



H

**Wednesday 20 June 2012 – Morning**

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

**A217/02** Unit 3: Modules B6 C6 P6 (Higher Tier)

Candidates answer on the Question Paper.  
A calculator may be used for this paper.

**Duration:** 40 minutes

**OCR supplied materials:**  
None

**Other materials required:**

- Pencil
- Ruler (cm/mm)



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**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- A list of physics equations is printed on page 2.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

## TWENTY FIRST CENTURY SCIENCE EQUATIONS

## Useful Relationships

## Explaining Motion

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

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

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

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

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

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

## Electric Circuits

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

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

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

$$\text{power} = \text{potential difference} \times \text{current}$$

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

## The Wave Model of Radiation

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

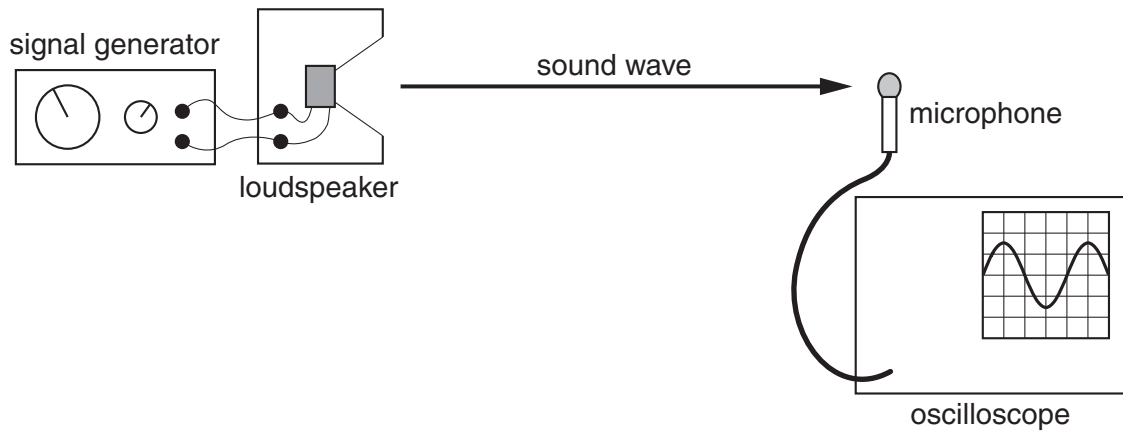
**BLANK PAGE**

**Question 1 starts on page 4**

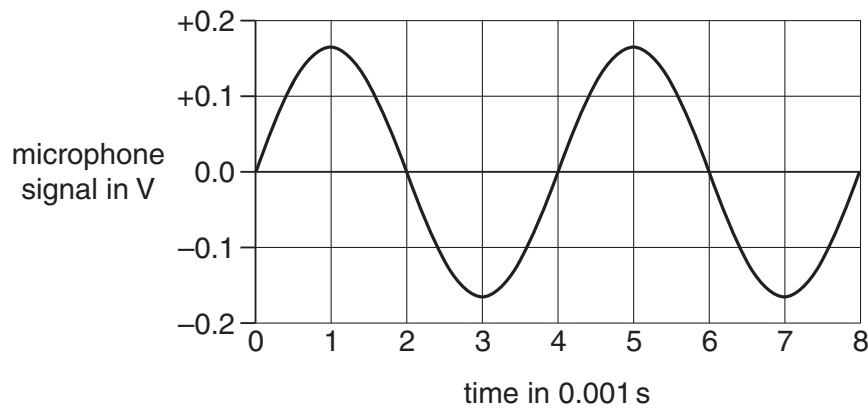
**PLEASE DO NOT WRITE ON THIS PAGE**

Answer **all** the questions.

- 1 Doris investigates sound waves with the apparatus below.



- (a) The oscilloscope screen shows this voltage-time graph for the microphone signal.



- (i) How should Doris calculate the frequency of the sound wave?

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

$$\frac{1}{8 \times 0.001}$$

$$\frac{1}{6 \times 0.001}$$

$$\frac{1}{4 \times 0.001}$$

$$\frac{1}{2 \times 0.001}$$

[1]

(ii) Doris alters the signal generator to increase the frequency of the sound wave.

Complete each sentence by putting a **ring** around the correct option in **bold**.

The frequency of the sound increases.

The speed of the sound    **decreases** / **increases** / **stays the same**.

So the wavelength of the wave    **decreases** / **increases** / **stays the same**.

[1]

(b) Doris knows that sound is a longitudinal wave.

Here are some statements about longitudinal waves moving **forwards** through solid matter.

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

They carry matter with them as they pass through.

They do not have any effect on the matter as they pass through.

They make matter move from side to side as they pass through.

They make matter move backwards and forwards as they pass through.

[1]

(c) Complete the sentence about waves. Choose words from this list.

**electromagnetic**

**empty space**

**solids**

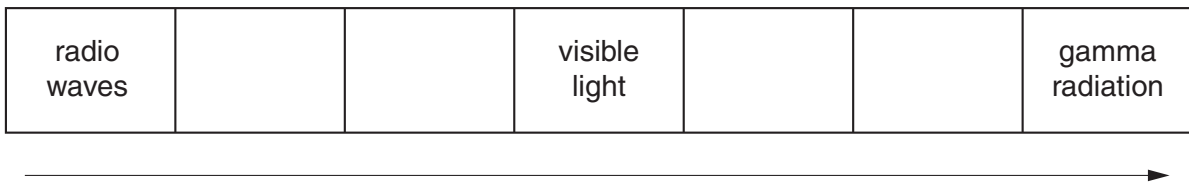
**sound**

..... waves cannot pass through .....

[1]

[Total: 4]

2 Here is an incomplete diagram of the electromagnetic spectrum.



(a) What wave property always increases from left to right in the diagram?

answer ..... [1]

(b) Write **microwaves** and **infrared** in the correct places on the diagram of the spectrum above. [1]

(c) The diagram shows a microwave oven with a rotating turntable.



In this microwave oven, the food will only cook evenly when the turntable rotates.

If the turntable does not rotate, some parts of the food cook much more than others.

Use ideas about **interference** to explain why the food needs to be rotated to cook evenly.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[3]

[Total: 5]

- 3 Jack and Jill use two-way radios to communicate when they are apart.



- (a) Jack speaks into his radio.

Complete the sentence with the correct technical term.

As Jack speaks, the radio waves emitted by the aerial are ..... [1]

- (b) Here are some possible reasons why radio waves might be used for communication.

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

- |   |                          |
|---|--------------------------|
| Radio waves are not absorbed by air.                    | <input type="checkbox"/> |
| Radio waves reflect off objects in their path.          | <input type="checkbox"/> |
| Radio waves diffract out of aerials in all directions.  | <input type="checkbox"/> |
| Radio waves are absorbed at the edge of the atmosphere. | <input type="checkbox"/> |

[1]



(c) The quality of the signal received by Jill gets worse as she moves away from Jack.

This is because the radios use **analogue** transmission.

Explain why the use of **digital** transmission could solve this problem.

.....

.....

.....

.....

.....

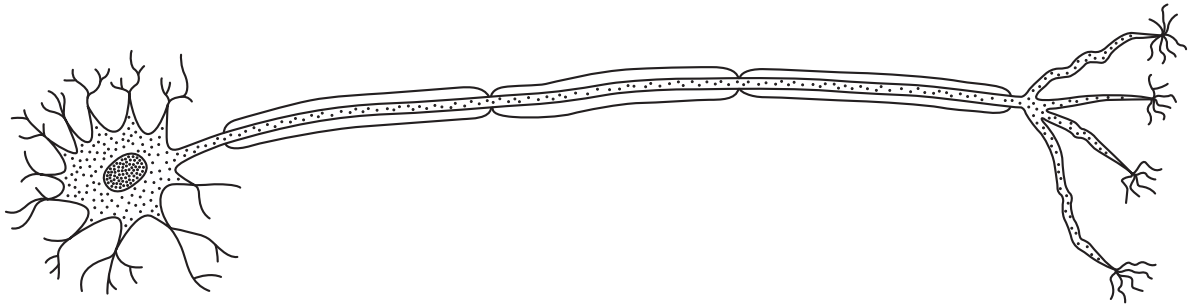
.....

.....

..... [3]

[Total: 5]

4 This is a diagram of a motor neuron involved in a reflex arc.



(a) Explain how this helps to produce rapid responses to changes in the environment.

Include ideas about the neuron and the reflex arc in your answer.

.....

.....

.....

.....

.....

.....

..... [3]

(b) The motor neuron can link to different cell types.

Put ticks (✓) in the boxes next to the **two** types of cell this motor neuron might send impulses to.

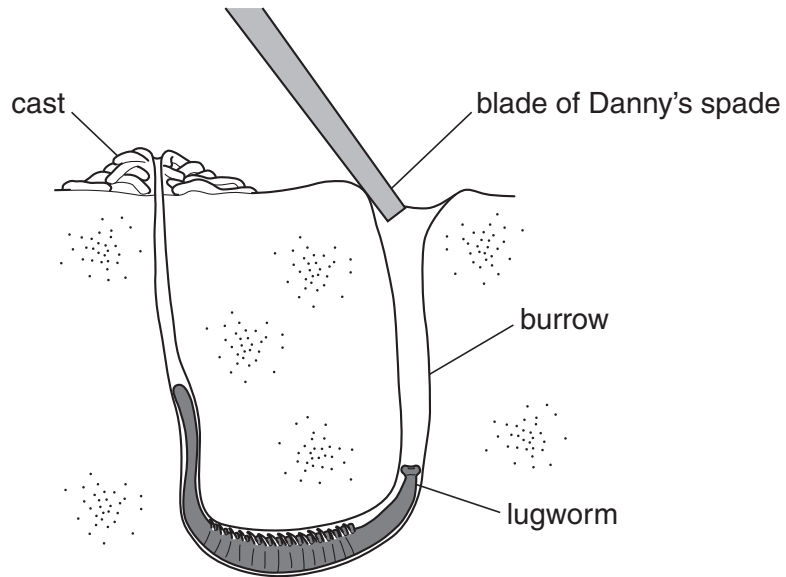
- muscle cells
- skin cells
- retina cells
- hormone secreting cells
- cerebral cortex cells

[1]

[Total: 4]

5 Danny is digging on the beach for lugworms.

Lugworms are simple animals that burrow in the sand and leave a worm cast above their burrows.



(a) When Danny digs, the worms go deeper into their burrows. This simple reflex helps the worm avoid danger.

What other **advantages** does the lugworm have as a result of simple reflexes?

Put ticks (✓) in the boxes next to the **two** correct answers.

- finding food
- growing
- communicating
- remembering
- reproducing

[1]

(b) Danny is told a better way to dig for lugworms.

He scoops the whole burrow out of the sand with the lugworm in it.

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

Danny's behaviour is adaptable to new situations because he	<b>has a complex brain.</b>	<input type="checkbox"/>
	<b>uses only reflex actions.</b>	<input type="checkbox"/>
	<b>has specialised sense organs.</b>	<input type="checkbox"/>
	<b>has more body mass.</b>	<input type="checkbox"/>

Danny's brain forms new	<b>neurons</b>	<input type="checkbox"/>	as he learns the new skill.
	<b>pathways</b>	<input type="checkbox"/>	
	<b>muscles</b>	<input type="checkbox"/>	
	<b>cells</b>	<input type="checkbox"/>	

Danny's nervous system uses his	<b>cerebral cortex</b>	<input type="checkbox"/>	to process what he is told.
	<b>peripheral system</b>	<input type="checkbox"/>	
	<b>reflex arcs</b>	<input type="checkbox"/>	
	<b>motor neurons</b>	<input type="checkbox"/>	

[2]

(c) Next time Danny will be able to remember how to catch lugworms.

(i) Which type of verbal memory will he use?

..... [1]

(ii) On his next seaside holiday Danny has a sudden recollection of being told how to catch lugworms.

Which statement could best explain why?

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

Danny has gained a reflex to hunt lugworms.

Danny's brain links the smell of sea air with the memory.

Danny's memory fades with time.

Danny's hypothalamus stores the memory.

Danny has acquired the skill at the right age.

[1]

[Total: 5]

6 Amy is having her eyes examined by the doctor.

When the doctor shines a light in her eye, Amy's pupil contracts.

This is a reflex.

(a) Choose the correct events in this reflex from each pair in the list, and place these events in the right order.

The last one has been done for you.

- A** Chemicals reach the end of the sensory neuron.
- B** An impulse reaches the end of the sensory neuron.
- C** The motor neuron is stimulated.
- D** The motor neuron is suppressed.
- E** Receptor molecules bind with any chemicals diffusing in the synapse.
- F** Receptor molecules bind with specific chemicals diffusing in the synapse.
- G** Chemicals are attracted by the sensory neuron.
- H** Chemicals are released by the sensory neuron.

			<b>C</b>
--	--	--	----------

[2]

- (b) To see the retina of Amy's eye better, the doctor uses a drug to stop the reflex. This effect only lasts for a few hours.

Put a tick (✓) in the box next to the **best** explanation of how this drug stops the reflex action.

The drug increases the frequency of impulses in the sensory neuron.

The drug blocks receptor sites at synapses.

The drug makes the cells of the retina more sensitive to light.

The drug stimulates the muscle cells in Amy's eye.

The drug makes Amy's brain need different chemicals.

[1]

- (c) What happens in Amy's brain as a result of new experiences and interaction with the environment?

Put a tick (✓) in the boxes next to the two **best** explanations.

Amy's brain grows many new neurons.

Amy was conditioned not to have the newborn reflexes.

Amy's brain develops new receptors.

Amy's brain forms new neuron pathways.

Amy's brain relies on different chemicals as she learns.

Amy's brain has some neuron pathways that are more likely to transmit impulses than other neuron pathways.

[2]

[Total: 5]

16  
BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE



7 Nick's water tank is blocked up with limescale.

He removes the limescale with concentrated hydrochloric acid.

(a) Limescale is calcium carbonate,  $\text{CaCO}_3$ . It reacts with hydrochloric acid,  $\text{HCl}$ , to make calcium chloride,  $\text{CaCl}_2$ , and water and carbon dioxide.

(i) One of the substances made is a salt. Which one?

..... [1]

(ii) Complete and balance the equation for this reaction

$\text{CaCO}_3 + \dots\dots\dots \text{HCl} = \dots\dots\dots + \dots\dots\dots + \dots\dots\dots$  [2]

(b) When Nick descales his kettle he uses a different acid.

He knows that when you put any acid into water it always produces the same ion.

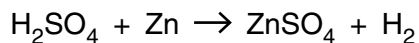
What is this ion?

..... [1]

[Total: 4]

- 8 Mary studies the reaction between sulfuric acid and pieces of zinc.

The equation for the reaction is



- (a) She wants to know how much zinc sulfate can be made in her reaction.
- (i) Use information from the Periodic Table to calculate the relative formula mass of zinc sulfate.

Show your working.

relative formula mass = ..... [2]

- (ii) What mass of zinc sulfate is made when 65 g of zinc reacts?

mass = ..... g [1]

- (b) When Mary uses more concentrated acid the reaction goes faster.

Draw **one** line to link the two statements which together provide the correct explanation for this.

**More concentrated acid has ...**

... higher pH.

... more surface area.

... more volume.

... more acid particles in every  $\text{cm}^3$ .

**This leads to ...**

... more collisions.

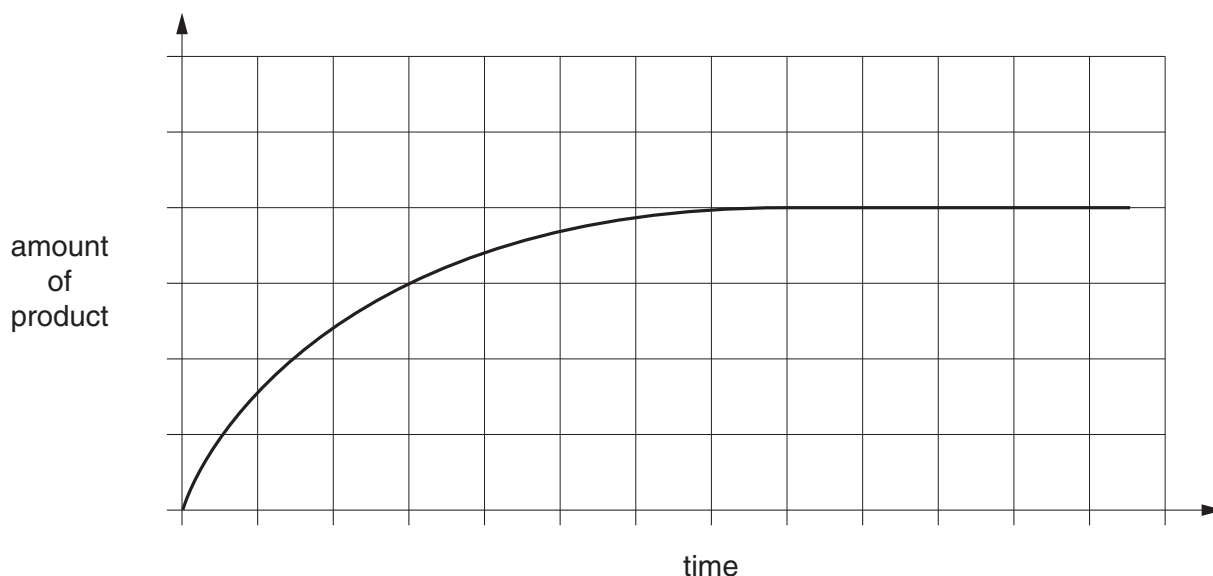
... bigger collisions.

... faster collisions.

... more collisions every second.

[2]

(c) Mary plots a graph of the progress of her reaction.



She does the experiment again.

The only difference is that this time she adds a catalyst.

On the graph draw a line to show the results of the experiment using the catalyst. [2]

(d) Mary did her experiment in a laboratory with small amounts of chemicals.

In industry, larger amounts are used and the rate of reaction has to be very carefully controlled.

Suggest why it is important to control the rate of reaction in an industrial process.

.....

.....

.....

..... [3]

[Total: 10]

**END OF QUESTION PAPER**

**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.

