OCR
Oxford Cambridge and RSA

Monday 11 October 2021 – Morning

AS Level Biology A

H020/01 Breadth in biology

Time allowed: 1 hour 30 minutes

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

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

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

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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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 Which of the options, **A** to **D**, describes the role of CITES?

A making conservation a part of normal farming practices

B restricting the trade in individuals of endangered species

C stopping the movement of endangered species

D requiring countries to develop strategies for sustainable development

Your answer ☐ **[1]**

2 Which of the options, **A** to **D**, would result in the formation of tissue fluid?

A hydrostatic pressure $<$ oncotic pressure

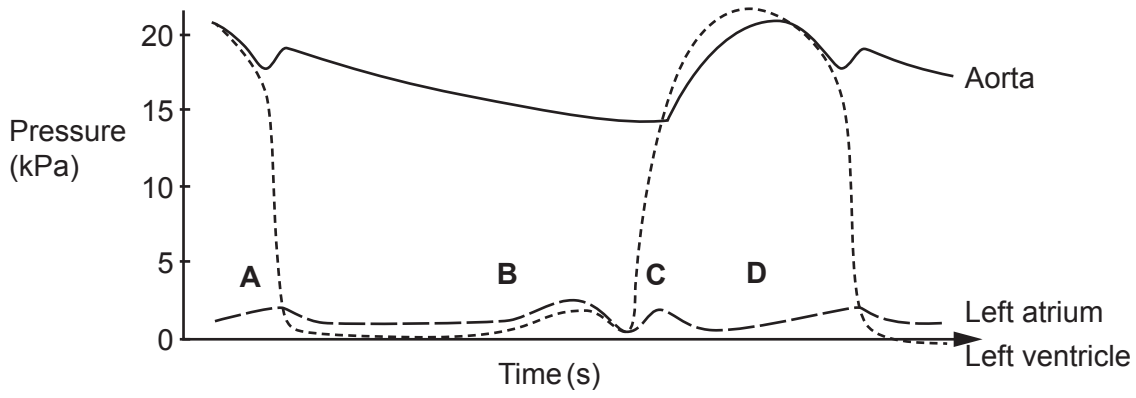
B hydrostatic pressure = oncotic pressure

C oncotic pressure $<$ hydrostatic pressure

D oncotic pressure $\geqslant$ hydrostatic pressure

Your answer ☐ **[1]**

3 Which of the options, **A** to **D**, on the diagram below shows the time at which the SAN sends out a wave of excitation to initiate a heartbeat?



Your answer ☐ **[1]**

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4 The sounds of the heartbeat due to heart valves closing can be described as 'lub-dub'. The 'lub' sound occurs at the beginning of ventricular systole.

Which of the options, **A** to **D**, describes what is happening when the 'lub' sound is heard?

A semilunar valves opening and blood entering the ventricles

B semilunar valves closing and blood entering the ventricles

C atrio-ventricular valves opening and blood leaving the ventricles

D atrio-ventricular valves closing and blood leaving the ventricles

Your answer ☐ **[1]**

5 The rate of transpiration of water can be estimated by recording the rate of water uptake using a potometer. Two potometers were set up, one with large leaves and one with small leaves. A calibrated capillary tube that had a diameter of 1 mm was used to introduce the bubble.

Which of the options, **A** to **D**, shows the most appropriate units to compare the rate of transpiration of large leaves compared to small leaves?

A $mm^2\,cm^{-1}\,min^{-1}$

B $mm^3\,cm^{-1}\,min$

C $mm^2\,cm^{-2}\,min^{-1}$

D $mm^3\,cm^{-2}\,min^{-1}$

Your answer ☐ **[1]**

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6 To determine the biodiversity of butterflies in a meadow, the number of different species of butterfly were sampled in a meadow on 12 consecutive days. The results are shown below.

Day	1	2	3	4	5	6	7	8	9	10	11	12
Number of species	11	12	14	18	12	12	18	19	18	12	14	20

Which row, **A** to **D**, shows the correct mode, mean and median for these data?

	Mode	**Mean**	**Median**
A	18	15	14
B	12	15	14
C	18	14	15
D	12	14	15

Your answer ☐ **[1]**

7 Which of the stains, **A** to **D**, would be chosen to bind to the phosphate group of DNA to make chromosomes more visible when using a light microscope?

A carbolfuchsin – a non-polar dye

B nigrosin – a negatively charged dye

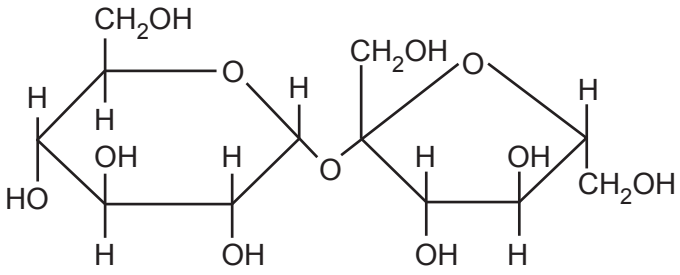
C methylene blue – a positively charged dye

D Sudan 111 – a lipid-soluble dye

Your answer ☐ **[1]**

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8 The molecule below is the disaccharide sucrose.



Which row, **A** to **D**, shows the type of reaction that occurs in the breakdown of sucrose and the monosaccharides produced by the reaction?

	Type of reaction	Monosaccharides	
A	condensation	α glucose	α glucose
B	condensation	α glucose	fructose
C	hydrolysis	α glucose	α glucose
D	hydrolysis	α glucose	fructose

Your answer ☐ **[1]**

9 Sucrase is the enzyme that breaks down sucrose.

Which of the bonds, **A** to **D**, is broken by sucrase?

A alpha glycosidic

B beta glycosidic

C ester

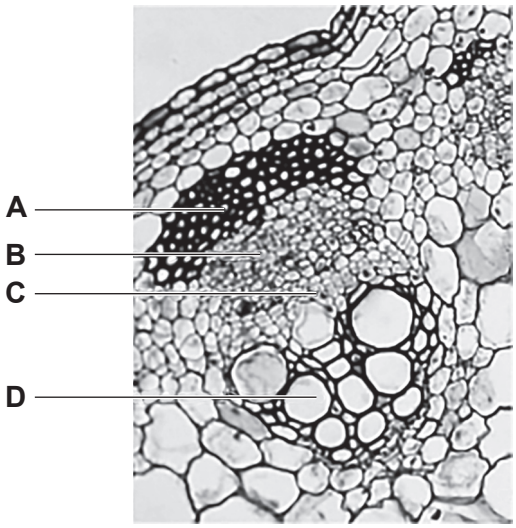
D peptide

Your answer ☐ **[1]**

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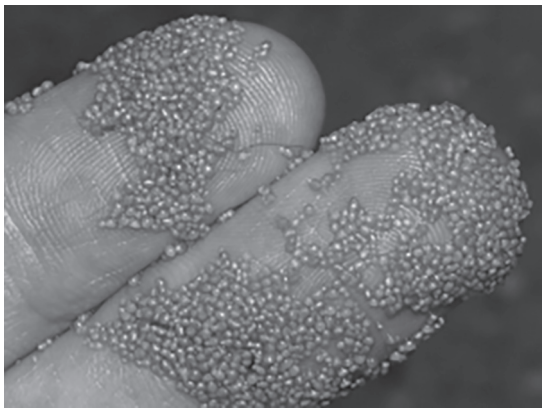
10 The image below shows a transverse section of a stem vascular bundle of a sunflower, *Helianthus annuus*.

Which of the options, **A** to **D**, labels the xylem vessels?



Your answer ☐ **[1]**

11 *Wolffia arrhiza* is one of the smallest flowering plants in the world.



Which of the options, **A** to **D**, explains the absence of a transport system in *Wolffia arrhiza*?

A It has no cell differentiation.

B It has a small surface area to volume ratio.

C It has a large surface area to volume ratio.

D It has a high metabolic rate.

Your answer ☐ **[1]**

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12 The enzyme microtubule depolymerase is responsible for the breakdown of spindle fibres in mitosis.

Which of the phases, **A** to **D**, will have the highest number of active microtubule depolymerase enzymes?

A anaphase

B metaphase

C prophase

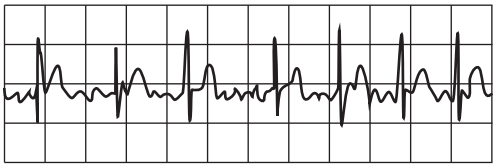
D telophase

Your answer ☐ **[1]**

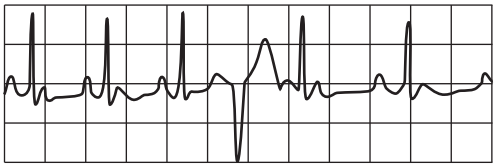
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13 The ECG traces below show four abnormal heartbeats recorded for six seconds.

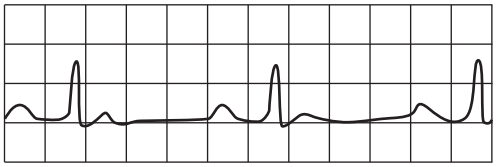
A



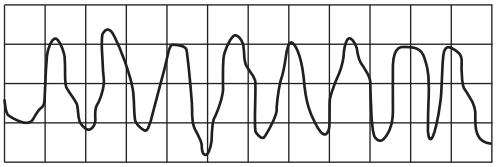
B



C



D

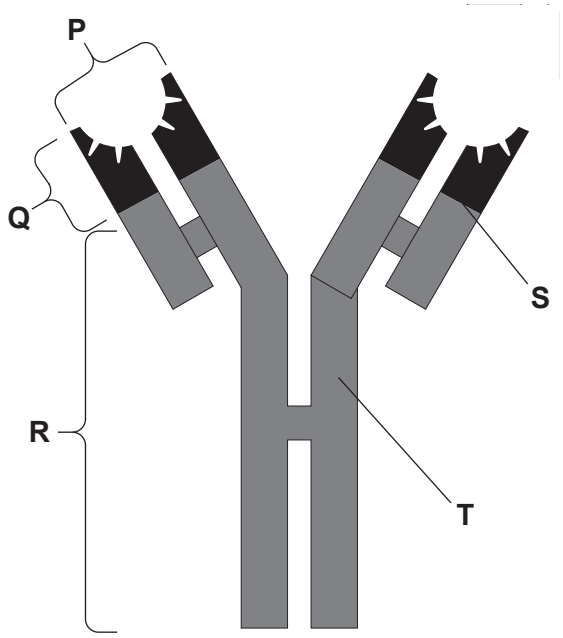


Which of the traces, **A** to **D**, shows atrial fibrillation?

Your answer ☐ **[1]**

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14 The image below shows an antibody structure with the parts labelled **P** to **T**.



Which row, **A** to **D**, correctly identifies the parts of the antibody structure.

	P	Q	R	S	T
A	light chain	antigen binding site	heavy chain	variable region	constant region
B	antigen binding site	variable region	constant region	heavy chain	light chain
C	light chain	antigen binding site	heavy chain	light chain	constant region
D	antigen binding site	variable region	constant region	light chain	heavy chain

Your answer ☐ **[1]**

15 Which of the options, **A** to **D**, best describes the chloride shift?

A hydrogen carbonate ions and chloride ions moving into red blood cells

B hydrogen carbonate ions moving out of red blood cells and chloride ions moving into red blood cells

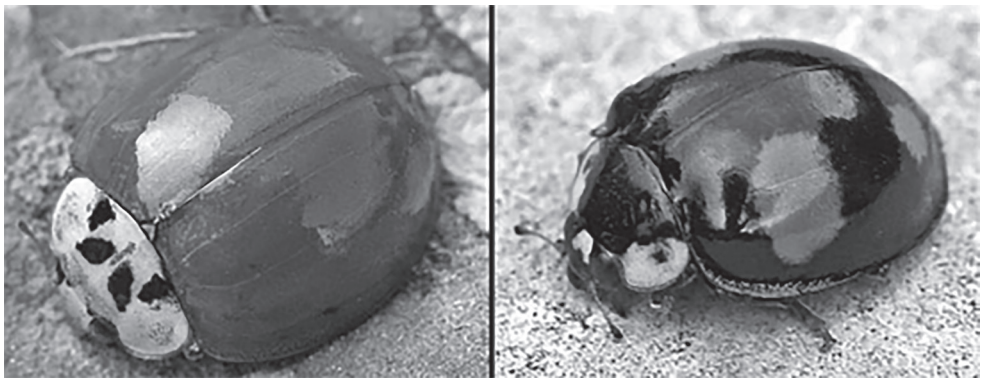
C hydrogen ions being buffered by chloride ions in red blood cells

D carbonic anhydrase using chloride ions to produce carbonic acid

Your answer ☐ **[1]**

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16 The harlequin ladybird, *Harmonia axyridis*, has many different distinct forms, two of which can be seen below.



Which of the terms, **A** to **D**, best describes this type of variation?

A interspecific continuous

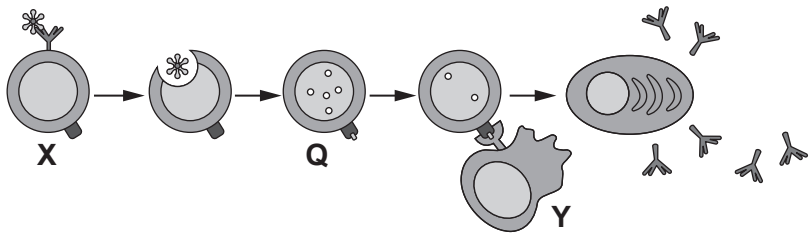
B interspecific discontinuous

C intraspecific continuous

D intraspecific discontinuous

Your answer ☐ **[1]**

17 Which row, **A** to **D**, identifies cells **X** and **Y** and process **Q** in the immune response in the diagram below?



	X	Y	Q
A	B cell	T helper cell	antigen presentation
B	phagocyte	T helper cell	clonal expansion
C	T cell	B memory cell	endocytosis
D	B cell	T killer cell	antigen presentation

Your answer ☐ **[1]**

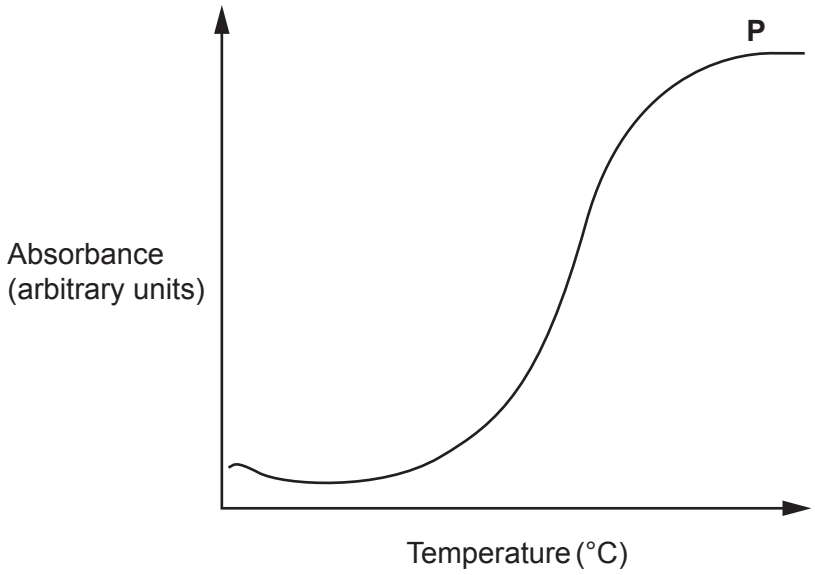
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18 Which row, **A** to **D**, shows the stages of meiosis where crossing over and independent assortment occur?

	Crossing over	Independent assortment
A	prophase 1	metaphase 1 and 2
B	metaphase 1	metaphase 2 only
C	prophase 1	metaphase 1 only
D	prophase 2	metaphase 1 and 2

Your answer ☐ **[1]**

19 The graph below shows readings from a colorimeter as pigment leaks out of beetroot membranes at different temperatures.



Which statement, **A** to **D**, explains why the absorbance stops increasing at point **P**?

A The phospholipid bilayer has melted.

B Vibration has created spaces between the phospholipids.

C Transmembrane proteins have denatured.

D Pigment is in equal concentration inside and outside the cells.

Your answer ☐ **[1]**

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20 A student carried out four tests on samples from a beaker of starch and amylase.

Which row, **A** to **D**, would show the correct results if the reaction was still happening?

	Iodine test	**Benedict's test**	**Biuret test**	**Emulsion test**
A	negative	positive	negative	positive
B	positive	negative	positive	positive
C	positive	positive	positive	negative
D	positive	positive	negative	negative

Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.

21 **Fig. 21** shows a molecule of ADP.

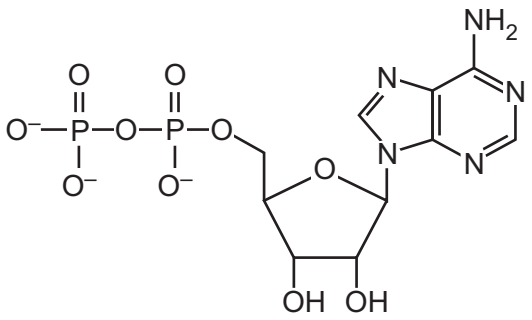


Fig. 21

(a) **(i)** **On Fig. 21**, draw a circle around the part of the ADP molecule that is a purine. **[1]**

(ii) State **two** differences between a molecule of ADP and a DNA nucleotide that contains adenine.

1 .....

.....

2 .....

.....

[2]

(iii) ADP binds with an inorganic phosphate (P_i) to make ATP.

Name this type of reaction.

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

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(b) DNA is a polymer of nucleotides that contains the genetic code needed for a protein to be made. Tubulin is a protein that is found in all eukaryotes and some prokaryotes.

(i) Explain how the genetic code in the gene for tubulin codes for the protein tubulin.

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

(ii) Tubulin is a globular protein that can polymerise to form the cell cytoskeleton.

One example of this is the formation of microtubules, which form the spindle fibres to move chromatids during mitosis and meiosis.

Describe **three** other cellular functions of the cytoskeleton.

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

(iii) Suggest **two** ways tubulin is essential to protein synthesis and protein secretion in eukaryotic cells.

1 .....

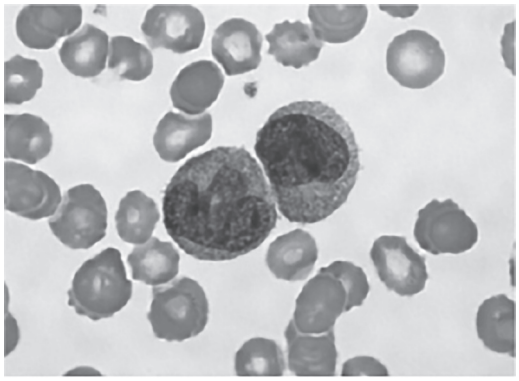
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2 .....

.....
[2]

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22 The image below shows two white blood cells in a blood sample, seen using a light microscope.



(a) Explain how to measure the diameter of the nucleus of one of the white blood cells, when observing the cells through a light microscope.

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..... **[4]**

(b) During a bacterial infection, activated white blood cells multiply by mitosis.

In order to study the behaviour of chromosomes during mitosis, higher resolution images are needed.

(i) Complete the table below about microscopes and their images.

	Laser scanning confocal microscope	**Scanning electron microscope**	**Transmission electron microscope**
Maximum resolution	200 nm	3–10 nm	0.5 nm
Image appearance	2D / 3D	.....	.....
Image colour	.....	.....	black and white

[2]

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(ii) A transmission electron microscope image of a white blood cell was studied. It was concluded that the cell had stopped dividing at the G2 checkpoint.

Suggest **two** observations that would have led to this conclusion.

1 .....

2 .....

[2]

(c) DNA can be extracted from a culture of white blood cells and precipitated using the following procedure:

1. Mix a culture of white blood cells with a detergent.
2. Add salt.
3. Add an enzyme.
4. Place in a water bath at 40 °C.
5. Filter the culture.
6. Gently pour ice-cold ethanol onto the filtrate.

(i) Suggest why the cells do not need to be crushed before adding detergent.

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

(ii) Explain why the detergent is used in step 1.

.....

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

(iii) Suggest the type of enzyme that should be used in step 3 and explain why.

.....

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

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23 **Fig. 23.1** shows a spirometer trace of a student at rest breathing for one minute.

The trace shows a period of resting breathing, followed by a maximum inhalation and exhalation.

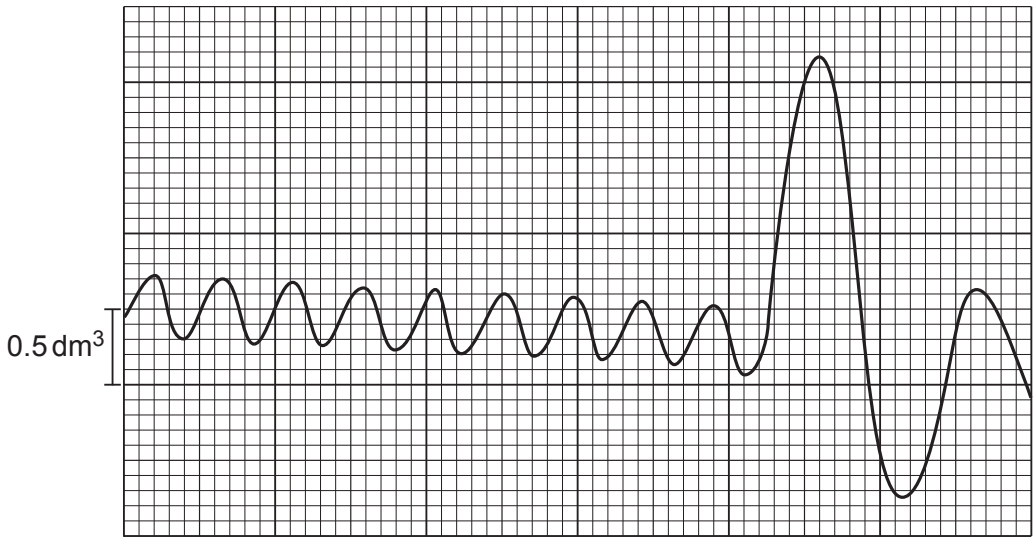


Fig. 23.1

(a) **(i)** Explain why there is a downward trend in the trace.

.....

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

(ii) Using **Fig. 23.1**, calculate the mean resting breathing rate.

Mean = ...breaths per minute **[2]**

(iii) Using the trace in **Fig. 23.1**, state the vital capacity.

Give your answer in cm^3.

Vital capacity = ... cm^3 **[2]**

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(b) **Fig. 23.2** shows the change in mean resting tidal volume with age in 122 boys and girls from age 12 to 19.

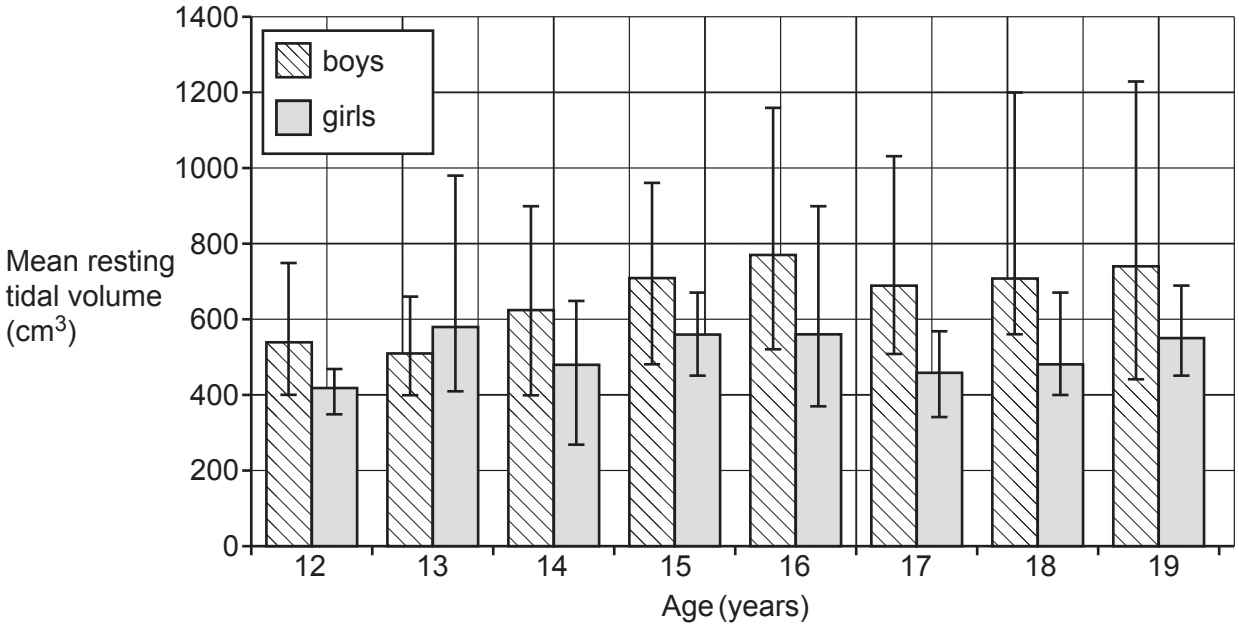


Fig. 23.2

The ranges shown in **Fig. 23.2** are the maximum and minimum values for each group.

(i) Describe **three** patterns in the data in **Fig. 23.2**.

1 .....

.....

2 .....

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3 .....

.....

[3]

(ii) State **one** group from **Fig. 23.2** that is likely to contain an anomaly. Explain your choice.

Group .....

Explanation .....

.....

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.....

[2]

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(iii) Explain why using standard deviation error bars in **Fig. 23.2** would increase the confidence in any conclusion made.

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

(iv) The table shows the raw data of resting tidal volume for 13-year-old boys in **Fig. 23.2**.

The mean resting tidal volume for this group is 510 cm^3.

Person	Resting tidal volume (cm^3)
1	410
2	660
3	650
4	440
5	400
6	450
7	540
8	530

Calculate the standard deviation of the resting tidal volume for 13-year-old boys.

Use the formula: $s = \sqrt{\frac{\Sigma(x-\overline{x})^2}{n-1}}$

Give your answer to **3** significant figures.

Standard deviation = ... **[3]**

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(v) Other than increasing the sample size, suggest **two** ways that the selection of participants in the study could have improved the validity of the data.

1 .....

.....

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2 .....

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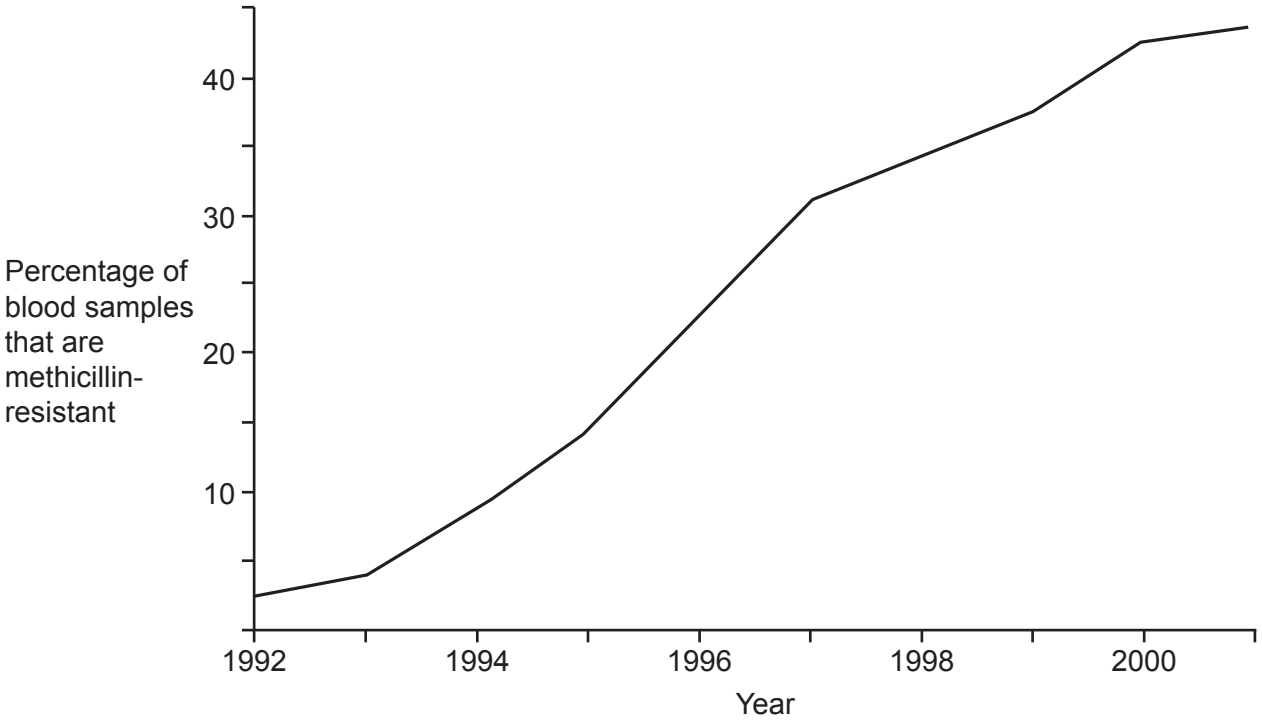
.....

[2]

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24 In England and Wales, between 1992 and 2001, samples of blood were taken from patients infected with the bacterium *Staphylococcus aureus*.

The graph shows the percentage of these samples that were methicillin-resistant (MRSA).



(a) (i) Suggest explanations for the positive correlation in the data in the graph.

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

(ii) *Staphylococcus aureus* is the binomial name for a species of bacterium.

State **one** advantage of referring to *Staphylococcus aureus* in this way.

.....

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

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(b) In 2019, scientists discovered a source of a new antibiotic in the roots of a wild bean plant, *Phaseolus vulgaris*, in Los Tuxtlas, Mexico.

The antibiotic, phazolicin, was extracted from the roots of the wild bean plant.

(i) Suggest **one** feature of a bacterium the phazolicin might attack.

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

(ii) Explain the importance of maintaining biodiversity for the discovery of new antibiotics like phazolicin.

.....

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

(c) Advances in medical technology include the development of personalised medicines and synthetic biology.

Explain what is meant by personalised medicine **and** synthetic biology.

Personalised medicine .....

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Synthetic biology .....

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[2]

END OF QUESTION PAPER

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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).

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