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RECOGNISING ACHIEVEMENT

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Wednesday 20 June 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A

A217/01   Unit 3: Modules B6 C6 P6 (Foundation Tier)

Duration: 40 minutes

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

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

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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.

signal generator

sound wave

microphone

loudspeaker
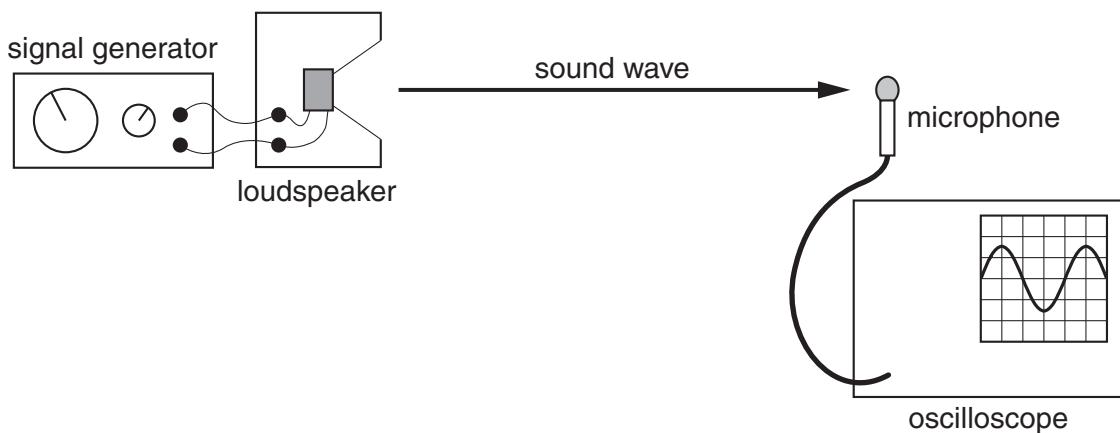
oscilloscope

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

microphone signal in V

time in 0.001 s
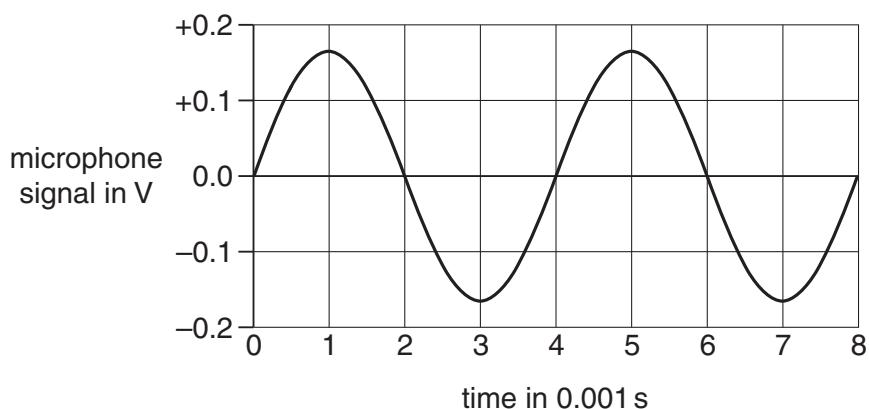
(i) How should Doris calculate the frequency of the sound wave?

Put a ring around the correct calculation.

$$\frac{1}{8 \times 0.001} \qquad \frac{1}{6 \times 0.001} \qquad \frac{1}{4 \times 0.001} \qquad \frac{1}{2 \times 0.001}$$

[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]

Turn over

2 Here is an incomplete diagram of the electromagnetic spectrum.

radio waves		infrared	visible light		X-rays	

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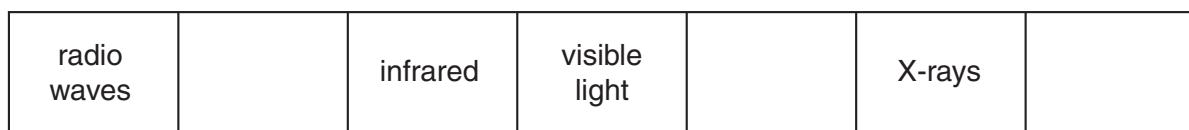
(a) What wave property always increases from left to right in the diagram?

Put a (ring) around the correct property.

amplitude　　　　**frequency**　　　　**speed**　　　　**wavelength**

[1]

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

(c) Mark uses a microwave oven to cook some food.

The walls of the oven are made of metal and the door contains a metal grid.

Explain how microwaves can cook food safely inside the oven.

Your answer should include

- how the microwaves cook the food

- why the walls and door of the oven are made of metal.

....

....

....

....

....

....

.... **[3]**

[Total: 5]

Turn over

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

(a) Jack speaks into his radio.

How does this affect the radio waves emitted by the aerial?

Put a (ring) around the correct word.

accelerates   diffracts   modulates   refracts

[1]

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

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

Radio waves cannot be reflected. ☐

Radio waves are absorbed by the ground. ☐

Radio waves travel slower than sound waves. ☐

Radio waves pass through the air without being absorbed. ☐

[1]

(c) Jill walks away from Jack as she listens to him on her radio.

The sound quality from her radio becomes poorer as she walks further away.

Explain why the sound quality decreases as Jill moves away.

....

....

....

....

....

....

.... **[3]**

[Total: 5]

Turn over

4 Danny and James are digging for lugworms on the beach.

Lugworms are simple animals that burrow in the sand.
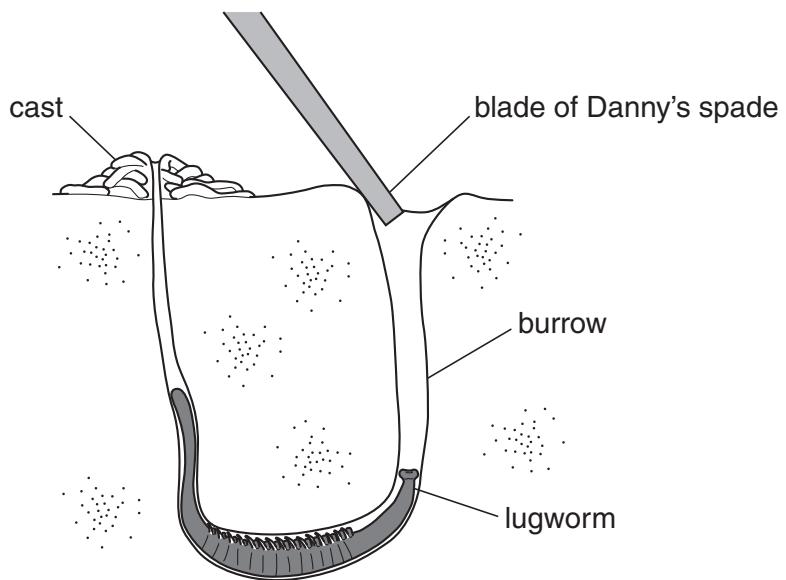
(a) When Danny digs, the worm's muscles contract, helping it to escape.

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

receptor	
response	
stimulus	

The sound of Danny digging is a   for the lugworm.

complex	
simple	
voluntary	

The lugworm escapes using a   reflex.

most	
none	
all	

Lugworms rely on reflexes for   of their escape behaviour.

[2]

(b) Danny's nervous system is more complex than the lugworm's.

Draw straight lines to connect each **part of Danny** to the correct **system**.

You should draw **four** lines.

part of Danny   **system**

brain

| sensory neurons | | central nervous system |
| --- | | --- |

| spinal cord | | peripheral nervous system |
| --- | | --- |

motor neurons

[2]

(c) (i) On his previous holiday, James was told how to catch lugworms.

He remembers how to do this.

Put (rings) around the **two** words which correctly describe memory.

translating   loss   retrieval   storage   understanding

[2]

(ii) James uses this memory from last year to catch lugworms.

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

short-term	
medium-term	
long-term	

James is using his [box above] verbal memory.

[1]

[Total: 7]

Turn over

5 Emma is learning the steps of a new dance.

Complete the sentences by choosing the best words from this list.

Each word may be used once, more than once, or not at all.

billions of

directions

neurons

less

hundreds of

a few

more

pathways

equally

Emma's brain has .... neurons.

These can make new .... as she practises the new steps.

When Emma repeats the steps, these parts of her brain are ....

likely to transmit impulses. **[3]**

[Total: 3]

6 This is a diagram of a motor neuron involved in a reflex arc.
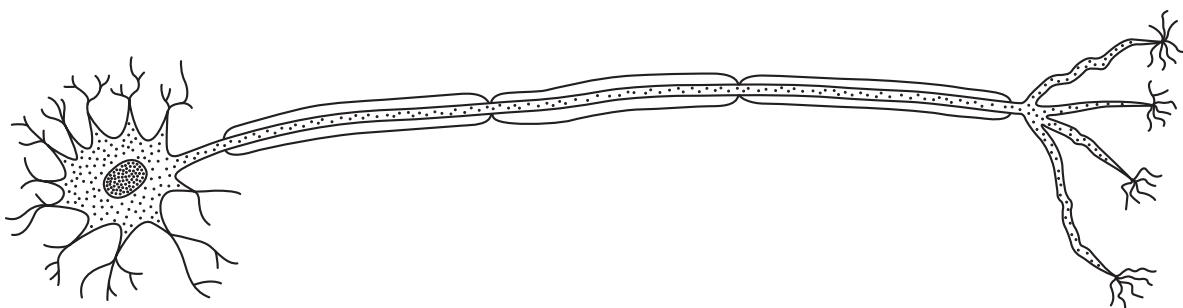
(a) Explain how this helps to produce rapid responses to changes in the environment.

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]

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

He removes the limescale with concentrated hydrochloric acid.

(a) Concentrated hydrochloric acid is toxic and corrosive.

Which two symbols should go on a bottle of the acid?

Put ticks (✓) in the boxes next to the **two** correct answers.
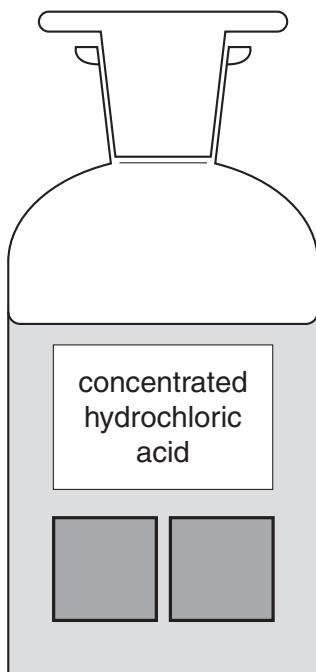
[1]

(b) Limescale is made of calcium carbonate, $CaCO_3$. It reacts with hydrochloric acid, HCl, to make calcium chloride, $CaCl_2$, and water and a gas.

   (i) What is the name of the gas?

   Put a (ring) around the correct answer.

   carbon dioxide   **hydrogen**   **chlorine**   **oxygen**

   [1]

   (ii) One of the substances made is a salt.

   What is the name of this salt?

   .... [1]

(c) Nick adds a cupful of the acid to the limescale in the tank to remove it.

   Not all the limescale is removed.

   When the acid is used up, he adds another cupful.

   How can he tell when the acid is used up?

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

   It stops fizzing. ☐

   The acid goes green. ☐

   The liquid disappears. ☐

   The limescale catches fire. ☐

   [1]

(d) 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: 5]

8 Mary reacts pieces of zinc with sulfuric acid to make zinc sulfate and hydrogen gas.

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

$Zn + H_2SO_4 + ZnSO_4 \rightarrow H_2$ ☐

$Zn \rightarrow H_2SO_4 + ZnSO_4 + H_2$ ☐

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ ☐

$Zn \rightarrow H_2SO_4 + ZnSO_4 \rightarrow H_2$ ☐
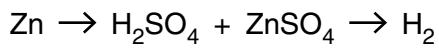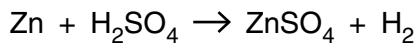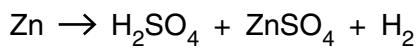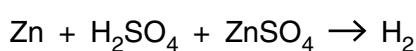
[1]

(b) It takes time for the zinc to react.

Mary knows that the reaction does not keep going at the same rate all the time.

She wants to find out how the rate of the reaction changes.

What should she measure, and when should she take her measurements?

....

....

....

... **[3]**

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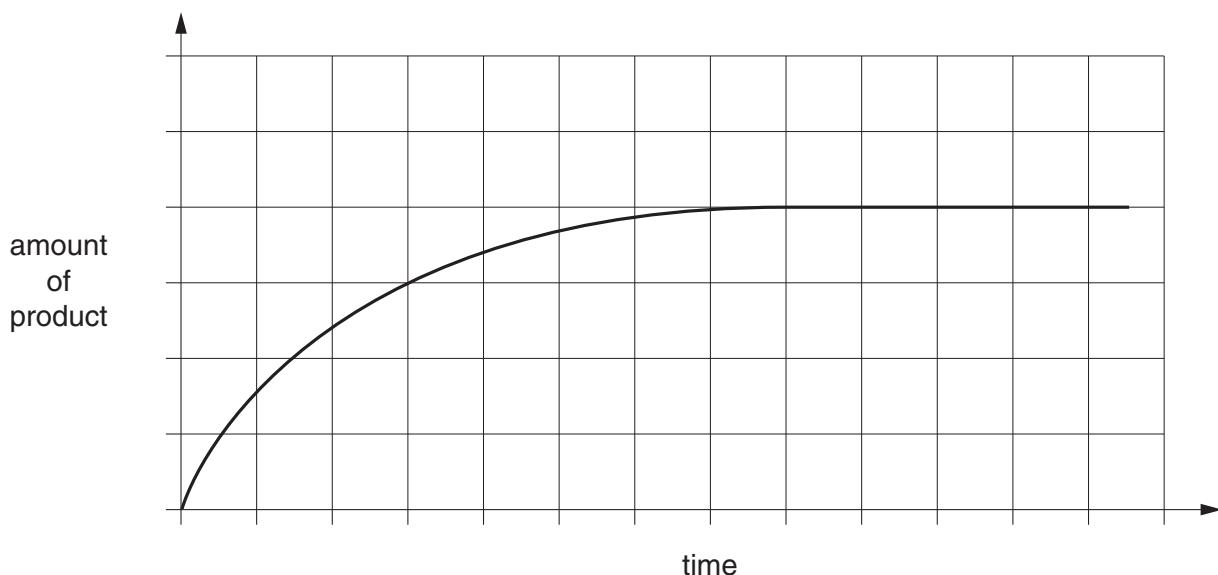
time

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]**

Turn over

(d) At the end of the reaction there is a solution of zinc sulfate with small pieces of zinc in the liquid.
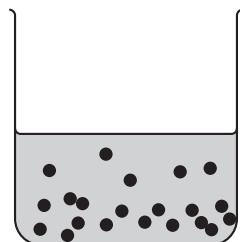
Mary wants to make a clean, dry sample of the zinc sulfate.

She puts the zinc sulfate solution and zinc into a filter funnel.

Put ticks (✓) in the correct boxes to complete the sentences.

This leaves

water	
zinc	
zinc sulfate	

behind in the filter paper.

She heats the zinc sulfate solution.
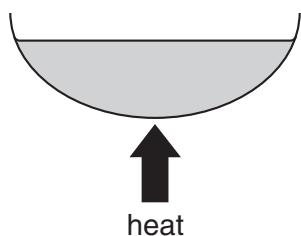
heat

Water from the solution goes into the air.

The water has …

… crystallised.	
… dissolved.	
… evaporated.	
… neutralised.	

So that crystals can grow, she stops heating when …

… all the water has gone.	
… half the water has gone.	

She washes the crystals and then she puts them in a warm oven to …

… dry.	
… melt.	
… purify.	

[3]

[Total: 9]

END OF QUESTION PAPER

The Periodic Table of the Elements

Key

| relative atomic mass |
| **atomic symbol** |
| name |
| atomic (proton) number |

1	2													3	4	5	6	7	0
						1 **H** hydrogen 1													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.