

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GCSE**

**A153/01**

**TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL SCIENCE A**

**Modules B6 C6 P6 (Foundation Tier)**

**THURSDAY 13 JUNE 2013: Morning**

**DURATION: 1 hour  
plus your additional time allowance**

**MODIFIED ENLARGED**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.  
A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**

**None**

**OTHER MATERIALS REQUIRED:**

**Pencil**


**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer ALL the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

## **INFORMATION FOR CANDIDATES**

- Your quality of written communication is assessed in questions marked with a pencil ()
- The number of marks is given in brackets [ ] at the end of each question or part question.
- A list of physics equations is printed on pages 4 and 5.
- The Periodic Table is printed on page 35.
- The total number of marks for this paper is 60.
- Any blank pages are indicated.

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# **TWENTY FIRST CENTURY SCIENCE EQUATIONS**

## **USEFUL RELATIONSHIPS**

### **THE EARTH IN THE UNIVERSE**

$$\text{distance} = \text{wave speed} \times \text{time}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

### **SUSTAINABLE ENERGY**

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

## **EXPLAINING MOTION**

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\frac{\text{change of momentum}}{\text{force}} = \frac{\text{resultant}}{\text{force}} \times \frac{\text{time for which it acts}}{\text{it acts}}$$

$$\frac{\text{work done by a force}}{\text{force}} = \frac{\text{distance moved in the direction of the force}}{\text{direction of the force}}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\frac{\text{change in gravitational potential energy}}{\text{weight}} = \frac{\text{vertical height difference}}{\text{vertical height difference}}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

## **ELECTRIC CIRCUITS**

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

## **RADIOACTIVE MATERIALS**

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

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**Answer ALL the questions.**

- 1 Some countries allow soft fruit to be sterilised by radiation so that it has a much longer shelf-life in the shops.**

**Food is sterilised by radiation in a processing centre without harming the people who work there.**

**Describe how food is sterilised by radiation. Include safety aspects.**



**The quality of written communication will be assessed in your answer.**

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**[6]**

**[TOTAL: 6]**

**2 Technetium is often used as a radioactive tracer in hospitals.**

**(a) Technetium comes from the radioactive decay of molybdenum.**

**It is important that the technetium is NOT contaminated with molybdenum.**

**Marie tests the purity of a sample of technetium.**

**She measures the activity of the sample at five different times.**

**Marie plots her results on a graph.**

**Marie uses this graph and the data in the table to make a conclusion.**

<b>Material</b>	<b>Half-life in hours</b>
<b>molybdenum</b>	<b>67</b>
<b>technetium</b>	<b>6</b>

**Marie concludes that the sample contains no molybdenum.**

**Is she correct? Justify your answer.**

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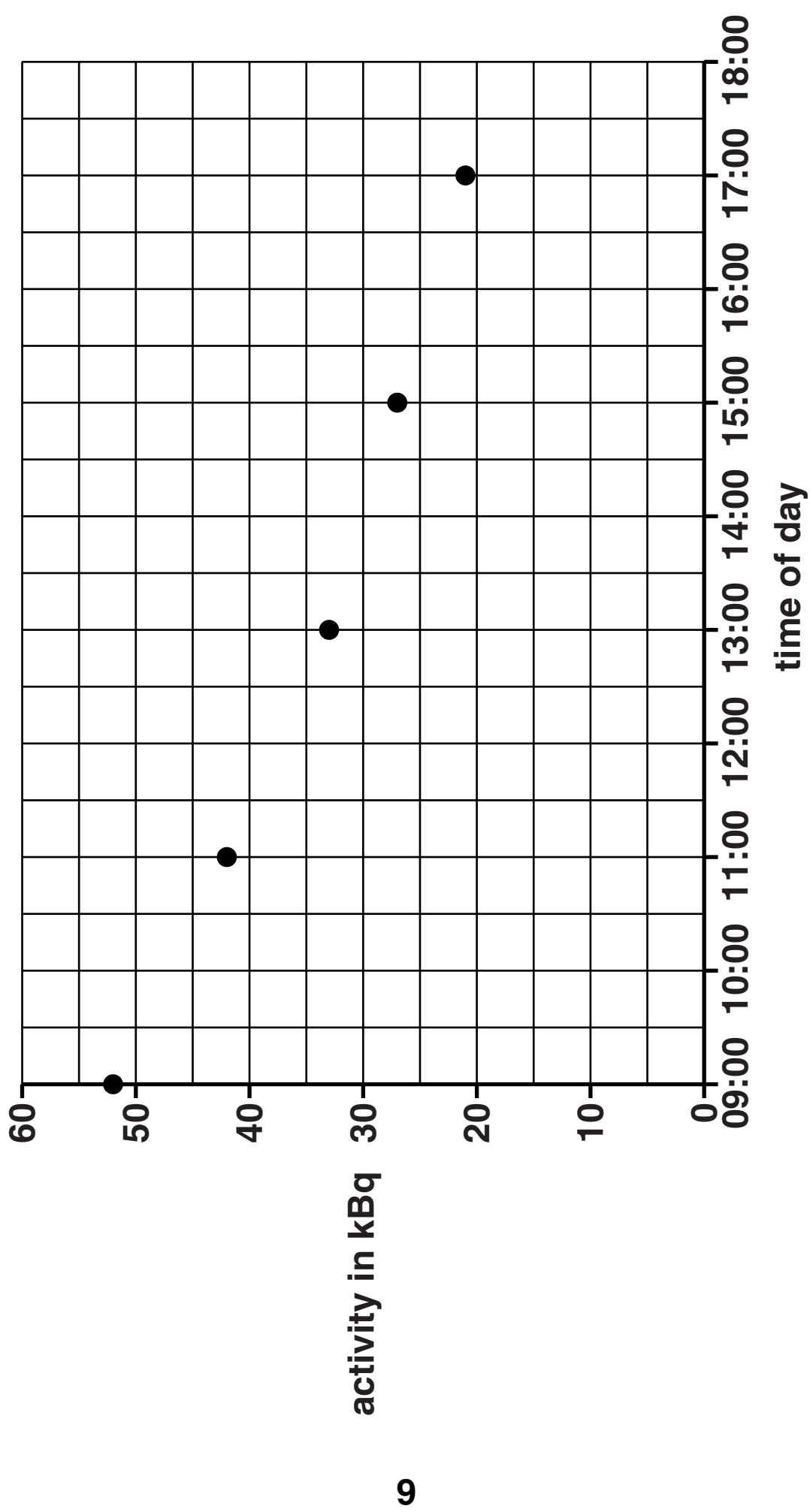
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**[3]**





**(b) Technetium is injected into patients to act as a tracer. This has both risks and benefits for the patients, workers and visitors at the hospital.**

**(i) Who at the hospital benefits MOST from the use of technetium?**

**Choose from the patients, the workers or the visitors.**

**Give a reason for your answer.**

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**[2]**

**(ii) Who at the hospital is LEAST at risk from the use of technetium?**

**Choose from the patients, the workers or the visitors.**

**Give a reason for your answer.**

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**[2]**

- (iii) There are regulations about the use of technetium in hospitals.

Who decides the regulations?

Put a ring around the correct answer.

THE DOCTORS

THE GOVERNMENT

THE MANUFACTURERS

THE PATIENTS

[1]

[TOTAL: 8]

**3 Your level of background radiation depends on where you live.**

<b>Region of UK</b>	<b>Background radiation dose mSv per year</b>
<b>East Anglia</b>	<b>0.5</b>
<b>Cornwall</b>	<b>8</b>
<b>London</b>	<b>2</b>

**(a) Adele lives in London for 40 years.**

**(i) Calculate her total background radiation dose over 40 years.**

**total radiation dose = \_\_\_\_\_ mSv [1]**

**(ii) Her chance of getting cancer from background radiation in those 40 years is 4 in 1000.**

**Adele thinks that her risk of getting cancer is proportional to her dose from the background radiation.**

**Suppose she lived in Cornwall instead of London.**

**What would her chance of getting cancer be using this idea?**

**Put a ring around the correct answer.**

**1 in 1000**

**4 in 1000**

**8 in 1000**

**16 in 1000**

**[1]**

**(b) Why does exposure to background radiation increase her risk of getting cancer?**

**Put a tick (✓) in the box next to the correct answer.**

**all radiation is reflected by her skin**

☐

**radiation breaks molecules into ions**

☐

**radiation only kills cells**

☐

**radiation passes straight through her**

☐

**[1]**

**(c) Bert is a radiographer at a hospital in Cumbria where the background radiation dose is 3 mSv per year.**

**The TOTAL allowed radiation dose for a radiographer is 20 mSv per year.**

**How much radiation dose, in mSv, is Bert allowed to receive from his work in a year?**

**Put a ring around the correct answer.**

**3**

**17**

**20**

**23**

**[1]**

**[TOTAL: 4]**

- 4 Uranium-235 is a nuclear fuel. It is used to make electricity in nuclear power stations.**

**Complete the sentences about an atom of uranium-235.**

**Choose words from this list.**

**ELECTRONS**

**NEUTRONS**

**PROTONS**

**At the centre of each atom is a nucleus which  
contains \_\_\_\_\_ and \_\_\_\_\_ .**

**The rest of the atom contains \_\_\_\_\_ . [2]**

**[TOTAL: 2]**

**5 Jenny has a stroke.**

**This is caused by a blood vessel in her brain becoming blocked.**

**Part of her brain is damaged.**

**She loses the ability to speak.**

**Jenny learns to speak again with practice.**

**(a) Put a tick (✓) in the box next to the correct word to complete each sentence.**

**The damaged part of her brain can be identified by an**

<b>IRM</b>	
<b>MIR</b>	
<b>MRI</b>	

**scan.**

**The damaged part of her brain is the**

<b>cortex.</b>	
<b>hypothalamus.</b>	
<b>pituitary.</b>	

**She can speak again because of the formation of new**

<b>spinal cord tissue.</b>	
<b>muscle fibres.</b>	
<b>neuron pathways.</b>	

**[2]**

- (b) As part of her treatment, Jenny has to memorise some words.**

**To help her remember the words, Jenny puts them into a pattern.**

**What else could Jenny do to help her remember the words?**

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**[1]**

- (c) Scientists develop a new treatment for people who have had a stroke.**

**They discuss whether the new treatment should replace the existing treatment.**

**BRIAN**

**The new treatment is cheaper than the existing one so it should be used.**

**CHARLIE**

**We should not use the new treatment until we know it is 100% safe.**

**DAWN**

**The new treatment has some side effects, but we should still use it because it works better than the existing treatment.**

**ERICA**

**We should allow people to choose which treatment they have.**



- (i) Which scientist argues that the right thing to do is the one which leads to the best outcome for most people involved?

answer \_\_\_\_\_ [1]

- (ii) Which scientist argues that it is right to do some things even if there are consequences?

answer \_\_\_\_\_ [1]

[TOTAL: 5]

**6 Terry measures the speed of impulses travelling along different neurons.**

**He obtains these results.**

<b>Diameter of neuron in <math>\mu\text{m}</math></b>	<b>Length of neuron in cm</b>	<b>Speed of impulse in m/s</b>
<b>2</b>	<b>12</b>	<b>12</b>
<b>6</b>	<b>3</b>	<b>36</b>
<b>10</b>	<b>5</b>	<b>60</b>
<b>14</b>	<b>15</b>	<b>84</b>
<b>18</b>	<b>10</b>	<b>108</b>

**(a) Which are correct conclusions from the data?**

**Put ticks (✓) in the boxes next to the TWO correct conclusions.**

**As the diameter of the neuron increases, the speed of the impulse increases.** ☐

**As the diameter of the neuron increases, the speed of the impulse decreases.** ☐

**As the length of the neuron increases, the speed of the impulse increases.** ☐

**As the length of the neuron increases, the speed of the impulse decreases.** ☐

**There is a correlation between diameter and length.** ☐

**There is a correlation between diameter and speed.** ☐

**There is a correlation between length and speed.** ☐

**[2]**

**(b) All the neurons Terry tested had fatty sheaths.**

**He then tests a neuron which does NOT have a fatty sheath.**

**It is 10  $\mu\text{m}$  in diameter and 5 cm long.**

**Predict the speed of impulse in this neuron.**

**Explain your answer.**

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**[2]**

**[TOTAL: 4]**

**7 Kate is surprised by a camera flash.**

**She blinks.**

**This is an example of a simple reflex.**

**(a) Describe what happens in Kate's nervous system to make her blink.**



**The quality of written communication will be assessed in your answer.**

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**[6]**

**(b) Kate tests her reactions using a reaction timer on her computer.**

**She presses a button as soon as she sees a dot appear on the screen.**

**She gets these results.**

	Test 1	Test 2	Test 3	Test 4	Test 5
Reaction time in ms	0.77	0.60	0.75	0.59	0.84

**Kate concludes that her reaction time improves with practice.**

**Explain why Kate's conclusion is wrong.**

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**[1]**

**[TOTAL: 7]**

**8 Simple animals rely on reflex actions for most of their behaviour.**

**(a) Write down ONE way that reflex actions help a simple animal to survive.**

\_\_\_\_\_  
\_\_\_\_\_ **[1]**

**(b) Other animals can be conditioned.**

**Pigs on a farm are always fed from a yellow bucket.**

**Eventually, the pigs salivate every time they see the yellow bucket, even if there is no food in it.**

**Explain why this is an example of conditioning.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ **[3]**

**[TOTAL: 4]**

- 9 Mark is doing a titration with hydrochloric acid and sodium hydroxide.

(a) Sodium hydroxide is an alkali.

Name ONE other alkali.

\_\_\_\_\_

[1]

(b) Mark tries to write a word equation for the reaction.

He has several attempts.

Put a tick (✓) in the box next to the correct equation.

acid + alkali + salt → water

☐

acid + alkali → salt + water

☐

acid → alkali + salt + water

☐

acid → alkali + salt → water

☐

[1]

(c) Which salt is made when nitric acid reacts with sodium hydroxide?

Put a ring around the correct answer.

SODIUM CHLORIDE

SODIUM HYDRATE

SODIUM NITRATE

SODIUM OXIDE

[1]



**(d) In his experiment Mark slowly adds acid to the alkali.**

**He measures the pH as it changes.**

**What can he use to measure the pH as it changes?**

**Suggest TWO different methods.**

**1** \_\_\_\_\_

**2** \_\_\_\_\_

**[2]**

**(e) Mark knows that one type of ion is made by all acids when they dissolve in water.**

**Put a ring around the formula of this ion.**

**H<sup>+</sup>**

**H<sup>-</sup>**

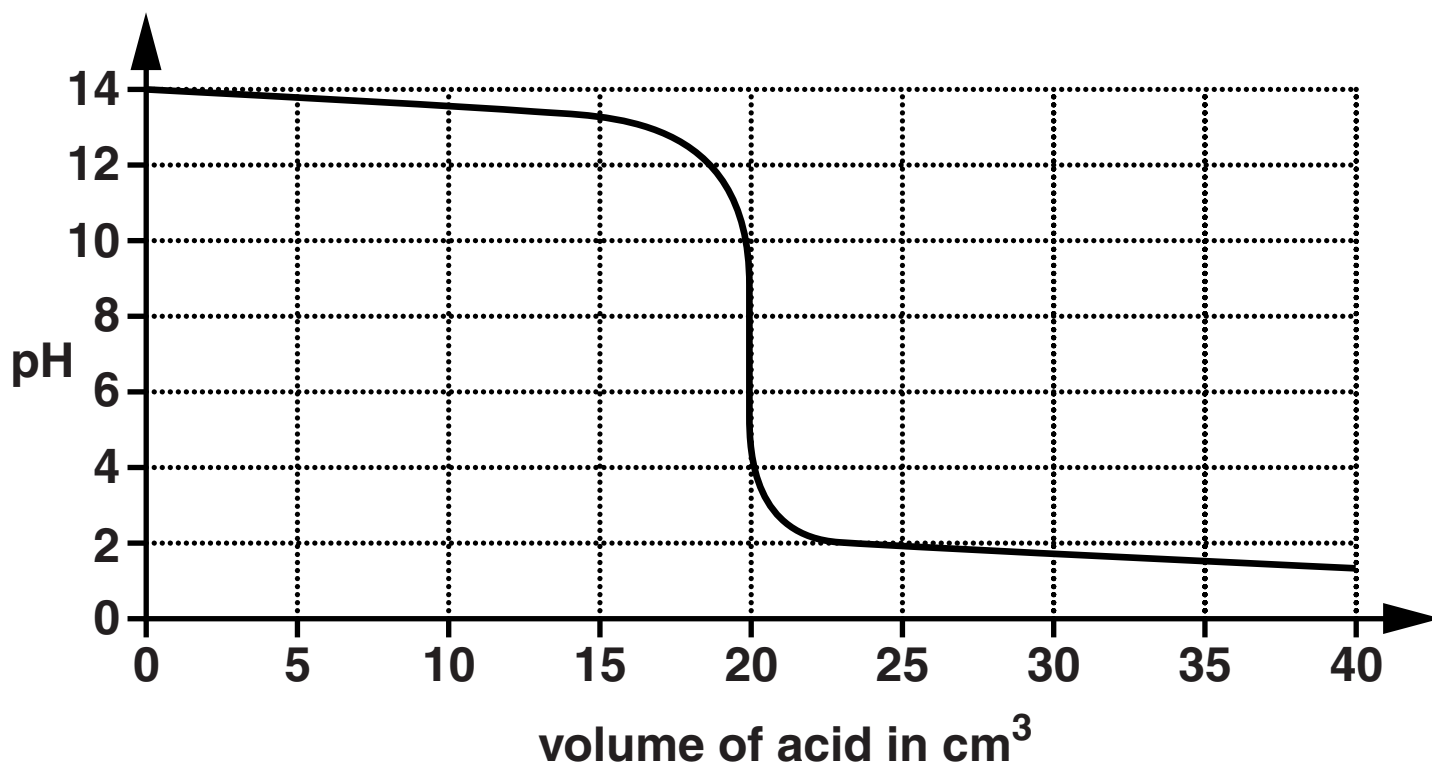
**OH<sup>+</sup>**

**OH<sup>-</sup>**

**[1]**

(f) Mark adds acid to 25 cm<sup>3</sup> of alkali.

He draws a graph of the change in pH during his titration.



(i) Describe what happens to the pH during this titration.

Include numbers in your answer.

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[3]

**(ii) Look at the graph.**

**When all of the alkali has reacted the pH = 7.**

**What volume of acid is needed to react with**

**the alkali? \_\_\_\_\_ [1]**

**(iii) What happens to the alkali as it reacts?**

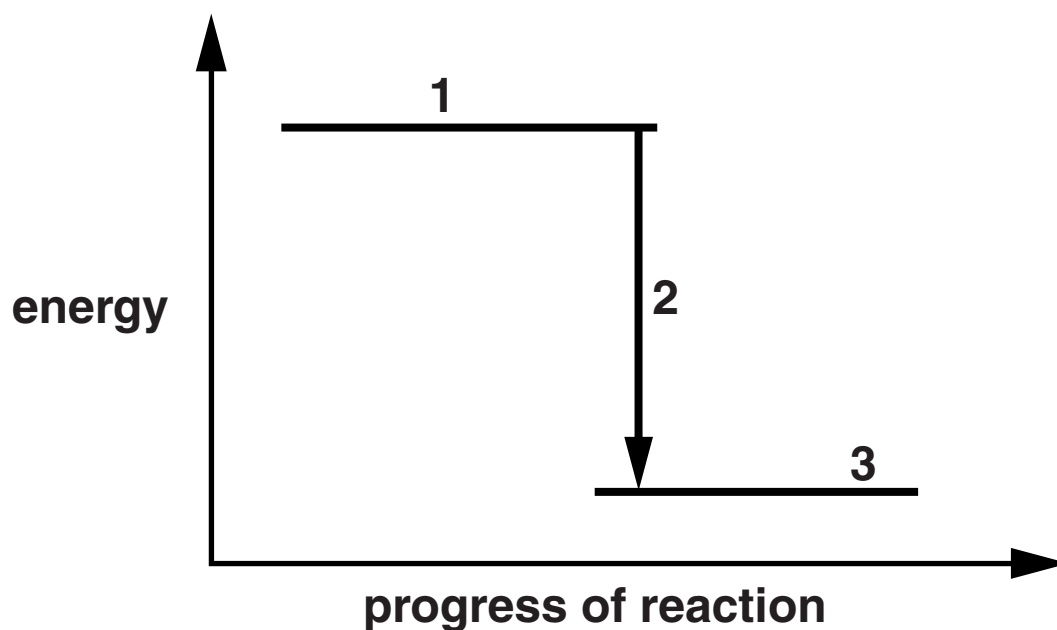
**Put a tick (✓) in the box next to the correct answer.**

**The alkali is**

<b>neutralised.</b>	
<b>oxidised.</b>	
<b>recycled.</b>	
<b>removed.</b>	

**[1]**

**(g) Mark draws an energy level diagram for the reaction.**



**Mark labels the diagram.**

**What should he write at points 1, 2 and 3 to show what this diagram tells you about the reaction?**

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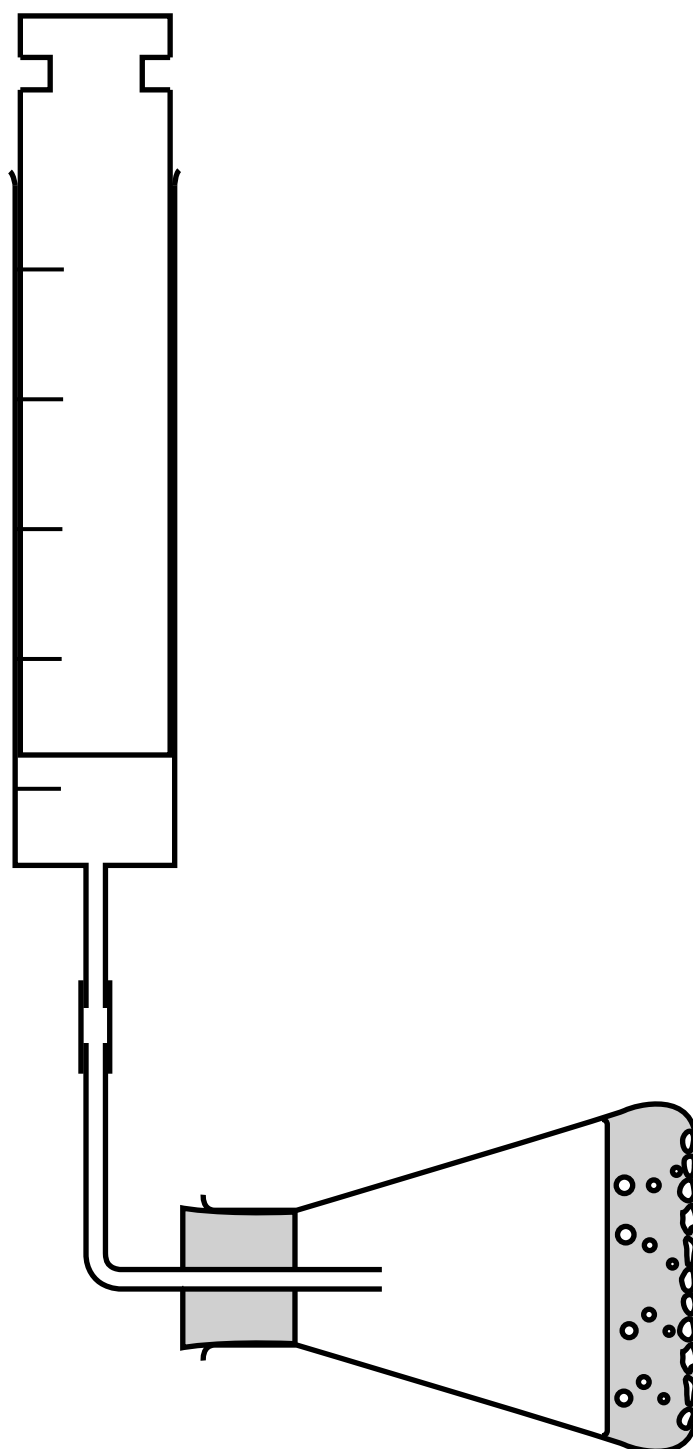
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**[3]**

**[TOTAL: 14]**

**10 Sarah plans to investigate the rate of the reaction between marble chips and hydrochloric acid.**



**She plans two experiments to investigate the effect of changing the concentration of the acid. This is what she wrote.**

**“In the first experiment I will use 10 g of marble chips in the flask.**

**I will add 25 cm<sup>3</sup> of the acid.**

**I will measure how fast the gas is given off.**

**In the second experiment I will use another 10 g of marble chips.**

**I will add 50 cm<sup>3</sup> of the same acid.”**

**Evaluate this plan and suggest how the investigation could be improved. [6]**



**The quality of written communication will be assessed in your answer.**

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**[TOTAL: 6]**

**END OF QUESTION PAPER**

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# The Periodic Table of the Elements

1	2	3					4	5	6	7	0	
		<div>1 H hydrogen 1</div>										
<div>Key</div>												
		<div>relative atomic mass atomic symbol name atomic (proton) number</div>										
7	9											
Li lithium 3	Be beryllium 4											
23	24											
Na sodium 11	Mg magnesium 12											
39	40											
K potassium 19	Ca calcium 20	45	48	51	52	55	56	59	63.5	65		
		Sc scandium 21	Ti titanium 22	V vanadium 23	Cr chromium 24	Mn manganese 25	Fe iron 26	Co cobalt 27	Ni nickel 28	Cu copper 29	Zn zinc 30	
85	88	89	91	93	96	[98]	101	103	106	108	112	
Rb rubidium 37	Sr strontium 38	Y yttrium 39	Zr zirconium 40	Nb niobium 41	Mo molybdenum 42	Tc technetium 43	Ru ruthenium 44	Rh rhodium 45	Pd palladium 46	Ag silver 47	Cd cadmium 48	
133	137	139	178	181	184	186	190	192	195	197	201	
Cs caesium 55	Ba barium 56	La* lanthanum 57	Hf hafnium 72	Ta tantalum 73	W tungsten 74	Re rhenium 75	Os osmium 76	Ir iridium 77	Pt platinum 78	Au gold 79	Hg mercury 80	
[223]	[226]	[227]	[261]	[262]	[266]	[264]	[277]	[268]	[271]	[272]	Elements with atomic numbers 112-116 have been reported but not fully authenticated	
Fr francium 87	Ra radium 88	Ac* actinium 89	Rf rutherfordium 104	Db dubnium 105	Sg seaborgium 106	Bh bohrium 107	Hs hassium 108	Mt meitnerium 109	Ds darmstadtium 110	Rg roentgenium 111		

\* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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