OCR
Oxford Cambridge and RSA

Friday 7 June 2024 – Afternoon

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/04 Combined Science (Foundation Tier)

Time allowed: 1 hour 45 minutes

F

You must have:
- a ruler (cm/mm)
- the Data and Equation Sheet for GCSE (9-1) Combined Science B (inside this document)

You can use:
- an HB pencil
- 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 _____

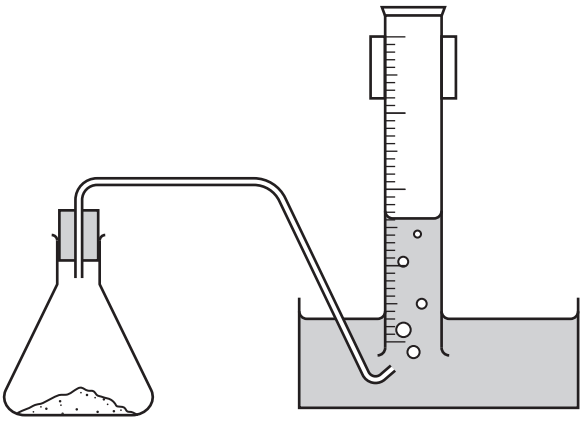
INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where 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 **75**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*****).
- This document has **28** pages.

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

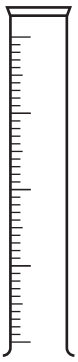
1 A student is investigating the rate of reaction between hydrochloric acid (HCl) and calcium carbonate powder ($CaCO_3$).

The equipment used is shown in the diagram.



(a)

(i) What is the name of this piece of equipment?



Tick (✓) **one** box.

Beaker ☐

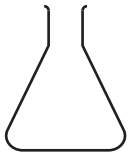
Conical flask ☐

Delivery tube ☐

Measuring cylinder ☐

[1]

(ii) What is the name of this piece of equipment?



Tick (✓) **one** box.

Beaker ☐

Conical flask ☐

Delivery tube ☐

Measuring cylinder ☐

[1]

(b) Suggest **one** safety precaution the student should take when working with acid.

.....

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

(c) A gas forms when hydrochloric acid and calcium carbonate powder react.

Draw **one** line from the **gas collected** to the **chemical test** that can identify the gas.

Gas collected	Chemical test
Carbon dioxide	Burns with a squeaky pop.
Hydrogen	Turns universal indicator blue
Oxygen	Turns lime water cloudy when it is bubbled through.

[2]

(d) The student repeats the experiment with different **concentrations** of hydrochloric acid.

(i) Explain why the rate of reaction increases when the concentration of the hydrochloric acid increases.

Use ideas about collisions in your answer.

.....

.....

.....

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

(ii) The student wants to ensure that the data they collect is valid.

State **two** variables that the student needs to control in this experiment.

1 .....

2 .....

[2]

BLANK PAGE

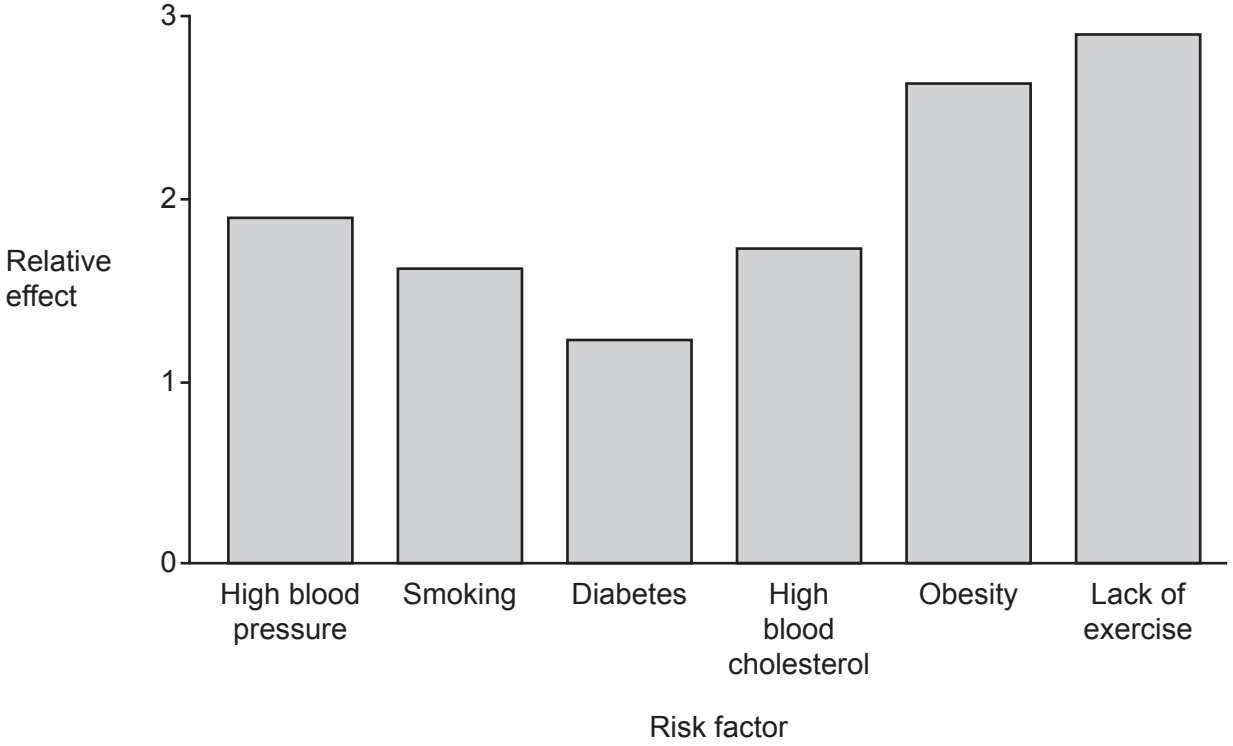
PLEASE DO NOT WRITE ON THIS PAGE

Turn over for the next question

2 Cardiovascular disease (CVD) is a disease that affects the heart and circulatory system.

Fig. 2.1 shows a bar chart of some risk factors for CVD and their relative effect.

Fig. 2.1



(a) State the risk factor that has the highest relative effect.

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

(b) Charlie is having a health check-up at the doctor's.

Charlie's doctor finds out that Charlie:

- plays hockey three times each week and goes running on a regular basis
- has diabetes
- is **not** obese
- does **not** have high blood pressure
- has high blood cholesterol
- has a high fat diet
- smokes.

State Charlie's **two** biggest risk factors for CVD.

Use **Fig. 2.1**.

1 .....

2 .....

[2]

(c) Suggest **one** other health-related question the doctor should ask Charlie to help determine her risk of developing CVD.

.....

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

(d)* Charlie is diagnosed with CVD. Charlie has been told she can treat her CVD by changing her lifestyle or using medicines.

Discuss reasons for and against Charlie treating her CVD by:

- changing her lifestyle
- using medicines.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

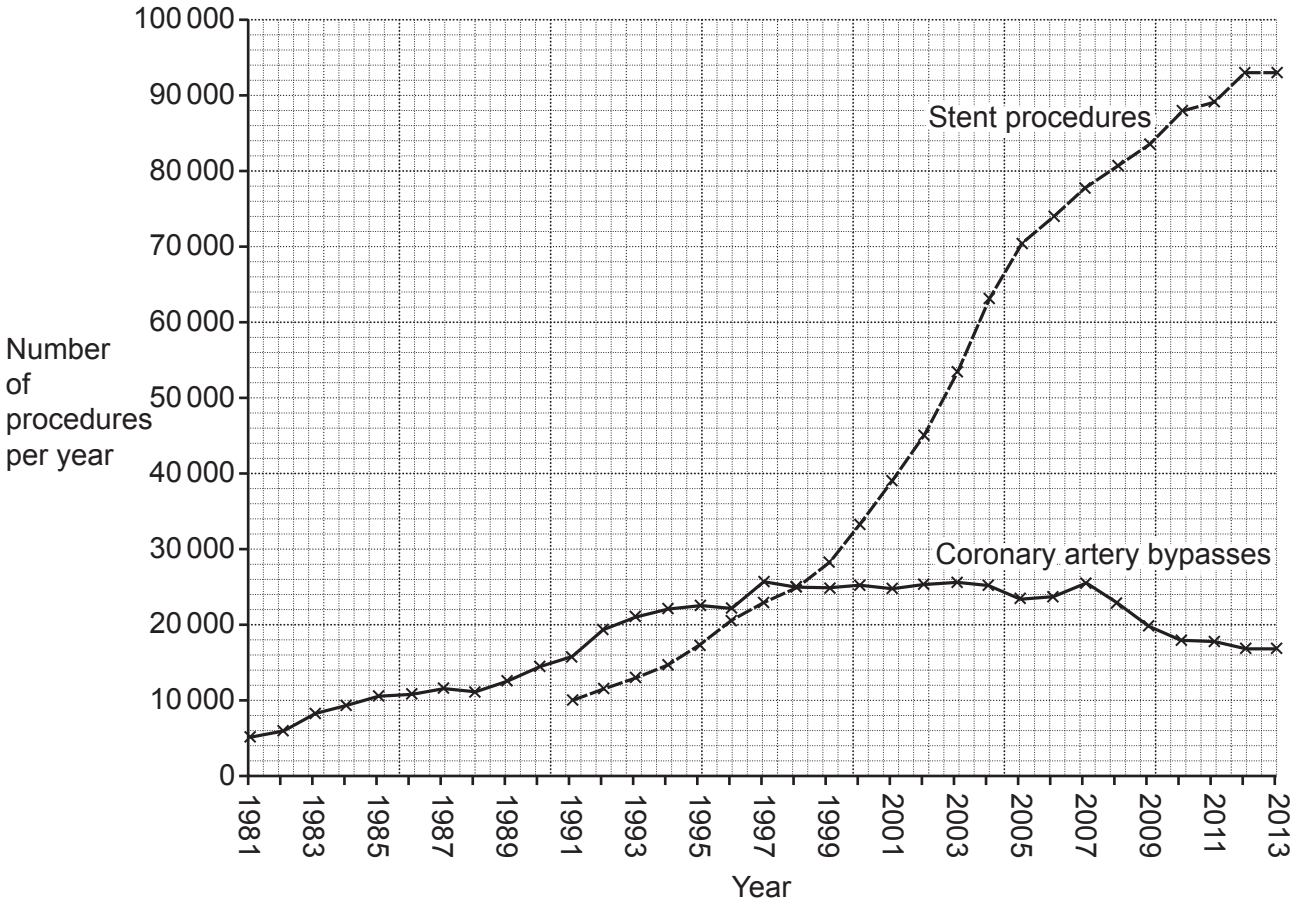
.....

..... **[6]**

(e) Surgery can be used to help people who have developed CVD.

Fig. 2.2 shows the number of coronary artery bypasses and stent procedures each year since 1981.

Fig. 2.2



(i) What year were stent procedures introduced?

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

(ii) Describe how the number of stent procedures and coronary artery bypasses changes from **1998** to **2013**.

.....

.....

.....

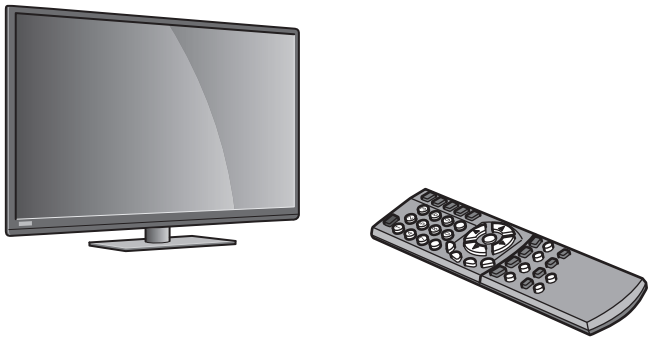
..... **[2]**

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

Turn over for the next question

3 The picture shows a TV and its remote control.



The remote control is pointed at a sensor on the TV.

(a) Complete the sentences about the remote control.

Use words from the list.

absorbed	**electromagnetic**	**sensor**	**sound**	**source**	**transmitted**

When a button is pressed, ... waves transfer

energy from the remote control to the .....,

where it is ..... .

[3]

(b) The table shows data for the remote control.

Current (A)	0.1
Potential difference (V)	3.0

Calculate the power of the remote control.

Use the Data and Equation Sheet.

Power = ... W **[3]**

(c) The TV uses mains electricity.

Electrical power is transmitted through the national grid transmission cables at high voltages.

Which row of the table describes the effect of using high voltage on the current in the transmission cables and the efficiency of transmission?

Tick (✓) **one** box.

Current in cables	More efficient because	
Decreased	Less heating	
Decreased	More heating	
Increased	Less heating	
Increased	More heating	

[1]

(d) The TV has a power rating of 110 W.

What is the energy transferred by the TV after being on for 2 hours?

Use the equation: energy transferred = power × time

Tick (✓) **one** box.

55 Wh ☐

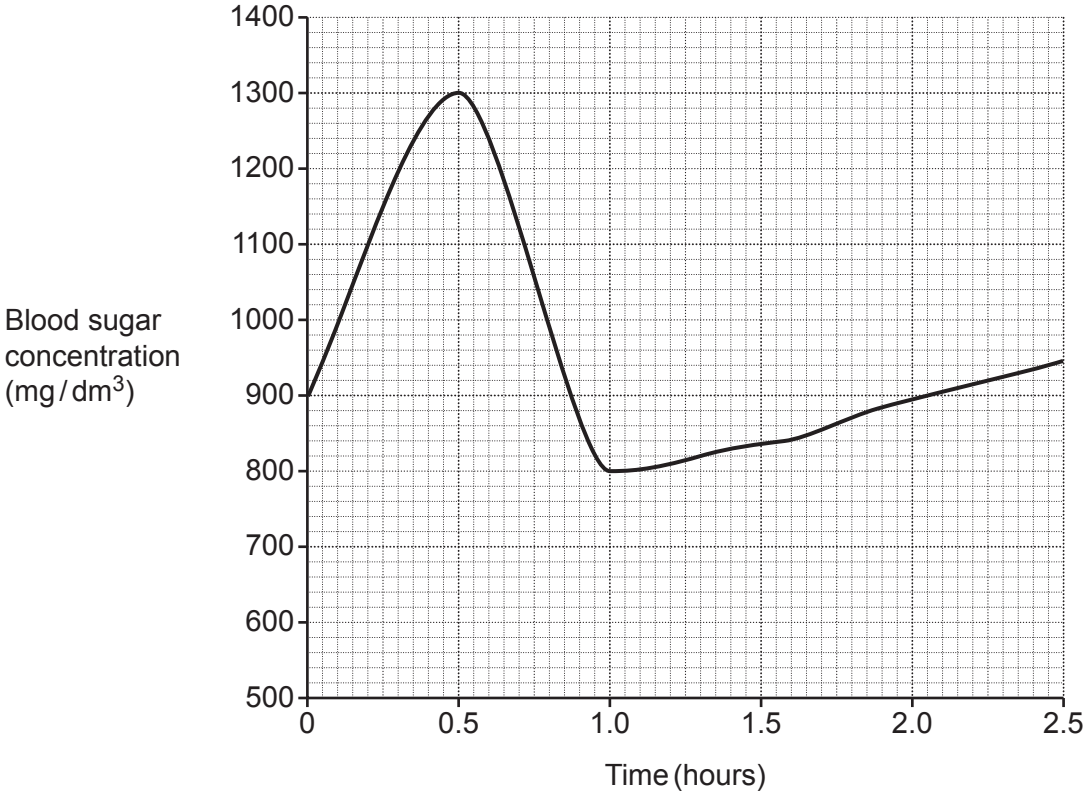
110 Wh ☐

220 Wh ☐

[1]

4 Diabetes is a condition that causes a person's blood sugar level to become too high.

(a) The graph shows the changes in blood sugar concentration in a person without diabetes immediately after eating.



Calculate the percentage decrease in blood sugar concentration between 0.5 and 1.0 hours.

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

Percentage decrease = ... % **[4]**

(b)

(i) Blood glucose can be measured by doing a finger-prick blood sample. This method uses a needle so that a drop of blood can be taken for testing.

A test strip and testing meter are then used to show the blood glucose level at the time the test is taken. The test should be taken just before a meal or two hours after a meal.

Suggest the **disadvantages** of this method of blood sugar monitoring.

.....

.....

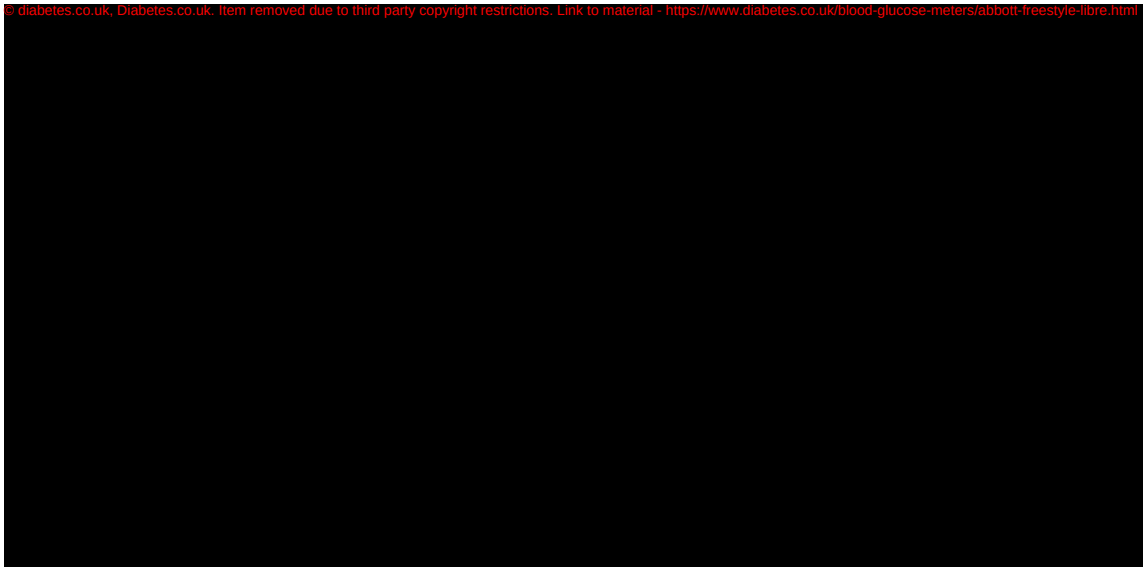
.....

.....

.....

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

(ii) Blood sugar can also be measured by using a sensor placed on a person's arm which sends information continuously to an app on a smartphone, as shown:



Suggest **two** disadvantages of using this method to monitor blood sugar.

1 .....

.....

2 .....

.....

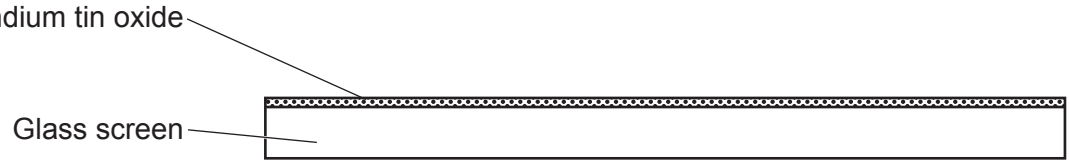
[2]

5 Indium (In) is a metal.

(a) Indium tin oxide is an important component of smartphones. The diagram shows a layer of indium tin oxide on a glass screen.

Indium atoms are approximately 3.9×10^{-10} m in diameter.

The thickness of the layer of indium tin oxide is 1.5×10^{-9} m.



NOT TO SCALE

Calculate the number of whole indium atoms that could fit across the thickness of this layer.

Number of whole indium atoms = ... **[3]**

(b) Suggest why the actual number of whole indium atoms across the thickness of the **indium tin oxide** layer is less than the number of whole indium atoms calculated in part **(a)**.

.....

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

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

Turn over for the next question

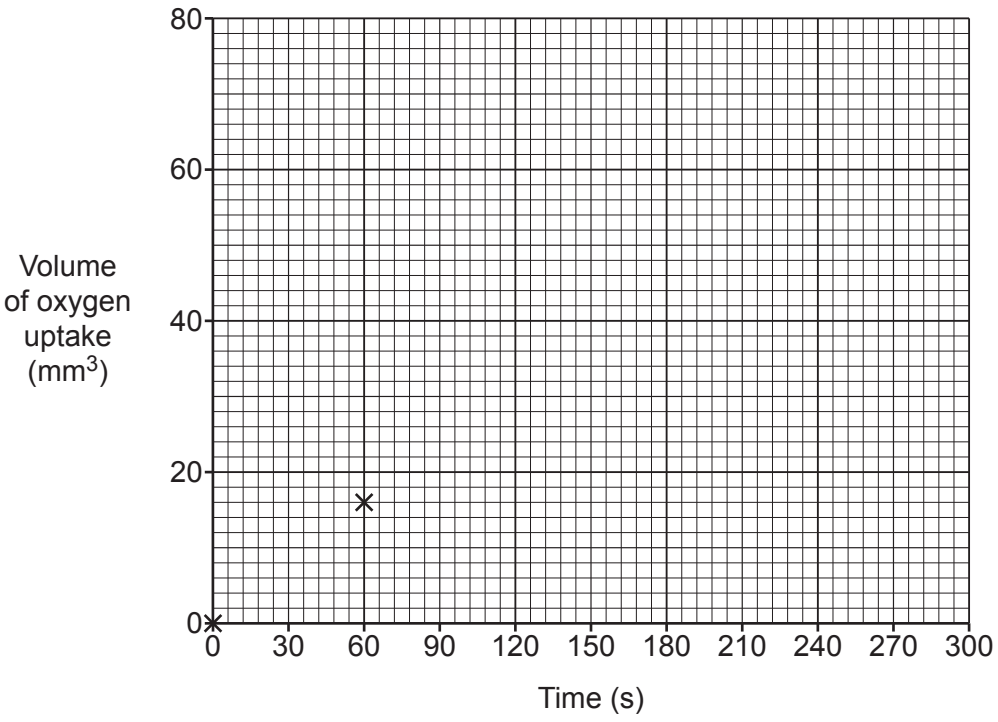
6 A student investigates the rate of cellular respiration in mung beans.

The student's results are shown in the table:

Time (s)	Volume of oxygen uptake (mm^3)
0	0
60	16
120	33
180	50
240	66

(a) Plot the results from the table on the graph.

Two points have already been plotted.



[2]

(b) Draw a straight line of best fit. **[1]**

(c) Use the graph to calculate the rate of respiration.

Use the equation: rate of respiration = $\frac{\text{change in volume}}{\text{change in time}}$

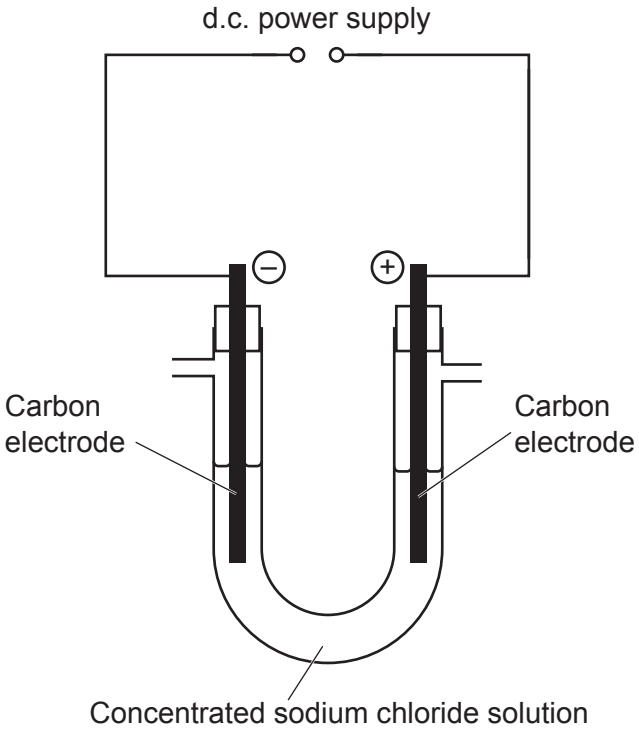
Give your answer to an appropriate number of significant figures.

Rate of respiration = ... mm^3/s **[4]**

(d) Predict the volume of oxygen uptake at 150 seconds.

Volume of oxygen uptake = ... mm^3 **[1]**

7 The diagram shows an electrolysis experiment.



(a) Which ions are present in a concentrated solution of sodium chloride?

Tick (✓) **one** box.

Cl^- H^+ Na^+ OH^-	☐
Cl^- H^+ S^{2-} OH^-	☐
Cl^- Na^+	☐
Cl^- S^{2-}	☐

[1]

(b)

(i) Name the gas that forms at the positive electrode.

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

(ii) Describe a test to identify this gas that forms.

.....

.....

.....

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

(c) The current in the circuit is 0.01A.

Calculate the charge that flows in the circuit in 15 minutes.

Use the equation: charge = current × time

Charge = ... C **[3]**

(d) The student adds two components to the circuit so that they can vary and measure the current.

(i) Name a component that can be used to **vary** the current.

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

(ii) Name a component that can be used to **measure** the current.

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

8 Doctors select radioactive isotopes for imaging scans and for treatments very carefully.

The table shows the radiation emitted and half-lives of 6 radioactive samples.

Sample	Radiation Emitted	Half-life
A	Alpha	10 days
B	Alpha	1600 years
C	Beta	8.0 days
D	Beta	2.7 days
E	Gamma	5.3 years
F	Gamma	8 days

(a) Which sample is suitable to be used as a radioactive tracer for an imaging scan?

Explain your answer.

Use data from the table.

Sample .....

Explanation .....

.....

.....

.....

.....

[3]

(b) Samples A and B emit alpha radiation.

Suggest **two** precautions that should be taken by hospital staff when handling samples A and B.

1 .....

2 .....

[2]

(c) One of the samples in the table is radium-226.

Determine the number of neutrons in a nucleus of a radium-226 atom.

Use the Data and Equation Sheet.

Number of neutrons = ... **[2]**

(d) How many outer shell electrons does each radium-226 atom have?

Explain your answer.

Use the Data and Equation Sheet.

Number of outer-shell electrons .....

Explanation .....

.....

.....

[2]

(e) Another of the radioactive isotopes in the table is iodine-131.

Which element will most readily react with iodine-131 to form a salt?

Tick (✓) **one** box.

Copper ☐

Gold ☐

Neon ☐

Sodium ☐

[1]

9 Some students are learning about radioactivity and radioactive half-life.

(a) What is the definition for the activity of a radioactive source?

Tick (✓) **one** box.

The current produced by the particles. ☐

The purpose the radioactive sample is used for. ☐

The number of decay events per second. ☐

The type of radiation that the substance emits. ☐

[1]

(b) What is the definition of half-life?

Tick (✓) **one** box.

Half of the original activity of a sample. ☐

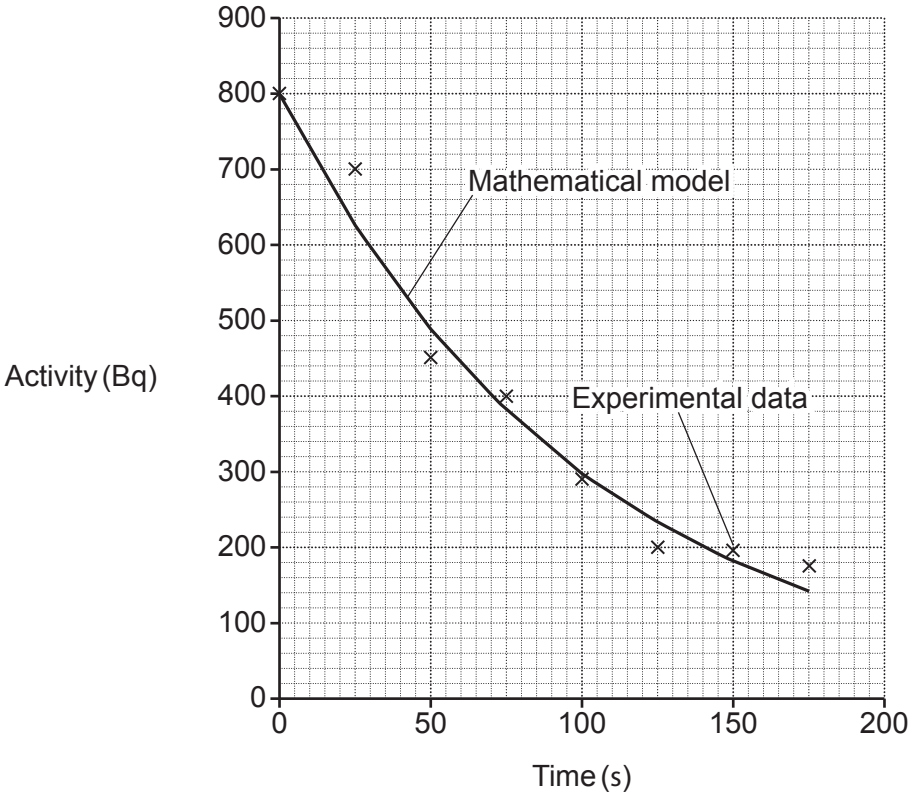
Half the lifetime of a radioactive substance. ☐

The time for half of a decay to happen. ☐

The time for the activity to fall to half. ☐

[1]

(c) The graph shows experimental data from a radiation detector, and a separate mathematical model of decay.



Complete the sentences about radioactive decay.

Use words from the list.

complete	**match**	**random**	**replace**	**selective**	**trend**

Radioactive decay is a ..... process.

Experimental data may not ..... the model results due to chance

but the overall ..... will be the same.

[3]

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

PLEASE DO NOT WRITE ON THIS PAGE