

**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)

**Monday 31 January 2011
Afternoon**

Duration: 40 minutes



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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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. 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

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

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

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

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

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

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

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

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.

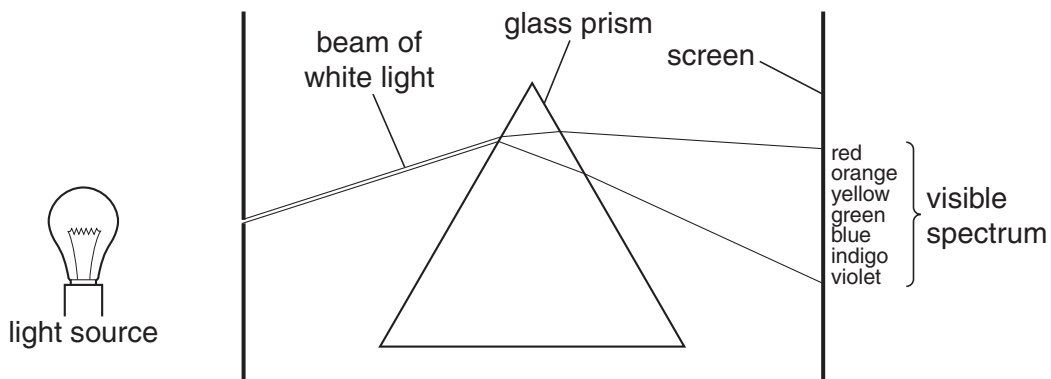
1 Isaac knows that light is made of waves.

(a) Draw a straight line to link the **start** of each sentence about light to its correct **end**.

start	end
The energy of a light wave decreases with increasing speed.
The amplitude of a light wave is transferred by the transfer of matter.
The wavelength of a light wave is the maximum value of its disturbance.
	... is transferred without the transfer of matter
	... is the distance from a crest to the next crest.
	... is the distance from a crest to the next trough.

[2]

(b) Isaac shines a beam of white light at a glass prism.



Isaac can see the spectrum of coloured light on the screen.

He uses the idea of photons to explain it.

Complete the sentences. Choose words from this list.

- absorbs amplitude diffracts emits**
reflects refracts shape wavelength

The light source continually a large number of different photons.

The prism each photon by an amount that depends on its

The screen these photons into Isaac's eyes so that he can see their colour.

[3]

- (c) Here are some possible equations for calculating the intensity of the light arriving at a point on the screen.

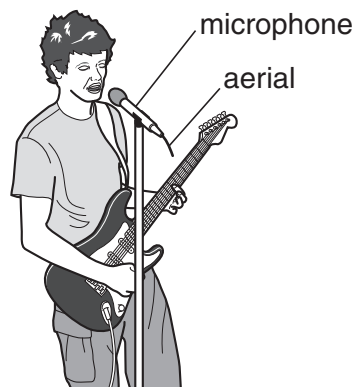
Which equation, **A**, **B**, **C** or **D**, is correct?

- A** intensity = photon energy \times photon rate
- B** intensity = photon power \times photon speed
- C** intensity = photon speed \times photon frequency
- D** intensity = photon amplitude \times photon wavelength

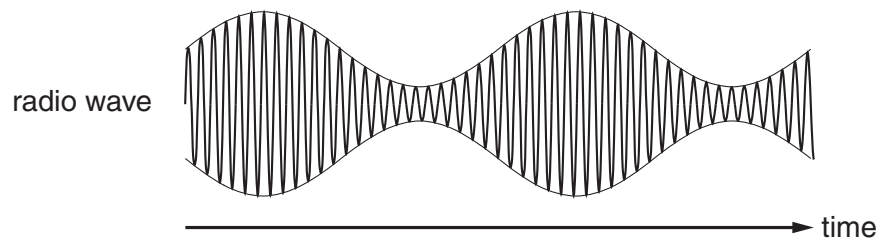
answer [1]

[Total: 6]

2 Paul uses a radio microphone to record a song.



(a) The microphone aerial emits an amplitude modulated radio wave.



Draw **in the space below** what a radio wave would look like if **frequency modulation** were used instead.

[1]

(b) Paul is not pleased with the quality of sound from the radio microphone.

He decides to use a microphone that sends the sound by **digital transmission**.

Explain how digital transmission improves the quality of the sound.

.....

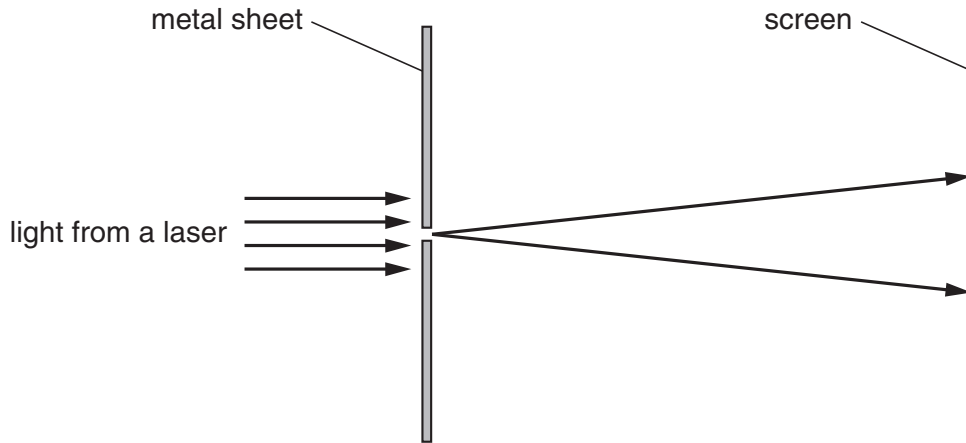
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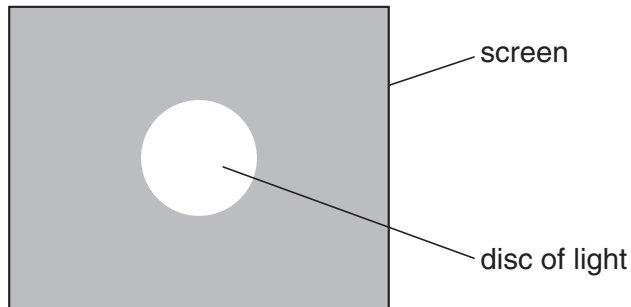
..... [3]

[Total: 4]

3 Thomas passes light from a laser through a small hole in a metal sheet.



(a) Thomas sees a disc of light when he looks at the screen.



The disc is much larger than the hole.

Light passes through the hole, then spreads out before it hits the screen.

(i) What is the name of this effect?

answer [1]

(ii) What does this observation suggest about light?

Put a tick (✓) in the box next to each of the **two** correct explanations.

Light has a wave nature.

Light is a longitudinal wave.

Light from the source has only one wavelength.

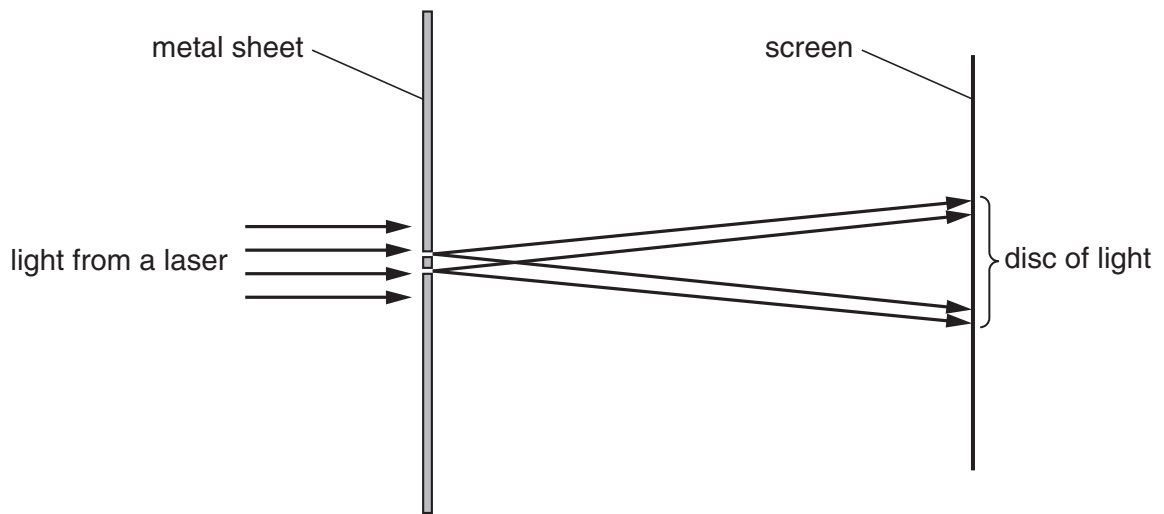
The size of the hole is similar to the wavelength of the light.

Photons carry the energy of the light from the source to the screen.

The amplitude of the light is much smaller than the size of the pinhole.

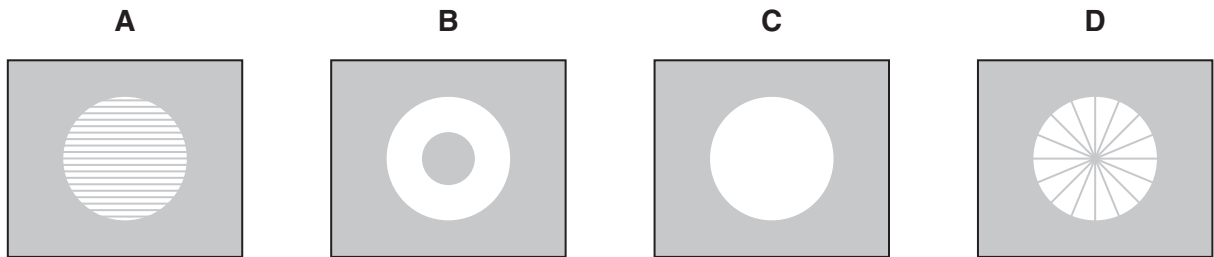
[2]

(b) Thomas makes a second hole in the metal sheet just above the first hole.



Thomas looks at the screen for an interference pattern.

Here are four possible patterns.

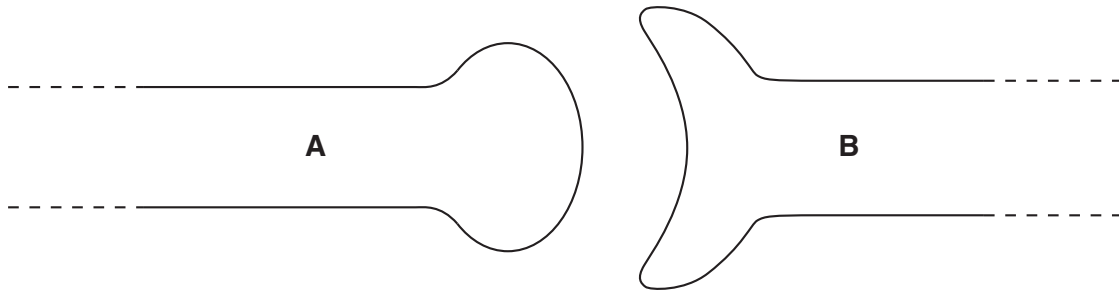


Which pattern, **A**, **B**, **C** or **D**, will Thomas see?

answer [1]

[Total: 4]

4 The diagram shows the synapse between neuron **A** and neuron **B**.



(a) Explain how the release of a chemical from neuron **A** can lead to an electrical impulse in neuron **B**.

.....

.....

.....

..... [3]

(b) Serotonin is a chemical found in some synapses in the brain.

The drug Ecstasy changes the concentration of serotonin.

Draw **one** line to join the correct **effect of Ecstasy** with the correct **consequence**.

effect of Ecstasy

consequence

- increases serotonin release from neuron **A**
- reduces serotonin removal by neuron **A**
- reduces serotonin release from neuron **A**
- increases serotonin removal by neuron **A**

- reduces serotonin concentration in synapse
- reduces serotonin concentration in neuron **B**
- increases serotonin concentration in synapse
- increases serotonin concentration in neuron **B**

[2]

[Total: 5]

11
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Question 5 starts on page 12
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5 This question is about reflexes.

(a) Reflexes such as the knee jerk reflex help an animal to survive.

Give **another** example of a reflex response and explain how it helps an animal to survive.

reflex response

.....

how it helps survival

.....

[2]

(b) Barbara is being served dinner in the canteen.

She is handed a hot plate.

Her reflex is to drop it, but she does not.

Complete the sentences to explain why Barbara does not drop the plate.

Use words from this list. You may use each word once, more than once, or not at all.

involuntary motor sensory voluntary

In a simple reflex arc the neuron transmits impulses to the spinal cord. To modify this reflex, Barbara's brain transmits impulses through a neuron to the neuron in the reflex arc.

This allows her response to be

[2]

(c) A conditioned reflex has certain characteristics.

Put a tick (✓) in the box next to each of the **two** correct characteristics.

A secondary stimulus is associated with a primary stimulus.

A stimulus is not needed.

More than one secondary stimulus is used.

The final response has no direct connection to the stimulus.

It does not involve learning.

[1]

(d) Some brightly coloured caterpillars taste bitter.

Many birds will avoid eating all brightly coloured caterpillars after eating a few of them.

Complete the sentences to explain why. Use words from this list.

- | | | |
|--------------------|------------------|-------------------|
| conditioned | modified | peripheral |
| primary | secondary | simple |

The bitter taste is a stimulus.

The bright colour is a stimulus.

This is a reflex.

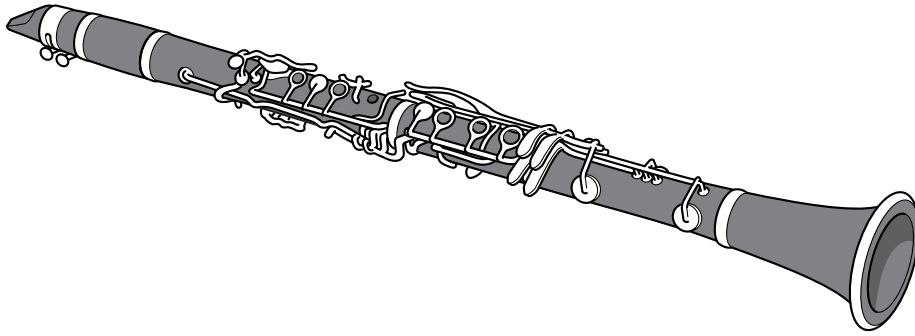
[2]

[Total: 7]

14
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- 6 Colin plays his clarinet in a school concert.



He has to practise playing so that he can perform.

Put ticks (✓) in the boxes next to the **two** statements that best explain what is happening in Colin's brain as he learns some new music.

Repetition causes neuron pathways to wear out.

New experiences cause new neuron pathways to form.

Repetition makes new pathways more likely to transmit impulses.

Repetition makes all new neurons more likely to transmit impulses.

New experiences cause neurons to make bigger electrical impulses.

[2]

[Total: 2]

7 Ann has some solid sodium hydroxide and she wants to know how pure it is.

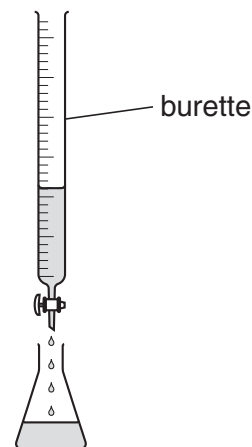
She weighs out a sample and dissolves it in water to make an alkali solution.

(a) Ann carries out an accurate titration to find out how much acid reacts with 25.0cm^3 of the alkali solution.

She puts 25.0cm^3 of the alkali solution into a conical flask.

She then adds a few drops of indicator solution.

She puts the acid into a burette.



Describe how Ann should carry out the rest of the titration.

Include any measurements that she should make.

.....

.....

.....

.....

.....

[4]

(b) Ann finds that her sodium hydroxide solution reacts with less acid than she expected.

Put a tick (✓) in the box next to the most likely reason for this.

- Titration results always vary.
- The acid contained impurities.
- Not all the sodium hydroxide reacts.
- The sodium hydroxide contained impurities.

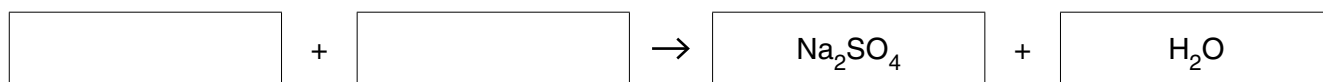
[1]

(c) Ann writes the equation for her reaction.

(i) The acid she used was sulfuric acid.

The alkali she used was sodium hydroxide.

Write the formula of each chemical in its box, then balance the whole equation.



[2]

(ii) The reaction between any acid and any alkali involves two ions.

Write the equation for this in the empty boxes.



[1]

[Total: 8]

- 8 Bernie buys stomach powder from his supermarket.



The powder contains magnesium carbonate and an acid.

- (a) Put a **ring** around the acid that is most likely to be in the powder.

citric acid

ethanoic acid

hydrogen chloride

sulfuric acid

[1]

- (b) The statements below explain what happens as the powder is added to water.

Put the statements in the correct order. One has been done for you.

- A** A gas is produced.
B The acid dissolves.
C The carbonate reacts.
D Hydrogen ions spread through the water.

			A
--	--	--	---

[2]

- (c) The magnesium carbonate reacts with hydrochloric acid in the stomach to form a salt.

Write down the name of the salt and its formula.

The symbols for the ions are Mg^{2+} and Cl^{-} .

name

formula

[2]

(d) What other magnesium compound also reacts with acids?

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

magnesium chloride

magnesium oxide

magnesium sulfate

magnesium nitrate

[1]

[Total: 6]

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
		9 Be beryllium 4		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		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		70 Ga gallium 31	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
	85 Rb rubidium 37	88 Sr strontium 38		115 In indium 49	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
	133 Cs caesium 55	137 Ba barium 56		204 Tl thallium 81	209 Pb lead 82	207 Po polonium 84	[210] At astatine 85	[222] Rn radon 86
	[223] Fr francium 87	[226] Ra radium 88		Elements with atomic numbers 112-116 have been reported but not fully authenticated				
				65 Zn zinc 30	63.5 Cu copper 29	108 Ag silver 47	112 Cd cadmium 48	
				59 Ni nickel 28	59 Co cobalt 27	106 Pd palladium 46	197 Hg mercury 80	
				56 Fe iron 26	59 Co cobalt 27	103 Rh rhodium 45	192 Ir iridium 77	
				55 Mn manganese 25	56 Fe iron 26	101 Ru ruthenium 44	190 Os osmium 76	
				52 Cr chromium 24	55 Mn manganese 25	103 Rh rhodium 45	192 Ir iridium 77	
				48 Ti titanium 22	52 Cr chromium 24	106 Pd palladium 46	195 Pt platinum 78	
				45 Sc scandium 21	51 V vanadium 23	103 Rh rhodium 45	192 Ir iridium 77	
				91 Zr zirconium 40	51 V vanadium 23	103 Rh rhodium 45	192 Ir iridium 77	
				93 Nb niobium 41	51 V vanadium 23	103 Rh rhodium 45	192 Ir iridium 77	
				178 Hf hafnium 72	51 V vanadium 23	103 Rh rhodium 45	192 Ir iridium 77	
				184 W tungsten 74	51 V vanadium 23	103 Rh rhodium 45	192 Ir iridium 77	
				186 Re rhenium 75	51 V vanadium 23	103 Rh rhodium 45	192 Ir iridium 77	
				[261] Rf rutherfordium 104	51 V vanadium 23	103 Rh rhodium 45	192 Ir iridium 77	
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