

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE**

A217/02

ADDITIONAL SCIENCE A

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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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

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

3

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Question 1 starts on page 4

PLEASE DO NOT WRITE ON THIS PAGE

4

Answer **all** the questions.

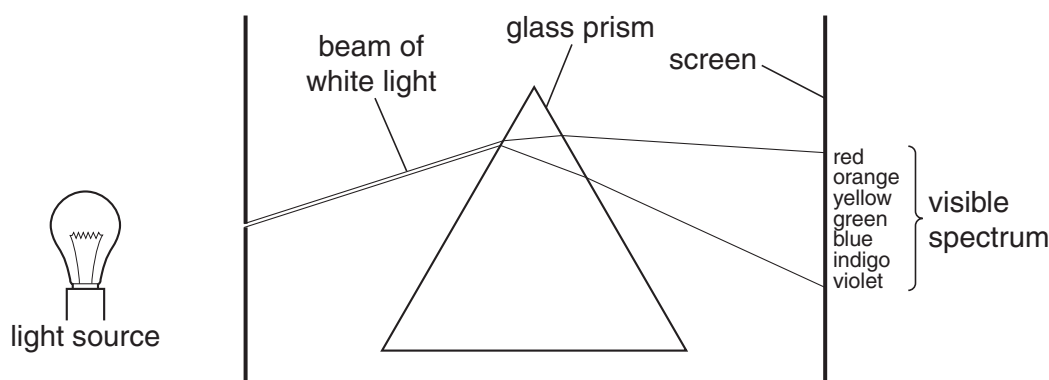
1 Isaac knows that light is made of waves.

(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.
	... is transferred by the transfer of matter.
The amplitude of a light wave ...	... is the maximum value of its disturbance.
	... is transferred without the transfer of matter
The wavelength of a light wave ...	... 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 notices 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]

5

- (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?

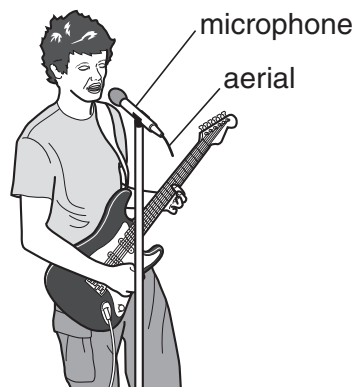
- A** intensity = photon energy $\times$ photon rate
- B** intensity = photon power $\times$ photon speed
- C** intensity = photon speed $\times$ photon frequency
- D** intensity = photon amplitude $\times$ photon wavelength

answer [1]

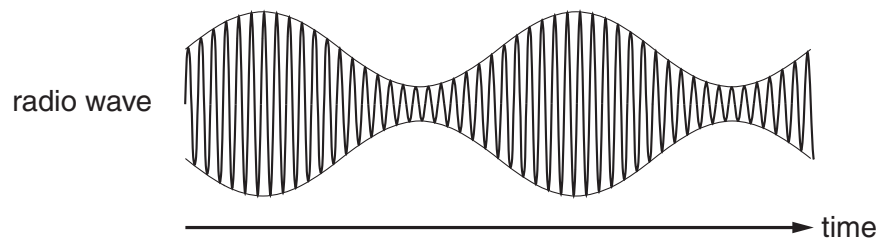
[Total: 6]

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]

7

(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.

.....

.....

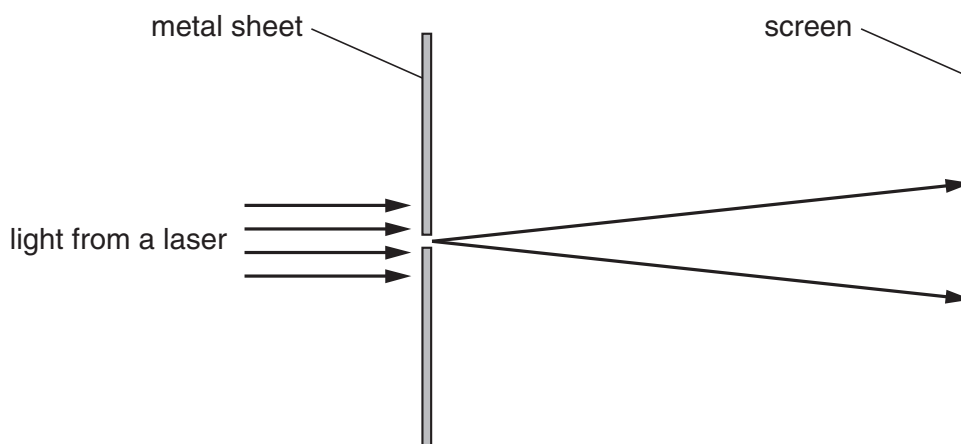
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..... [3]

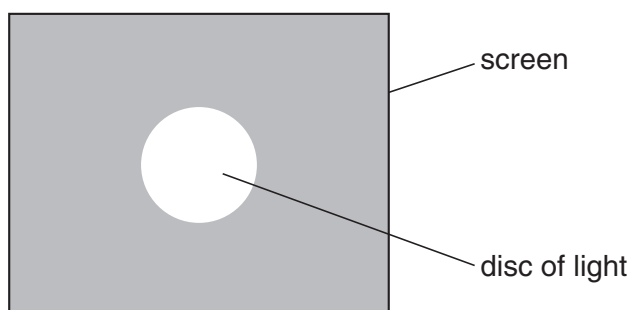
[Total: 4]

8

- 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 that passes through the hole 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.

☐

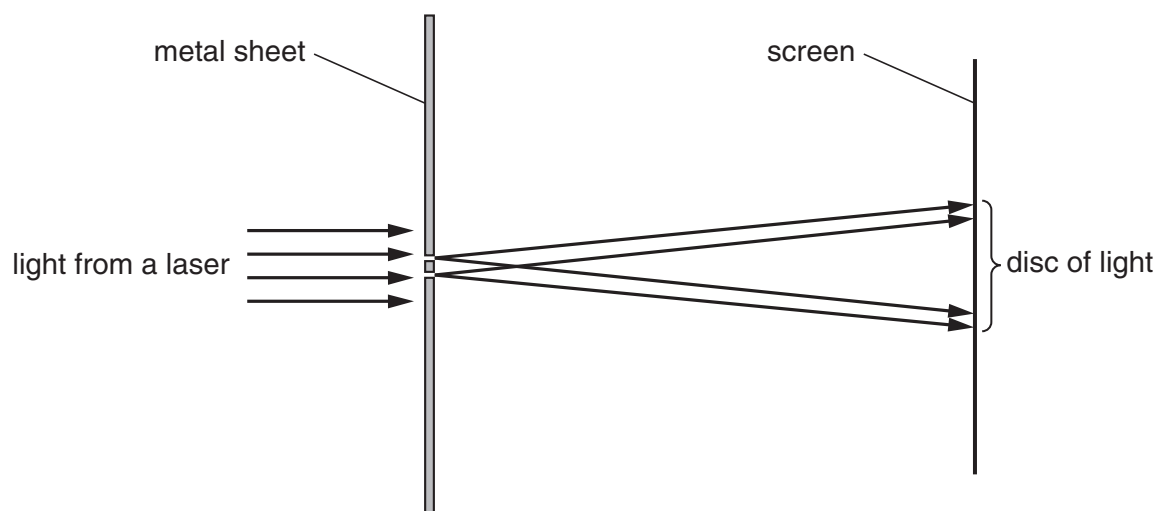
The amplitude of the light is much smaller than the size of the pinhole.

☐

[2]

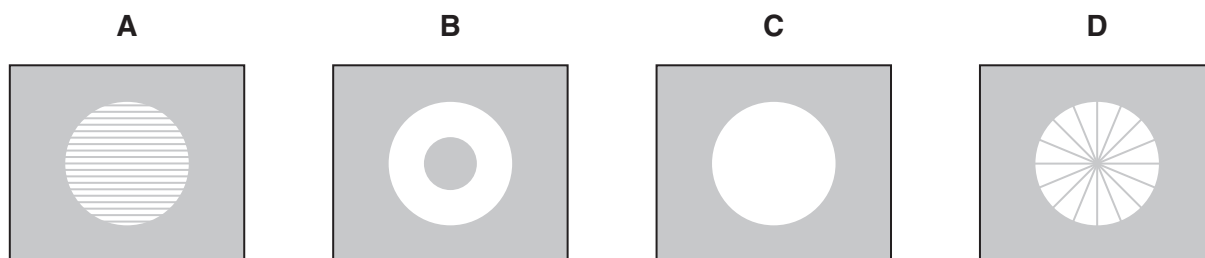
9

(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.

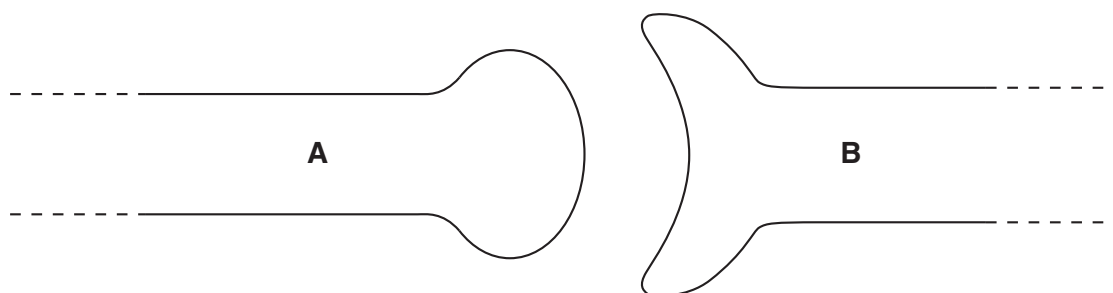


Which pattern, **A**, **B**, **C** or **D**, will Thomas see?

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 alters the concentration of serotonin.

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

effect of Ecstasy

increases serotonin release from neuron **A**

reduces serotonin removal by neuron **A**

reduces serotonin release from neuron **A**

increases serotonin removal by neuron **A**

consequence

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's chances of survival.

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]

13

- (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]

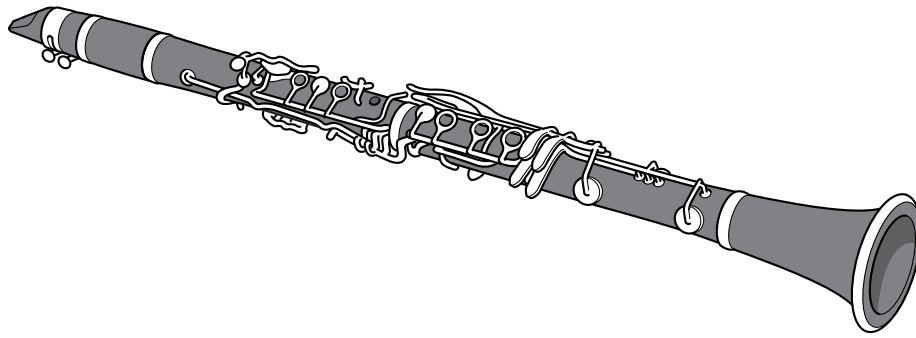
[Total: 7]

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15

- 6 Colin plays his clarinet in a school concert.



He has to practise playing to be able to 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 25.0 cm^3 of the alkali solution.

She puts 25.0 cm^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.

☐

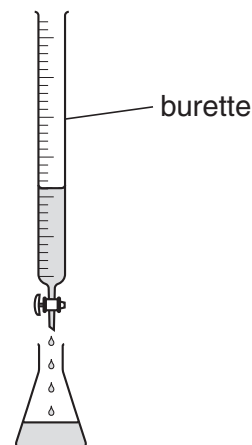
Not all the sodium hydroxide reacts.

☐

The sodium hydroxide contained impurities.

☐

[1]



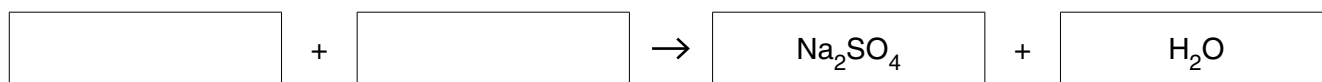
17

(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]

19

(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 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.