

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
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)

**Wednesday 22 June 2011
Morning**

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. Pencil may be used for graphs and diagrams only.
- 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).
- Answer **all** the questions.
- 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

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

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

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

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

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

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

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

Electric Circuits

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

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

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

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

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

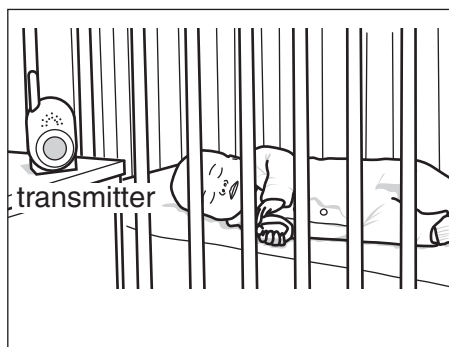
The Wave Model of Radiation

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

3

Answer **all** questions.

- 1 Julie uses a baby monitor so that she can hear when her baby cries in another room.
The monitor has a radio transmitter and a radio receiver.



- (a) The transmitter uses digital transmission.

The digital code uses only two symbols.

What are these symbols called?

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

left and right **one and zero** **plus and minus** **up and down** [1]

- (b) Complete the sentences for the baby monitor system by putting a **ring** around the correct words in bold.

The transmitter changes the radio waves in a process which is called

demodulation / **diffraction** / **modulation** / **reflection** .

As the waves travel away from the transmitter, some **charge** / **light** / **noise** / **sound** is picked up along the way.

The receiver converts the pattern of radio wave pulses into

infrared / **interference** / **microwaves** / **sound** .

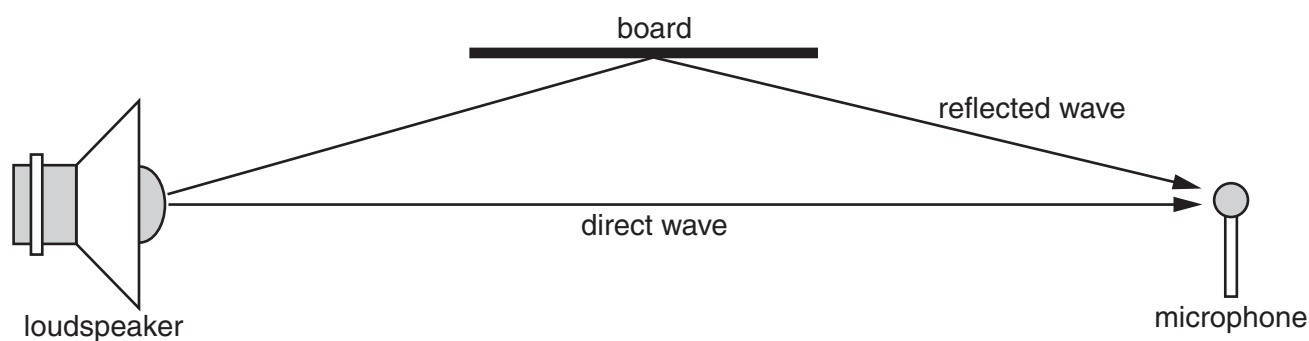
[3]

[Total: 4]

Turn over

4

- 2 The diagram shows two paths for sound to get from a loudspeaker to a microphone.



- (a) The loudspeaker produces a steady sound.

The microphone detects almost no sound.

Here are some possible explanations.

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

The intensity of the reflected wave is zero.

☐

The board diffracts the wave so that it misses the microphone.

☐

The reflected wave arrives at the microphone in step with the direct wave.

☐

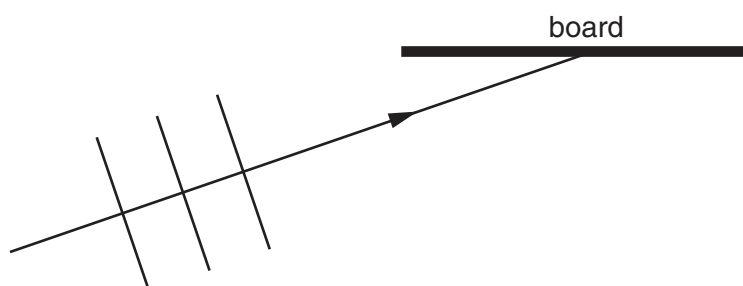
The reflected wave arrives at the microphone out of step with the direct wave.

☐

[1]

- (b) Some of the sound gets to the microphone by reflecting off a board.

The diagram shows three wavefronts of the wave **before** it hits the board.



Complete the diagram to show the three wavefronts **after** they have all hit the board.

[1]

5

- (c) The loudspeaker makes sound with a frequency of 680 Hz.

The sound waves move with a speed of 340 m/s.

What is the wavelength of the sound?

Put a ring around the correct answer.

0.5 m

2 m

1020 m

231 200 m

[1]

- (d) Explain what is meant by the **wavelength** of a sound wave.

.....

.....

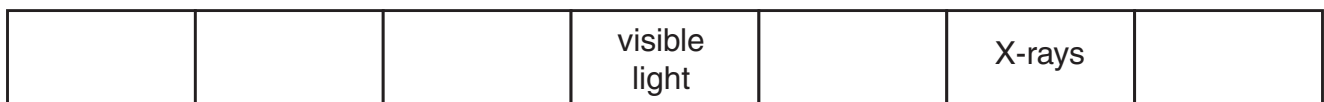
..... [2]

[Total: 5]

- 3 Dentists use X-rays to image teeth.



- (a) X-rays and visible light are shown in this diagram of the electromagnetic spectrum.



increasing frequency →

Add **infrared** and **ultraviolet** to the spectrum.

[1]

- (b) In certain conditions, all waves in the electromagnetic spectrum share one property.

No other waves have that property.

Describe the property shared by **all** waves in the electromagnetic spectrum.

Under what conditions is this true?

.....

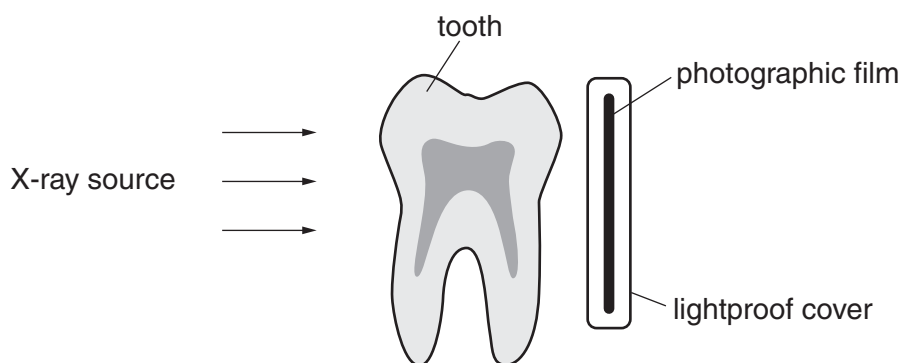
.....

..... [2]

7

(c) A dentist needs to image a tooth.

She places an X-ray source in front of the tooth and a photographic film behind it.



Here are some explanations for the formation of an image on the photographic film.

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

Whiter parts of the tooth reflect more X-rays away from the film.

☐

Harder parts of the tooth interfere with the X-rays on their way to the film.

☐

Denser parts of the tooth reduce the intensity of the X-rays arriving at the film.

☐

X-rays are absorbed in any gaps in the tooth and do not reach the film.

☐

Softer parts of the tooth diffract the X-rays towards the film.

☐

[1]

(d) What do X-ray photons carry from their source to the photographic film?

..... [1]

[Total: 5]

4 Anil has to make up a new password to go on his school computer system.

(a) He talks to some classmates about the problem of making it a password he can remember.

Reuben Your memory just processes information. 	Niall Your memory is divided in to short-term memory and long-term memory. 	Jessica Memory just retrieves information. 
 Ammaar If you can remember it for five minutes you'll remember it next week.	 Beth Memory is both storage and retrieval of information.	

Which **two** classmates make correct statements about memory?

answer and [2]

(b) Anil knows that the part of his brain concerned with memory also has other functions.

Suggest **one** other function of this part of the brain.

..... [1]

(c) Scientists have used different methods to study this part of the brain.

Give **one** of these methods.

..... [1]

9

- (d) Anil's teacher gives him some hints on how to be able to remember the password in next week's lesson.

One hint is to use a pattern such as A1B2C3.

Describe **two** other ways he can use to help remember the password.

.....

.....

.....

..... [3]

[Total: 7]

10

- 5 Some dogs have been trained to produce saliva when they hear a bell.

They do this even when they cannot see or smell the food.

- (a) Put a ring around the correct words to complete the sentences.

This type of reflex is **complex** / **conditioned** / **simple** .

The sound of the bell is a **primary** / **secondary** / **tertiary** stimulus .

The final response **has a** / **has a lot of** / **has no** / direct connection to the stimulus .

The dogs have brains with **hundreds** / **thousands** / **billions** of neurons that allow learning from experience .

[3]

- (b) When they were puppies, these dogs learned to sit when told.

Put ticks (✓) in the boxes next to the **two** statements which best explain the changes in their brains as they learn.

New neurons have grown.

☐

New links between their ears and legs have grown.

☐

New pathways linking neurons have developed.

☐

Repeating a stimulus makes pathways more likely to transmit impulses.

☐

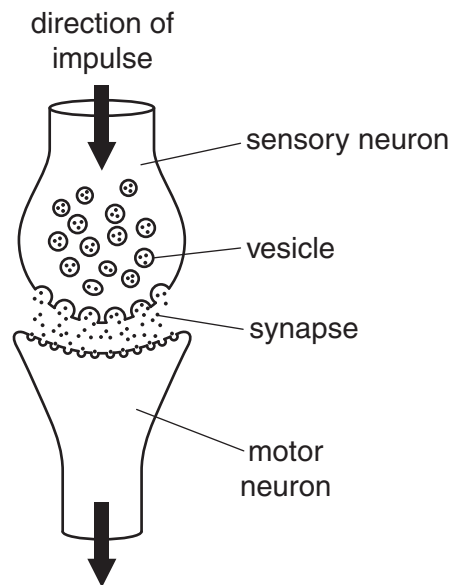
Repeating a stimulus makes pathways wear out.

☐

[2]

[Total: 5]

- 6 This is a diagram of a synapse between a sensory neuron and a motor neuron.



An impulse is transmitted across the synapse.

The stages in this process are shown. They are in the wrong order.

- A Transmitter binds with receptors.
- B There is an electrical impulse in the motor neuron.
- C Transmitter diffuses.
- D There is an electrical impulse in the sensory neuron.
- E Transmitter is released.

Fill in the boxes to show the correct order.

--	--	--	--	--

[2]

[Total: 2]

12

- 7 Titanium oxide is a white solid which is used in paint.

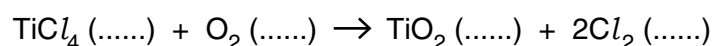
Impurities in natural titanium oxide spoil its white colour, so they are removed.

To remove the impurities two chemical reactions are carried out.

reaction 1 – the solid titanium oxide, TiO_2 , is converted into liquid titanium chloride, TiCl_4 .

reaction 2 – the liquid titanium chloride, TiCl_4 , is later converted back into titanium oxide, TiO_2 .

- (a) Complete the balanced symbol equation for reaction 2 by adding in the state symbols.



[1]

- (b) The impurities do not take part in these reactions.

This makes them easy to remove.

Suggest

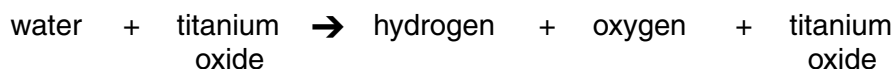
- why this makes them easy to remove
- how you might remove them
- at which stage they are removed.

.....
.....
.....
..... [3]

13

- (c) Titanium oxide is a catalyst for the breakdown of water molecules into hydrogen gas and oxygen gas.

Yvonne writes this equation into her book.



What is a catalyst?

Your answer should include

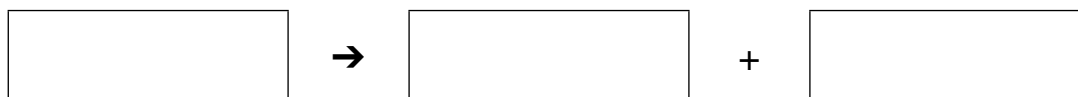
- what it does
- why it is on both sides of this equation.

.....

 [1]

- (d) Water will break down into hydrogen gas and oxygen gas without using a catalyst.

Write a balanced symbol equation for this reaction.



[2]

[Total: 7]

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

- 8 Flour mills in the nineteenth century sometimes exploded.

Flour mills grind wheat grains into flour, a fine powder.

Wheat grains will burn slowly in air.

Flour dust burns much more quickly than wheat grains.

The rooms inside the flour mill had clouds of flour dust in the air.

A single spark was enough to make the flour dust explode.



The rate of reaction is much greater when a cloud of flour dust reacts with air.

Explain why.

Use ideas about particles in your answer.

.....

.....

.....

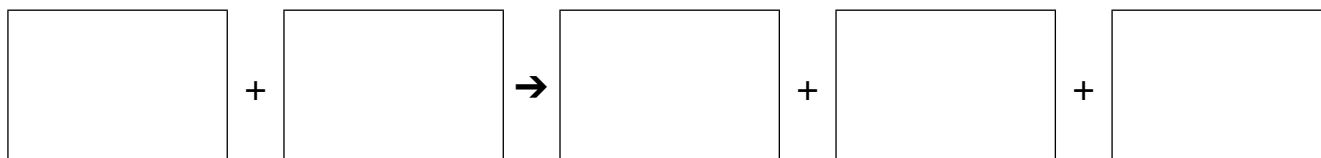
..... [2]

[Total: 2]

9 David has limescale on the wall of his house.

He knows that limescale is calcium carbonate, so he decides to remove it using hydrochloric acid.

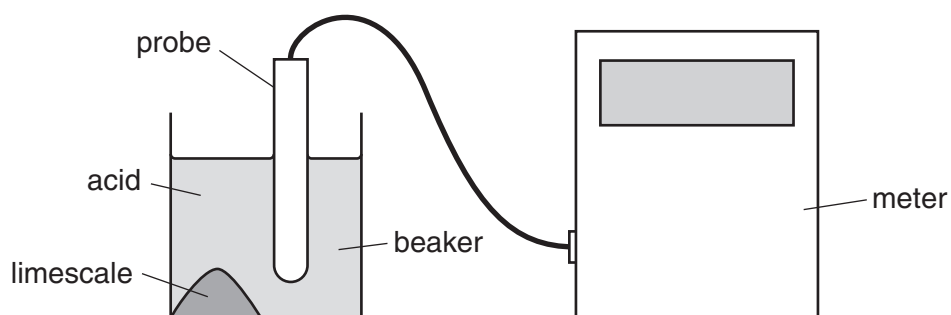
(a) Fill in the boxes to write the word equation for this reaction.



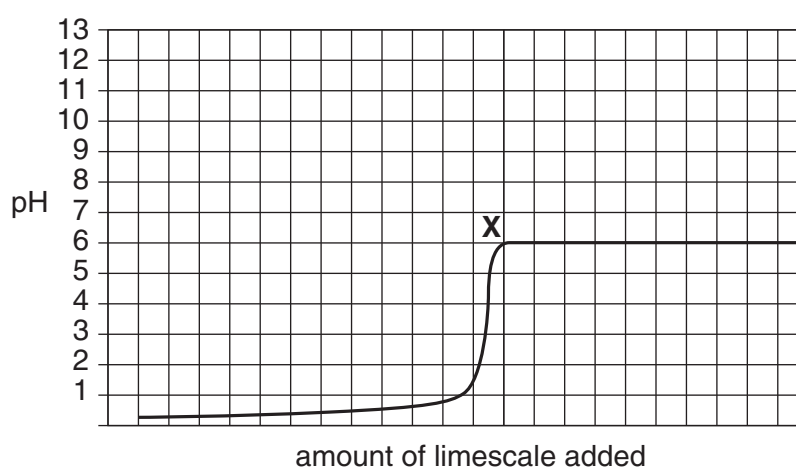
[1]

(b) He investigates the reaction between limescale and hydrochloric acid in the laboratory.

He puts some acid into a beaker and adds powdered limescale a little at a time.



He measures the pH of the acid as the limescale reacts.



17

- (i) David wants to know how much acid is in the beaker at different stages in the reaction.

He looks at the pH.

Why is this not a good way to tell how much acid is in the beaker?

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

pH does not increase at the same rate as the acid is used up.

☐

pH is nothing to do with the amount of acid left.

☐

pH is a measure of the hydrogen ion concentration.

☐

The more acid there is, the lower the pH.

☐

[1]

- (ii) What can he say about point X on the graph?

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

All the acid is used up.

☐

Almost no acid is used up.

☐

All the limescale is used up.

☐

Unreacted acid and unreacted limescale are both present.

☐

[1]

18

- (c) David dilutes some concentrated hydrochloric acid to make his acid solution.

He notices acidic fumes coming off the concentrated hydrochloric acid.

Why is this?

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

All concentrated acids give off fumes.

☐

Hydrochloric acid contains chlorine gas.

☐

All concentrated acids are dangerous.

☐

Hydrochloric acid is a solution of hydrogen chloride gas.

☐

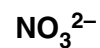
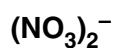
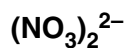
[1]

- (d) David knows that if he uses nitric acid on limescale, he will make calcium nitrate.

The formula for calcium nitrate is $\text{Ca}(\text{NO}_3)_2$.

The symbol for the calcium ion is Ca^{2+} .

Put a ring around the symbol for the nitrate ion.



[1]

[Total: 5]

END OF QUESTION PAPER

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) 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.

The Periodic Table of the Elements

1	2	Key										3	4	5	6	7	0
		relative atomic mass atomic symbol name atomic (proton) number															
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.