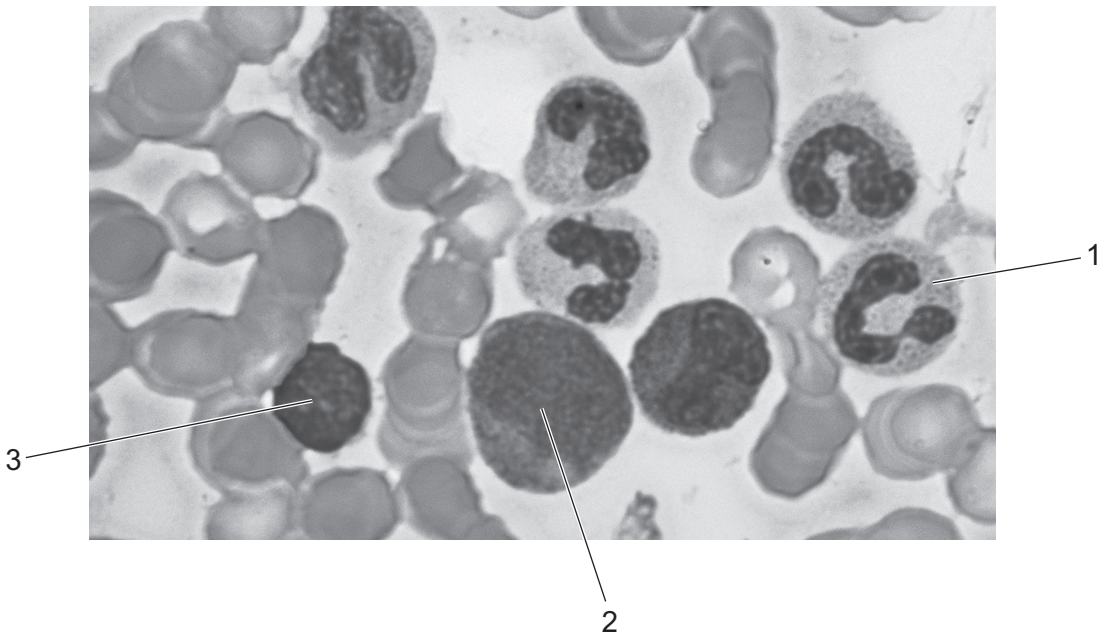
**A** The atrioventricular node causes the immediate contraction of the ventricle, causing the atrioventricular valve to close.

**B** The Purkyne tissue between the atrium and ventricle causes the ventricle to contract, closing the atrioventricular valve and opening the semilunar valve.

**C** The sinoatrial node causes the atrium to stop contracting and the blood pressure in the ventricle to increase above that in the atrium.

**D** The wave of excitation causes the ventricle to contract so that the blood pressure in the ventricle is higher than in the aorta, opening the semilunar valve.

**33** The photograph shows blood cells as seen using a high power light microscope.




Which row correctly identifies the different types of white blood cell?

| | 1 | 2 | 3 |
|---|---|---|---|
| **A** | lymphocyte | monocyte | neutrophil |
| **B** | monocyte | neutrophil | macrophage |
| **C** | neutrophil | monocyte | lymphocyte |
| **D** | phagocyte | lymphocyte | monocyte |

**34** Which of these processes are responsible for the Bohr shift?

1 Carbon dioxide reacts with haemoglobin to form carbaminohaemoglobin.

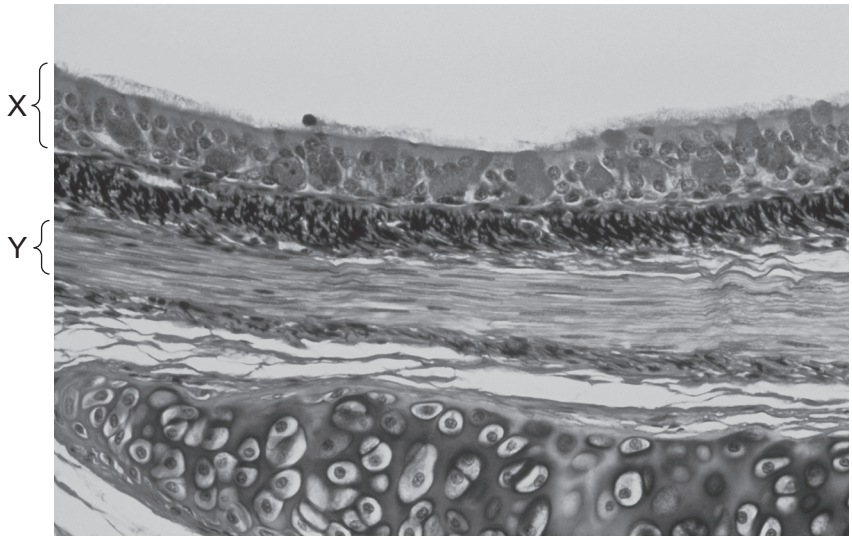
2 Carbon dioxide reacts with water to form carbonic acid.

3 Haemoglobinic acid is formed from the dissociation of carbonic acid.

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

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**35** The photomicrograph shows a cross-section through a bronchus.




What is the function of the tissues X and Y?

| | X | Y |
|---|---|---|
| **A** | secrete mucus | prevent collapse of the airway |
| **B** | support the airway | dilate airway |
| **C** | trap dust and dirt | secrete mucus |
| **D** | waft dust and dirt upwards | constrict airway |

**36** Which flow diagram correctly describes the effect of tar entering the lungs?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A** | carcinogens come into contact with DNA | → | mutation occurs | → | uncontrolled cell division | → | mass of cells produced |
| **B** | goblet cells secrete more mucus | → | mucus accumulates causing infection | → | phagocytes attracted by inflammation | → | causes irritation and coughing |
| **C** | goblet cells secrete more mucus | → | mutation occurs | → | phagocytes attracted by inflammation | → | mass of cells produced |
| **D** | phagocytes attracted by inflammation | → | mutation occurs | → | uncontrolled cell division | → | elastase destroys the alveolar walls |

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**[Turn over**

**37** The antibiotic penicillin prevents the formation of cross-links between peptidoglycans during bacterial cell wall synthesis by blocking the enzyme transpeptidase.

Which statements describe the action of penicillin on bacteria?

1 It is an enzyme inhibitor.

2 It weakens the bacterial cell wall.

3 It will work at any stage during the bacterial life cycle.

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

**38** Which pathogens are spread by droplet infection?

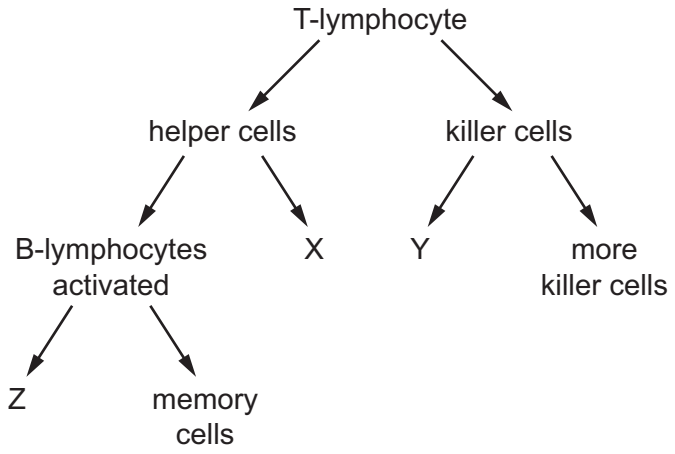
1 *Mycobacterium tuberculosis*

2 *Vibrio cholerae*

3 *Morbillivirus*

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

**39** The flow diagram shows the events following activation of a T-lymphocyte by binding to antigens on an infected cell.




Which row correctly identifies X, Y and Z?

| | X | Y | Z |
|---|---|---|---|
| **A** | memory cells | macrophages | antibodies |
| **B** | memory cells | memory cells | plasma cells |
| **C** | neutrophils | memory cells | plasma cells |
| **D** | plasma cells | neutrophil | memory cells |

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**40** Smallpox was eradicated from the human population by a worldwide preventative programme.

Which type of immunity was triggered in people who were treated as part of this programme?

**A** artificial active immunity

**B** artificial passive immunity

**C** natural active immunity

**D** natural passive immunity

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