Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/12**

Paper 1 Multiple Choice **February/March 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.

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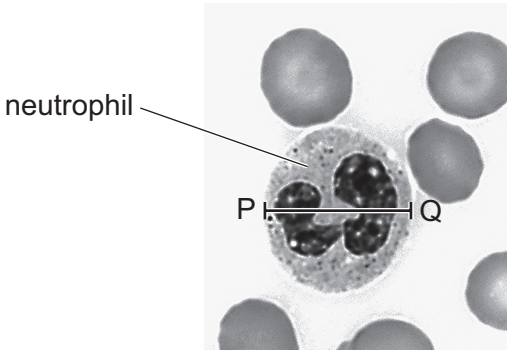
[Turn over

1 The photomicrograph shows cells from a human blood smear.



Which calculation shows a correct method to calculate the actual diameter of the neutrophil shown in the photomicrograph in micrometres (μm)?

A $\frac{\text{length of line PQ in mm} \times 1000}{\text{magnification of photomicrograph}}$

B $\frac{\text{length of line PQ in mm} \times 10\,000}{\text{magnification of photomicrograph}}$

C $\frac{\text{magnification of photomicrograph}}{\text{length of line PQ in mm} \times 1000}$

D $\frac{\text{magnification of photomicrograph}}{\text{length of line PQ in mm} \times 10\,000}$

2 A student calibrated an eyepiece graticule using a stage micrometer.

- Each division of the stage micrometer was 0.01 mm.
- With a ×10 magnification objective lens, 10 eyepiece graticule units matched 10 divisions on the stage micrometer.

The same microscope was used with a ×40, instead of a ×10, magnification objective lens to measure the diameter of an alveolus. The diameter of the alveolus was found to be 96 eyepiece graticule units.

The eyepiece lens was not changed.

What is the best estimate for the diameter of the alveolus?

A 0.960 mm **B** 3.84 mm **C** 240 μm **D** 384 μm

3 Which statements are correct for chloroplasts and also for mitochondria?

1 They contain 80S ribosomes.

2 They can transcribe their circular DNA.

3 They can translate mRNA.

4 They are enclosed by double membranes.

A 1, 2, 3 and 4

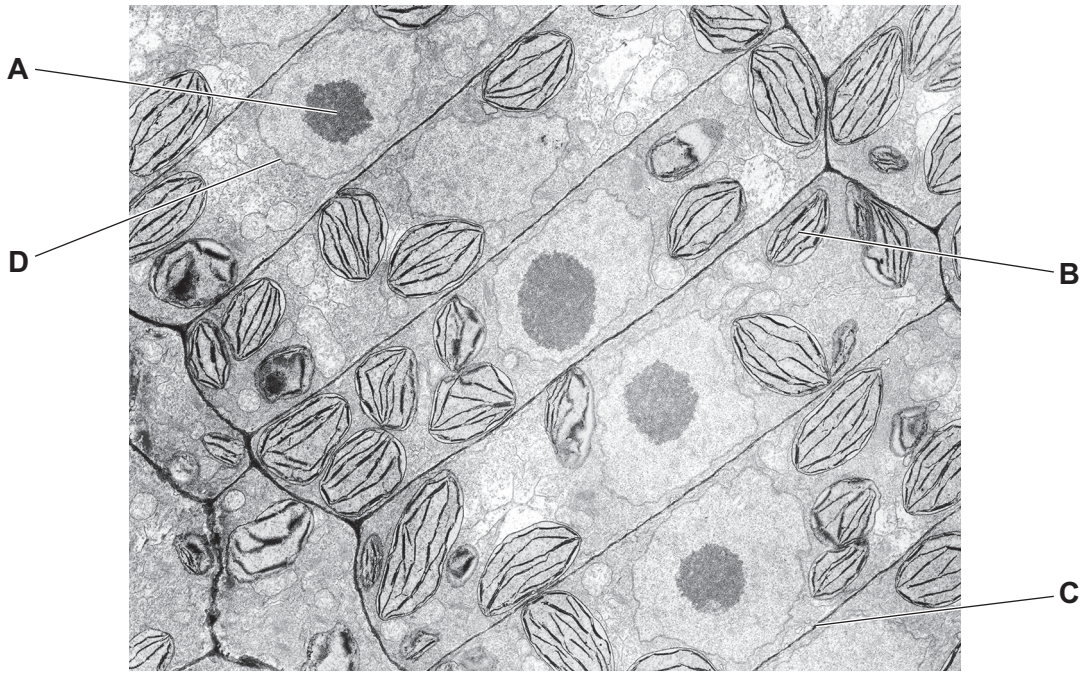
B 1 and 2 only

C 2, 3 and 4 only

D 3 and 4 only

4 The electron micrograph shows some cells from a root.

Which cell structure is **not** usually found in cells from a root?



5 Dialysis (Visking) tubing is an artificial partially permeable membrane with pore sizes of approximately 2.5 nm. Glucose molecules have a diameter of about 1.5 nm and can pass through the pores in the membrane.

What else can pass through the pores?

1 bacteria

2 haemoglobin

3 ribosomes

4 fructose

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

6 What is present in all viruses?

A ribose

B deoxyribose

C adenine

D thymine

7 To estimate the concentration of glucose in an unknown solution, equal volumes of a range of known concentrations of glucose were each mixed with the same excess volume of Benedict's solution. After mixing, the solutions were placed in a thermostatically controlled water-bath at 90 °C for three minutes.

The unknown solution was then treated in the same way and the colours of the known and unknown solutions compared.

What is the independent variable in this procedure?

A concentration of glucose

B final colour of solutions

C temperature of water-bath

D volume of glucose solutions

8 Which statements are correct for amylose and also for amylopectin?

1 They are carbohydrate molecules.

2 They are formed by condensation reactions.

3 They are linear molecules.

4 They contain α-1,4 glycosidic bonds.

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

9 Which statement is a correct comparison between saturated triglyceride molecules and unsaturated triglyceride molecules of approximately the same molecular masses?

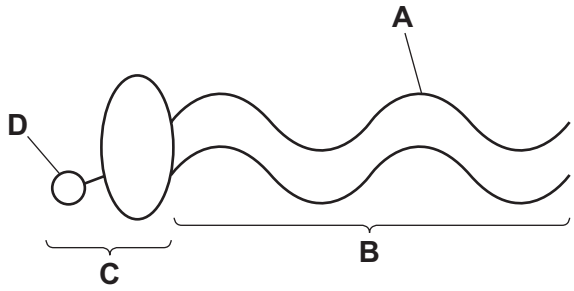
A Unsaturated triglycerides have more double bonds and fewer hydrogen atoms than saturated triglycerides.

B Unsaturated triglycerides have fewer double bonds and fewer hydrogen atoms than saturated triglycerides.

C Unsaturated triglycerides have more double bonds and more hydrogen atoms than saturated triglycerides.

D Unsaturated triglycerides have fewer double bonds and more hydrogen atoms than saturated triglycerides.

10 The diagram represents a molecule from a cell surface membrane.



Which description of one of the labels is correct?

A fatty acid at the hydrophilic end of the molecule

B hydrophobic end of the triglyceride molecule

C hydrophobic end of the glycerol molecule

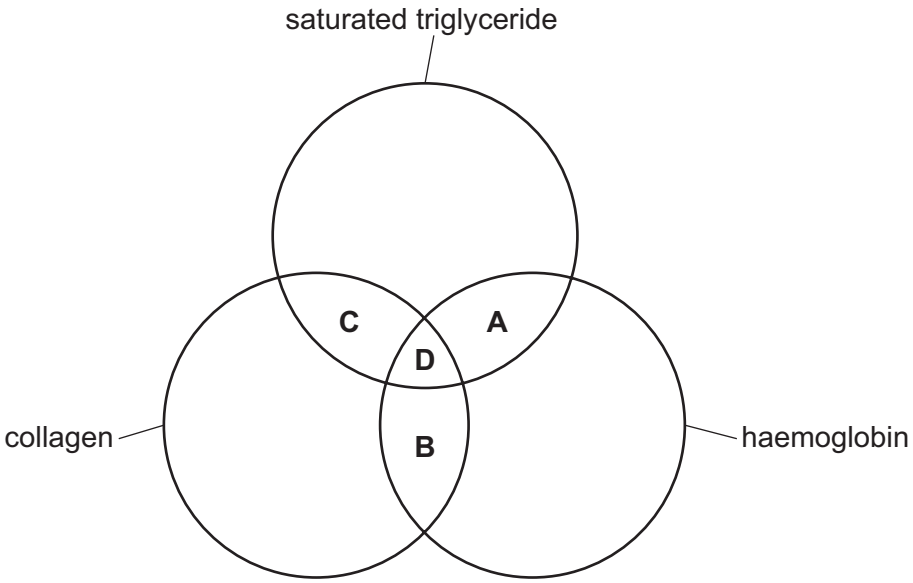
D phosphate group at the hydrophilic end of the molecule

11 Which row correctly shows levels of protein structure that can be held together by each type of interaction?

	hydrogen bonds	hydrophobic interactions	covalent bonds
A	primary, secondary and tertiary structure	tertiary structure	primary and tertiary structure
B	secondary structure	primary and tertiary structure	tertiary structure
C	secondary and tertiary structure	tertiary structure	primary and tertiary structure
D	secondary and tertiary structure	tertiary structure	primary and secondary structure

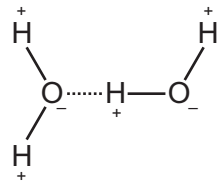
[Turn over

12 Which molecules contain at least three double bonds?

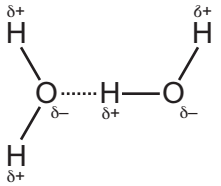


13 Which diagram correctly shows hydrogen bonding between two water molecules?

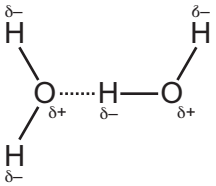
A



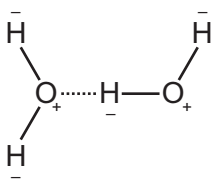
B



C



D



14 Which statement describes an example of an extracellular enzyme?

A Amylase in saliva is an enzyme that catalyses the breakdown of starch in the mouth.

B Carbonic anhydrase is an enzyme that helps in the transport of carbon dioxide in blood.

C DNA polymerase is an enzyme that helps build DNA molecules from nucleotides.

D RNA polymerase is an enzyme involved in the process of gene transcription.

15 Which row is correct for enzymes that catalyse reactions using the lock-and-key hypothesis?

	effect of the enzyme on the activation energy of the reaction being catalysed	shape of active site in comparison to the substrate
A	lowers the activation energy	changes to become complementary as the enzyme–substrate complex forms
B	lowers the activation energy	complementary before, during and after the formation of an enzyme–substrate complex
C	raises the activation energy	changes to become complementary as the enzyme–substrate complex forms
D	raises the activation energy	complementary before, during and after the formation of an enzyme–substrate complex

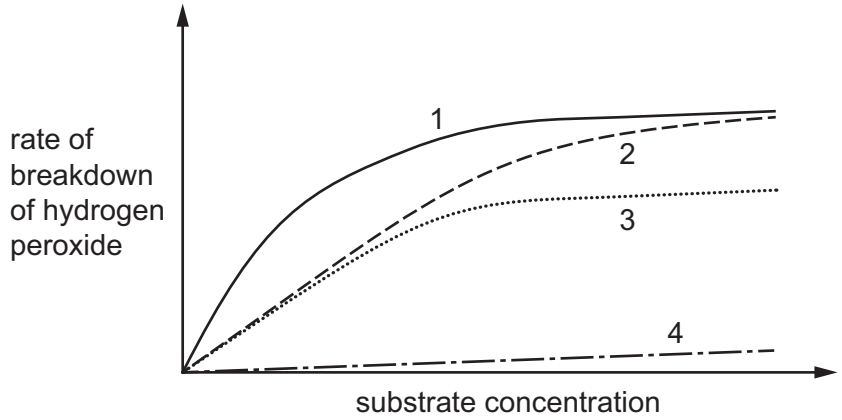
[Turn over

16 A scientist investigated the rate of breakdown of hydrogen peroxide.

Four experiments were carried out using different mixtures.

- substrate only
- substrate + enzyme
- substrate + enzyme + competitive inhibitor
- substrate + enzyme + non-competitive inhibitor

The results are sketched in the graph.



Which row shows the correct lines for two of the experimental mixtures?

	substrate only	substrate + enzyme + competitive inhibitor
A	1	2
B	4	2
C	1	3
D	4	3

17 Which of these substances can pass directly through cell surface membranes without using a carrier protein or a channel protein?

1 Ca^{2+}

2 CO_2

3 $C_6H_{12}O_6$

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

18 What happens to the surface area to volume ratio of a cube when the length of each side is doubled?

A The ratio decreases by four times.

B The ratio halves.

C The ratio doubles.

D The ratio increases by four times.

19 Which events are part of the mitotic cell cycle?

1 interphase

2 telophase

3 cytokinesis

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

20 The estimated total number of red blood cells in the human body is 2.5×10^{13}.

It is estimated that, each day, 2.5×10^{11} red blood cells are removed from the circulation and are replaced by stem cells in the bone marrow.

Which percentage of the total number of red blood cells is replaced each day?

A 0.01% **B** 0.1% **C** 1% **D** 10%

21 DNA polymerase catalyses condensation reactions between molecules during semi-conservative replication of DNA.

What is joined by DNA polymerase?

A base and base

B base and nucleotide

C nucleotide and nucleotide

D phosphate and ribose

22 Two polynucleotide strands make up a DNA molecule.

Which description is correct?

A The percentage of cytosine is 50% of that of guanine in the whole molecule.

B The percentage of cytosine is the same as that of guanine in the whole molecule.

C The percentage of cytosine is the same as that of guanine in each strand.

D The percentage of cytosine is the same in each strand of the molecule.

23 The PDx1 protein is found in a wide range of animal species where it is regarded as essential for normal metabolism. In sand rats, the gene coding for the PDx1 protein has a much lower proportion of A and T nucleotides than *PDx1* genes from other animals.

Finding the complete DNA sequence of the *PDx1* gene in sand rats has been difficult. Sequencing involves splitting off nucleotides one at a time from single-stranded DNA.

What could account for the difficulty in finding the DNA sequence of the *PDx1* gene in sand rats?

1 The *PDx1* gene is present in only a small proportion of nuclei.

2 The *PDx1* gene is transcribed in only some cells.

3 The strength of the hydrogen bonding between the two strands of the *PDx1* gene is unusually high.

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

24 Different tissues in a plant were supplied with a radioactively labelled substance to identify which tissues were actively synthesising mRNA.

Which radioactively labelled substances would be suitable for this experiment?

1 adenine

2 uracil

3 inorganic phosphate

4 ribose

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 2 and 4 only

D 4 only

25 Which row correctly matches the structure and function of phloem sieve tube elements?

	structure	function
A	peripheral cytoplasm with no nucleus	to provide as little resistance to flow as possible
B	end walls modified to form sieve plates	to slow down the rate of transport of solutes
C	elongated cells joined end to end	to form a tube to transport dissolved mineral ions and water
D	cellulose cell wall with no lignin	to prevent loss of water

26 Which feature of xylem vessel elements helps adhesion during transpiration?

A Lignin forms a complete secondary wall.

B New vessels carry extra water as the plants grow.

C There are no cross walls between vessel elements.

D The vessel elements form a narrow tube.

27 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

28 Cellulose, lignin and suberin are components of various plant cell walls.

Descriptions of these cell wall components are listed.

1 a component of the Casparian strip

2 redirects water into the symplast pathway

3 a hydrophobic component of cell walls

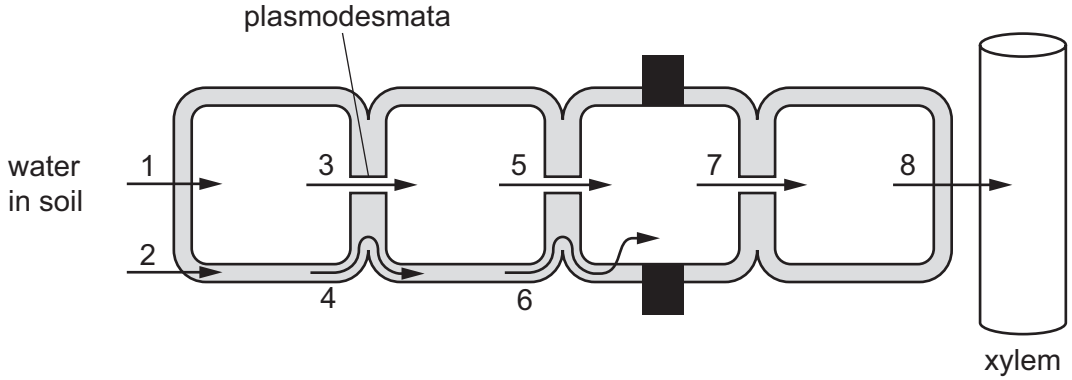
4 water interacts with this molecule in the apoplast pathway

Which row correctly matches three of the descriptions with cell wall components?

	cellulose	lignin	suberin
A	2	4	1
B	3	4	2
C	4	1	2
D	4	3	1

[Turn over

29 The arrows show the direction of water movement across a plant root, from water in the soil to the xylem.



Which arrows show water movement **only** in the apoplast pathway?

A 1, 3, 5, 7 and 8

B 2, 4 and 6

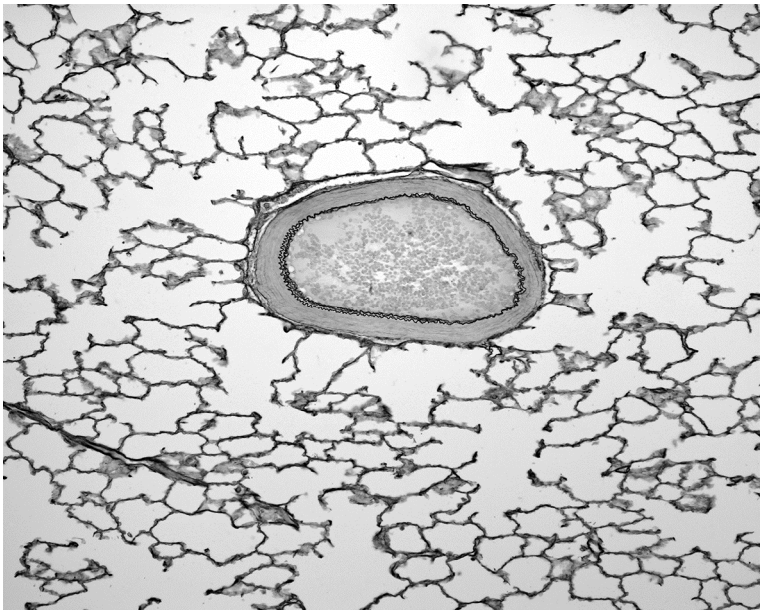
C 2 and 4 only

D 3, 5 and 7 only

30 Which row correctly identifies sources and sinks of sugars?

	root cells absorbing mineral ions	storage cells of seed that is starting to grow
A	sink	source
B	sink	sink
C	source	source
D	source	sink

31 The photomicrograph shows a section through a tissue with an artery.



Which row correctly shows the type of artery and whether the blood inside the artery is oxygenated or deoxygenated?

	type of artery	blood
A	muscular	deoxygenated
B	muscular	oxygenated
C	elastic	deoxygenated
D	elastic	oxygenated

32 Heart surgery may cause a decrease in the transmission of impulses in the Purkyne tissue to the right side of the heart.

What is a possible effect of this decrease?

A Impulses would be delayed by the atrioventricular node.

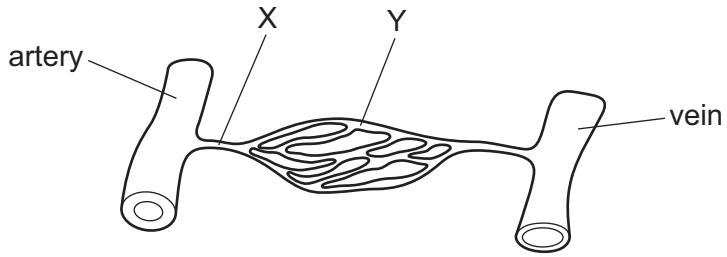
B The muscle of the right ventricle would contract slightly more slowly than the muscle of the left ventricle.

C The muscle of the right atrium would not contract as fully as the muscle of the left atrium.

D The sinoatrial node would transmit fewer impulses.

[Turn over

33 The diagram shows a network of blood vessels that supply blood to muscle tissue in the human body.



What is a correct comparison between the blood at X and the blood at Y when the muscle tissue is at rest?

	blood pressure at X compared with blood pressure at Y	water potential of blood at X compared with water potential of blood at Y
A	equal	higher
B	equal	lower
C	higher	higher
D	higher	lower

34 Scientists have shown that the oxygen dissociation curves for haemoglobin of smaller mammals are to the right of those of larger mammals.

What does this suggest about the haemoglobin of smaller mammals?

A At low partial pressures of oxygen, it binds to oxygen more strongly than the haemoglobin of larger mammals.

B It saturates with oxygen at lower partial pressures of oxygen than the haemoglobin of larger mammals.

C It releases oxygen more easily than the haemoglobin of larger mammals.

D When the partial pressure of oxygen is high, it carries more oxygen than the haemoglobin of larger mammals.

35 What is an effect of an increased concentration of carbon dioxide in the blood?

A increased movement of chloride ions out of red blood cells

B increased concentration of haemoglobinic acid

C decreased concentration of hydrogencarbonate ions in blood plasma

D decreased concentration of carbaminohaemoglobin

36 Two of the requirements of an efficient gas exchange system are a large surface area and a short diffusion distance.

Which row correctly describes how alveoli are adapted to meet these requirements?

	large surface area	short diffusion distance
A	elastin fibres prevent the alveolus wall from collapsing	an extracellular layer inside the alveolus wall contains blood capillaries
B	gases dissolve in a layer of liquid to speed up diffusion	alveolar walls are next to capillaries
C	alveoli are folded and interconnected	walls of alveoli are only one cell thick
D	walls of alveoli are formed of squamous epithelial cells	red blood cells are very close to capillary walls

37 What defines infectious diseases?

A Symptoms are caused by a bacterium that passes from contaminated air, soil or water to a host.

B Symptoms are caused by a pathogen that is transmitted from one host to another.

C Symptoms are caused by a microorganism that is carried by a vector.

D Symptoms are caused by a virus that mutates to infect a new species.

38 A hurricane destroys a large town on an island. People move away from the town and set up tents, where sanitation is poor.

Which disease is most likely to spread within a week of the change in living conditions?

A cholera

B HIV

C malaria

D TB

39 Which statement correctly explains why viruses are unaffected by penicillin?

A Penicillin only affects host cell metabolism.

B Penicillin only binds with 70S ribosomes.

C Penicillin only blocks mRNA synthesis in prokaryotes.

D Penicillin only blocks peptidoglycan synthesis.

[Turn over

40 Which processes characterise the mode of action of phagocytes?

1 antibody production

2 receptor binding

3 endocytosis

4 exocytosis

5 hydrolysis

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