

Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
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TOTAL	



General Certificate of Secondary Education  
Higher Tier  
June 2014

## Additional Science

AS2HP

### Unit 6

H

Monday 19 May 2014 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

**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 4(d) 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.



J U N 1 4 A S 2 H P 0 1

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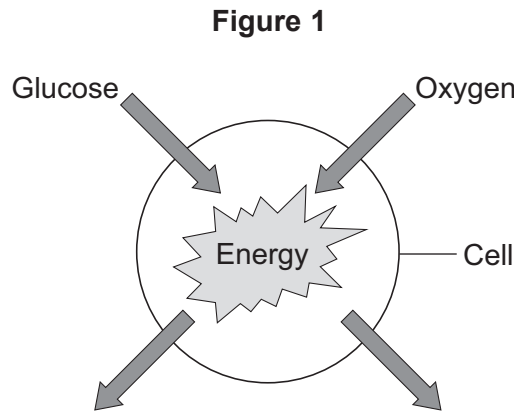
AS2HP

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

**Biology Questions**

1 Respiration releases energy.

1 (a) **Figure 1** shows what happens during aerobic respiration in a cell.



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Write the names of the two products of respiration in the spaces on **Figure 1**.

**[2 marks]**

1 (b) Cardiac output is the volume of blood that can be pumped out of the heart each minute.

$$\text{Cardiac output} = \text{stroke volume} \times \text{heart rate}$$

- Stroke volume is the volume of blood pumped by the heart each beat.
- Heart rate is the number of heart beats per minute.

Free-divers stay under water for as long as they can with no air supply. They cannot breathe until they get back to the surface.

**Table 1** shows information about one free-diver at rest and during a free-dive.

**Table 1**

	Stroke volume in cm <sup>3</sup>	Heart rate in beats per minute	Cardiac output in cm <sup>3</sup> per minute
At rest	70	65	4550
During a free-dive	160	15	

1 (b) (i) Calculate the free-diver's cardiac output during the free-dive.

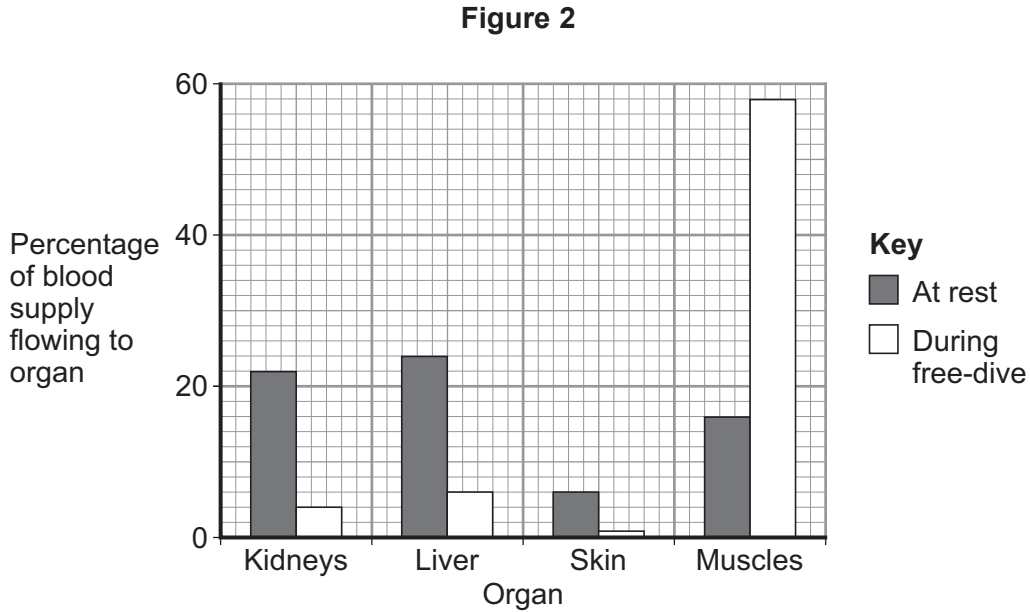
**[1 mark]**

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Cardiac output = ..... cm<sup>3</sup> per minute



1 (b) (ii) **Figure 2** shows the percentages of blood flowing to some of the free-diver's organs at rest and during a free-dive.



The volume of blood flowing to the free-diver's muscles at rest was 728 cm<sup>3</sup> per minute.

Calculate the volume of blood flowing to the free-diver's muscles per minute during a free-dive.

Use the formula:

$$\text{volume of blood flowing to organ per minute} = \text{cardiac output} \times \frac{\% \text{ of blood flowing to organ}}{100}$$

Use your answer to part 1(b)(i) in your calculation.

**[2 marks]**

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Volume of blood = ..... cm<sup>3</sup> per minute

**Question 1 continues on the next page**

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1 (b) (iii) Free-divers may have a lung volume of more than twice the normal lung volume.

A free-diver has set a world record of 23 minutes under water.

Training makes free-divers tolerant of high lactic acid concentrations.

The equation for anaerobic respiration is:

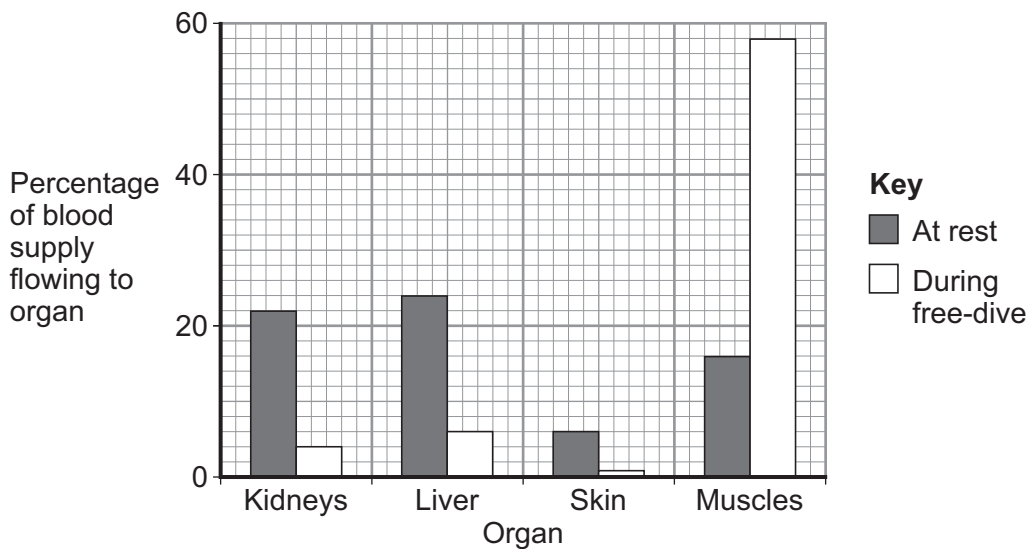


How can free-divers stay under water for such a long time without breathing?

In your answer you should refer to respiration and blood flow to the free-diver's organs.

**[4 marks]**

Figure 2 is repeated below to help you.



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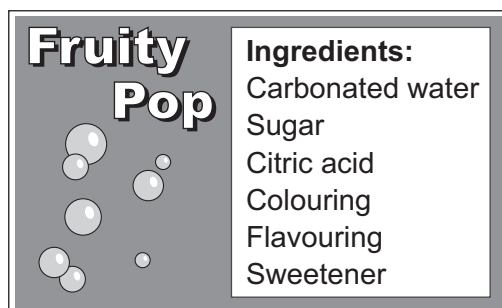
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## Chemistry Questions

- 2 **Figure 3** is a label showing the ingredients in a fizzy fruit drink.

Figure 3



- 2 (a) Carbonated water is made by dissolving carbon dioxide in water.  
Aqueous carbonic acid is produced. This is a reversible reaction.  
Write the word equation for the reaction.

[1 mark]

..... + .....  $\rightleftharpoons$  .....

- 2 (b) (i) The pH of Fruity Pop is 4.1.

Name the **two** ingredients which give Fruity Pop a pH of 4.1.

[2 marks]

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- 2 (b) (ii) Which ion will cause Fruity Pop to have a pH of 4.1?

[1 mark]

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0 7

3 A student makes copper sulfate crystals by reacting copper oxide with an acid.

3 (a) (i) What type of substance is copper oxide?  
Draw a ring around the correct answer to complete the sentence.

[1 mark]

Copper oxide is an insoluble

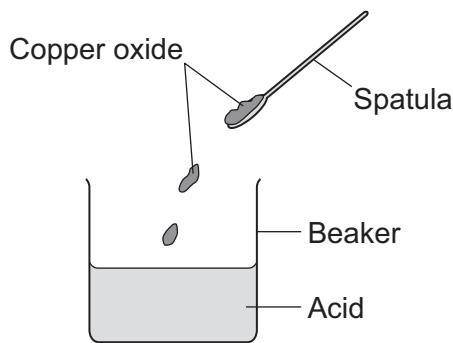
alkali.
base.
salt.

3 (a) (ii) Name the acid used to make copper sulfate. ....

[1 mark]

3 (b) A student puts the acid into a beaker.  
The student adds copper oxide to the acid, as shown in **Figure 4**, until a black solid remains in a blue solution.

Figure 4



3 (b) (i) Why does the black solid remain in the solution?

[1 mark]

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3 (b) (ii) Describe how the student can produce copper sulfate crystals from the mixture of black solid and blue solution.

[2 marks]

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**3 (c)** Copper oxide reacts faster with the acid at higher temperatures.

Explain why in terms of particles.

**[3 marks]**

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### Physics Questions

**4** Nuclear fusion and nuclear fission are both processes that release energy.

**4 (a)** Energy is released in stars by the process of nuclear fusion.

What is nuclear fusion?

**[1 mark]**

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**4 (b)** Stars go through a life cycle.

Elements lighter than iron are formed by fusion processes during the main sequence part of the life cycle.

Name the part of the life cycle during which elements heavier than iron are formed.

**[1 mark]**

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**4 (c)** The life cycle depends on the size of the star.

**Table 2** gives information about three stars, **J**, **K** and **L**.

**Table 2**

Star	Relative mass of the star compared to the Sun	Estimated time to complete the life cycle of the star in millions of years
<b>J</b>	0.1	100 000 000
<b>K</b>	1.0	13 000
<b>L</b>	10.0	100

**4 (c) (i)** What conclusion can be made from the data shown in **Table 2**?

**[1 mark]**

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**4 (c) (ii)** Why is the time to complete the life cycle of a star only an estimate?

**[1 mark]**

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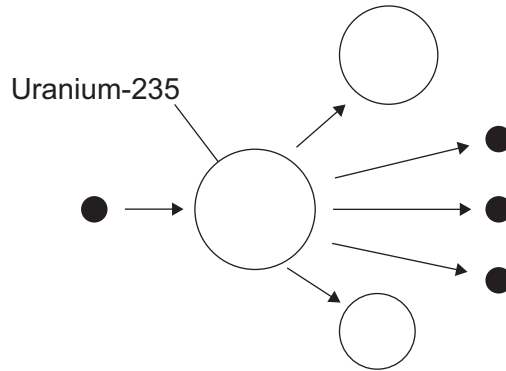


4 (d) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Uranium-235 is a fissionable substance used in nuclear reactors to release energy.

Figure 5 shows a simplified nuclear fission reaction.

Figure 5



- Describe the process of nuclear fission.
- How is the energy released in nuclear fission used in a nuclear power station to generate electricity?

[6 marks]

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Extra space .....

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**Biology Questions**

**5** Lipase is an enzyme that digests lipid.

**5 (a) (i)** What are the **two** products of the digestion of lipid?

**[2 marks]**

1 .....

2 .....

**5 (a) (ii)** Name **one** part of the human digestive system where lipase is made.

**[1 mark]**

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**5 (b)** Students investigated the effect of temperature on the time it takes for human lipase to break down lipid.

The students used a range of temperatures from 10 °C to 50 °C.  
Between 10 °C and 40 °C the time to break down the lipid decreased.

The students did **not** do the investigation at 80 °C.

What would happen in the investigation at 80 °C?

Explain your answer.

Use your knowledge of enzymes to help you.

**[2 marks]**

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**5 (c)** In the stomach, hydrochloric acid is added to food.

Lipase works best in alkaline conditions.

Explain how the liver helps to provide alkaline conditions.

**[2 marks]**

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**Turn over for the next question**

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6 Scientists believe that life on Earth began over three billion years ago.

6 (a) Why are scientists **not** sure what the earliest forms of life looked like?

[2 marks]

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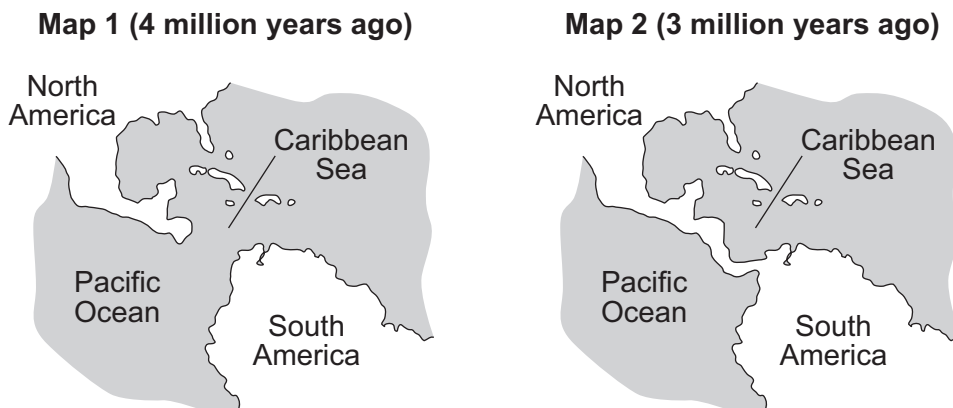
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6 (b) Four million years ago, fish were able to swim from the Caribbean Sea to the Pacific Ocean.

About 3.5 million years ago, North America and South America joined together.

Map 1 and Map 2 in Figure 6 show this change.

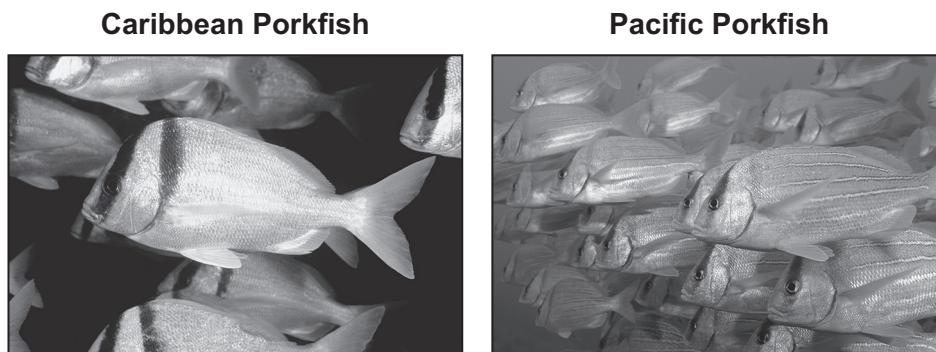
Figure 6



There are two modern species of porkfish. The Caribbean porkfish lives in the Caribbean Sea. The Pacific porkfish lives in the Pacific Ocean.

The photographs in Figure 7 show the two species of fish.

Figure 7





**6 (b) (i)** Scientists believe that four million years ago there was only one original species of porkfish.

Both modern species of porkfish have evolved from this original species.

Suggest how this could have happened.

**[4 marks]**

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**6 (b) (ii)** In the 1900s the Panama Canal was built. The canal joins the Pacific Ocean to the Caribbean Sea.

Both modern species of porkfish swim through the canal.

The two modern species **cannot** successfully interbreed with one another.

Give **one** reason why.

**[1 mark]**

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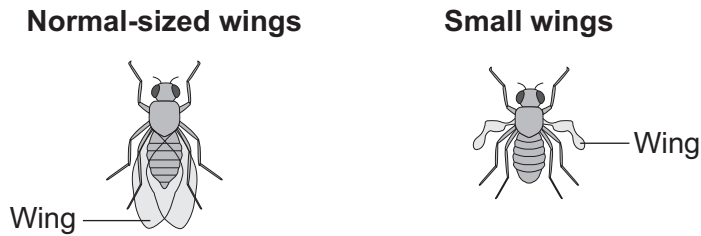
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7 Students investigated inheritance in fruit flies.

Fruit flies may have normal-sized wings or small wings, as shown in **Figure 8**.

**Figure 8**



7 (a) The students crossed a fly with normal-sized wings with a fly that was homozygous for small wings.

All the offspring of this cross had normal-sized wings.

Suggest why.

**[2 marks]**

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7 (b) The students allowed the offspring of the cross to breed with each other to produce a second generation.

7 (b) (i) The students predicted:  
“the ratio of flies with normal-sized wings to flies with small wings in the second generation will be 3 : 1”.

Why is the students’ prediction correct?

In your answer:

- include a genetic diagram
- use the symbols  
**A** to represent the dominant allele  
**a** to represent the recessive allele.

[4 marks]

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7 (b) (ii) The students collected the flies from the second generation.

They found that the ratio of flies with normal-sized wings to flies with small wings was **not** exactly 3 : 1.

Suggest why the ratio did **not** exactly match their predicted ratio.

[1 mark]

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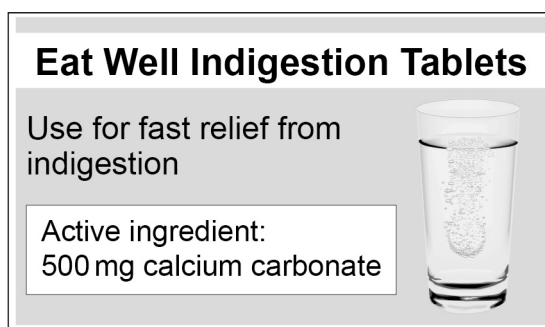


## Chemistry Questions

8 Indigestion tablets are used to neutralise excess acid in the stomach.

Figure 9 shows a label from a packet of indigestion tablets.

Figure 9



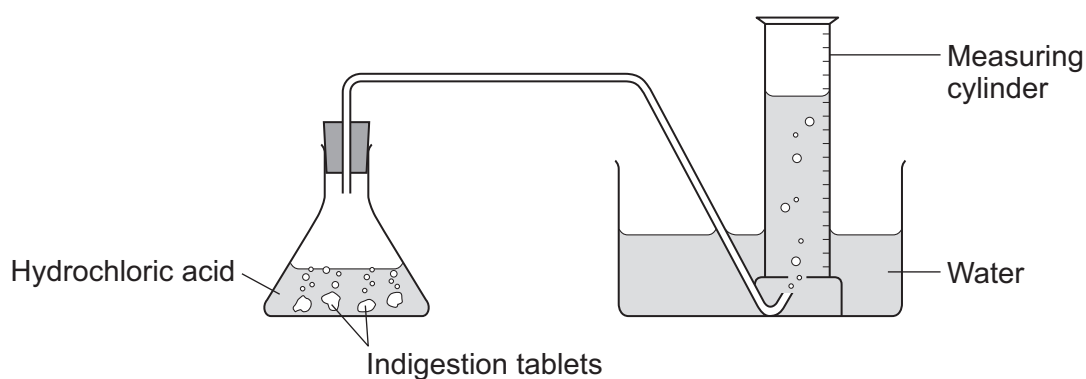
The equation shows the reaction between calcium carbonate and hydrochloric acid:



8 (a) A student investigated the reaction of indigestion tablets with excess hydrochloric acid.

The student used the apparatus shown in Figure 10.

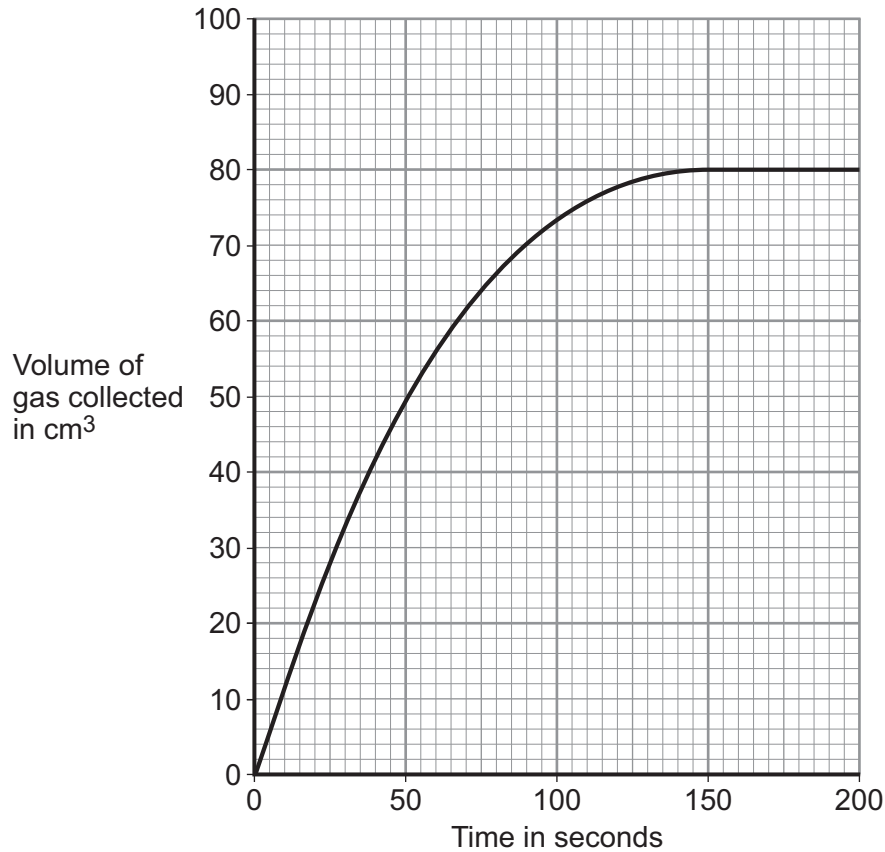
Figure 10



The student measured the volume of gas produced every 10 seconds.

The student drew a graph to show the results, as shown in **Figure 11**.

**Figure 11**



- 8 (a) (i)** The student repeated the investigation using hydrochloric acid with a greater concentration.

Sketch on **Figure 11** the curve you would expect the student to obtain using hydrochloric acid with a greater concentration.

**[2 marks]**

- 8 (a) (ii)** Give **two** variables the student should control in the investigation to allow a fair comparison to be made.

**[2 marks]**

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**8 (b)** The instructions on the packet of indigestion tablets state, 'for faster relief chew the tablets'.

Explain why chewing the tablets will give faster relief.

**[3 marks]**

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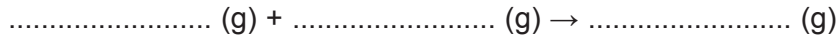


**9** In industry, sulfuric acid is made using the Contact Process.

One step in the process produces the gas sulfur trioxide (SO<sub>3</sub>) from sulfur dioxide and oxygen using vanadium(V) oxide as a catalyst.

**9 (a)** Write a balanced symbol equation for this reaction.

**[2 marks]**



**9 (b)** Suggest **two** reasons why a catalyst is used in this process.

**[2 marks]**

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**9 (c)** The pressure of the reacting gases is increased.

Explain why increasing the pressure increases the rate of reaction.

**[2 marks]**

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10 Many trophies are silver plated.

Figure 12 shows a silver-plated trophy.

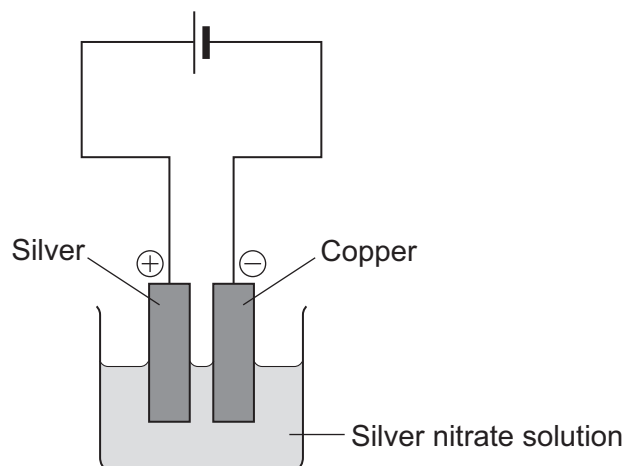
Figure 12



The trophies are made of copper and then silver plated by electrolysis.

A student used the apparatus shown in Figure 13 to investigate silver plating onto copper by electrolysis.

Figure 13



10 (a) Why must the silver nitrate used be in solution?

[1 mark]

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**10 (b)** Complete the half equation for the reaction at the negative electrode.

**[2 marks]**



**10 (c)** What will happen to the concentration of the silver nitrate solution during electrolysis?

Explain your answer.

**[2 marks]**

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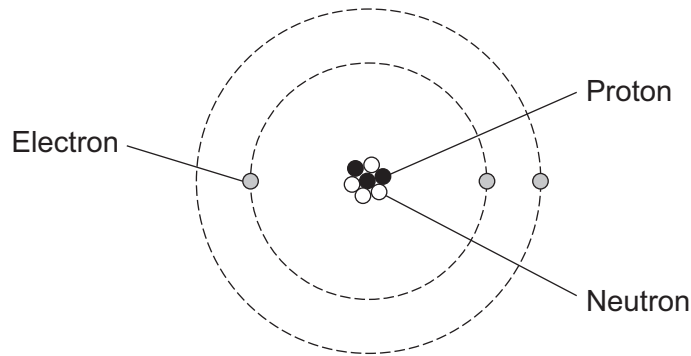
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**Physics Questions**

**11 (a)** Figure 14 shows the structure of an atom.

**Figure 14**



**Table 3** gives information about the particles in an atom.

Complete **Table 3**.

**[3 marks]**

**Table 3**

Particle	Relative charge	Relative mass
Electron	-1	Very small
Proton		
Neutron		1

**11 (b)** What is an ion?

**[1 mark]**

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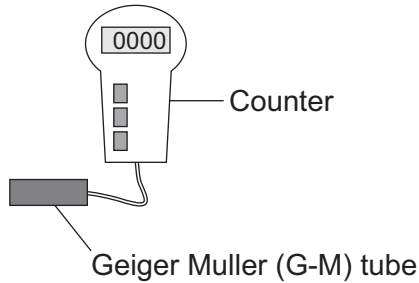
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- 12 **Figure 15** shows the apparatus a teacher used to show a class the properties of nuclear radiation.

**Figure 15**



- 12 (a) The teacher started by finding the mean value of the background radiation.

The mean background radiation was 17 counts per minute.

Suggest a reason for using the mean value of the background radiation and **not** a single reading.

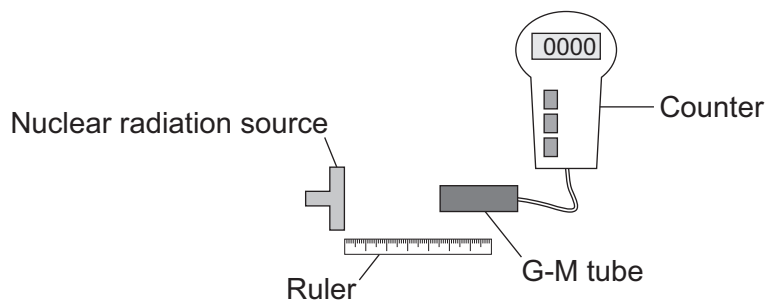
[1 mark]

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- 12 (b) **Figure 16** shows the apparatus the teacher used to show the range of nuclear radiation in air.

**Figure 16**



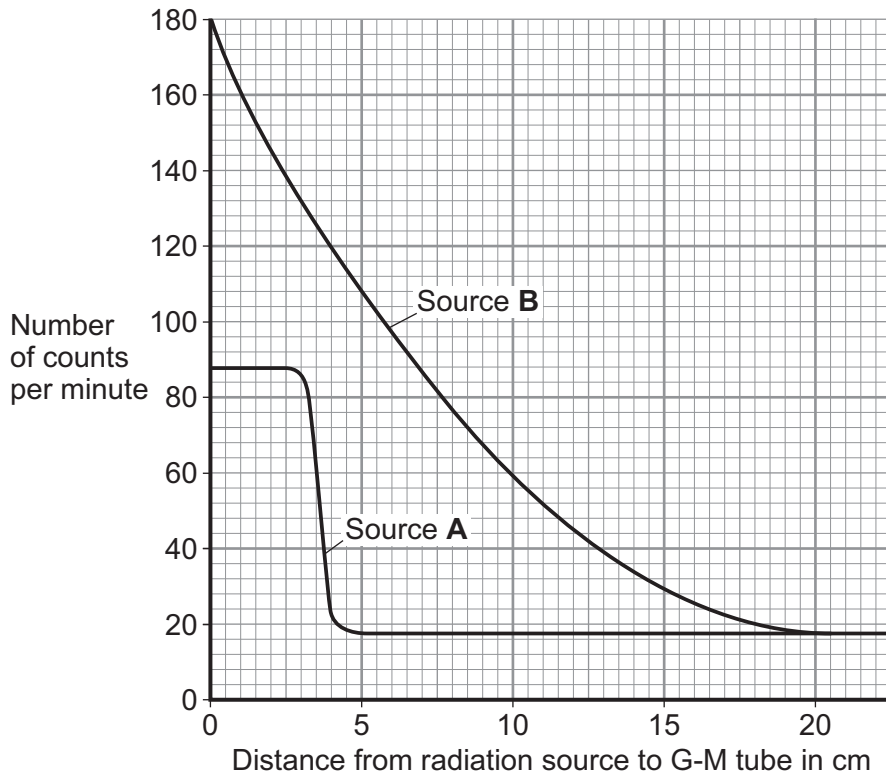
Two different sources of nuclear radiation, **A** and **B**, were used.

The G-M tube was placed at different distances away from each source.



Figure 17 shows the graph of the results.

Figure 17



The number of counts in one minute does **not** reach zero on **Figure 17**.

Suggest why.

[1 mark]

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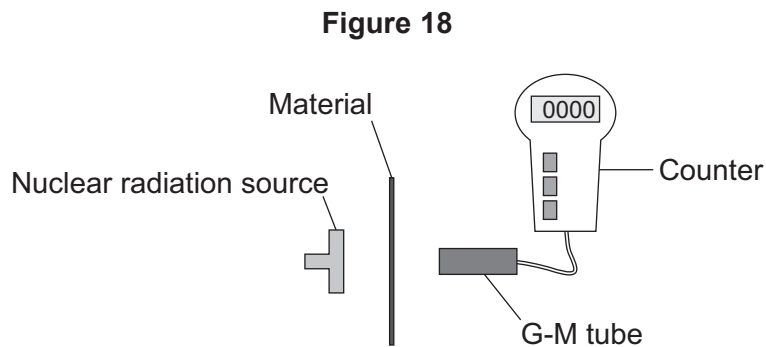
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- 12 (c)** **Figure 18** shows the apparatus the teacher used to show the penetration of the nuclear radiation from the two sources through different materials.



Different materials were placed between the G-M tube and each of the two nuclear radiation sources.

The number of counts in one minute was measured each time.

**Table 4** shows the results.

**Table 4**

Source	Material	Counts per minute
<b>A</b>	None	86
	Thick paper	18
	Thin aluminium	19
<b>B</b>	None	178
	Thick paper	174
	Thin aluminium	45



Use information from **Table 4** and the graph in **Figure 17** to answer the following questions.

**12 (c) (i)** What type of nuclear radiation does source **A** emit? **[1 mark]**

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Give **two** reasons for your answer. **[2 marks]**

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**12 (c) (ii)** What type of nuclear radiation does source **B** emit? **[1 mark]**

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Give **two** reasons for your answer. **[2 marks]**

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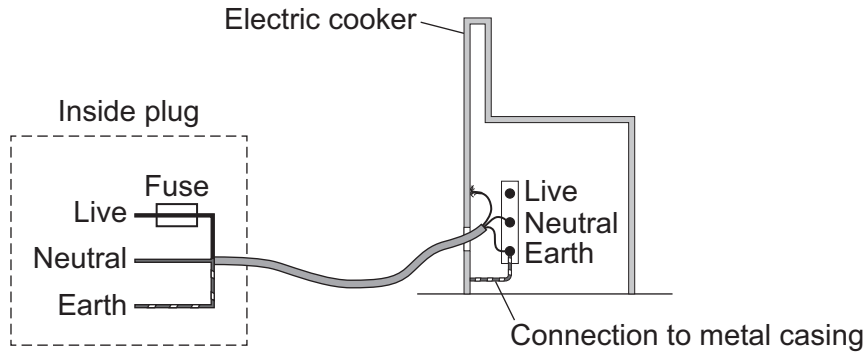




13 (a) Some household appliances must have an earth wire.

Figure 19 shows an electrical fault in an electric cooker. The live wire has become loose and is touching the metal casing.

Figure 19



Later, a man touches the metal casing of the cooker and does **not** get an electrical shock.

Explain what happens after the electrical fault occurs so that the man does **not** get an electrical shock.

[4 marks]

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- 13 (b)** Some older houses have large fuses to protect the different electric circuits in the house.

**Figure 20** shows the large fuses in a fuse box.

New houses have Residual Current Circuit Breakers (RCCBs) and **not** large fuses.

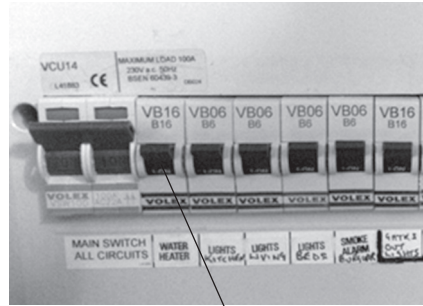
**Figure 21** shows the RCCBs in a consumer unit.

**Figure 20**



Fuse

**Figure 21**



RCCB

**Table 5** shows information about a single 30 A fuse and an RCCB.

**Table 5**

	Fuse	RCCB
<b>Cost</b>	£0.50	£18.00
<b>How it works</b>	breaks the circuit for currents greater than 30 A	breaks the circuit when a small difference in current is detected between the live and neutral wire
<b>How long it takes to work</b>	10 seconds to 0.1 seconds, depending on how much the current is greater than 30 A	25 milliseconds
<b>How it can be reset</b>	fuse removed and a new fuse wire of the correct rating fixed in	switch turned back to 'on' position



Suggest why new houses have RCCBs and **not** large fuses.

Use information from **Table 5**.

**[4 marks]**

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**END OF QUESTIONS**



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Photograph of Pacific Porkfish © Getty.

Figure 12: Photograph of trophy © Thinkstock.

Figures 20 and 21: Photographs of fuse box and RCCB © Nick Stokes.

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