Oxford Cambridge and RSA

Tuesday 21 May 2019 – Afternoon

AS Level Biology B (Advancing Biology)

H022/01 Foundations of biology

Time allowed: 1 hour 30 minutes

You may use:
- a scientific or graphical calculator
- a ruler (cm/mm)

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name StemUp Model Solution

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **32** pages.

© OCR 2019 [601/4721/0]
DC (RW/SW) 133066/3
OCR is an exempt Charity

stemup.co.uk

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

© OCR 2019

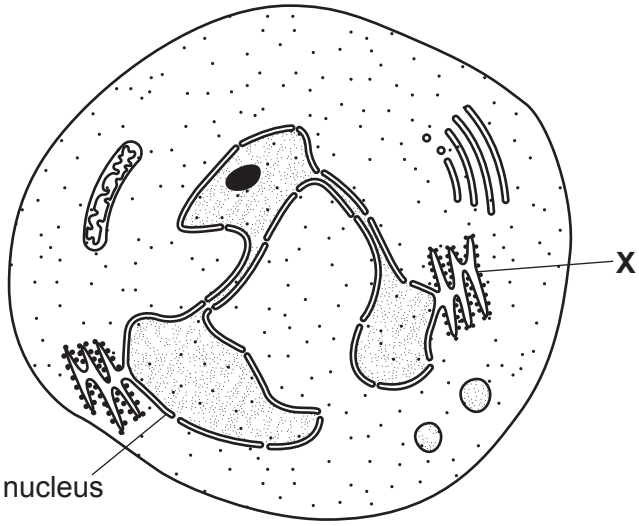
SECTION A

You should spend a maximum of 25 minutes on this section.

Write your answer for each question in the box provided.

Answer **all** the questions.

1 The diagram below shows a cell found in the bloodstream of a mammal.



Which of the statements, **A** to **D**, correctly identifies the cell and structure **X**?

A The cell is a neutrophil and structure **X** is rough endoplasmic reticulum.

B The cell is a monocyte and structure **X** is rough endoplasmic reticulum.

C The cell is a lymphocyte and structure **X** is a ribosome.

D The cell is a neutrophil and structure **X** is the Golgi apparatus.

Your answer A

[1]

© OCR 2019

stemup.co.uk

2 A scientist was observing electron micrographs of eukaryotic cells and writing descriptions for the organelles observed. One of the organelles was described as:

Two groups of microtubules usually arranged at right angles to each other.

Which of the options, **A** to **D**, is the organelle being described by the scientist?

A centriole

B lysosome

C endoplasmic reticulum

D Golgi apparatus

Your answer A

[1]

3 *Haladaptatus cibarius* is a photosynthetic organism found in salt lakes.

The cells of *H. cibarius* do not have nuclei or membrane-bound organelles.

Which of the options, **A** to **D**, describes the cells of *H. cibarius*?

A eukaryotic animal

B eukaryotic plant

C prokaryotic

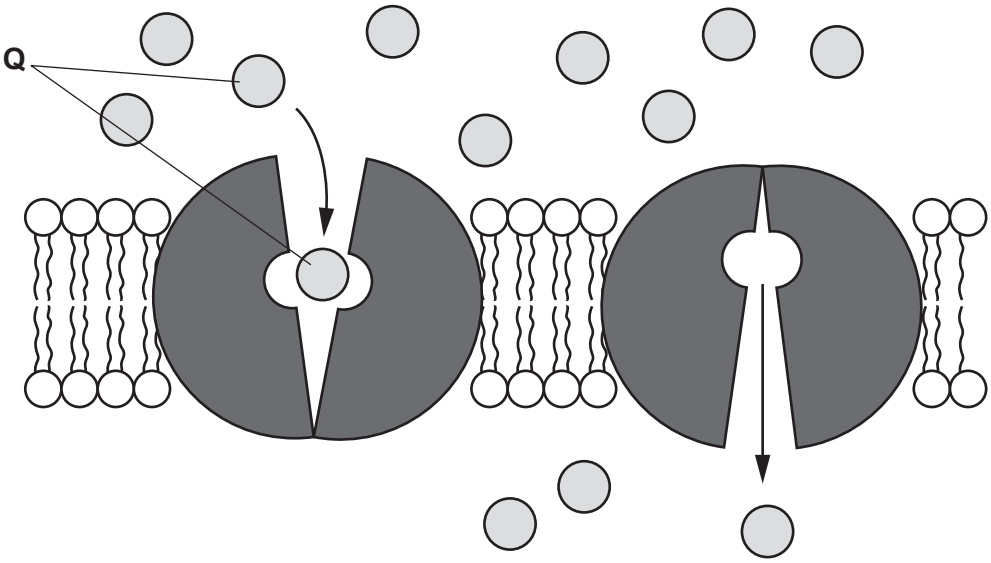
D viral

Your answer C

[1]

© OCR 2019

4 The diagram below shows the transport of solute **Q** through a cell surface membrane.



Which of the statements, **A** to **D**, describes the transport of solute **Q**?

A Solute **Q** is glucose being transported by active transport through a carrier protein.

B Solute **Q** is oxygen being transported by active transport through a channel protein.

C Solute **Q** is glucose being transported by facilitated diffusion through a carrier protein.

D Solute **Q** is oxygen being transported by facilitated diffusion through a channel protein.

Your answer C

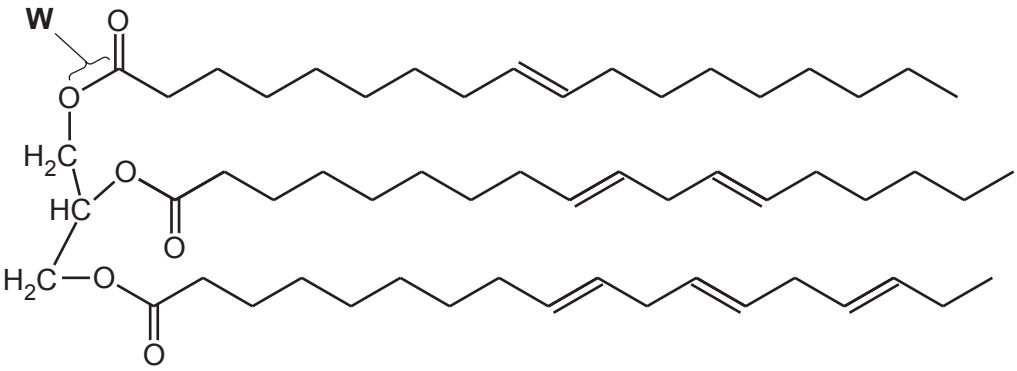
[1]

© OCR 2019

stemup.co.uk

5 Linseed oil is a polyunsaturated triglyceride that can be extracted from the seeds of the flax plant, *Linum usitatissimum*.

A diagram of a linseed oil molecule is shown below.



Which of the options, **A** to **D**, identifies the bond labelled **W**?

A glycosidic

B phosphodiester

C peptide

D ester

Your answer D

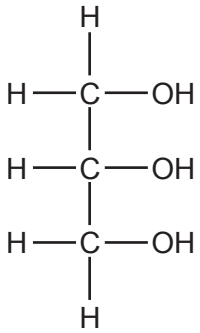
[1]

© OCR 2019

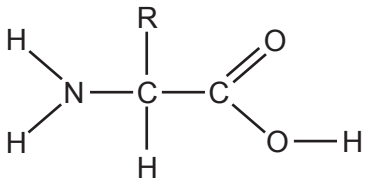
6 Lactase is an enzyme found in mammals that breaks down lactose.

Which of the molecules, **A** to **D**, would be found in a solution following the complete hydrolysis of the enzyme lactase?

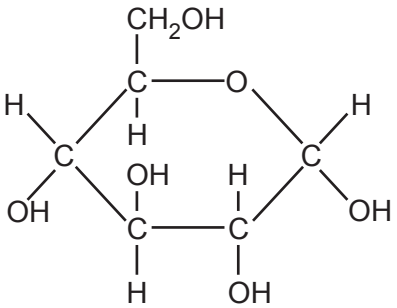
A



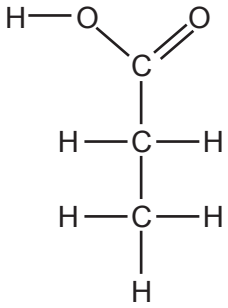
B



C



D



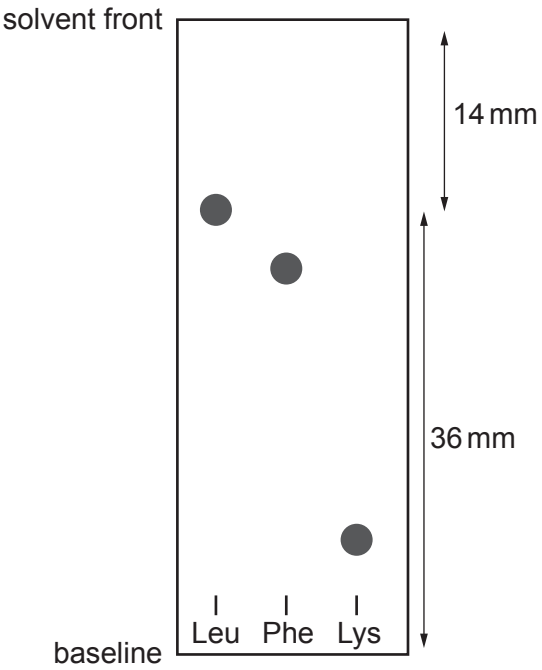
Your answer B

[1]

© OCR 2019

stemup.co.uk

7 The diagram below is a chromatogram of three different amino acids. The distance travelled by the solvent from the baseline is 50 mm.



Using the information in the chromatogram, which of the options, **A** to **D**, is the Rf value for the amino acid leucine (Leu)?

A 0.39

B 0.28

C 0.72

D 1.39

Your answer C

[1]

© OCR 2019

8 Haemoglobin is a protein molecule found in mammalian erythrocytes.

Which of the statements, **A** to **D**, about the structure of haemoglobin is correct?

A Primary structure does not contain any oxygen-carrying haem groups.

B Secondary structure is stabilised by hydrogen bonds between different polypeptide chains.

C Tertiary structure has two α and two β polypeptide chains.

D Quaternary structure is stabilised by peptide bonds between the polypeptide chains.

Your answer A

[1]

9 During a clinical trial, two groups of patients that had received blood transfusions were compared.

Some of the results are shown below.

Patient group	Number of patients	Number of deaths during the hospitalisation period	Mortality rate (%)
Group 1	420	118	28.1
Group 2	418	93	

Which of the options, **A** to **D**, is the correctly calculated difference in mortality rate between the two groups?

A 22.2%

B 50.3%

C 71.9%

D 5.9%

Your answer D

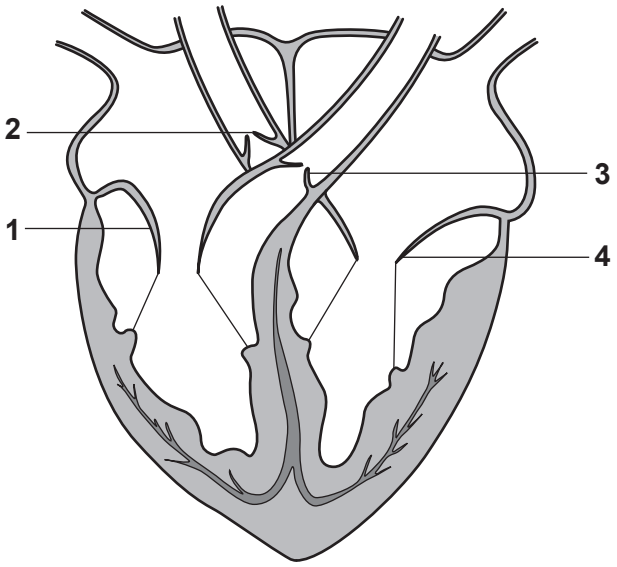
[1]

© OCR 2019

stemup.co.uk

10 The diagram below shows the internal structure of a mammalian heart.

Valves have been labelled **1**, **2**, **3** and **4**.



Which of the rows, **A** to **D**, describes the positions of these valves during ventricular systole?

	1	2	3	4
A	open	closed	open	open
B	open	closed	closed	open
C	closed	open	open	closed
D	closed	open	open	open

Your answer C

[1]

© OCR 2019

11 A student was investigating the effect of exercise on heart function. Some of the results are shown in the table below.

	Heart rate (bpm)	**Cardiac output (cm^3 min^{-1})**
At rest	75	5625
During exercise	120	12600

Which of the options, **A** to **D**, is the correctly calculated **stroke volume** for this heart at rest?

A 0.01 cm^3

B 75 cm^3

C 105 cm^3

D 421 875 cm^3

Your answer B

[1]

© OCR 2019

stemup.co.uk

12 Some students are preparing for a lecture on the mammalian transport system.

student A
I'd say that valves in veins help to maintain pressure and keep blood moving so that it doesn't agglutinate.

student B
I think closed double circulations only maintain useful pressure in the systemic system.

student C
A double circulatory system saves the heart from having to deal with deoxygenated blood.

student D
I think that respiratory gases are transferred between body cells and circulating blood via tissue fluid.

Which of the students, **A** to **D**, has the correct idea about the mammalian transport system?

A student A

B student B

C student C

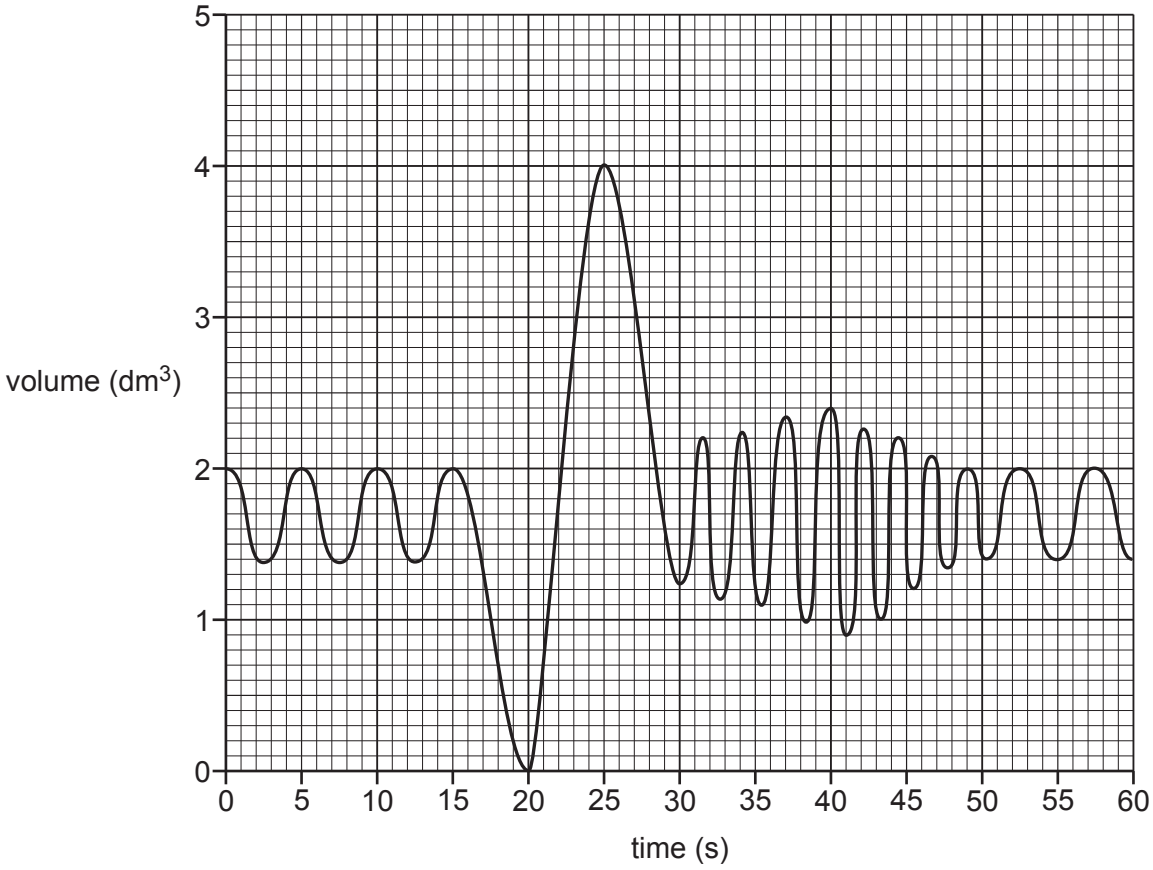
D student D

Your answer D

[1]

© OCR 2019

13 A spirometer was used to monitor the breathing of a student during periods of rest and exercise. The resulting spirometer trace is shown below.



Using the spirometer trace, which of the options, **A** to **D**, is the value for the resting tidal volume?

A 2.0 dm^3

B 2.6 dm^3

C 0.6 dm^3

D 4.0 dm^3

Your answer C

[1]

© OCR 2019

stemup.co.uk

14 During a routine visit to the antenatal clinic, a woman in the early stages of pregnancy was offered advice about why she should increase her intake of certain nutrients.

Which of the following nutrients, **A** to **D**, should be increased for synthesis of DNA and production of erythrocytes?

A iron

B folic acid

C calcium

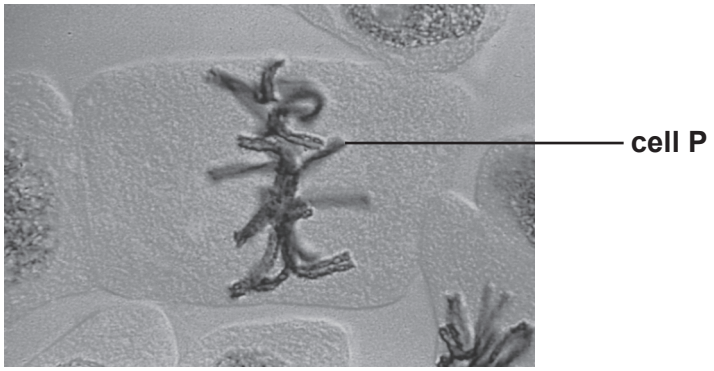
D vitamins A and C

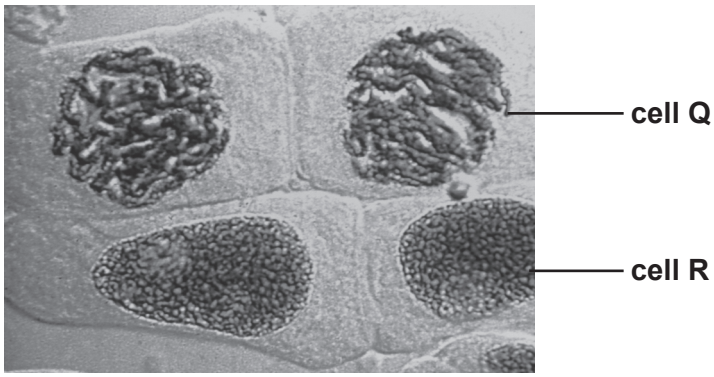
Your answer B

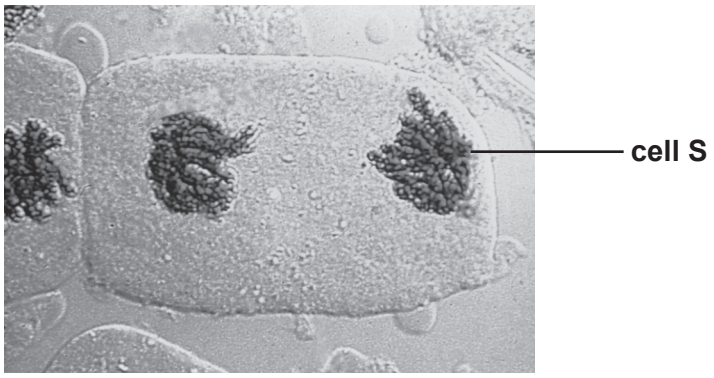
[1]

© OCR 2019

15 The photomicrographs show plant cells in different stages of the cell cycle.







Which of the rows, **A** to **D**, correctly identifies the stages of the cell cycle occurring in the cells?

	Cell P	Cell Q	Cell R	Cell S
A	metaphase	interphase	telophase	anaphase
B	anaphase	prophase	interphase	telophase
C	metaphase	prophase	interphase	telophase
D	metaphase	interphase	prophase	anaphase

Your answer C

[1]

© OCR 2019

stemup.co.uk

16 Living organisms are classified by biologists in hierarchical groupings called taxonomic ranks.

After domain and kingdom, which of the options, **A** to **D**, is the correct sequence for these ranks?

A phylum, order, class, family, genus, species

B phylum, class, order, family, genus, species

C phylum, order, family, class, genus, species

D phylum, class, family, order, genus, species

Your answer B

[1]

17 Which of the options, **A** to **D**, are molecules that enhance phagocytosis by marking antigens during an immune response?

A cytokines

B agglutinins

C anti-toxins

D opsonins

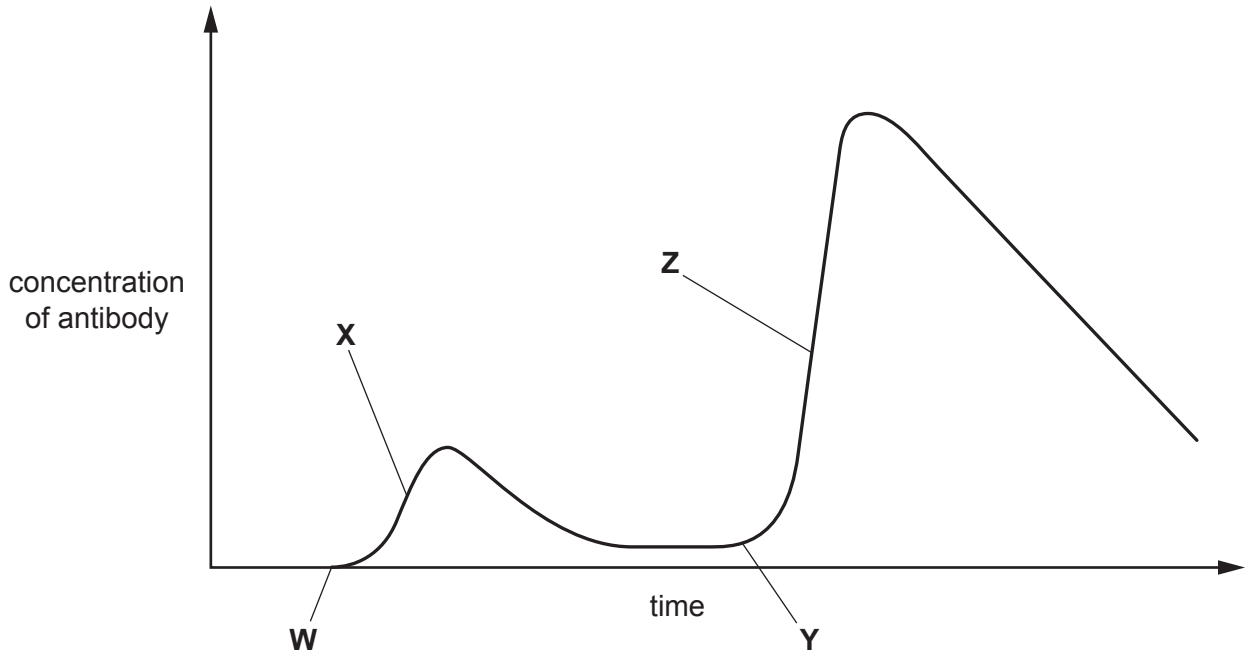
Your answer D

[1]

© OCR 2019

18 Vaccination can provide immunity to infectious diseases.

The graph below shows an immune response for a person who has been vaccinated against an infectious disease.



Which of the options, **A** to **D**, describes what is happening during this immune response?

A At **W** the person was first exposed to the pathogen and at **X** the person was vaccinated.

B At **X** the person is producing a primary response to the vaccine and at **Z** the person is producing a primary response to the same antigen as that found in the vaccine.

C At **W** the person was vaccinated and at **Z** the person is producing a secondary response to the same antigen as that found in the vaccine.

D At **X** the person was vaccinated and at **Y** the person is producing a secondary response to the same antigen as that found in the vaccine.

Your answer C

[1]

© OCR 2019

stemup.co.uk

19 Cromolyn is a medicinal drug derived from plants. It has properties that make it useful in the treatment of asthma.

Which of the options, **A** to **D**, describes a property that would be most useful for the treatment of asthma?

A inhibits mitosis

B is antibacterial

C acts as a painkiller

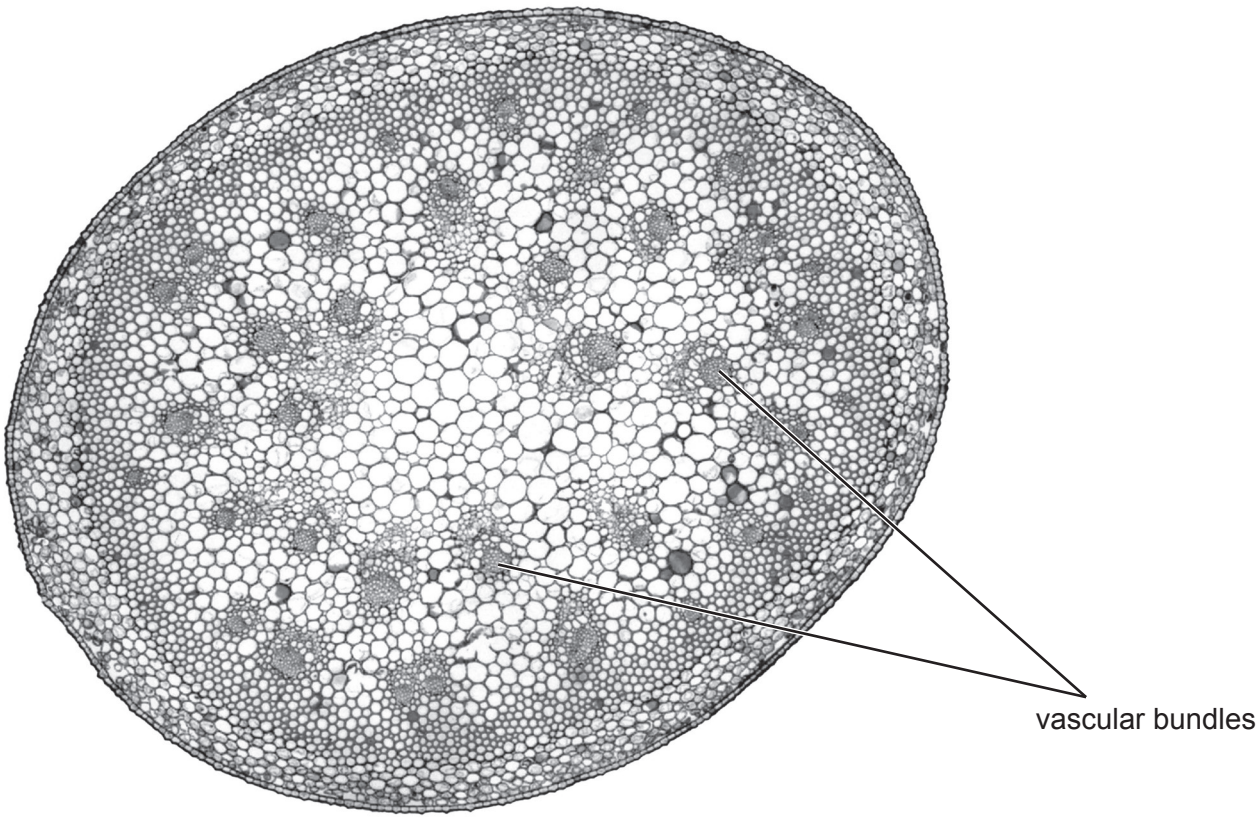
D acts as a relaxant of smooth muscle

Your answer D

[1]

© OCR 2019

20 The photomicrograph below shows a transverse section of a plant organ.



Which of the plant organs, **A** to **D**, is shown in the photomicrograph?

A stem of a dicotyledon

B stem of a monocotyledon

C root of a dicotyledon

D root of a monocotyledon

Your answer B

[1]

© OCR 2019

stemup.co.uk

SECTION B

Answer **all** the questions.

21 In addition to stomata, seedlings of trees such as the red maple, *Acer rubrum*, develop lenticels in their stems as they grow.

(a) Explain why tree seedlings need to develop lenticels in addition to stomata as they grow.

Lenticels allow diffusion of gases (oxygen and carbon dioxide) between the atmosphere and the intercellular spaces of the stem. As the seedling grows, the stem becomes woody and develops bark, which gases cannot pass through, and there are not enough leaves, so not enough stomata, to supply all the tissues. **[2]**

(b) Flooded or waterlogged soils can affect the development of lenticels in *A. rubrum* seedlings.

The effect of waterlogged soils on lenticel development was investigated *in situ* on a sloping hillside as shown in Fig. 21.1.

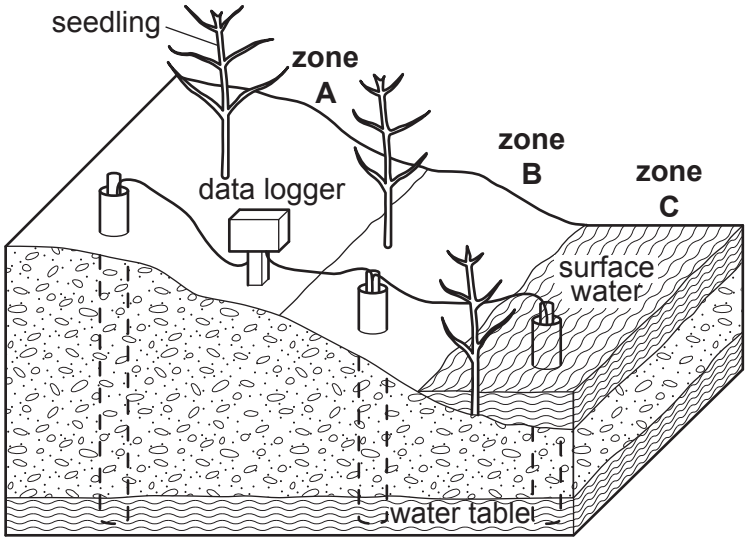


Fig. 21.1

Three zones were established:

- **Zone A** (upland) dry soil. Seedlings would only receive water when it rained
- **Zone B** (saturated) wet soil. Roots of the seedlings would always be in contact with water
- **Zone C** (wetland) water-logged soil with surface water always present at a depth of at least 5 cm. Both stems and roots of seedlings would always be in contact with water.

© OCR 2019

(i) The level of the water table shown in Fig. 21.1 was monitored throughout the investigation.

Suggest why.

Changes in the water table would affect the validity of the results, e.g. if it rose, seedlings in zones A and B could also be waterlogged, so changes can be accounted for when analysing the results. **[1]**

(ii) Suggest one advantage **and** one disadvantage of carrying out this investigation ***in situ*** rather than in a laboratory.

advantage Seedlings are exposed to the natural environment, e.g. natural light and day length, and roots do not become pot bound.

disadvantage Conditions such as rainfall and temperature cannot be controlled, and the data loggers may get damaged.

[2]

© OCR 2019

stemup.co.uk

(c) There were 100 seedlings in each zone and the number of lenticels on the stem of each seedling was counted over a period of 13 weeks.

Fig. 21.2 shows the results of the investigation.

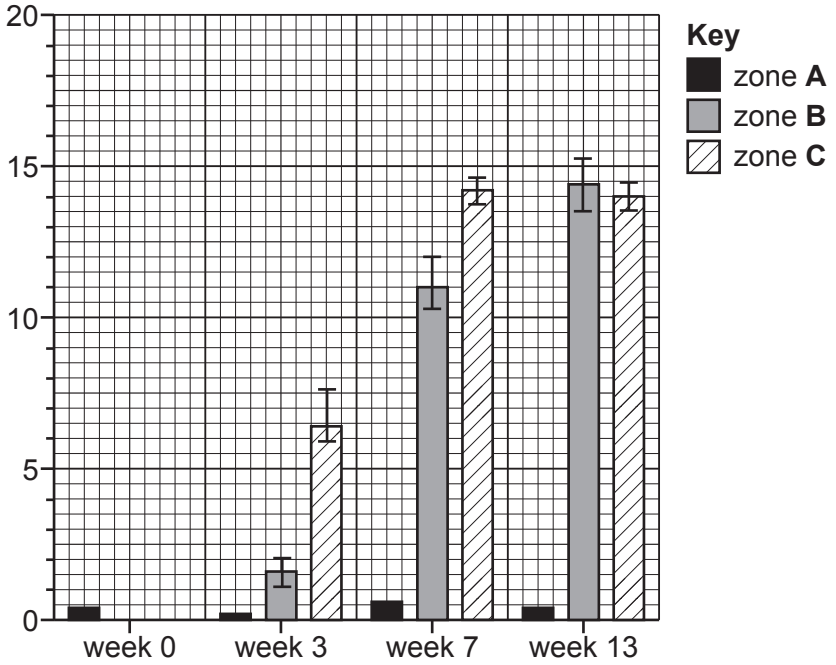


Fig. 21.2

(i) What would be a suitable label for the *y*-axis of the bar chart shown in Fig. 21.2?

mean number of lenticels per seedling ..... **[1]**

(ii) Using Fig. 21.2, what can you conclude about the results for zones **B** and **C** over the period of the investigation?

No data for B and C at week 0, so no conclusion about the start.

Mean number of lenticels in B increases throughout (1.5, 11, 14.5).

Mean is greater in C at weeks 3 and 7 (6.5 and 14.25); C increases

up to week 7 then levels off (14). Range bars overlap at week 13, so

no difference between B and C then. ..... **[2]**

© OCR 2019

(d) After 13 weeks it was noticed that the seedlings in zone **C** developed an increase in thickness of the stem (stem hypertrophy) caused by enlargement of cells in the cortex of the stem.

(i) Apart from enlargement of cells, name **one** other process that would result in an increase in the thickness of the seedling stem.

Mitosis (cell division), increasing the number of cells.

..... **[1]**

(ii) Suggest why the roots of *A. rubrum* seedlings in zone **C** had reduced uptake of nutrients during the investigation.

Waterlogging causes a lack of oxygen in the soil, so there is less aerobic respiration in the root cells and less ATP is produced. So active transport of mineral ions (e.g. nitrates) into the roots cannot take place. Nutrients may also be leached out of the waterlogged soil.

..... **[2]**

© OCR 2019

stemup.co.uk

22 Fig. 22 represents one branch of a phylogenetic tree for the evolution of hominids.

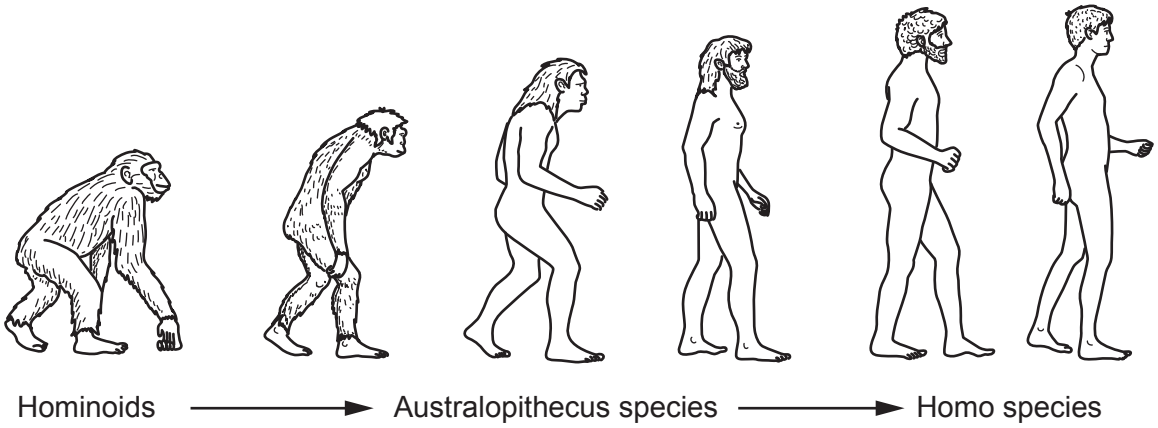


Fig. 22

(a) Using Fig. 22, describe one anatomical adaptation that arose during the evolution of hominids and suggest how this was an advantage to early hominids such as *Australopithecus africanus*.

adaptation

Body became more upright, walking on two legs (bipedalism).

advantage

Frees the hands for using tools and hunting or carrying food, and is a more efficient way of walking over open plains.

[2]

(b) There are many different theories for the evolution of language in hominids.

In the late nineteenth century, the Royal Linguistic Society banned any discussion about the evolution of language based on the fact that none of the theories could be proven scientifically.

Using your knowledge of the theories for the evolution of language, outline methods that have been developed in recent years to test these theories.

Theories such as the 'gossip' and 'mother tongue' theories can now be tested using fossil evidence, e.g. the shape of the hyoid bone shows if speech was possible; archaeological evidence, e.g. artefacts; genetics, e.g. the FOXP2 gene linked to language development; comparisons with other species, e.g. the descended larynx in humans or observing primates; and computer simulations.

[3]

© OCR 2019

(c) Evidence from fossils and biochemical molecules, such as DNA, has enabled scientists to classify hominids.

Complete the following passage about DNA using the most appropriate terms.

DNA is a double helix made of two .polynucleotide..... strands. The individual molecules in each strand are held together by .phosphodiester..... bonds formed during a series of ..condensation..... reactions. The two strands are held together by bonds between pairs of nitrogenous bases. Evidence showed that cytosine, a type of ...pyrimidine..... base, always pairs with .....guanine..... . This is called complementary base pairing.

[5]

© OCR 2019

stemup.co.uk

23 Variegin is a small protein molecule that has been isolated from the salivary glands of the tick species, *Amblyomma variegatum*.

(a) Variegin is a competitive inhibitor of the blood-clotting enzyme, thrombin.

(i) Using your knowledge of the role of thrombin in the blood-clotting process, explain how variegin acts as a competitive inhibitor.

In clotting, thrombin is the enzyme that converts fibrinogen into fibrin. Variegin has a similar shape to the substrate fibrinogen, so it can bind to (occupy) the active site of thrombin. This prevents fibrinogen binding to the active site, so fewer enzyme-substrate complexes form and fibrinogen is converted to fibrin more slowly. Binding is temporary, not permanent. **[3]**

(ii) Fig. 23 shows the effect of two different inhibitors, **Y** and **Z**, on the activity of thrombin as substrate concentration increases.

Curve **X** shows the effect of substrate concentration without an inhibitor.

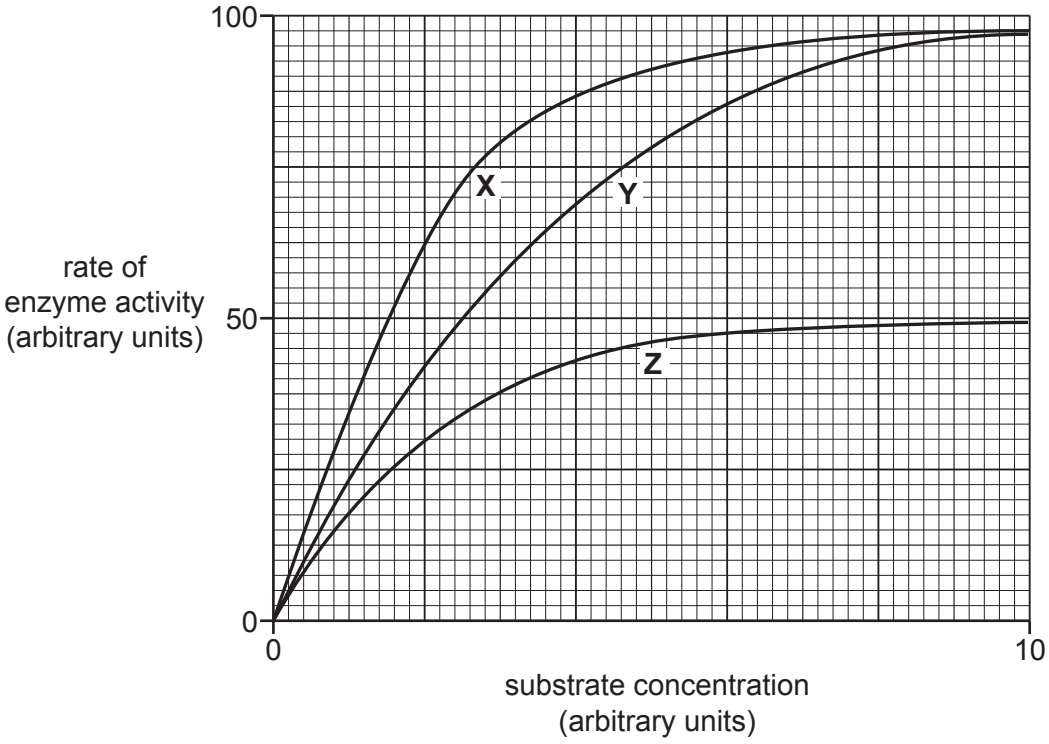


Fig. 23

© OCR 2019

Which of the curves, labelled in Fig. 23, shows the effect of variegin on the activity of thrombin?

Give a reason for your choice.

Curve Y, because at high substrate concentrations it reaches the same maximum rate as curve X (curve Z shows non-competitive inhibition). **[1]**

(iii) Using Fig. 23, calculate the percentage decrease in rate of enzyme activity when inhibitor **Z** is present at a substrate concentration of 4.0 arbitrary units.

Give your answer to **2** significant figures.

At 4.0 a.u.: no inhibitor (X) = 87.5, with Z = 42.5

% decrease = (87.5 − 42.5) ÷ 87.5 × 100

= 51.4% = 51% (2 s.f.)

decrease = 51 % **[2]**

(b) Heparin is a blood-clotting inhibitor which can be used to treat people with a disorder known as antiphospholipid antibody syndrome (APS).

People with APS produce antibodies that attach to phospholipid molecules in cells.

Suggest why this may result in the formation of blood clots in the circulatory system.

Phospholipids are components of cell membranes, so the antibodies attach to cells, e.g. erythrocytes, and cause clumping (agglutination) of the cells. The cell membranes are damaged, and damaged endothelial cells lining the blood vessels can lead to clots forming. **[2]**

© OCR 2019

stemup.co.uk

24 *Aspergillus fumigatus* is a fungus normally found in soil humus. It is an opportunistic pathogen known to cause a variety of diseases in mammals and birds called aspergillosis.

Aspergillosis can occur in any area of the body, but the respiratory system is most commonly affected.

(a) **(i)** Using *A. fumigatus* as an example, explain what is meant by the term opportunistic.

A. fumigatus normally lives in the soil without causing disease, and only causes disease when the host's immune system is weakened. **[1]**

(ii) Outline **one** mechanism used by pathogenic fungi such as *A. fumigatus* to infect body tissues.

The fungus releases enzymes (e.g. proteases) and toxins, and the enzymes break down the cells and tissues. Its spores and hyphae then invade the tissues. **[2]**

(b) One method of diagnosing aspergillosis in the human respiratory system is to use a light microscope to observe sputum samples.

Fig. 24 is a photomicrograph showing the presence of *A. fumigatus* in a human sputum sample.

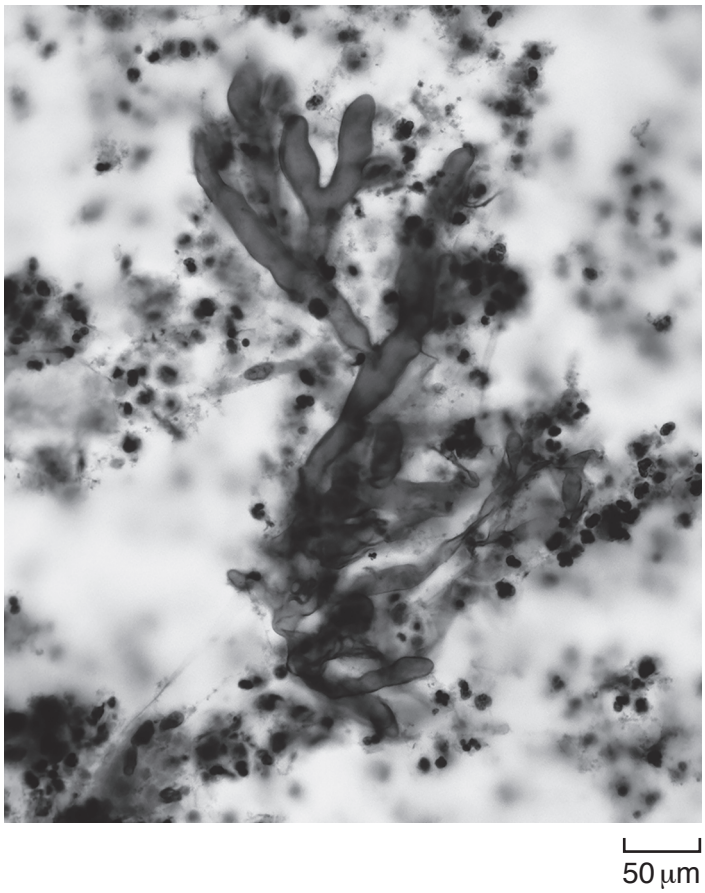


Fig. 24

© OCR 2019

(i) Describe how the sputum sample in Fig. 24 could have been prepared for viewing the cells of *A. fumigatus* using a light microscope.

Spread the sputum thinly on a microscope slide (smear it with another slide), fix it, e.g. with methanol, then add a differential stain so the fungal cells can be distinguished, and add a coverslip.

..... **[2]**

(ii) Calculate the magnification of the photomicrograph shown in Fig. 24.

scale bar length = 10 mm = 10 000 μm

magnification = image size ÷ actual size

= 10 000 ÷ 50 = 200

magnification = x 200 **[2]**

(c) *A. fumigatus* can also be observed using other types of microscope such as scanning electron microscopes and transmission electron microscopes.

The table below lists a number of features that could apply to **either or both** of these types of electron microscope.

Complete the table by indicating with a tick (✓) which of the features apply to each type of electron microscope.

Feature	Scanning electron microscope	Transmission electron microscope
The electron beam reflects off the surface of the specimen	✓	
A 3-D image is produced	✓	
Heavy metals are used to stain or coat the specimen	✓	✓
Specimens **must** be extremely thin		✓

[4]

© OCR 2019

stemup.co.uk

25 Fig. 25 shows the number of cancer cases linked to human papilloma virus (HPV) that occurred worldwide in 2002.

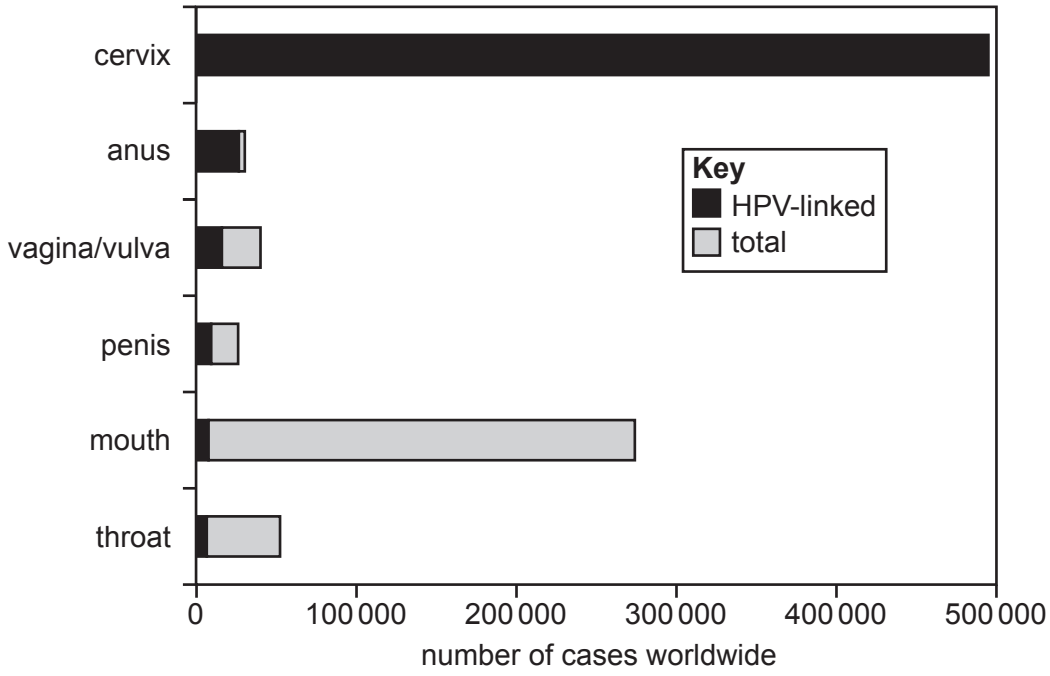


Fig. 25

(a) It has been concluded that women are at greater risk than men of developing cancer linked to HPV. The most common cancer linked to HPV in women is cervical cancer.

(i) Using Fig. 25, suggest what additional information would be needed to conclude that women are at greater risk than men of developing **other** cancers linked to HPV.

The numbers of men and women who have the non-gender related cancers (anus, mouth and throat cancers). **[1]**

(ii) A vaccine against HPV has been developed to protect young women from cervical cancer. It has been suggested that young men could also benefit from this vaccine.

Suggest why some people might object to compulsory vaccination of young men.

Young men do not have a cervix, so cannot suffer from cervical cancer, and they may not be sexually active. It may be an unnecessary cost (financial implications), and there is a lack of awareness of the benefits of vaccinating young men. **[2]**

© OCR 2019

(b) In the UK, the HPV vaccine is now part of the national childhood vaccination programme.

Administration of vaccines such as the HPV vaccine is an example of a type of artificial immunity.

(i) Describe examples of **two** types of **natural** immunity.

Natural active immunity: after infection (exposure to the antigen) the person produces their own antibodies and memory cells, which protect them in future.

Natural passive immunity: antibodies are passed from the mother to the fetus across the placenta, or to the baby in breast milk (colostrum).

[3]

(ii) Studies have shown the presence of memory B lymphocytes in recipients of the HPV vaccine eight years after it was administered.

Outline the role of memory B lymphocytes in providing long-term immunity to HPV.

Memory B cells survive for long periods in the bloodstream after vaccination.

If HPV infects later, the memory cells recognise its antigen, so antigen presentation is quicker and there is more rapid clonal selection and expansion.

They divide into plasma cells, so antibody production increases faster and to a higher concentration. This secondary response is quicker, so the virus is destroyed before symptoms develop. **[3]**

(c) In some areas of the UK, screening tests for HPV were trialled in addition to the normal cervical screening test.

Suggest why women in these trials were offered both screening tests.

The HPV test may give false results, and a positive HPV result does not necessarily mean cancer. **[1]**

END OF QUESTION PAPER

© OCR 2019

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

OCR
Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

© OCR 2019