OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A217/02

Unit 3: Modules B6 C6 P6 (Higher Tier)

OCE/33512

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

A217702

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

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

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved by the force

change in energy = work done

change in GPE = weight × vertical height difference

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

Electric Circuits

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

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

energy transferred = power × time

power = potential difference × current

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

The Wave Model of Radiation

wave speed = frequency × wavelength

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.

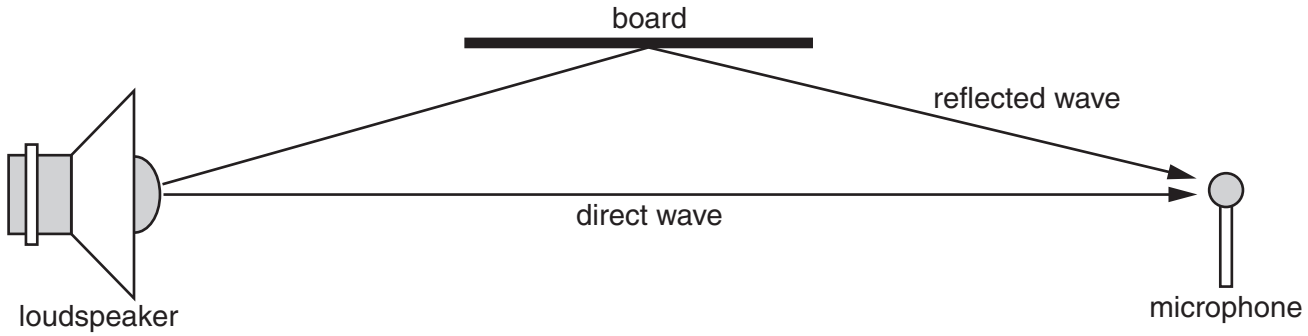
The receiver converts the pattern of radio wave pulses into

infrared / interference / microwaves / sound .

[3]

[Total: 4]

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. ☐

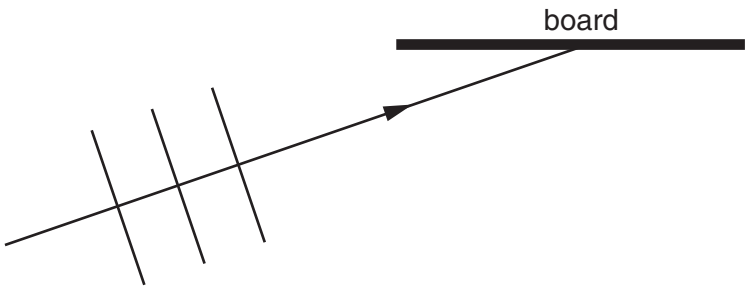
The reflected wave arrives at the microphone in step with the direct wave. ☐

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]**

(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.

.....

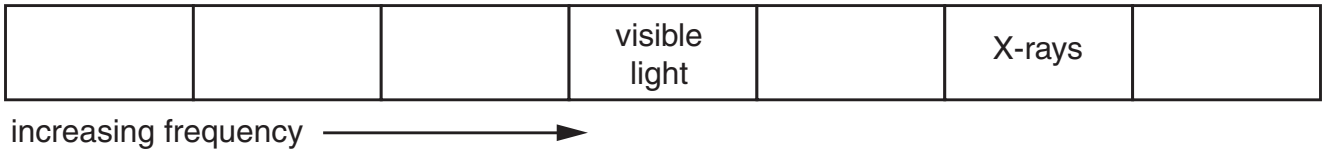
.....

..... **[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.



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?

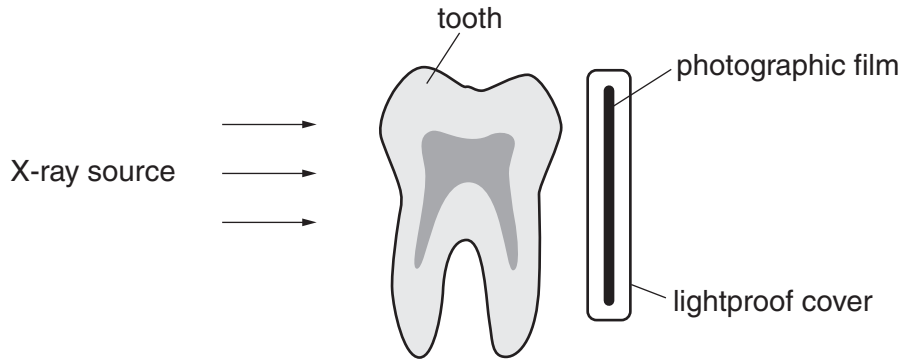
.....

.....

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

(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]

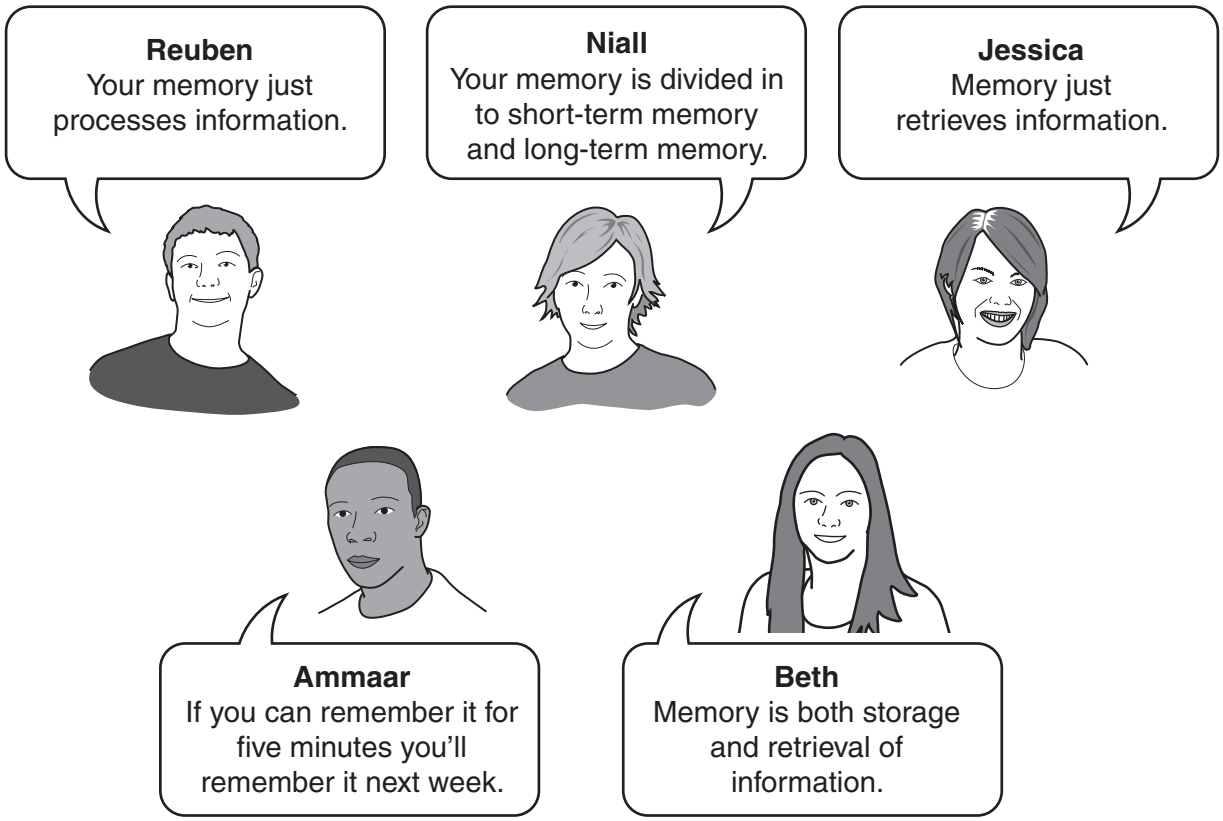
(d) What do X-ray photons carry from their source to the photographic film?

..... **[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.



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]**

(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]

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. ☐

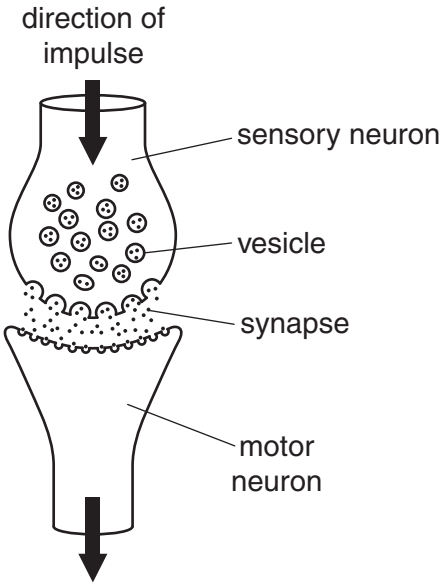
Repeating a stimulus makes pathways more likely to transmit impulses. ☐

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]

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.

$$TiCl_4 (.....) + O_2 (.....) \rightarrow TiO_2 (.....) + 2Cl_2 (.....)$$

[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]**

(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.

water + titanium oxide → hydrogen + oxygen + titanium oxide

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]

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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.

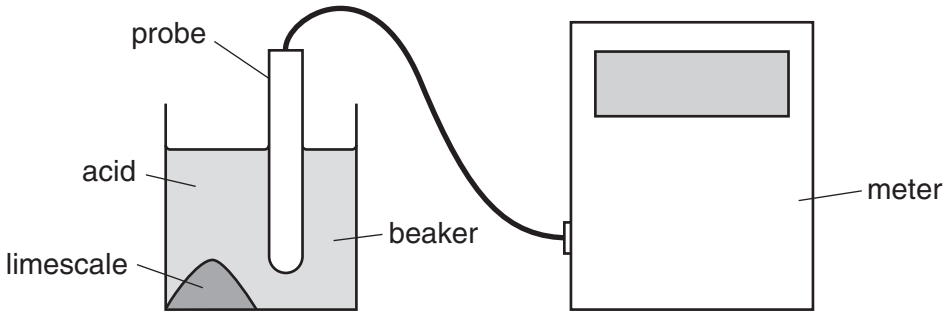
He knows that limescale is calcium carbonate, so he decides to remove it using hydrochloric acid.

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

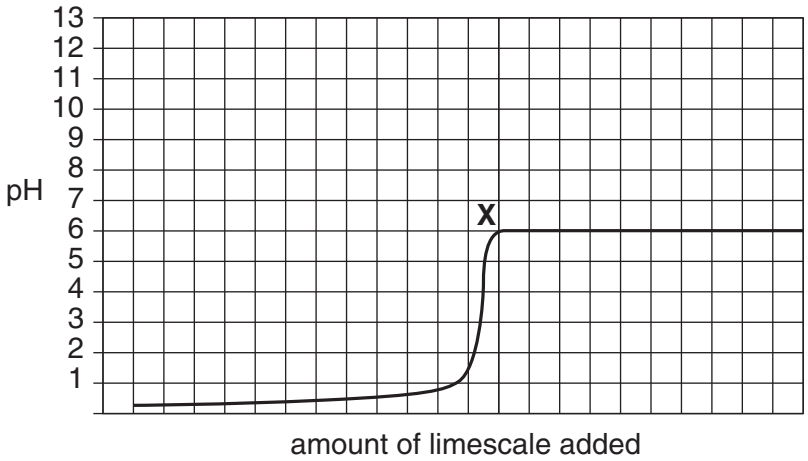
[1]

(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.



(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]

(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 $Ca(NO_3)_2$.

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

Put a (ring) around the symbol for the nitrate ion.

$(NO_3)_2^{2-}$ **$(NO_3)_2^{-}$** **NO_3^{-}** **NO_3^{2-}** **[1]**

[Total: 5]

END OF QUESTION PAPER

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The Periodic Table of the Elements

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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** 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.