

**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.

**OCR supplied materials:**  
None

**Other materials required:**

- Pencil
- Ruler (cm/mm)

**Duration:** 40 minutes



Candidate  
forename

Candidate  
surname

Centre number

Candidate number

**MODIFIED LANGUAGE**

**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

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

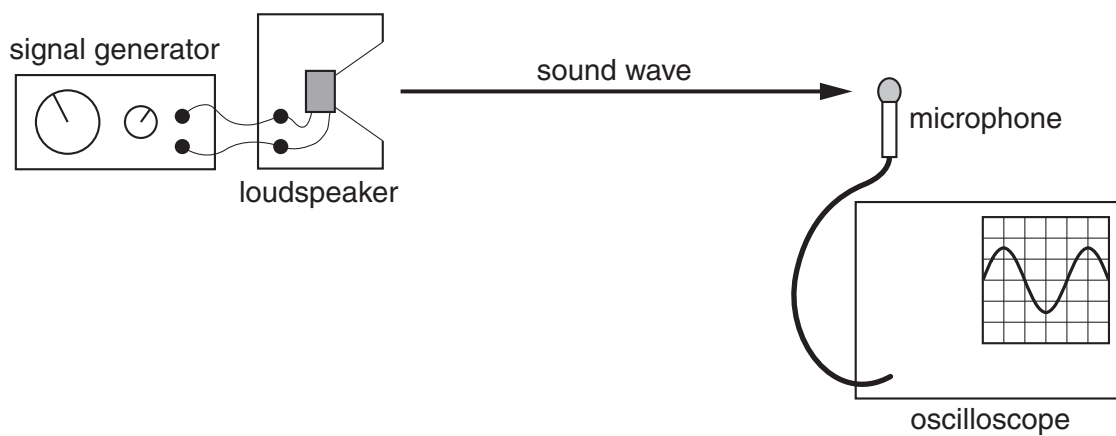
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**Question 1 starts on page 4**

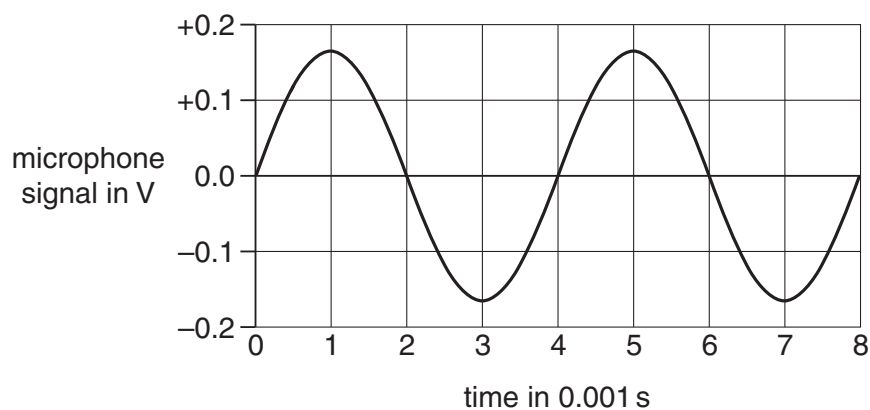
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Answer **all** the questions.

- 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 a diagram of the electromagnetic spectrum.

Some words are missing.

radio waves			visible light			gamma radiation
-------------	--	--	---------------	--	--	-----------------



(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.

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.....

.....

.....

.....

.....

.....

..... [3]

[Total: 5]

- 3 Jack and Jill use two-way radios to communicate.



- (a) Jack talks 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.

☐

Radio waves reflect off objects in their path.

☐

Radio waves diffract out of aerials in all directions.

☐

Radio waves are absorbed at the edge of the atmosphere.

☐

[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.

.....

.....

.....

.....

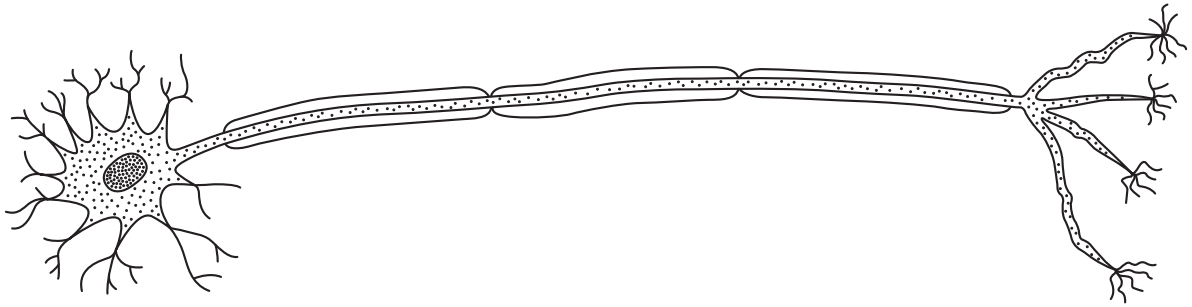
.....

.....

..... [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.

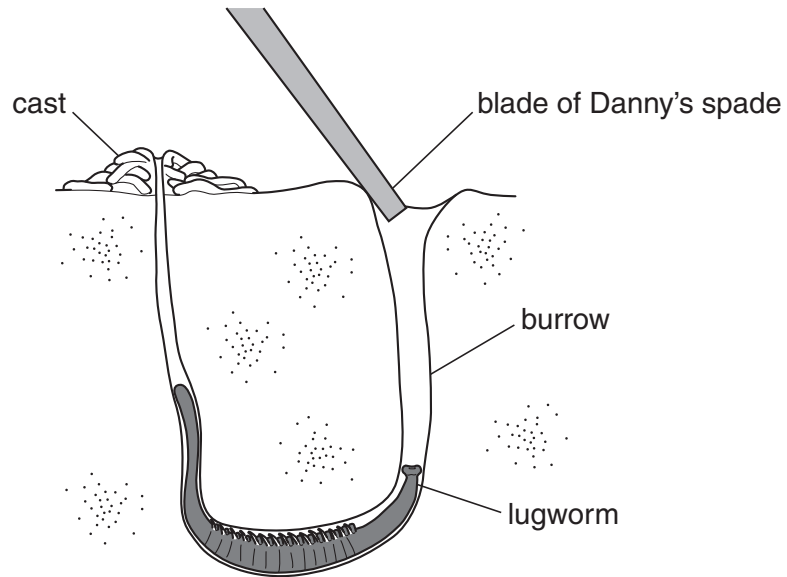
muscle cells	<input type="checkbox"/>
skin cells	<input type="checkbox"/>
retina cells	<input type="checkbox"/>
hormone secreting cells	<input type="checkbox"/>
cerebral cortex cells	<input type="checkbox"/>

[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  | <input type="checkbox"/> |
| growing       | <input type="checkbox"/> |
| communicating | <input type="checkbox"/> |
| remembering   | <input type="checkbox"/> |
| reproducing   | <input type="checkbox"/> |

[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>	
<b>uses only reflex actions.</b>	
<b>has specialised sense organs.</b>	
<b>has more body mass.</b>	

Danny's brain forms new

<b>neurons</b>	
<b>pathways</b>	
<b>muscles</b>	
<b>cells</b>	

as he learns the new skill.

Danny's nervous system uses his

<b>cerebral cortex</b>	
<b>peripheral system</b>	
<b>reflex arcs</b>	
<b>motor neurons</b>	

to process what he is told.

[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) The doctor needs to see the retina of Amy's eye better. He 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**  
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- 7 Nick's water tank is blocked up with limescale.

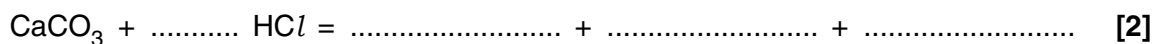
He removes the limescale with concentrated hydrochloric acid.

- (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



- (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.

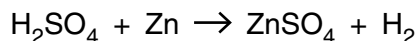
What is this ion?

..... [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.

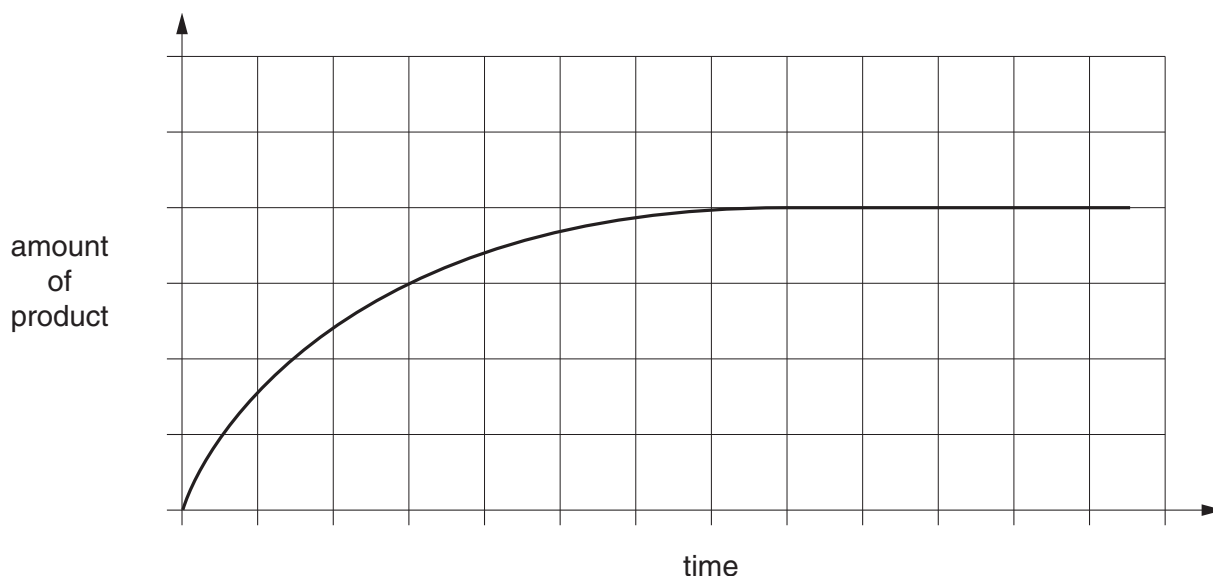
... bigger collisions.

... 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**

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# The Periodic Table of the Elements

20

1	2	Key										3	4	5	6	7	0
1 H hydrogen 1		relative atomic mass atomic symbol name atomic (proton) number										4 He helium 2					
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

\* 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.