AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
ADDITIONAL SCIENCE

H

Higher Tier Unit 6

Friday 17 June 2016 Morning Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a ruler
- a calculator
- the Chemistry Data Sheet and Physics Equations Sheet Booklet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 1(c) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

Biology Questions

1 Enzymes are important chemicals in living things.

1 (a) What type of molecule are enzymes made from?

[1 mark]

_____

1 (b) The enzyme isomerase is used in industry to convert glucose into fructose.

1 (b) (i) Why is glucose converted into fructose by industry?

[1 mark]

_____

1 (b) (ii) **Table 1** shows the effect of pH on the rate of the reaction.

Table 1

pH	Rate of reaction in arbitrary units
5	13
7	24
9	17
11	0

Suggest why there is no reaction at pH 11.

[1 mark]

_____

_____

1 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe how enzymes in the human digestive system break down the chemicals in food.

In your answer you should refer to:

- the names of enzymes
- the food substances the enzymes break down
- the products of the breakdown.

[6 marks]

Extra space

9

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

Chemistry Questions

2 This question is about rates of reaction.

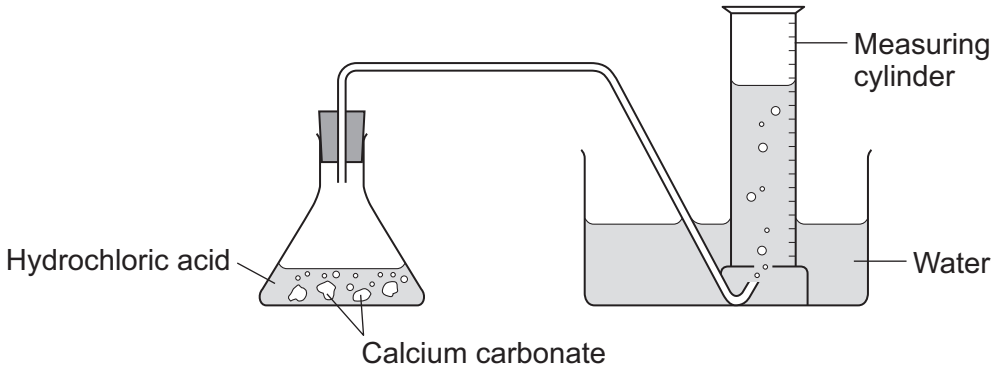
A student investigated the rate of the reaction between calcium carbonate and hydrochloric acid.

The equation for the reaction is:

$$CaCO_3(s) + 2HCl\,(aq) \longrightarrow CaCl_2\,(aq) + CO_2\,(g) + H_2O\,(l)$$

Figure 1 shows the apparatus the student used.

Figure 1



2 (a) Which equation should the student use to calculate the rate of reaction?

[1 mark]

Tick (✓) **one** box.

Rate of reaction = $\dfrac{\text{Time}}{\text{Volume of gas produced}}$ ☐

Rate of reaction = Volume of gas produced × time ☐

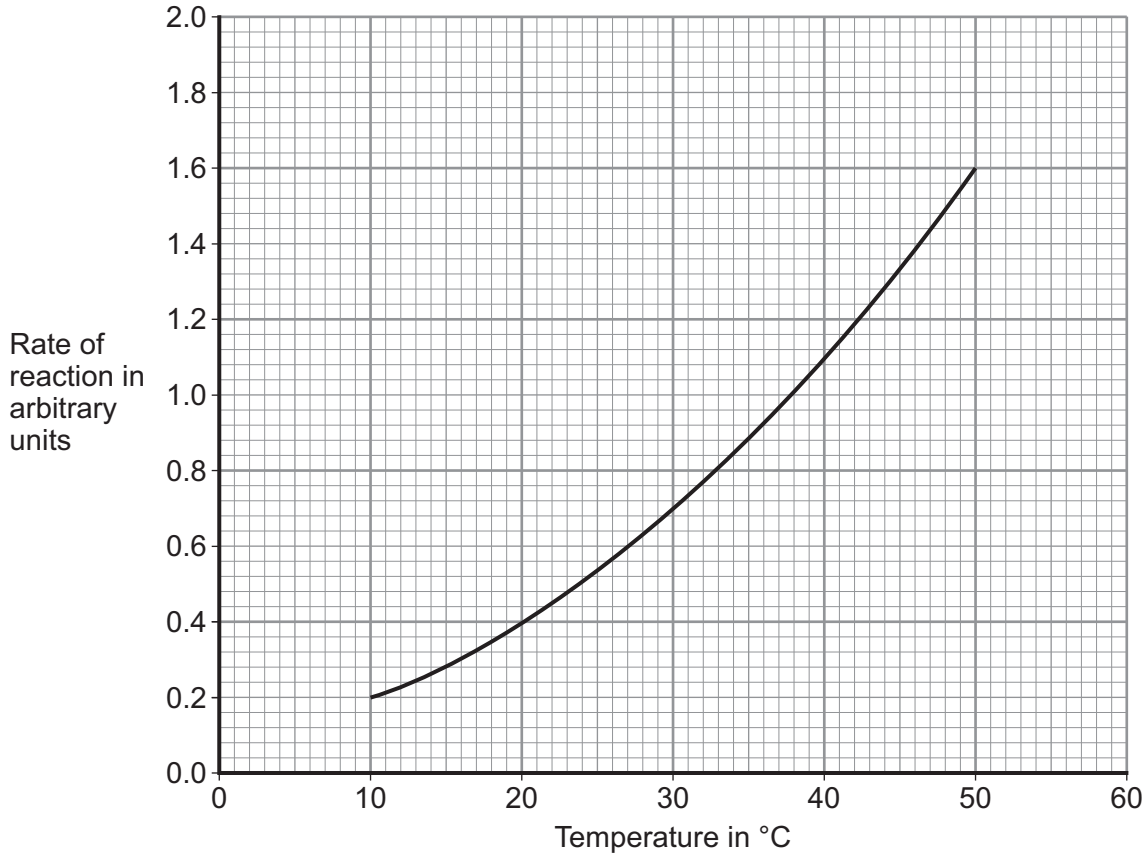
Rate of reaction = $\dfrac{\text{Volume of gas produced}}{\text{Time}}$ ☐

Question 2 continues on the next page

2 (b) The student plotted a graph of the rate of reaction against temperature.

Figure 2 shows the graph.

Figure 2



2 (b) (i) What is the rate of reaction at 15 °C?

[1 mark]

Rate of reaction at 15 °C = _____ arbitrary units

2 (b) (ii) The student concluded:

'The rate of reaction doubles for every 10 °C increase in temperature.'

Figure 2 shows the student's conclusion is **not** correct for the whole of the temperature range.

Describe how data from **Figure 2** supports and does **not** support the student's conclusion.

[3 marks]

Supports _____

_____

_____

_____

Does not support _____

_____

_____

_____

2 (c) (i) Explain, in terms of particles, why an increase in temperature increases the rate of reaction.

[2 marks]

_____

_____

_____

_____

2 (c) (ii) Give **two** other ways of increasing the rate of reaction between calcium carbonate and hydrochloric acid.

[2 marks]

_____

_____

_____

_____

9

Physics Questions

3 The Sun is a star and releases energy by the process of nuclear fusion.

3 (a) What is meant by nuclear fusion?

[1 mark]

3 (b) The age of the Sun is estimated to be 4.5 billion years.
It is thought that the Sun will continue to release energy for another 5 billion years.

Why is the Sun able to maintain its energy output for such a long time?

[1 mark]

3 (c) The first stage in the life cycle of a star is the formation of a protostar.

3 (c) (i) Describe how a protostar is formed.

[2 marks]

3 (c) (ii) Name the stage of the life cycle that the Sun is currently in.

[1 mark]

3 (d) **Table 2** shows information about the Sun and two other stars.

Table 2

Star	Temperature in °C	Mass compared to the Sun
Tau Ceti	5 000	0.8
Sun	6 000	1.0
Rigel	11 000	18

3 (d) (i) The star Rigel will become a supernova.

What is a supernova?

[1 mark]

_____

_____

3 (d) (ii) State **one** stage of the life cycle of a star that could happen to Rigel after the supernova stage.

[1 mark]

_____

_____

3 (d) (iii) Complete the sentence.

[1 mark]

Elements heavier than _____ are only formed in a supernova.

3 (d) (iv) The star Tau Ceti will **not** become a supernova.

Give the reason why.

[1 mark]

_____

_____

9

Biology Questions

4 (a) (i) Describe **one** difference in genotype between male and female humans.

[1 mark]

_____

_____

4 (a) (ii) What scientific technique could be used to distinguish between cells taken from two different people?

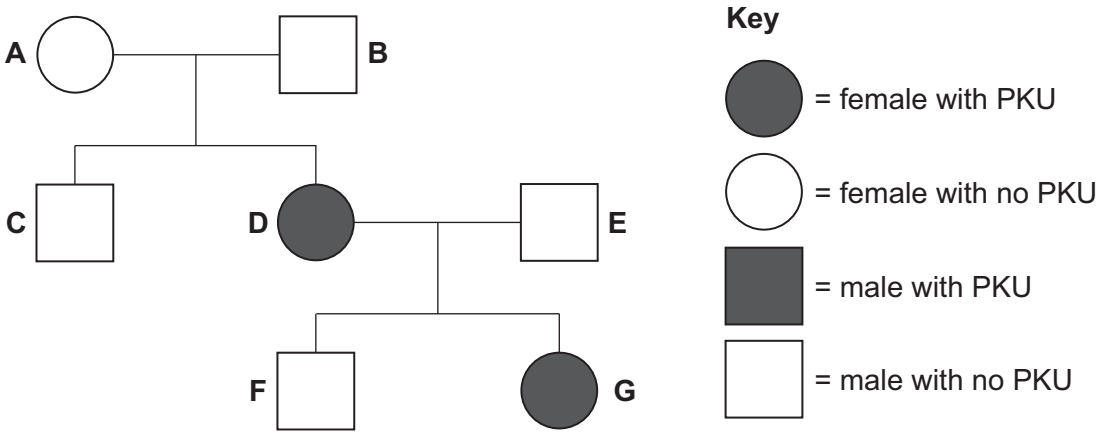
[1 mark]

_____

4 (b) Phenylketonurea (PKU) is an inherited disorder.

Figure 3 shows the inheritance of PKU in one family.

Figure 3



Explain how person **D** has PKU but parents **A** and **B** do **not** have PKU.

[3 marks]

In your answer to this question you should use the symbols:

R to represent the dominant allele,
r to represent the recessive allele.

You may use a genetic diagram in your answer.

Question 4 continues on the next page

4 (c) In a person with PKU, phenylalanine from the diet builds up in the blood.

- Phenylalanine is found in foods such as meat, dairy products and some vegetables.
- High levels of phenylalanine in the blood can lead to severe health problems.
- Some damage begins before birth.

There are two methods of testing for PKU in babies.

Blood test
A baby's blood is tested for PKU soon after birth. If the test is positive, the baby will need a special diet for the rest of its life. The baby will then develop normally.

Embryo screening
An embryo can be screened for PKU during early pregnancy.

- A hollow needle is inserted through the mother's abdomen into the mother's womb (uterus).
- Fluid containing cells from the embryo is removed through the needle.
- These cells are tested for the presence of the allele for PKU.

If the embryo is homozygous for the allele for PKU the mother should eat a special diet during pregnancy. The baby will need a special diet for the rest of its life.

Describe advantages and disadvantages of using embryo screening rather than blood testing to test for PKU.

[4 marks]

9

Turn over for the next question

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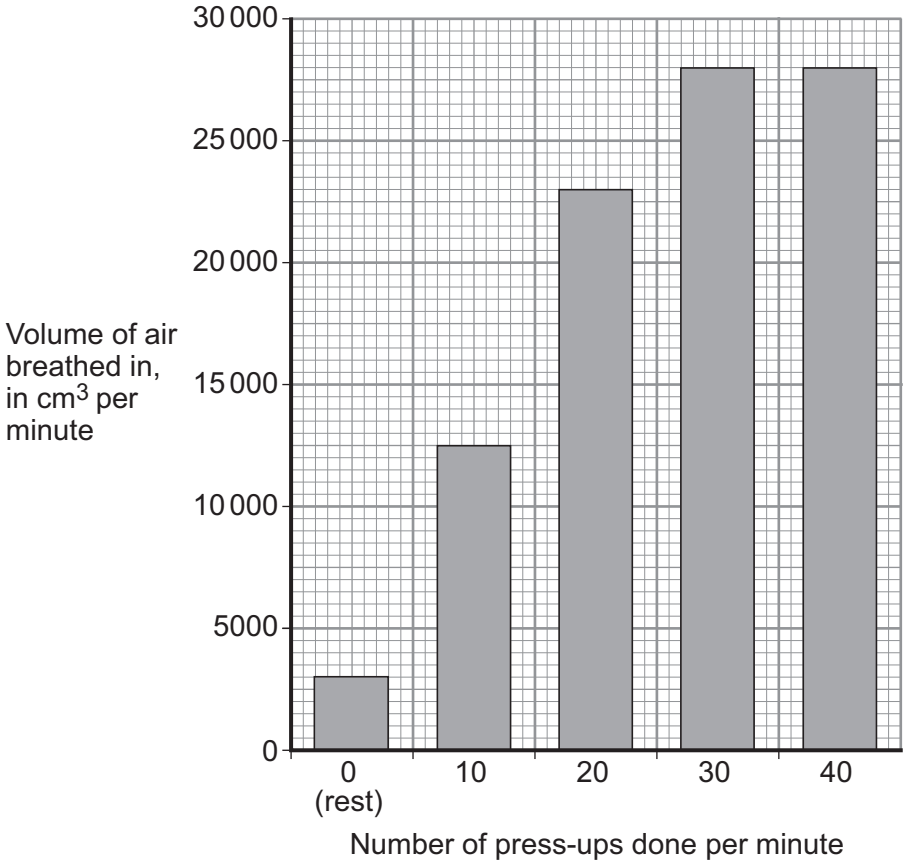
ANSWER IN THE SPACES PROVIDED

5 A student measured the volume of air he breathed in per minute as he did press-ups.

Figure 4 shows the results.

Figure 4



5 (a) (i) Calculate the extra volume of air breathed in per minute when the student did 20 press-ups per minute compared to being at rest.

[1 mark]

_____

_____

Extra volume of air breathed in = _____ cm^3 per minute

5 (a) (ii) Atmospheric air contains 20% oxygen. Breathed out air contains 16% oxygen.

Calculate the extra volume of oxygen that the student used when doing 20 press-ups per minute compared to being at rest.

Use your answer to part **(a)(i)** in your calculation.

[2 marks]

Extra volume of oxygen used = _____ cm^3 per minute

5 (b) The student needed more energy to do 40 press-ups per minute than to do 30 press-ups per minute.

5 (b) (i) Explain the evidence in **Figure 4** which shows that this extra energy is supplied by anaerobic respiration.

[2 marks]

5 (b) (ii) Give **one** disadvantage of anaerobic respiration compared with aerobic respiration.

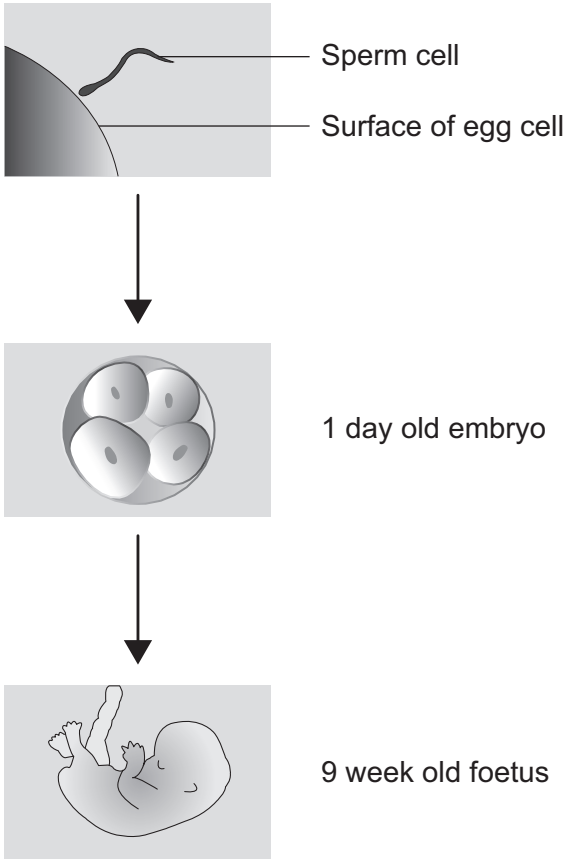
[1 mark]

6

Turn over for the next question

6 **Figure 5** shows part of the development of a human.

Figure 5



(not to scale)

6 (a) Cells in the 1 day old embryo in **Figure 5** are stem cells.

Name and describe the process by which the stem cells of the embryo develop to form cells in the foetus.

[2 marks]

6 (b) Scientists can use stem cells from embryos or from adult bone marrow in medical treatments.

Table 3 shows information about stem cells from adult bone marrow collected in the UK.

Table 3

Age of donor in years	Number of donors	Mean volume of bone marrow collected per donor in cm^3	Mean number of stem cells collected per donor $\times 10^6$
1–20	35	92	414
21–40	203	100	403
41–60	83	100	367
61–80	11	88	302

6 (b) (i) Calculate the mean number of stem cells per cm^3 of bone marrow collected from 1–20 year olds.

[2 marks]

Mean number of stem cells = _____ per cm^3

6 (b) (ii) Describe **one** way in which stem cells can be used in a medical treatment.

[1 mark]

6 (b) (iii) Stem cells from human embryos can be used to form any kind of human cell.

Stem cells from adult bone marrow can be used to form only some kinds of human cell.

Suggest **one** reason why stem cells from adult bone marrow are more commonly used in medical treatments than stem cells from embryos, even though they can form fewer types of cells.

[1 mark]

6

Chemistry Questions

7 This question is about ammonium nitrate.

7 (a) (i) Ammonium nitrate is produced in a neutralisation reaction.

Complete the equation to represent a neutralisation reaction.

[1 mark]

_____ (aq) + OH^- (aq) ⟶ _____ (l)

7 (a) (ii) In the reaction to produce ammonium nitrate an excess of ammonia solution is added to nitric acid.

Why is an excess of ammonia solution added?

[1 mark]

7 (a) (iii) Describe a test to show that ammonia solution is in excess.

Give the result of the test.

[2 marks]

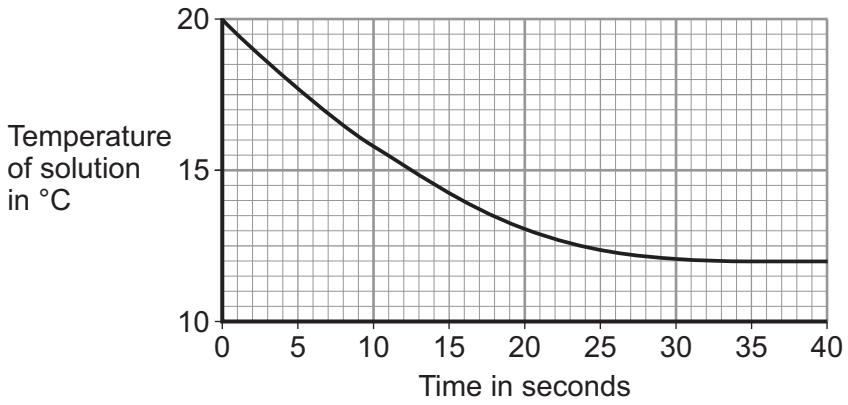
7 (a) (iv) How would you obtain crystals of ammonium nitrate from the solution of ammonium nitrate?

[1 mark]

7 (b) A student added ammonium nitrate to water.
The mixture was stirred.
The student measured the temperature of the solution every 5 seconds.

Figure 6 shows the student's results.

Figure 6



7 (b) (i) Use **Figure 6** to explain in terms of energy what type of reaction this is.

[3 marks]

7 (b) (ii) The reaction is reversible. The energy change for the forward reaction is 340 J.

Give **one** similarity and **one** difference in the energy change for the reverse reaction.

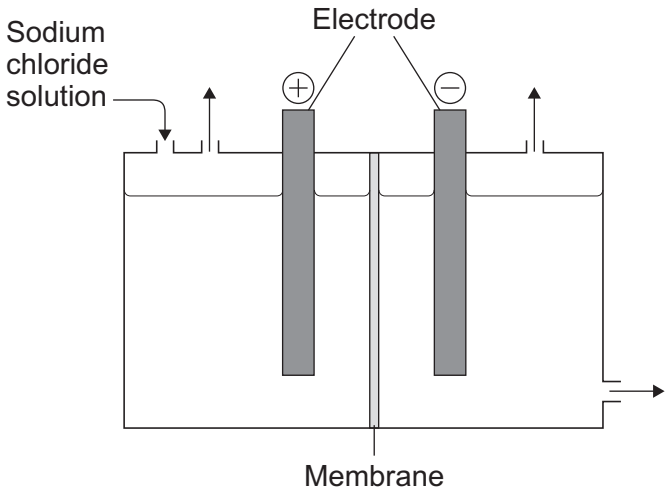
[2 marks]

10

8 The electrolysis of sodium chloride solution is an industrial process.

Figure 7 shows the electrolysis cell used.

Figure 7



8 (a) Sodium chloride solution contains sodium ions (Na^+), chloride ions (Cl^-), hydrogen ions (H^+) and hydroxide ions (OH^-).

Explain why two different ions are attracted to the negative electrode but only one product is formed at the negative electrode.

[3 marks]

8 (b) Chlorine is produced at the positive electrode.

Complete and balance the half equation for the reaction.

[2 marks]

$$Cl^- \longrightarrow Cl_2$$

8 (c) Suggest why a membrane is used in the electrolysis cell.

[1 mark]

_____

_____

6

Turn over for the next question

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9 This question is about an insoluble salt, lead iodide.

9 (a) The equation represents a reaction between two soluble salts to produce lead iodide.

Balance the equation.

[1 mark]

$$Pb(NO_3)_2\,(aq) + KI\,(aq) \longrightarrow PbI_2\,(s) + KNO_3\,(aq)$$

9 (b) What name is given to this type of reaction?

[1 mark]

_____

9 (c) Name the **two** soluble salts used in the reaction above to make lead iodide.

[1 mark]

_____

_____

9 (d) Describe how this reaction could be used to remove lead ions from waste water.

[2 marks]

_____

_____

_____

_____

5

Turn over for the next question

Physics Questions

10 A laboratory power supply can provide an alternating current (a.c.) or a direct current (d.c.).

10 (a) (i) What is the difference between an alternating current and a direct current?

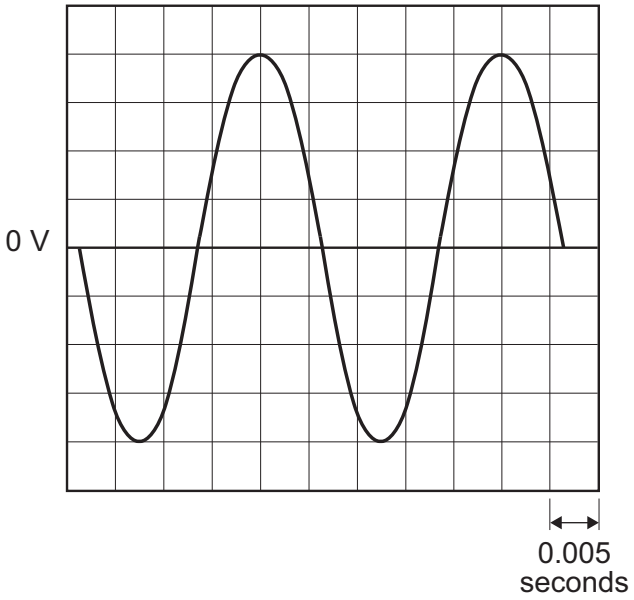
[2 marks]

10 (a) (ii) A student uses an oscilloscope to measure the frequency of an a.c. power supply.

Figure 8 shows the trace that is displayed on the screen of the oscilloscope.

Each horizontal division represents 0.005 seconds.

Figure 8



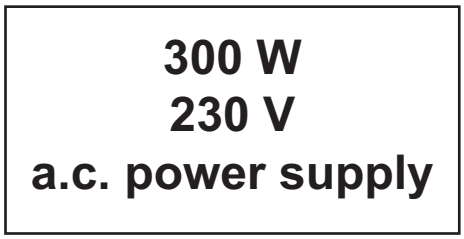
Use information from **Figure 8** to determine the frequency of the a.c. supply. Give the unit.

[4 marks]

Frequency = _____ Unit _____

10 (b) **Figure 9** shows the information label on the back of the laboratory power supply.

Figure 9



10 (b) (i) Calculate the current drawn by the laboratory power supply from the electricity mains.

[2 marks]

Use the correct equation from the Physics Equations Sheet.

Current = _____ amps

10 (b) (ii) A different laboratory power supply draws a current of 2.0 A from the electricity mains.

The laboratory power supply is fitted with a fuse.

The following fuses are available: **1 A**, **3 A**, and **13 A**.

Evaluate the suitability of **each** of these fuses for the power supply.

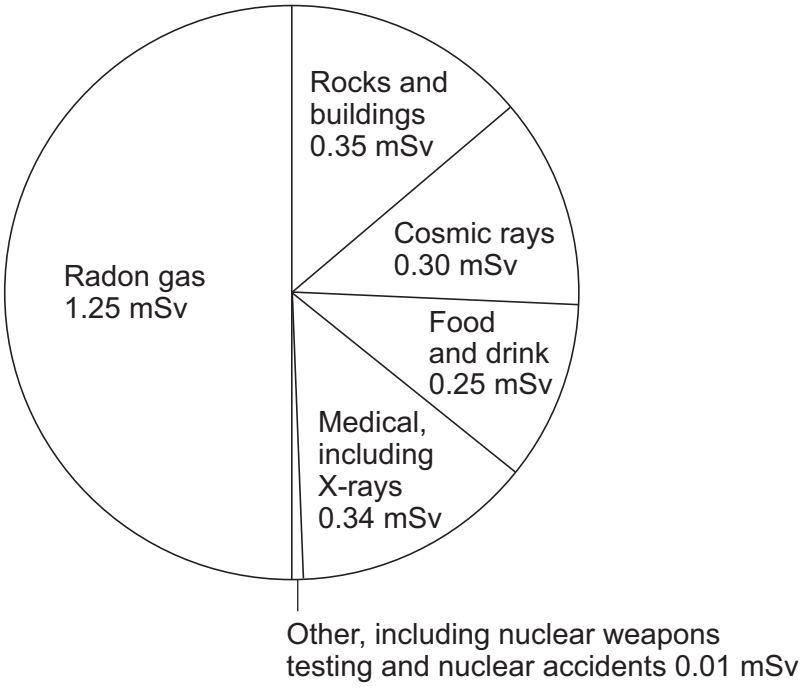
[3 marks]

11

11 (a) **Figure 10** shows the sources of the background radiation and the radiation doses that the average person in the UK is exposed to in one year.

Radiation dose is measured in millisieverts (mSv).

Figure 10



11 (a) (i) What is meant by background radiation?

[1 mark]

11 (a) (ii) A person who lives 2 km from a nuclear power station gains an extra 0.005 mSv of radiation each year from the power station.

Do you think the person should be concerned about this increase in radiation dose?

Draw a ring around your answer.

Yes **No**

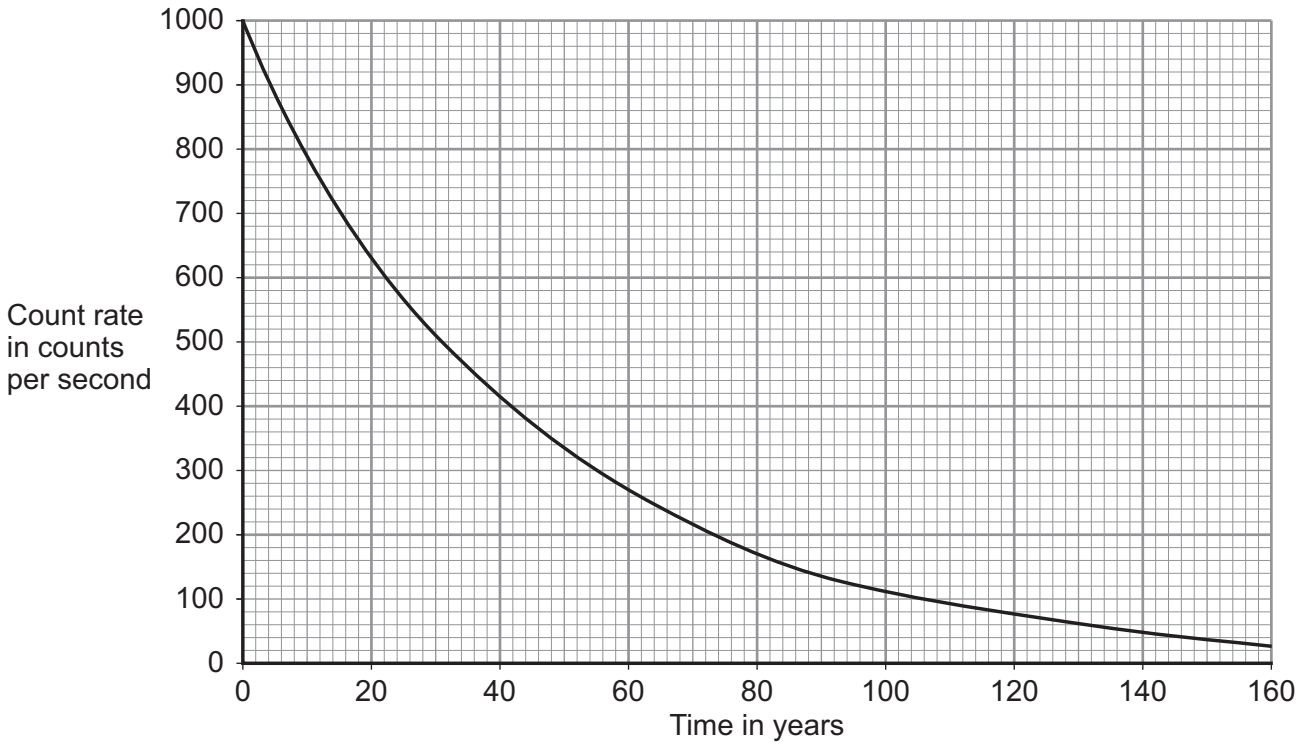
Give a reason for your answer.

[1 mark]

11 (b) Caesium-137 is a radioactive isotope produced in a nuclear power station.

Figure 11 shows how the count rate from a sample of caesium-137 decreases over time.

Figure 11



Use **Figure 11** to calculate the half-life of caesium-137.

[2 marks]

Half-life = _____ years

11 (c) Caesium-137 emits both beta and gamma radiation.

What is gamma radiation?

[1 mark]

_____

_____

Question 11 continues on the next page

11 (d) **Figure 12** shows one way of identifying the types of radiation emitted by a radioactive source.

A magnetic field is used to deflect the radiation which leaves a mark on photographic film.

Figure 12

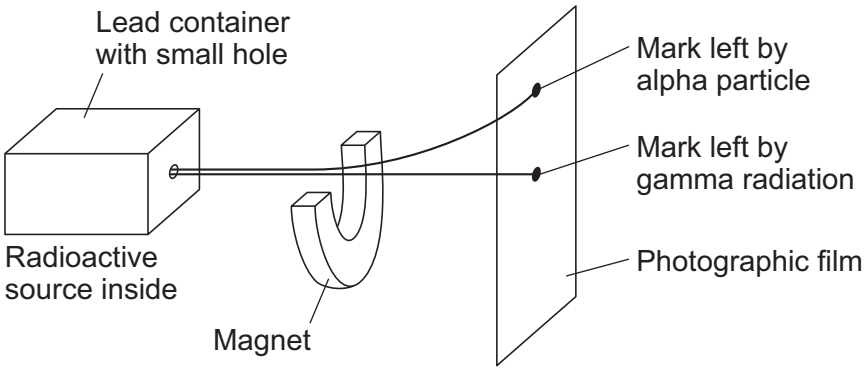
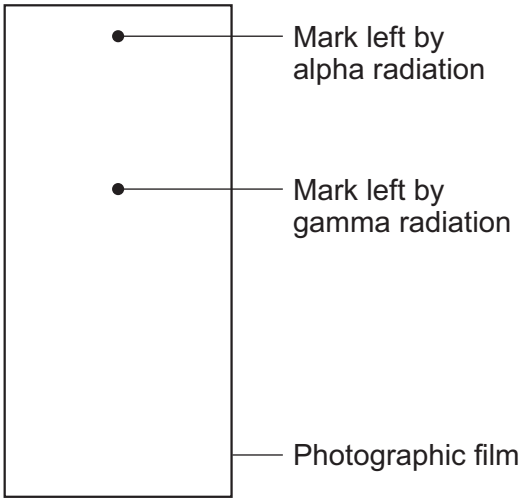


Figure 13 shows the marks left on the photographic film by an alpha particle and gamma radiation.

Figure 13



11 (d) (i) On **Figure 13**, draw the position of the mark left by a beta particle.

Explain your answer.

[3 marks]

_____

_____

_____

_____

11 (d) (ii) Two important features of the container in **Figure 12** are:

- it is made of lead
- it has a single small hole.

Give a different reason for each of these features.

[2 marks]

It is made of lead _____

_____

It has a single small hole _____

_____

10

END OF QUESTIONS

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