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**A217/02**

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

Unit 3 Modules B6 C6 P6 (Higher Tier)

**TUESDAY 29 JANUARY 2008**

Afternoon

Time: 40 minutes



Candidates answer on the question paper

**Additional materials (enclosed):**

None

Calculators may be used

**Additional materials:** Pencil

Ruler (cm/mm)



Candidate  
Forename

Candidate  
Surname

Centre  
Number

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Candidate  
Number

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**INSTRUCTIONS TO CANDIDATES**

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

**INFORMATION FOR CANDIDATES**

- The number of marks for each question 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 two.
- The Periodic Table is printed on the back page.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	4	
2	5	
3	5	
4	4	
5	7	
6	3	
7	4	
8	5	
9	5	
<b>TOTAL</b>	<b>42</b>	

This document consists of **19** printed pages and **1** blank page.

## 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

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

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

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

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

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

## The Wave Model of Radiation

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

**Question 1 starts on page 4**

**PLEASE DO NOT WRITE ON THIS PAGE**

Answer **all** the questions.

1 Jo uses a microwave oven to heat her dinner.



(a) These sentences are about the microwave oven.

Draw a straight line from the **start** of each sentence to its correct **end**.

**start**

The microwaves interfere ...

**end**

... by the water in the food.

The microwaves are reflected ...

... when they pass through a gap.

The microwaves are diffracted ...

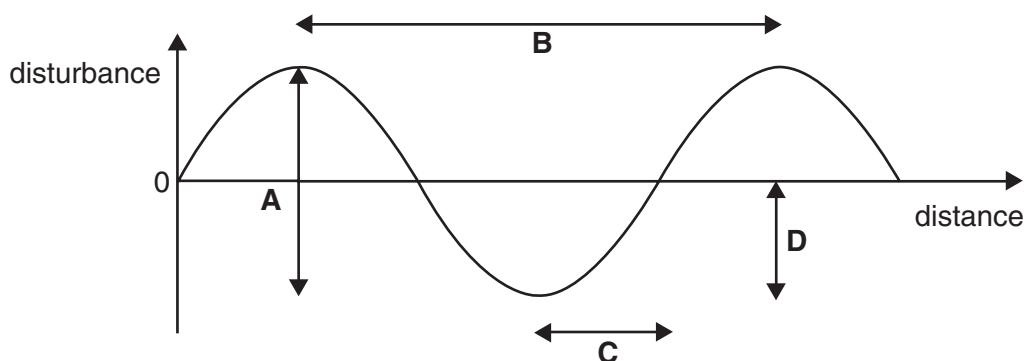
... by the metal walls of the oven.

The microwaves are absorbed ...

... where they overlap with each other.

[3]

(b) This graph shows a microwave.



Which distance, **A**, **B**, **C** or **D**, is the wavelength of the microwave?

answer ..... [1]

[Total: 4]

2 Isobel uses a remote control to adjust her TV set.



(a) The remote control uses a beam of infrared to carry information to the TV set.

Finish the sentences by choosing the **best** words from this list.

colour  
energy  
photons  
strength  
intensity  
momentum

The ..... of the beam is the energy it delivers per second.

Its value depends on the number of ..... put into the beam each second, as well as their .....

[2]

(b) The infrared is modulated each time that Isobel presses a button on the remote control. The beam is pulsed on and off in a code, with a different code for each button.

Draw a straight line from the **start** of each sentence to its correct **end**.

**start**

Each pulse represents ...

**end**

... a 0 in the code.

... a 1 in the code.

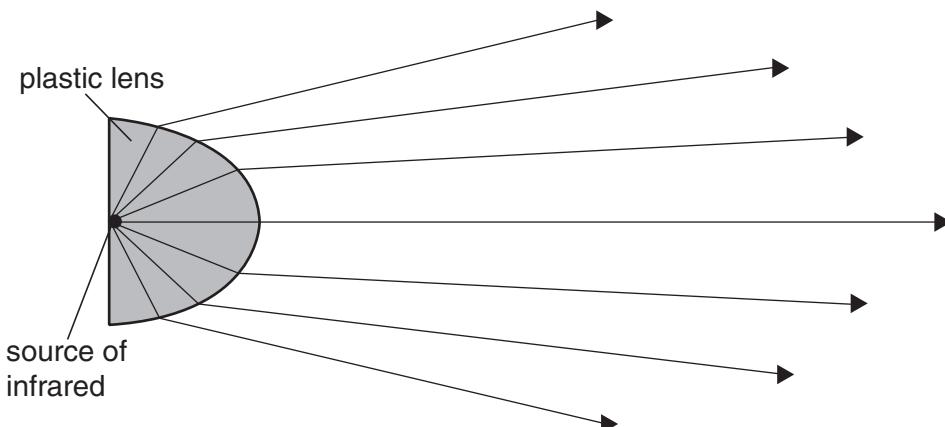
... information as a digital code.

The pulsed infrared beam transfers ...

... information as an analogue code.

[1]

(c) An LED is the source of the infrared in the remote control.



The LED is enclosed in a plastic lens.

(i) As the infrared leaves the plastic, most of it changes direction.

What is the name of this process?

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

**diffraction**

**reflection**

**refraction**

**rotation**

[1]

(ii) Which **one** of these statements explains the change of direction?

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

The infrared spreads out as it leaves the lens.

The infrared rotates against the plastic as it reflects off the air.

The infrared speeds up as it moves from the plastic into the air.

The infrared slows down as it moves from the plastic into the air.

[1]

[Total: 5]

3 Jenny is a presenter for Radio CA.



(a) Jenny sings into the microphone.

(i) The speed of sound waves in the studio is 340 m/s.  
 Jenny sings a note of frequency 680 Hz.  
 Which of these calculations gives the wavelength of her sound?

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

$$\frac{680}{340}$$

$$680 \times 340$$

$$\frac{340}{680}$$

[1]

(ii) Here are some statements about sound waves.  
 Some of these statements are true. Some are false.

Write **T** in the box next to each **true** statement and **F** in the box next to each **false** one.

**T** (true)  
 or  
**F** (false)

**The disturbance of a sound wave ...**

... and its energy flow are in the same direction.

... increases in amplitude as the sound gets louder.

... is at right angles to the wave's direction of energy flow.

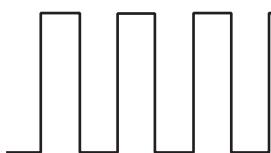
[1]

10

(b) Information in the sound wave modulates the radio wave from the transmitter.

(i) Which diagram represents frequency modulation of the radio wave?

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



[1]

(ii) Complete these sentences. Choose words from this list.

**regular**  
**random**  
**amplified**  
**analogue**  
**amplitude**  
**modulated**  
**wavelength**

The frequency modulated radio wave is an ..... signal.

As it moves away from the transmitter its ..... decreases.

The radio wave also picks up ..... signals called noise.

This is still present when the signal is ..... at the receiver.

[2]

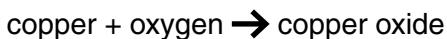
[Total: 5]

4 Jane has some copper.  
She uses this to make copper sulfate.

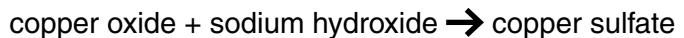
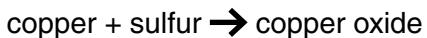
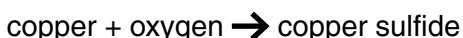
(a) Jane uses one reaction from the **first** list and one from the **second** list.

Draw **one** straight line from the correct **first** reaction to the correct **second** reaction.

**first**



**second**



[2]

(b) The copper sulfate Jane makes is not pure.  
She uses these four steps to purify the copper sulfate.

They are in the wrong order.

- A drying
- B filtration
- C dissolving
- D crystallisation

Fill in the boxes to show the right order. The first one has been done for you.

C			
---	--	--	--

[2]

[Total: 4]

5 Michael reacts magnesium with sulfuric acid.



(a) Use relative atomic masses from the Periodic Table on the back page of this booklet to answer the following questions.

(i) What mass of hydrogen is produced when 24 g of magnesium react with an excess of sulfuric acid?

mass of hydrogen = ..... g [1]

(ii) What is the relative formula mass of magnesium sulfate,  $\text{MgSO}_4$ ?

relative formula mass = ..... [1]

(iii) What mass of magnesium sulfate is produced when 3 g of magnesium react with an excess of sulfuric acid?

mass of magnesium sulfate = ..... g [1]

(b) Michael works out that his reaction should produce 8 g of magnesium sulfate. In fact it only produces 2 g.

Put a (ring) around the percentage yield for this reaction.

16%

25%

40%

60%

[1]

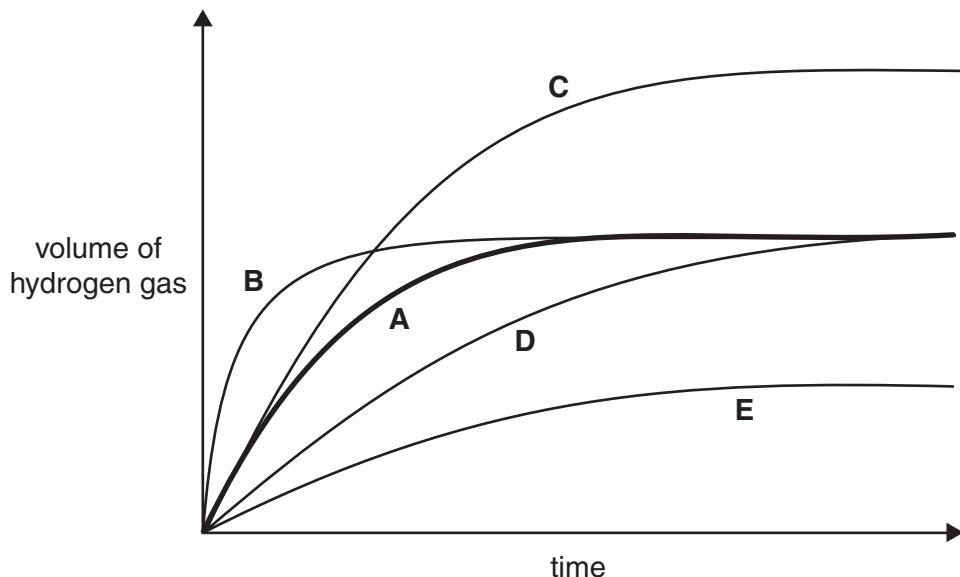
(c) Michael reacts magnesium with an excess of sulfuric acid at 20 °C.

He measures the volume of hydrogen gas given off at intervals of time.

He repeats the experiment five times, changing **one** of the conditions used each time.

He plots a graph for each reaction, **A**, **B**, **C**, **D** and **E**.

The line for Michael's first experiment at 20 °C is marked **A**.



13

(i) He carries out one reaction at 40 °C.  
Which line, **B**, **C**, **D** or **E**, shows this reaction?

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

**B****C****D****E**

[1]

(ii) In one reaction he uses more magnesium.  
Which line, **B**, **C**, **D** or **E**, shows this reaction?

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

**B****C****D****E**

[1]

(iii) In one reaction he uses the same mass of magnesium, but in larger pieces.  
Which line, **B**, **C**, **D** or **E**, shows this reaction?

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

**B****C****D****E**

[1]

[Total: 7]

6 Dave reacts copper carbonate with nitric acid.

(a) The reaction produces carbon dioxide, water and another product.

Give the name and formula of the other product.

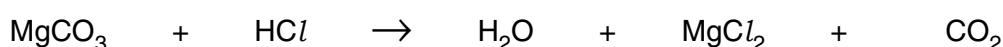
name .....

formula .....

[2]

(b) He then reacts magnesium carbonate with hydrochloric acid.  
This produces magnesium chloride,  $MgCl_2$ .

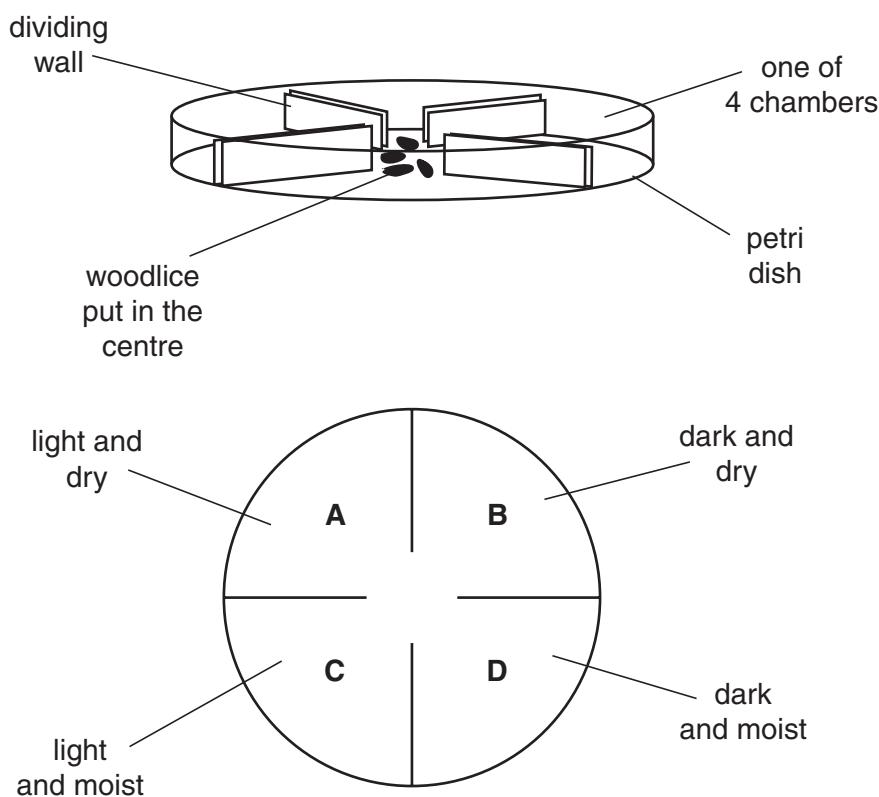
Balance this equation for the reaction.



[1]

[Total: 3]

7 Charlie carries out an experiment using woodlice. He puts 20 woodlice into the centre of a petri dish so that they can move freely into four chambers, **A**, **B**, **C** and **D**. Each chamber has different conditions.



After five minutes, Charlie counts the woodlice in each chamber. He records his results in a table.

chamber	chamber conditions	number of woodlice
<b>A</b>	light and dry	1
<b>B</b>	dark and dry	6
<b>C</b>	light and moist	4
<b>D</b>	dark and moist	9

(a) What is the percentage of woodlice found in chamber **D**?

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

9%

20%

45%

90%

[1]

15

(b) Put a tick (✓) in the box next to **each** statement which could be used to explain the behaviour of the woodlice in the experiment.

Woodlice are attracted to light.

Woodlice are attracted to shade more than to moisture.

Woodlice avoid too much moisture.

Woodlice may dry out easily.

[2]

(c) The behaviour pattern of the woodlice shown in this experiment is a reflex action.

Finish the sentence. Choose a word from this list.

**complex**

**involuntary**

**voluntary**

Simple reflexes produce rapid ..... responses.

[1]

[Total: 4]

8 This question is about synapses between sensory and motor neurons.

(a) Here are the steps which take place at a synapse as an impulse passes from a sensory neuron to a motor neuron.

They are in the wrong order.

- A chemical released into the synapse
- B chemical diffuses across the synapse
- C motor neuron transmits an impulse
- D sensory neuron transmits an impulse
- E chemical binds to the receptor molecules

Fill in the boxes to show the right order. The first one has been done for you.

D				
---	--	--	--	--

[3]

(b) The drug ecstasy blocks the removal of the synapse chemical serotonin.

How will this affect the amount of serotonin in the synapse gap between two neurons?

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

same amount of serotonin

increased amount of serotonin

decreased amount of serotonin

[1]

(c) Synapse chemicals, like serotonin, are recognised by a specific receptor molecule found on one side of the synapse.

How does this affect the transmission of nerve impulses?

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

The strength of the nerve impulse is increased.

The nerve impulses can only travel in one direction.

The speed of the nerve impulse transmission is increased.

[1]

[Total: 5]

9 The Russian scientist Ivan Pavlov is famous for his work with learned behaviour in dogs.

His experiments included the following steps.

- A dog salivates when given food.
- A bell is rung each time the dog is fed.
- After some time, the bell is rung without giving the dog food.
- The dog salivates when it hears the bell.

(a) What is the function of each step?

Draw a straight line from each **step** to its correct **function**.

step	function
bell ringing	primary stimulus
food given	response
dog salivating	secondary stimulus

[1]

(b) Which part of the dog's brain is involved in learned behaviour patterns?

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

**hypothalamus**

**pituitary gland**

**medulla**

**cerebral cortex**

[1]

(c) Which of the following types of behaviour are learned?

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

Some bacteria can swim towards sources of food.

Some birds may avoid eating caterpillars with warning colours.

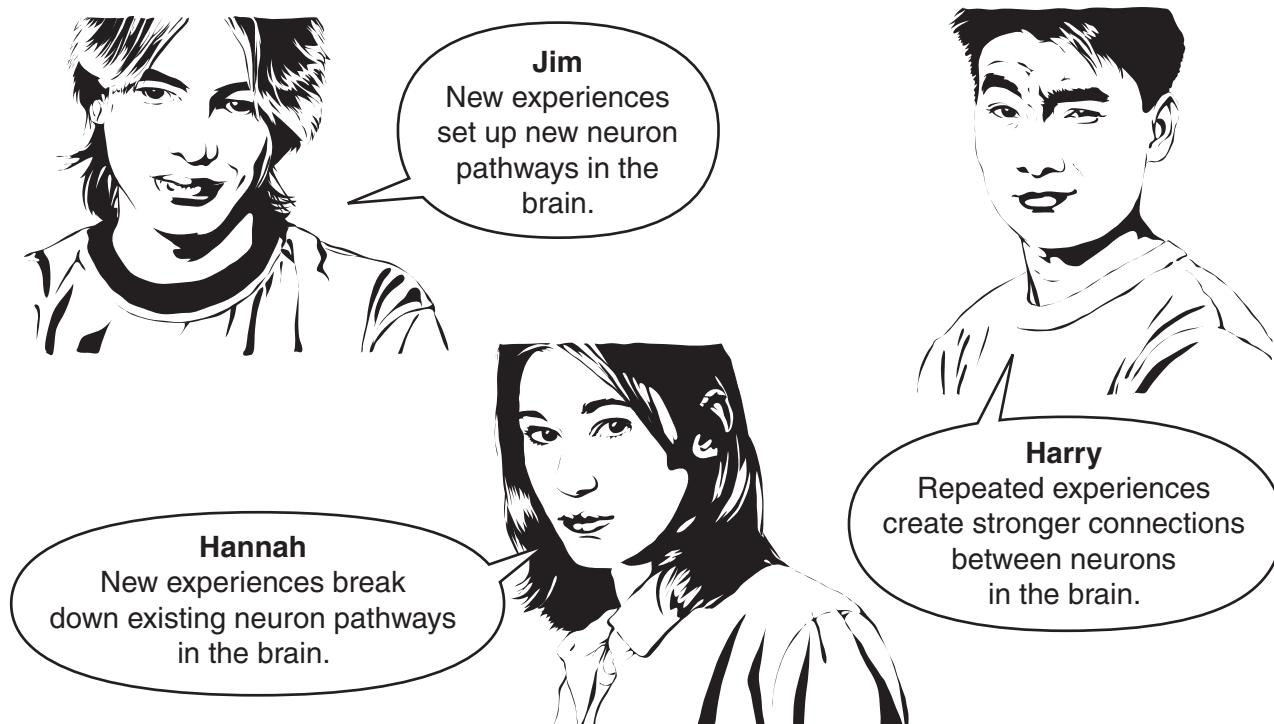
Houseflies fly rapidly away if they detect any sign of movement.

Snails draw into their shells if they detect any sign of movement.

Goldfish may swim to the front of their tank when people walk up to feed them.

[2]

(d) Three friends discuss different ways of explaining what happens in the human brain when we learn.



Put a **ring** around the names of the **two** people with the **best** explanations.

Jim

Hannah

Harry

[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
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 aluminum 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
85 Rb rubidium 37	88 Sr strontium 38	91 Y yttrium 39	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45
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
[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	[268] Mt meitnerium 109
				[277] Hs hassium 108	[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

20

\* 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.