

**Thursday 13 June 2013 – Morning**

**GCSE TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL SCIENCE A**

**A153/02** Modules B6 C6 P6 (Higher Tier)

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)

**Duration:** 1 hour



Candidate forename		Candidate surname	
--------------------	--	-------------------	--

Centre number						Candidate number				
---------------	--	--	--	--	--	------------------	--	--	--	--

**INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes above. 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).
- Do **not** write in the bar codes.

**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 page 2.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

## 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

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

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

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

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

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

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

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

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

#### Electric circuits

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

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

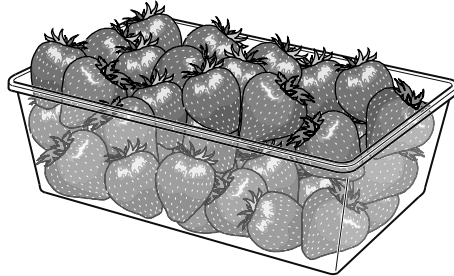
$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

#### Radioactive materials

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

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.

Explain how food is sterilised by radiation. Include safety aspects.



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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

**[Total: 6]**

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

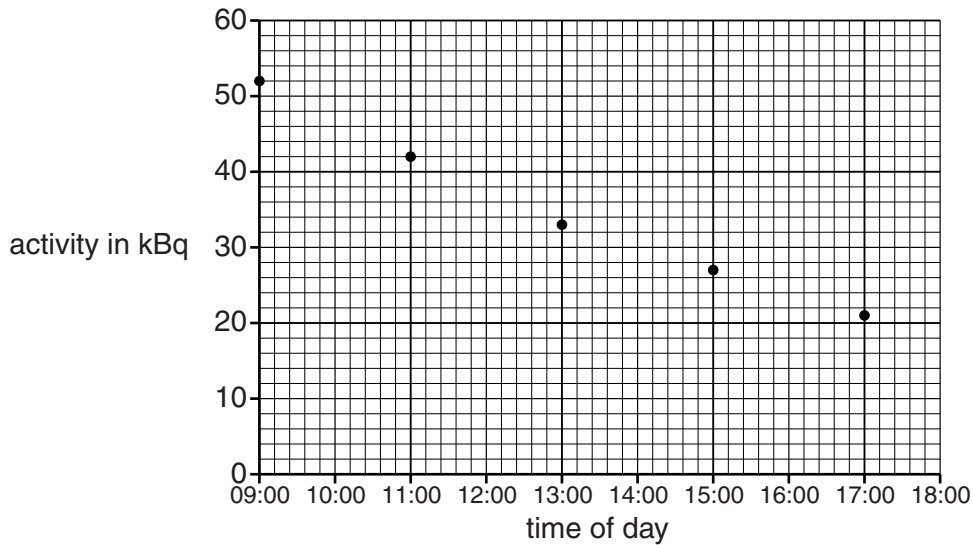
(a) Technetium comes from the radioactive decay of molybdenum.

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.

Material	Half-life in hours
molybdenum	67
technetium	6

Marie concludes that the sample contains no molybdenum.

Is she correct? Justify your answer.

.....

.....

.....

..... [3]

(b) Explain the benefit **and** risk to patients of being injected with technetium.

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

(c) Technetium is an emitter of gamma radiation. This means that health workers at the hospital are at risk of contamination and irradiation when they use technetium.


(i) Health workers are required to wear rubber gloves when they handle technetium. Explain why this **only** protects them from contamination.

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

(ii) Suggest **two** reasons why health workers accept this risk.

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

(iii) The use of radioactive materials in hospitals is strictly controlled by the Government. Here are some ideas about why the regulations are necessary.

<p><b>Alan</b> Workers can't see or feel radioactivity, so they don't assess the risk correctly.</p>			<p><b>Bess</b> They save the hospital money by preventing health workers earning more money by doing overtime.</p>
<p><b>Carlos</b> So that visitors who get contaminated accidentally can't sue the hospital for compensation.</p>			<p><b>Davina</b> They make sure that there is no risk at all to the patients or health workers.</p>

Who is correct?

answer ..... [1]

[Total: 9]

Turn over

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

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

- (a) Adele lives in East Anglia for 20 years. The risk of her developing cancer from the background radiation in that time is 5 in 10000.

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

Bill lives in Cornwall for only 10 years.

Calculate his risk of developing cancer from the background radiation using Adele's idea.

risk = ..... in 10000 [1]

- (b) The increased risk in Cornwall is from radon-222 gas seeping out of the ground.

- (i) Each nucleus of radon-222 contains protons and neutrons.

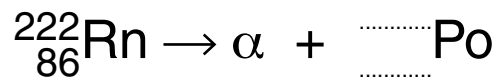
How many neutrons are there in a single nucleus of  ${}^{222}_{86}\text{Rn}$ ?

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

86      136      222      308

[1]

- (ii) Radon emits an alpha particle when it decays to an isotope of polonium. Complete the nuclear equation for the reaction.



[1]

[Total: 3]

4 Nuclear reactors use the fission of uranium nuclei to release energy.

(a) State the name of the particle that causes the fission of a uranium nucleus.

..... [1]

(b) A nuclear power station releases  $2.7 \times 10^{13}$  J of energy from its fuel when it operates for a day.

Calculate the change of mass of the fuel in that day.

$c$  (speed of light in a vacuum) =  $3.0 \times 10^8$  m/s

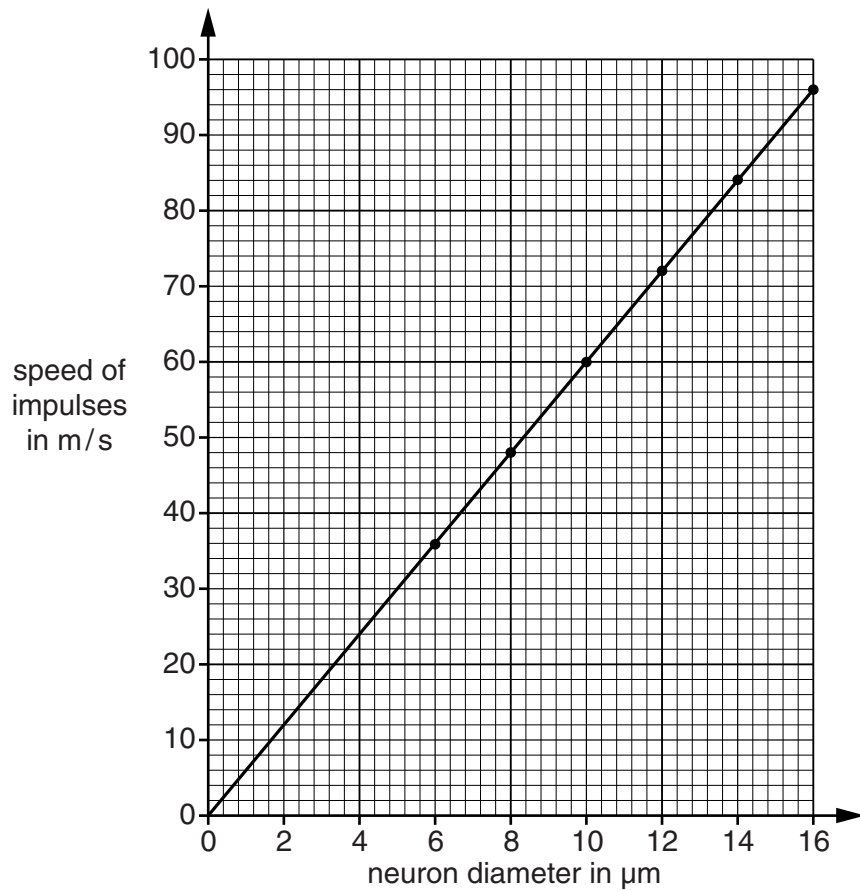
mass change = ..... kg [1]

[Total: 2]

**Question 5 begins on page 8**

- 5 Andy is learning about the speed of impulses in neurons.

He finds this graph in his textbook. It shows the speed of impulses in neurons of different diameter with fatty sheaths.



- (a) Andy measures a neuron.

It has a diameter of  $9\ \mu\text{m}$ .

Use the graph to predict the speed of impulses in this neuron.

Show your working on the graph.

speed = ..... m/s [2]



(b) Andy checks the diameter of the neuron and confirms it is  $9\mu\text{m}$ .

He measures the speed of an impulse in this neuron and finds it is  $0.6\text{ m/s}$ .

Both of these measurements are accurate.

Suggest why the measured speed does **not** match the predicted value from the graph.

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

[Total: 4]

Question 6 begins on page 10

6 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) Reflexes in more complex animals can be conditioned.

Put ticks (✓) in the boxes next to the **two** correct statements about conditioning.

A secondary stimulus ...

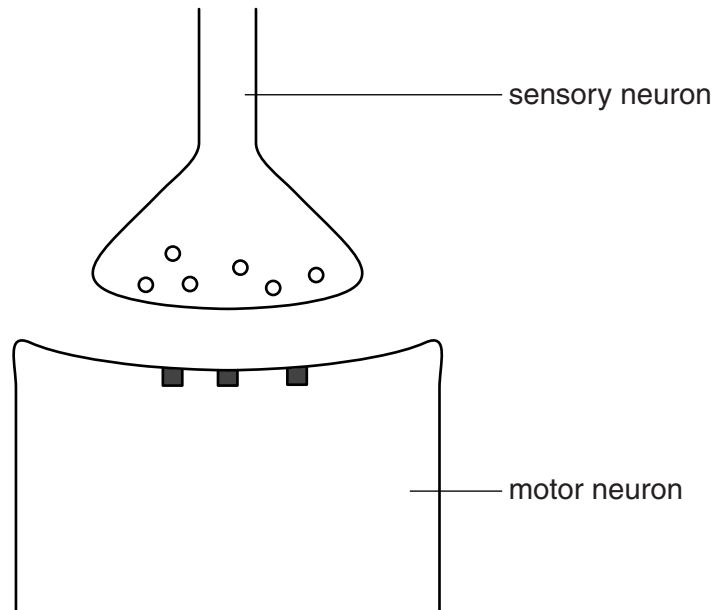
- ... is given along with a primary stimulus.
- ... is always given on its own.
- ... is not needed for the conditioning.
- ... has no direct link to the final response.
- ... can only be used in dogs.

[2]

[Total: 3]

7 This question is about the transmission of a nerve impulse across a synapse.

The diagram shows a synapse between a sensory neuron and a motor neuron.



The sentences describe events at a synapse.

They are not in the correct order.

(a) Put a **ring** around the correct choice to complete each sentence.

- A An electrical impulse travels towards the synapse along the **sensory / motor** neuron.
- B The transmitter substance binds to receptors on the **sensory / motor** neuron.
- C The transmitter substance is released by the **sensory / motor** neuron.
- D The **transmitter substance / electrical impulse** crosses the gap.

[1]

(b) Put the letters **A**, **B**, **C** and **D** in the boxes to show the correct sequence of events at a synapse.

--	--	--	--

[1]

[Total: 2]



- (b) (i) The risk of a woman of Jenny's age having a stroke is 1 in 200.

There are 6 million women of this age in the UK.

How many of these women are likely to have a stroke?

answer = ..... [1]

- (ii) Research shows that women who eat less salt in their diet have less chance of having a stroke.

The Government is considering an expensive public health campaign to encourage women to eat less salt.

Should the Government go ahead with the campaign?

Justify your conclusion.

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

**Question 8(c) begins on page 14**

(c) Scientists develop a new treatment for people who have had a stroke. They discuss whether the new treatment should replace the existing treatment.



(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?

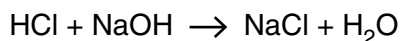
answer ..... [1]

[Total: 11]

**15**  
**BLANK PAGE**

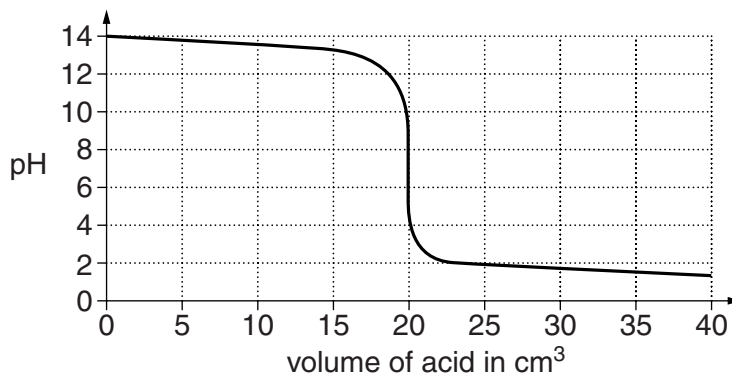
**Question 9 begins on page 16**  
**PLEASE DO NOT WRITE ON THIS PAGE**

- 9 Mark is doing a titration between hydrochloric acid and sodium hydroxide. In the equation for this reaction one formula of the acid reacts with one formula of the alkali.



He slowly adds 40 cm<sup>3</sup> of acid to 25 cm<sup>3</sup> of alkali.

He measures the pH during his experiment.



- (a) (i) What volume of acid is needed to neutralise the alkali? Explain how you can tell.

.....

.....

.....

..... [2]

- (ii) Mark uses the volume of acid that just neutralises the alkali solution to calculate the concentration of the alkali solution.

He uses the formula

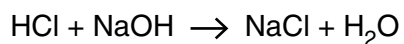
$$\frac{\text{concentration} \times 25}{40} = 0.1 \times \text{acid volume}$$

Calculate the concentration of the alkali used in this experiment.

concentration = ..... g/dm<sup>3</sup> [1]

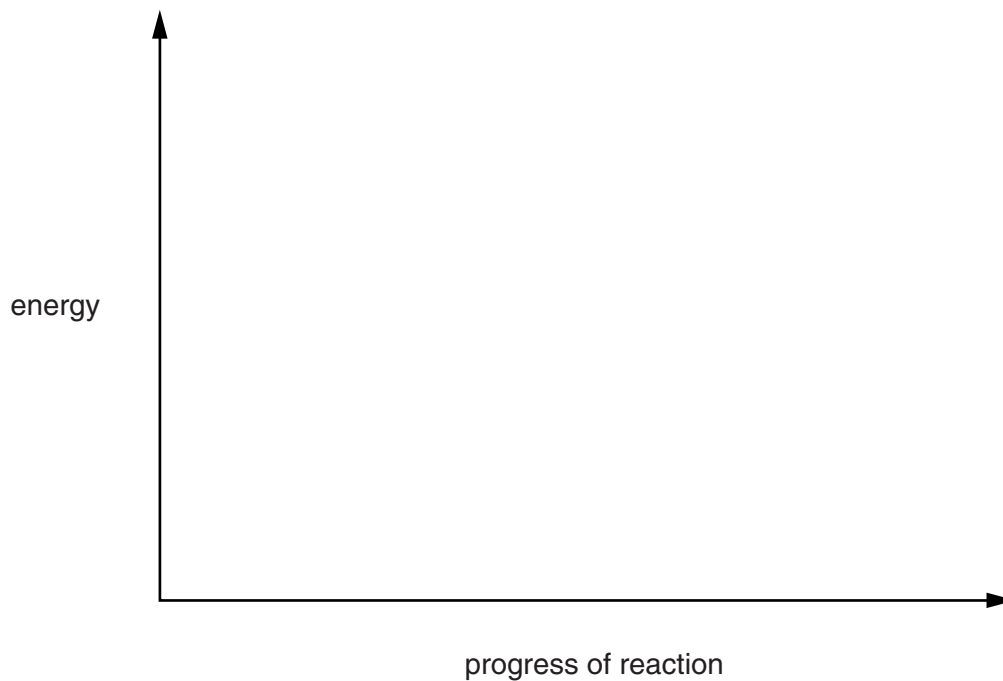


(b) Mark draws an energy level diagram for the reaction:



He knows that this reaction is exothermic.

(i) Using the axes below, draw a labelled energy level diagram for this reaction.



[3]

(ii) Write the ionic equation for the reaction that happens when **any** acid reacts with **any** alkali.

..... [2]

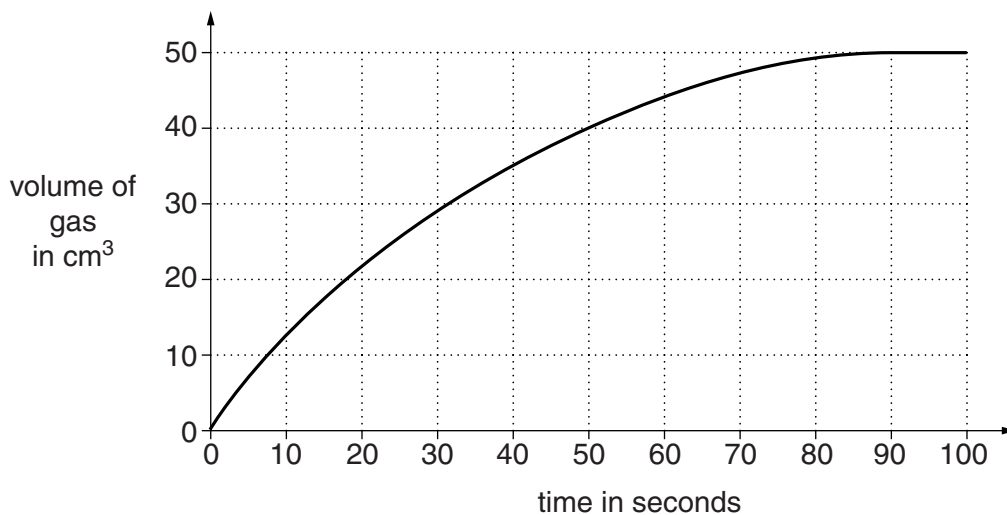
[Total: 8]



(b) The reaction produces carbon dioxide gas and also calcium chloride.

Write the formula for calcium chloride. .... [1]

(c) Sarah measures the gas given off.



(i) Calculate the average rate of the reaction over the first 50 seconds.  
Show your working.

average rate ..... [2]

(ii) What units is this rate of reaction measured in?

units of rate ..... [1]

(d) Sarah doubles the acid concentration.

(i) What effect does this have?

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

twice as many collisions during the course of the reaction

twice as many collisions per second

collisions last a shorter time

collisions are more violent

[1]

(ii) She then increases the temperature for this reaction.

What effect does this have?

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

It makes the reaction quicker.

It stops the reaction.

It makes more product.

It makes hydrogen.

[1]

[Total: 12]

**END OF QUESTION PAPER**

21  
BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

**BLANK PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**



**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

