



Oxford Cambridge and RSA

# AS Level Biology B (Advancing Biology)

H022/01 Foundations of biology

**Thursday 25 May 2017 – Afternoon**

**Time allowed: 1 hour 30 minutes**



**You may use:**

- a scientific or graphical calculator
- a ruler (cm/mm)



|               |  |  |  |  |  |                  |  |  |  |  |
|---------------|--|--|--|--|--|------------------|--|--|--|--|
| First name    |  |  |  |  |  |                  |  |  |  |  |
| Last name     |  |  |  |  |  |                  |  |  |  |  |
| Centre number |  |  |  |  |  | Candidate number |  |  |  |  |

## INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- 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.
- Do **not** write in the barcodes.

## INFORMATION

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [ ].
- This document consists of **28** pages.

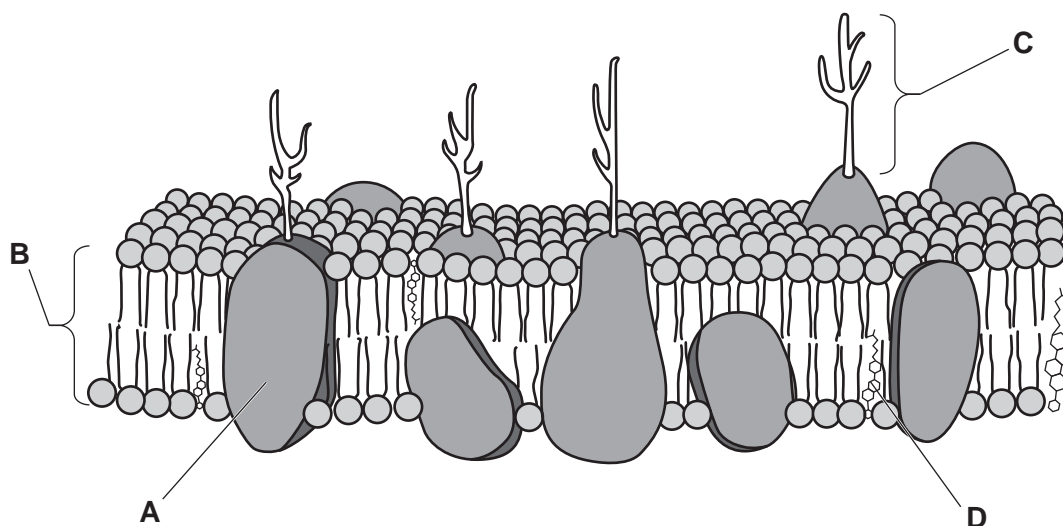
2  
SECTION A

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

Write your answer to each question in the box provided.

Answer **all** the questions.

- 1 The diagram below shows the structure of a cell surface (plasma) membrane.



Which of the components, labelled **A** to **D**, regulates the fluidity of the membrane?

Your answer

[1]

- 2 Transpiration in plants is affected by environmental factors.

Which of the environmental factors, **A** to **D**, will affect transpiration by changing the kinetic energy of water molecules?

- A** humidity
- B** temperature
- C** light intensity
- D** carbon dioxide concentration

Your answer

[1]

3

3 The table below shows the mean blood pressure measurements for four patients.

|           | Mean blood pressures (mmHg) |           |
|-----------|-----------------------------|-----------|
|           | Systolic                    | Diastolic |
| Patient A | 80                          | 120       |
| Patient B | 100                         | 190       |
| Patient C | 190                         | 100       |
| Patient D | 80                          | 50        |

Which of the patients, **A** to **D**, would be diagnosed with **hypotension**?

- A Patient A
- B Patient B
- C Patient C
- D Patient D

Your answer

[1]

4 DNA barcodes are sequences of DNA that can be used for identifying species.

Which of the statements, **A** to **D**, is a property of a DNA barcode that makes it ideal for identifying species?

- A shows a large amount of variation between species
- B shows a large amount of variation within a species
- C is long, so quick to analyse
- D is found in the mitochondria of most taxa

Your answer

[1]

4

5 Which of the options, **A** to **D**, accurately describes a clinical trial in which neither the patients nor the scientists know which treatment is being issued?

- A placebo
- B double-blind
- C randomised
- D blind

Your answer

[1]

6 The blood clotting process is a series of enzyme-controlled reactions.

Which of the reactions, **A** to **D**, occurs in the blood clotting process?

- A Fibrinogen is converted to fibrin by the enzyme thromboplastin.
- B Thrombin is converted to prothrombin by the enzyme thromboplastin.
- C Prothrombin is converted to thrombin by the enzyme thromboplastin.
- D Prothrombin is converted to thromboplastin by the enzyme thrombin.

Your answer

[1]

5

- 7 The table below shows the results of a survey investigating asthma in children from an urban population of China in 2010.

|                             | <b>Males</b> | <b>Females</b> |
|-----------------------------|--------------|----------------|
| <b>Number in population</b> | 6096         | 5986           |
| <b>Number with asthma</b>   | 352          | 199            |

Which of the options, **A** to **D**, is the correctly calculated percentage prevalence rate of asthma in this population of children?

- A** 5.7%
- B** 3.3%
- C** 5.5%
- D** 4.6%

Your answer

[1]

6

- 8 The photomicrograph below is a transverse section through a dicotyledonous stem showing two types of cell in phloem tissue.



structure X

The structure labelled X allows exchange of materials between the two types of cells.

Which of the options, A to D, identifies structure X?

- A plasmodesma
- B stoma
- C lenticel
- D casparian strip

Your answer

[1]

7

- 9 *HER-2/neu* is a type of gene that produces a protein involved in regulating the normal growth of breast cells.

A mutation in the *HER-2/neu* gene causes large quantities of this protein to be produced which leads to the development of breast cancer.

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

- A** *HER-2/neu* is a proto-oncogene that becomes an oncogene when it is mutated.
- B** *HER-2/neu* is a tumour suppressor gene that becomes an oncogene when it is mutated.
- C** *HER-2/neu* is an oncogene that becomes a proto-oncogene when it is mutated.
- D** *HER-2/neu* is a tumour suppressor gene that becomes a proto-oncogene when it is mutated.

Your answer

[1]

- 10 The table below shows features of the blood types of four patients, **1**, **2**, **3** and **4**.

|                  | <b>Antigens on erythrocytes</b> | <b>Antibodies in blood plasma</b> |
|------------------|---------------------------------|-----------------------------------|
| <b>Patient 1</b> | A and B                         | none                              |
| <b>Patient 2</b> | none                            | anti-A and anti-B                 |
| <b>Patient 3</b> | A                               | anti-B                            |
| <b>Patient 4</b> | B                               | anti-A                            |

Which of the options, **A** to **D**, shows the patient with the correct blood type for receiving blood from a donor with blood group AB?

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

Your answer

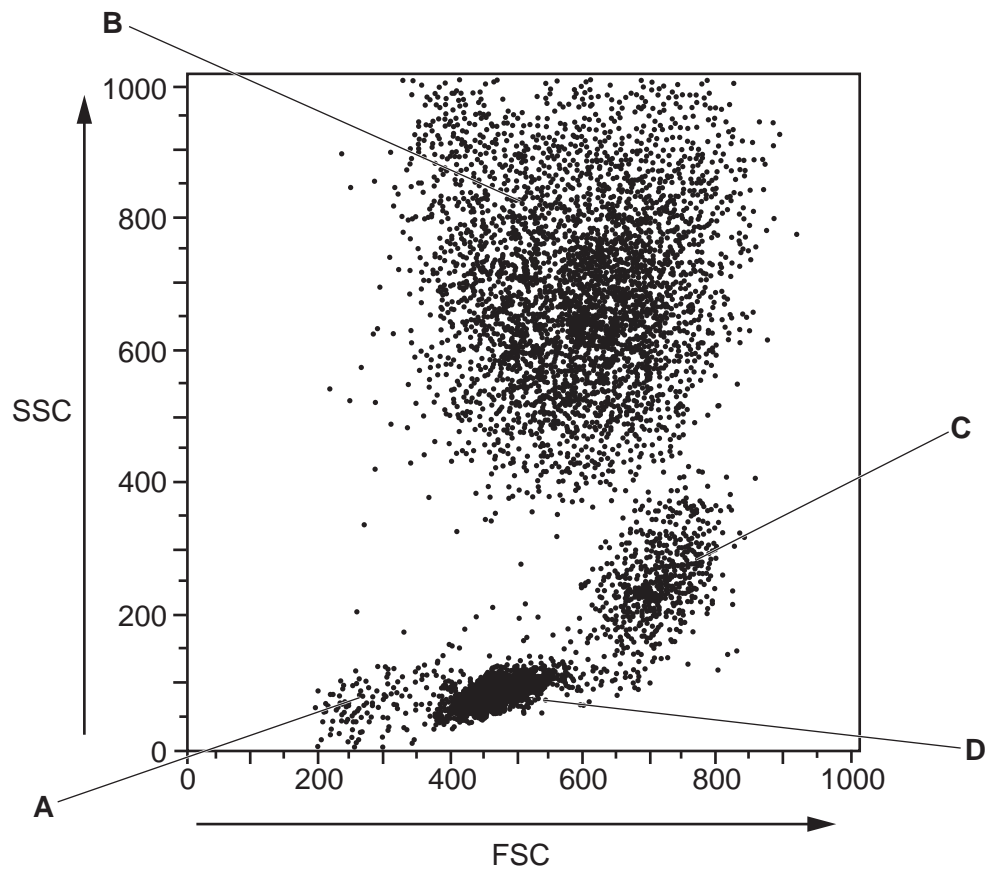
[1]

## 8

- 11 Flow cytometry can be used to distinguish types of leucocyte depending on the size of the cell and the granularity of the cytoplasm.

The diagram below shows the analysis of a blood sample using flow cytometry.

- Each dot represents a single cell
- The greater the forward scatter of light (FSC) the larger the cell
- The greater the side scatter of light (SSC) the more granular the cell



Which of the areas on the diagram, labelled **A** to **D**, shows the position of neutrophils?

Your answer

[1]



9

- 12 A patient was admitted to hospital with a resting heart rate of 40bpm. Their electrocardiogram (ECG) trace showed that the distance between the QRS peaks was longer than that of a normal trace.

Which of the options, **A** to **D**, is the heart condition being described?

- A tachycardia
- B bradycardia
- C myocardial infarction
- D ventricular fibrillation

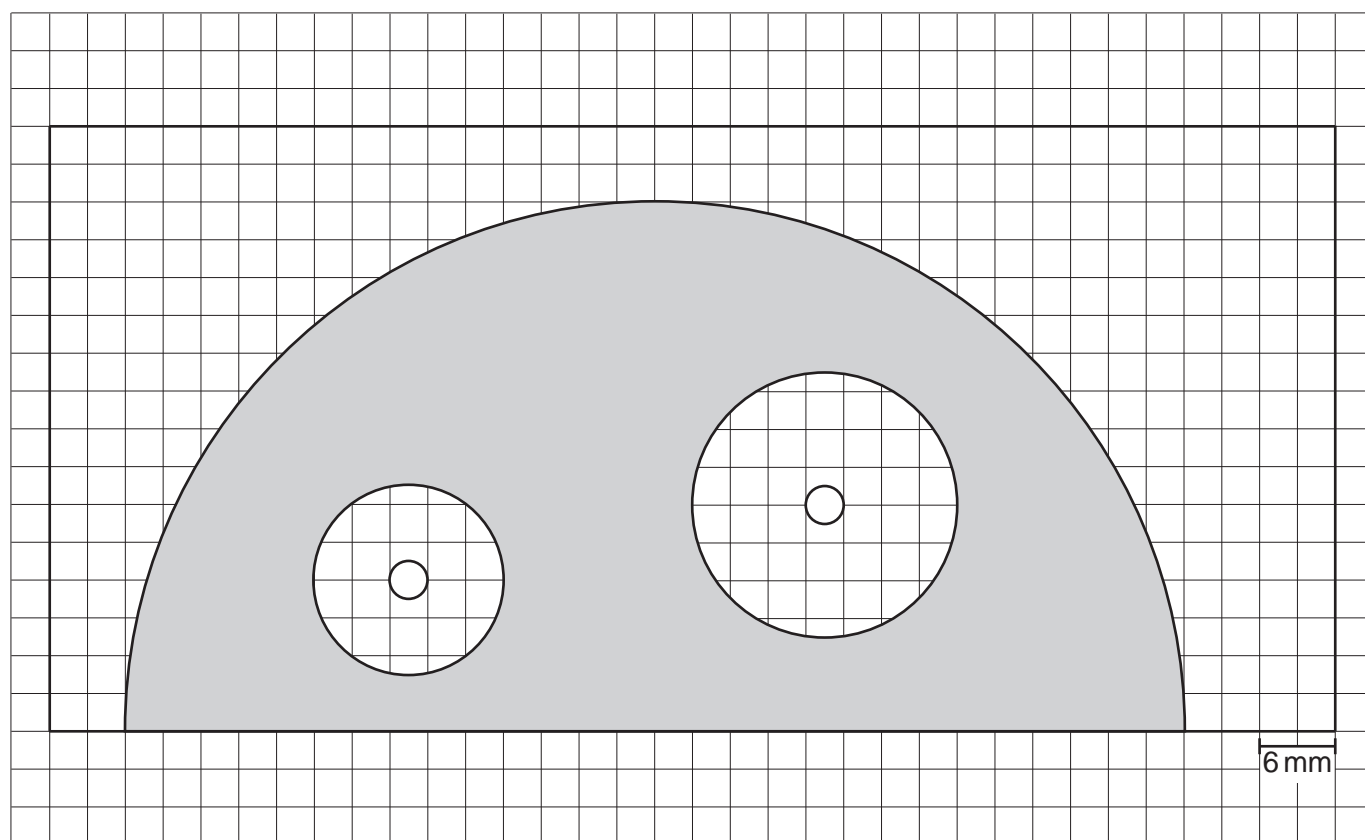
Your answer

[1]

10

- 13 A group of students was investigating the effect of different antibiotics on the growth of colonies of the bacterium, *Escherichia coli*.

The results are shown below.



Which of the options, **A** to **D**, is the inhibition zone of the **least effective** antibiotic?

- A 1385 mm<sup>2</sup>
- B 707 mm<sup>2</sup>
- C 346 mm<sup>2</sup>
- D 177 mm<sup>2</sup>

Your answer

[1]

14 The structure of blood vessels is related to their function.

Which of the blood vessels, **A** to **D**, has a wall consisting of only endothelial cells?

- A venule
- B vein
- C capillary
- D arteriole

Your answer

[1]

15 Embryonic stem cells can be used in cell replacement therapies. Embryonic stem cells can differentiate into any type of body cell but cannot form a whole organism.

Which of the options, **A** to **D**, is the type of stem cell being described?

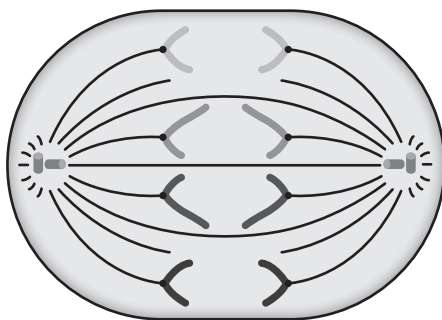
- A pluripotent
- B totipotent
- C unipotent
- D multipotent

Your answer

[1]

12

16 The diagram below shows a cell during cell division. The diploid number of this cell is four.



Which of the options, **A** to **D**, is correct?

- A** the cell is in telophase 1 of meiosis
- B** the cell is in telophase of mitosis
- C** the cell is in anaphase of mitosis
- D** the cell is in anaphase 1 of meiosis

Your answer

[1]

17 Chromosome mutations can cause syndromes such as Down's syndrome.

Which of the options, **A** to **D**, is the correct chromosome content in the cells of a male with Down's syndrome?

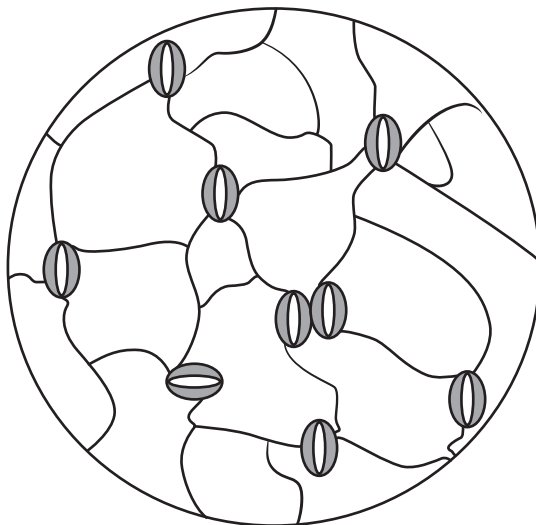
- A** 47 chromosomes, XXY
- B** 47 chromosomes, XY
- C** 45 chromosomes, OY
- D** 45 chromosomes, XY

Your answer

[1]

18 A student used a light microscope to count the number of stomata in the lower epidermis of a leaf.

The diagram below shows a drawing of the field of view made by the student.



The student was given the following information:

- Diameter of the field of view = 1 mm.
- The lower epidermis of the leaf had a total area of  $150\text{mm}^2$ .

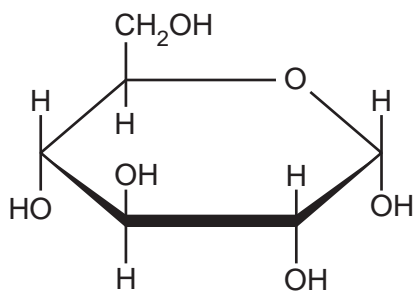
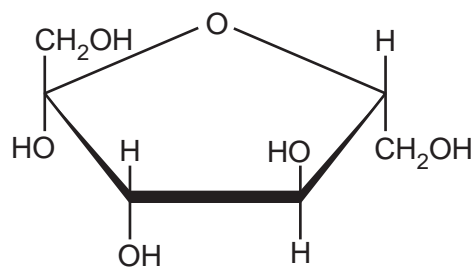
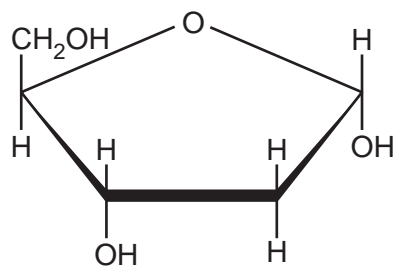
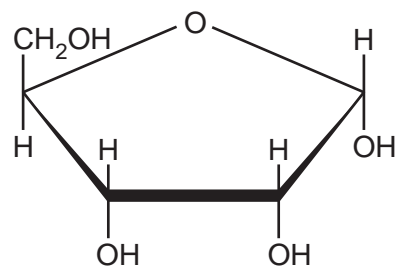
Which of the options, **A** to **D**, is the correctly calculated number of stomata in the lower epidermis of this leaf?

- A 430
- B 1350
- C 1719
- D 17

Your answer

[1]

- 19 Which of the molecules, **A** to **D**, can be described as a pentose monosaccharide with a general formula of  $C_x(H_2O)_y$  ?

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

Your answer

[1]

- 20 Which of the options, **A** to **D**, is a primary defence mechanism against pathogens?

- A** antibody molecules
- B** the HPV vaccine
- C** lysozyme, an enzyme found in saliva and tears
- D** penicillin, an antibiotic

Your answer

[1]

15

## SECTION B

Answer **all** the questions.

21 The molecule shown in Fig. 21 is one of the nucleotides found in ribonucleic acid (RNA).

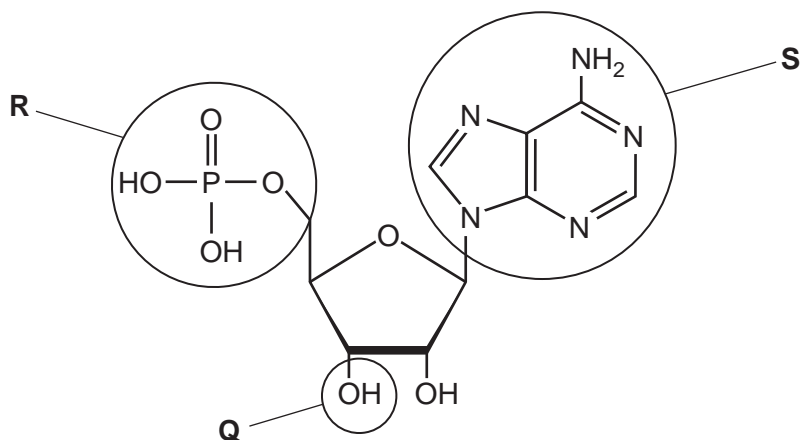


Fig. 21

(a) Parts of the molecule have been labelled **Q**, **R** and **S**.

Which part(s) of the molecule labelled in Fig. 21

(i) can form a phosphodiester bond with other nucleotides?

.....

[1]

(ii) can join with phosphate groups to form ATP?

.....

[1]

(iii) can form hydrogen bonds with another nucleotide?

.....

[1]

(b) Describe how a nucleotide found in deoxyribonucleic acid would differ from the nucleotide shown in Fig. 21.

.....

..... [1]





22 *Beta vulgaris* (beetroot) is a species of beet plant.

The membrane-bound vacuole of beetroot cells contains the red pigment, betanin.

(a) Name the membrane that surrounds the vacuole in plant cells.

..... [1]

(b) Beetroot was used by a group of students to investigate the effect of pH on the permeability of cell membranes. When the vacuole membrane is damaged its permeability to betanin increases and betanin leaks out into the surrounding solution.

- The students cut discs of beetroot and placed them in test tubes containing solutions of different pH for ten minutes.
- The students then used a colorimeter with a blue filter to measure the light absorption in the resulting solutions.

(i) During this investigation, the same volume of solution was used in each test tube.

State **two** other variables that must also be controlled in this investigation **and** suggest how they could be controlled.

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



(c) Betanin is soluble in water.

Explain how the properties of the membrane surrounding the vacuole ensure that betanin does not leak out into the cytoplasm of healthy beetroot cells.

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

(d) The passage below describes some of the research into the use of beetroot products for the treatment of obesity.

Chronic inflammation is often associated with obesity.

Beetroot extracts have been investigated as potential anti-inflammatory agents. Some of their effects seem to be in interfering with the cell signalling cascades that initiate, regulate and amplify the inflammatory response.

In particular betalain pigments, such as betanin, in beetroot have been shown to interfere with the action of cytokines.

(i) Describe the inflammatory response.

.....  
.....  
.....  
.....  
.....  
..... [3]

(ii) Using your knowledge, suggest how betalain pigments could interfere with the action of cytokines.

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

23 Fig. 23.1 is a photograph of non-identical twin fetuses, A and B, in the uterus.

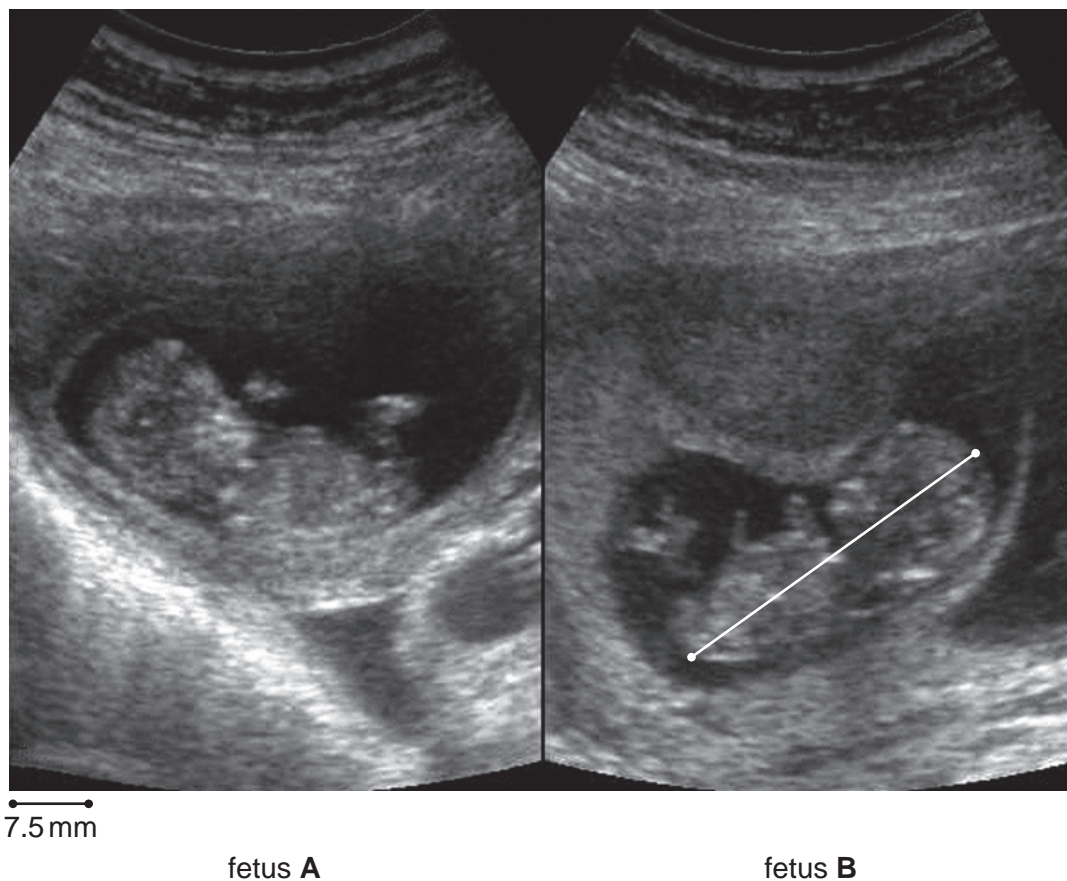


Fig. 23.1

(a) (i) Describe how the diagnostic technique, used to produce the photograph in Fig. 23.1, is used to measure the biparietal diameter of a fetus.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) Calculate the crown-rump length (CRL) of fetus **B** in Fig. 23.1.

Use the white line as an indicator for the positions of the crown and rump of the fetus.

Show your working and give your answer to **two** significant figures.

= ..... mm [2]

(iii) Fig. 23.2 shows a fetal growth chart.

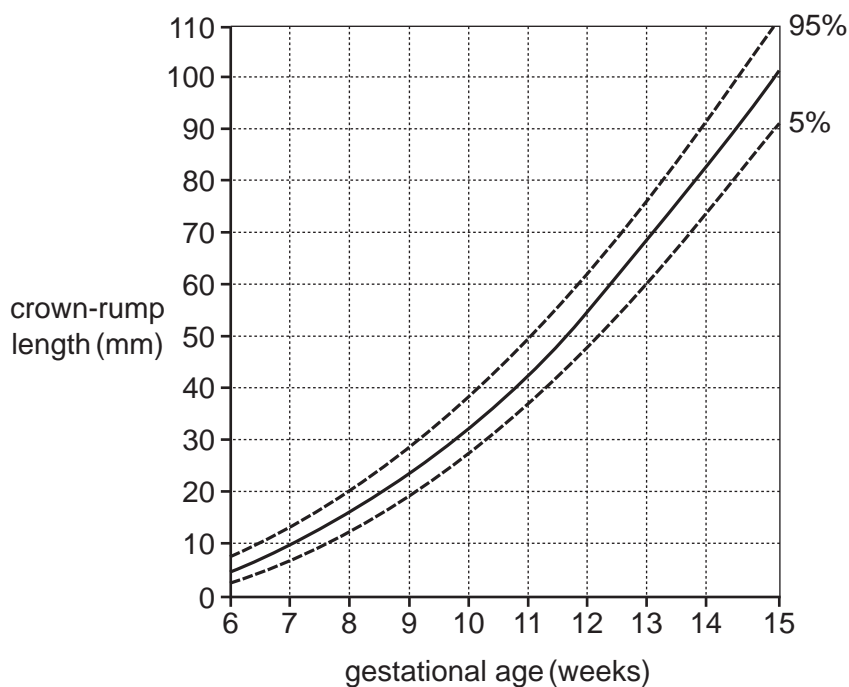


Fig. 23.2

Using Fig. 23.2 and your calculation in (a)(ii), estimate the gestational age of fetus **B**.

..... [1]

(iv) Suggest **two** factors that must be taken into account when using the growth chart in Fig. 23.2 to estimate the gestational age of fetus **B**.

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

(b) Non-identical twins show as much genetic variation as other offspring.

Using the most appropriate word(s), complete the sentences below about the processes that contribute to genetic variation.

Two processes occur during meiosis that contribute to genetic variation. During ..... of meiosis 1, ..... chromosomes begin to pair up to form a bivalent. Crossing over occurs in which sister ..... exchange genetic information at points of cross over called .....

As meiosis 1 continues, alignment on the equator of the spindle and separation of the chromosomes in each pair to opposite poles of the cell is random. This process is called .....

[5]

## 23

24 Medical practitioners can measure parameters such as PEF<sub>R</sub> and FEV<sub>1</sub> to assess lung function in their patients.

(a) Explain the terms PEF<sub>R</sub> and FEV<sub>1</sub>

PEF<sub>R</sub> .....

.....

FEV<sub>1</sub> .....

.....

[2]

(b) Table 24 gives details of a 22-year-old male.

| Weight<br>(Kg) | Height<br>(cm) | PEFR<br>(dm <sup>3</sup> min <sup>-1</sup> ) | FEV <sub>1</sub><br>(dm <sup>3</sup> ) |
|----------------|----------------|--|--|
| 110            | 175            | 400  | 2.9                                    |

Table 24

FEV<sub>1</sub> values can be compared to a predicted value calculated using the formula below:

$$FEV_1 = ((4.3 \times \text{height in metres}) - (0.029 \times \text{age in years})) - 2.49$$

Calculate the predicted value of FEV<sub>1</sub> for this male **and** suggest what can be concluded about his health.

Show your working and give your answer to **one** decimal place.

Answer ..... dm<sup>3</sup>

.....

..... [3]

(c) Expired air resuscitation (EAR) is a first-aid procedure used when a person stops breathing.

When EAR is carried out on a small child the First Aider will cover both the mouth and nose of the patient, rather than just the mouth.

State one **other** way in which the procedure must differ when being carried out on a small child.

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



25

25 There are different types of vaccine for immunising against different diseases.

The table below shows three different types of vaccine.

Complete the missing information in the table.

| (a) Type of vaccine                 | Features of the vaccine   | Advantage   |
|-------------------------------------|---|---|
| <p>.....</p> <p>.....</p>           | <p>Non-pathogenic, modified strains of the bacteria or virus are used</p> | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>                   |
| <p>Isolated extracted antigens</p>  | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>                       | <p>Can produce vaccines for different strains of bacteria/viruses</p> |
| <p>Killed inactivated pathogens</p> | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>                       | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>                   |

[3]

(b) In 2015, a trial was conducted in Guinea, Africa to test the effectiveness of the vaccine rVSV-ZEBOV against the Ebola virus.

- Researchers wanted to save as many lives as possible, so ring vaccination was used during the trial instead of a placebo.
- In communities where at least one new case of the disease had been reported, 7651 participants were randomly assigned to one of two groups.
- Group one were vaccinated immediately after Ebola was reported.
- Group two were vaccinated ten days after group one.
- The incubation time for the Ebola virus is ten days.

Results showed that there were no new cases of Ebola among the 4123 people in group one and 16 cases among the 3528 people in group two.

(i) What was the purpose of **group two** in this trial?

..... [1]

(ii) Discuss the ethical issues related to this trial.

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

(iii) Using the information, evaluate the effectiveness of the rVSV-ZEBOV vaccine.

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

**END OF QUESTION PAPER**

**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).

A large rectangular area with a solid vertical line on the left side and horizontal dotted lines extending across the page, providing space for writing answers.

