Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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10	
11	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
June 2015

Additional Science

AS2HP

H

Unit 6

Wednesday 20 May 2015 1.30 pm to 3.00 pm

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

Time allowed
- 1 hour 30 minutes

A

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 2(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 Protease enzymes digest proteins.

1 (a) What type of substance is produced when protein is digested?

[1 mark]

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1 (b) A student investigated the digestion of protein by protease.

Egg white is a protein.

Boiling changes egg white from a clear liquid to a white solid.

The student:

Step 1 put 10 cm^3 of liquid egg white into a measuring cylinder

Step 2 put the measuring cylinder in boiling water until the egg white went solid

Step 3 put 5 cm^3 of protease solution into a test tube

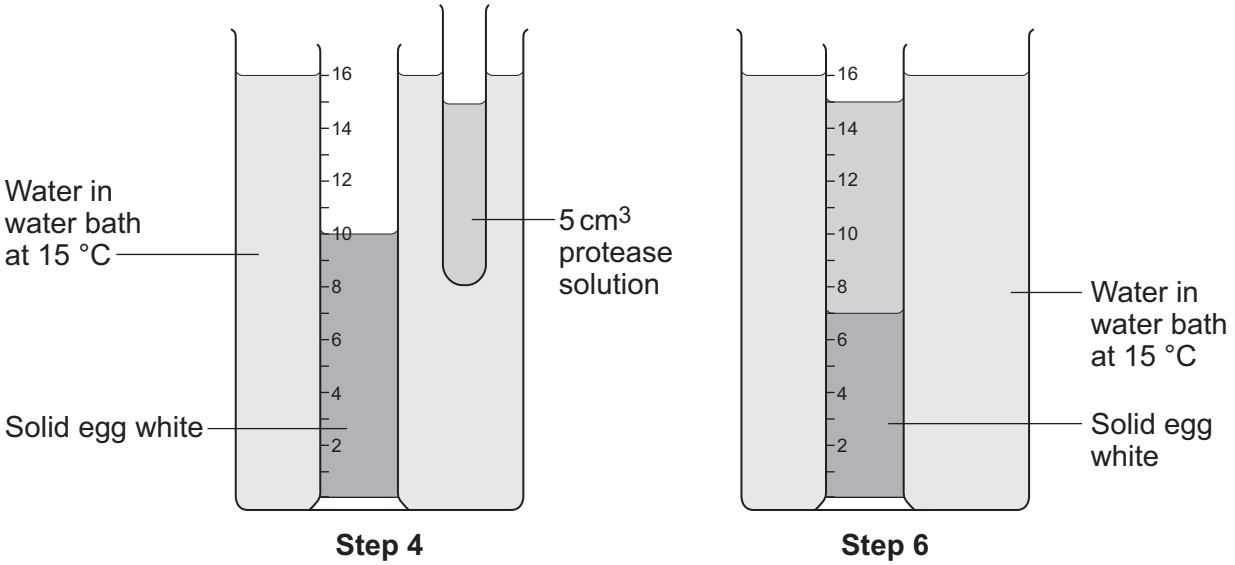
Step 4 put both the measuring cylinder and the test tube into a water bath at 15 °C for ten minutes

Step 5 added the protease to the solid egg white in the measuring cylinder

Step 6 recorded the volume of solid egg white in the measuring cylinder after 24 hours.

Figure 1 shows **Step 4** and **Step 6** of the investigation.

Figure 1



1 (b) (i) In **Step 4**, why were the solid egg white and protease solution put into the water bath for 10 minutes before being added together?

[1 mark]

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1 (b) (ii) Calculate the volume of solid egg white digested after 24 hours at 15 °C.

Use **Figure 1** to work out your answer.

[1 mark]

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Volume of solid egg white digested = ... cm^3

Question 1 continues on the next page

1 (c) Other students repeated the investigation at different temperatures using 20 cm^3 of liquid egg white.

The students used the same concentration of protease solution for each temperature.

Table 1 shows the results.

Table 1

Temperature in °C	**Volume of egg white that had been digested in 24 hours in cm^3**
10	2
20	4
30	8
40	16
50	0

1 (c) (i) Describe the relationship between temperature and the volume of egg white digested at temperatures from 10 °C to 40 °C.

[2 marks]

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1 (c) (ii) **Student 1** wrote a conclusion:

"Protease works best at 40 °C."

This conclusion may not be accurate.

Suggest how the investigation should be changed so that **Student 1** could find a more accurate value for the best temperature.

[2 marks]

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1 (c) (iii) **Student 2** wrote a different conclusion:

"At 50 °C protease is killed by the high temperature."

Why is the conclusion written by **Student 2 not** correct?

[2 marks]

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How should **Student 2** correct the conclusion?

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9

Turn over for the next question

Chemistry Questions

2 Magnesium sulfate is a salt.

Magnesium sulfate solution is produced from magnesium oxide (MgO) and sulfuric acid (H_2SO_4).

2 (a) Magnesium oxide is insoluble.

What type of substance is magnesium oxide?

[1 mark]

Draw a ring around the correct answer.

acid **alkali** **base**

2 (b) The equation represents the reaction between magnesium oxide and sulfuric acid.

Complete the equation by writing the correct state symbol in each space.

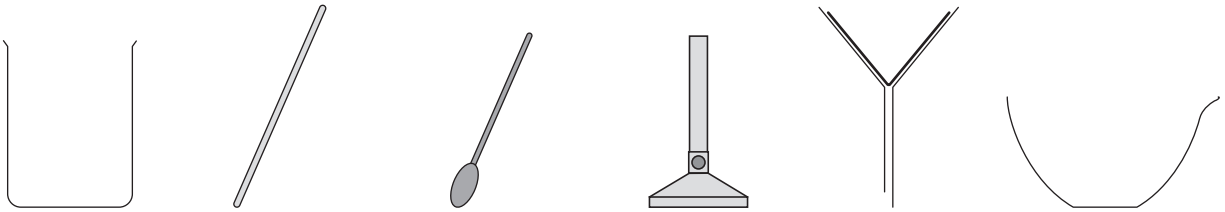
[2 marks]

$$MgO\ (.....) + H_2SO_4(aq) \longrightarrow MgSO_4\ (.....) + H_2O\ (.....)$$

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

Figure 2 shows **some** of the equipment which is used to make magnesium sulfate crystals.

Figure 2



Stirring rod Spatula

Describe how you would make crystals of magnesium sulfate from magnesium oxide and sulfuric acid.

Include in your answer:

- how you would use the equipment
- how to separate the solution
- how to produce magnesium sulfate crystals from the solution.

[6 marks]

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Extra space .....

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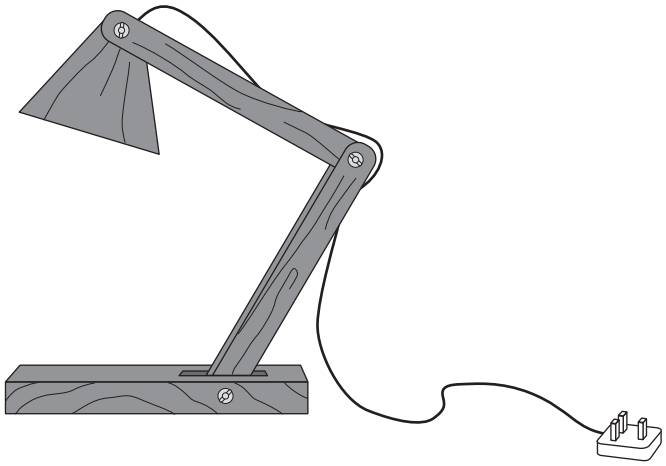
Physics Questions

3 **Figure 3** shows a wooden desk lamp.

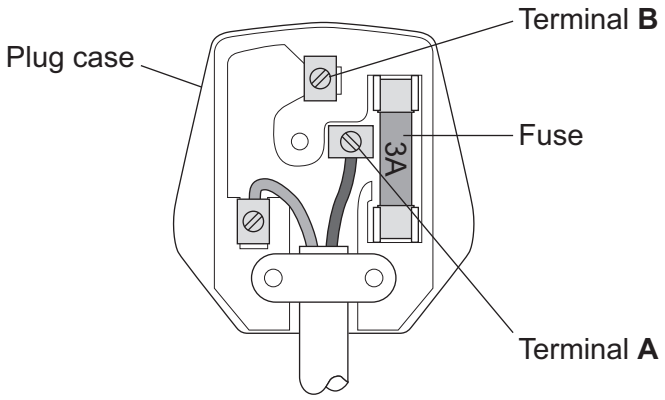
The lamp is connected to a three-pin plug using two-core cable.

Figure 3



3 (a) **Figure 4** shows the inside of the three-pin plug.

Figure 4



3 (a) (i) What is the name of the wire connected to the fuse at Terminal **A**?

[1 mark]

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3 (a) (ii) The desk lamp does **not** need a wire connected to Terminal **B**.

Why?

[1 mark]

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3 (a) (iii) Why is plastic a suitable material for the plug case?

[1 mark]

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3 (a) (iv) The fuse has a current rating of 3 A. What does this mean?

[2 marks]

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3 (b) The desk lamp has been made for use in the UK.

Figure 5 shows part of the label from the lamp.

Figure 5

50 Hz a.c.
Maximum power of bulb 60 W

What information does the label give about the UK mains electricity supply?

[2 marks]

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Question 3 continues on the next page

3 (c) The potential difference of the UK mains electricity supply is 230 V.

The current flowing through the bulb in the desk lamp is 0.13 A.

Calculate the power of the bulb.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Power = ... W

3 (d) **Table 2** gives information about three different bulbs, **A**, **B** and **C**.

Table 2

Bulb	Electrical power input in watts	Light power output in watts
A	22	14
B	28	14
C	60	14

A person is going to buy **one** of the bulbs **A**, **B** or **C**. The bulbs cost the same.

Use **Table 2** to decide which **one** of the bulbs, **A**, **B** or **C**, the person should buy.

Give a reason for your answer.

[1 mark]

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Biology Questions

4 This question is about respiration.

4 (a) Anaerobic respiration is different from aerobic respiration.

The equation shows anaerobic respiration.

glucose ⟶ **lactic acid**

Aerobic respiration does **not** produce lactic acid.

Give **two** more differences between anaerobic respiration and aerobic respiration.

[2 marks]

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4 (b) Blood contains glucose.

The amount of glucose in the blood at the start of a long-distance race will **not** be enough for a runner during the race.

The runner does **not** eat or drink during the race.

4 (b) (i) How do the runner's muscles get the extra glucose needed to run the long-distance race?

[3 marks]

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4 (b) (ii) Lactic acid builds up in the runner's muscles, causing an oxygen debt.

What is meant by an oxygen debt?

[1 mark]

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6

Turn over for the next question

5 There are two types of cell division, mitosis and meiosis.

5 (a) Complete **Table 3** to compare mitosis and meiosis, for one complete cell division, in humans.

[3 marks]

Table 3

	Mitosis	**Meiosis**
Number of times the cell divides		
Number of cells formed		
Number of chromosomes in each of the cells formed in humans		

5 (b) One type of colour-blindness is caused by a mutation of a gene on an X chromosome.

A colour-blind male must have inherited colour-blindness from his mother.

Explain why.

[2 marks]

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6 Evidence for early forms of life comes from fossils.

6 (a) Fossils may be formed from footprints in mud when the mud changed into rock.

Describe, in detail, **two** more ways in which fossils may be formed.

[4 marks]

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Question 6 continues on the next page

6 (b) The approximate age of some fossils can be calculated using 'radioactive carbon dating'.

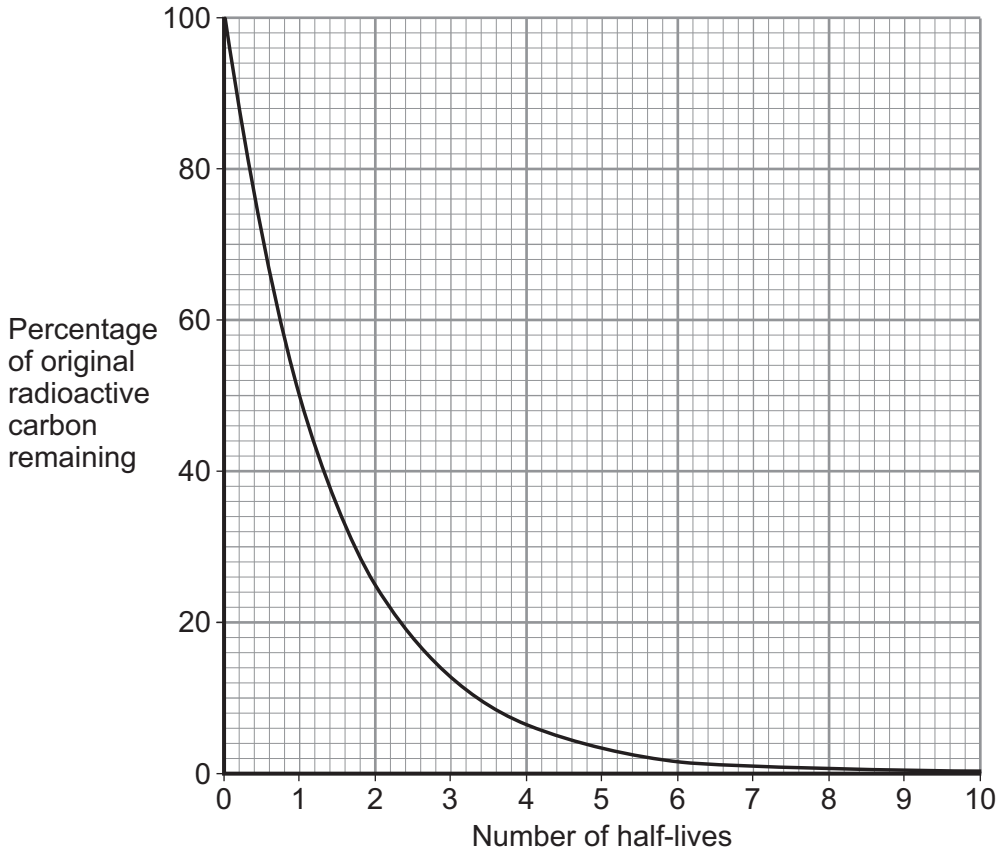
Carbon exists in non-radioactive and radioactive forms.

After an organism dies the proportion of radioactive carbon in the dead organism decreases at a constant rate.

It takes 5730 years for half the radioactive carbon to decay. This time is called the half-life of the radioactive carbon.

Figure 6 shows how the percentage of radioactive carbon changes over time.

Figure 6



6 (b) (i) Suggest why estimates of the age of fossils, using this method, will probably be more accurate if the fossil is recent, rather than if the fossil is much older.

[1 mark]

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6 (b) (ii) Recently a human fossil was found.

Analysis showed that the fossil had 28% of the original radioactive carbon remaining.

Estimate how long ago the human died.

Use the information provided in this question and **Figure 6**.

[3 marks]

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6 (b) (iii) There are very few fossils of the earliest forms of life.

Explain why.

[2 marks]

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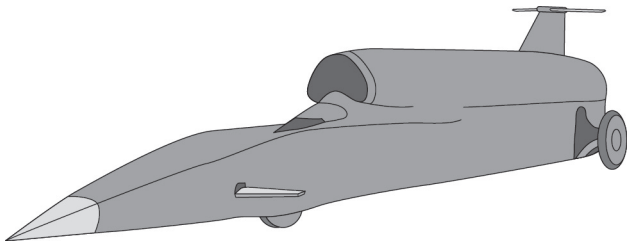
Turn over for the next question

Chemistry Questions

7 **Figure 7** shows a rocket-powered car.

Figure 7



The car uses hydrogen peroxide to power the rocket. Hydrogen peroxide (H_2O_2) is passed over a silver catalyst. The hydrogen peroxide decomposes to produce water and oxygen gas (O_2).

7 (a) Write a balanced symbol equation for the decomposition of hydrogen peroxide.

[2 marks]

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7 (b) The silver catalyst is used as small beads and **not** as a single block.

Explain, in terms of collisions, why silver is used as small beads.

[3 marks]

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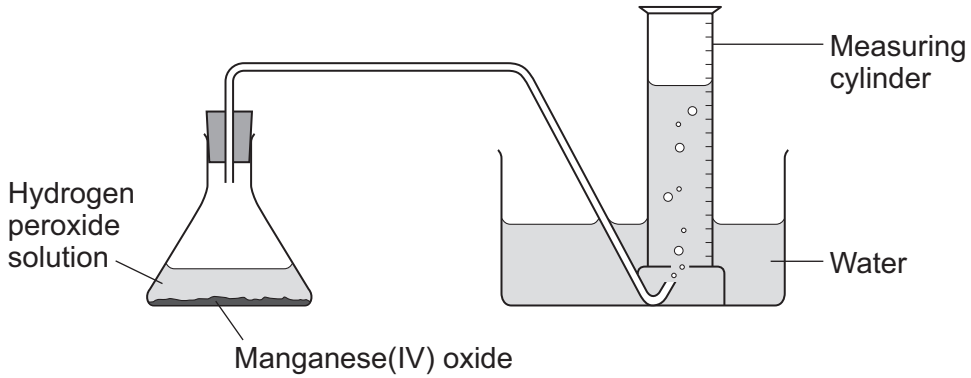
7 (c) A student investigated the use of manganese(IV) oxide as a catalyst in the reaction to decompose hydrogen peroxide solution.

The student used the apparatus shown in **Figure 8**.

Figure 8



The student measured the volume of gas produced every 5 seconds.

The student repeated the investigation using lead(IV) oxide instead of manganese(IV) oxide.

The student controlled the volume of hydrogen peroxide solution.

Give **two** other variables that the student should control when doing the investigation.

[2 marks]

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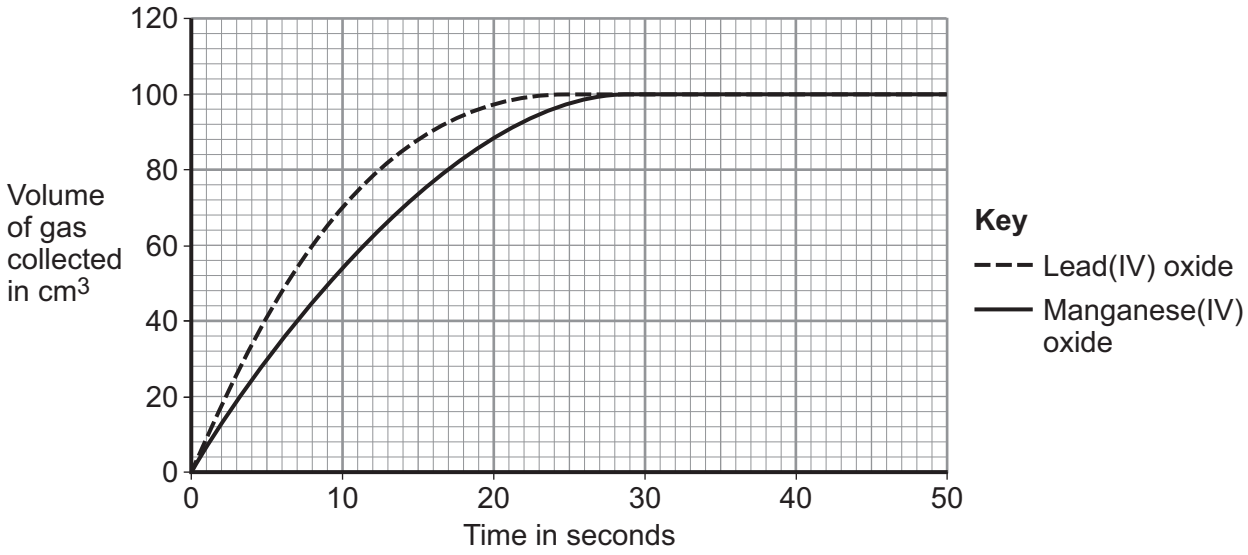
Question 7 continues on the next page

7 (d) The student used the results to draw the graph shown in **Figure 9**.

Figure 9



7 (d) (i) Give **two** ways **Figure 9** shows lead(IV) oxide is a more effective catalyst than manganese(IV) oxide.

[2 marks]

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7 (d) (ii) The same final volume of gas is produced with lead(IV) oxide and manganese(IV) oxide.

Explain why.

[2 marks]

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11

Turn over for the next question

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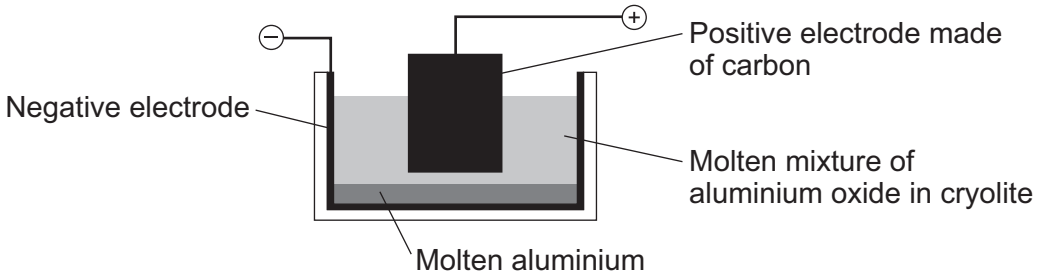
8 Aluminium metal is extracted from aluminium oxide using electrolysis.

Figure 10 is a diagram of the process.

Figure 10



8 (a) Aluminium is often extracted near to power stations. Suggest **one** reason why.

[1 mark]

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8 (b) Explain why aluminium oxide is mixed with cryolite in this process.

[2 marks]

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8 (c) (i) Which is the correct half equation for oxygen production at the positive electrode?

[1 mark]

Tick (✓) **one** box.

$O^{2-} \longrightarrow O_2 + 2e^-$ ☐

$2O^{2-} \longrightarrow O_2 + 2e^-$ ☐

$2O^{2-} \longrightarrow O_2 + 4e^-$ ☐

8 (c) (ii) Explain why the positive carbon electrode needs to be replaced regularly.

[3 marks]

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8 (d) Describe how aluminium is produced from aluminium ions at the negative electrode.

[3 marks]

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Physics Questions

9 Deuterium and tritium are isotopes of hydrogen.

9 (a) (i) State **one** way in which the nucleus of a deuterium atom is different from the nucleus of a tritium atom.

[1 mark]

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9 (a) (ii) State **one** way in which the nucleus of a deuterium atom is the same as the nucleus of a tritium atom.

[1 mark]

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9 (b) The fusion of deuterium and tritium releases large amounts of energy in the Sun.

9 (b) (i) The mass of the Sun is 2×10^{30} kg. Hydrogen is converted to energy at a rate of 1×10^{16} kg every year.

Use this information to explain how the Sun is able to maintain its energy output for millions of years.

[2 marks]

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9 (b) (ii) The Sun will end its life cycle as a black dwarf.

97% of all stars in our galaxy will eventually end their life cycle as black dwarfs.

State **two** ways in which the life cycle for the other 3% of stars in our galaxy might end.

[2 marks]

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9 (b) (iii) The fusion processes in a main sequence star produce elements lighter than iron.

Explain why the Earth contains elements heavier than iron.

[2 marks]

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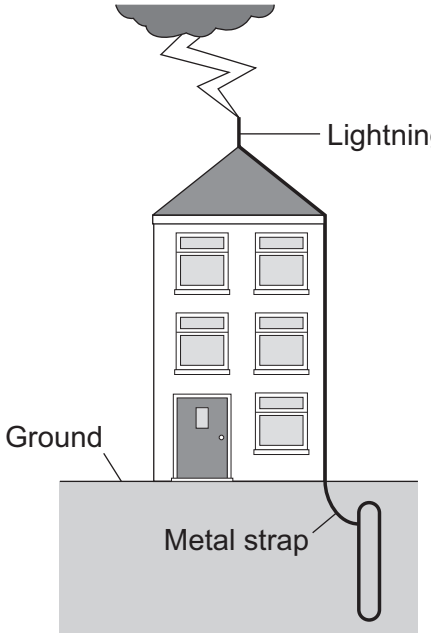
Turn over for the next question

10 **Figure 11** shows lightning striking a tall building. Information about the lightning strike is given in the box.

Figure 11



The lightning strike lasts for 5.0×10^{-4} s.

The charge transferred is 15 C.

The potential difference between the cloud and building is 3.0×10^{7} V.

10 (a) Calculate the energy transferred by the lightning strike.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Energy transferred = ... J

10 (b) A lightning conductor is designed to protect the building from a lightning strike. The lightning conductor allows the charge to flow to earth through a metal strap.

What will happen to the metal strap as the charge flows through it?

[1 mark]

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10 (c) Some people think it would be a good idea to use the electrical power from lightning to supply homes.

Suggest **one** reason why this is **not** done.

[1 mark]

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4

Turn over for the next question

11 Radon gas is one source of background radiation.

Radon decays by emitting an alpha particle.

11 (a) What is an alpha particle?

[1 mark]

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11 (b) What is the range of an alpha particle in air?

[1 mark]

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11 (c) Radon gas can get into a house.

Radon gas comes from uranium compounds found in rocks underground. The gas can collect in spaces under a house and then seep into the rooms of the house.

The Health Protection Agency (HPA) monitors background radiation levels in houses.

11 (c) (i) The HPA advises people that the radiation levels should be measured in houses built near rocks containing uranium compounds.

Explain why radon gas can be harmful to the people living in these houses.

[3 marks]

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11 (c) (ii) To find out if a home has too much radiation from radon gas, the HPA advises taking measurements using two detectors.

The HPA gives the following instructions when using the two detectors:

- place the two detectors in different rooms
- take readings from each detector over three months.

Following these instructions is likely to give a valid measurement of the radiation level.

Suggest why.

[3 marks]

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END OF QUESTIONS

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