OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A216/02

Unit 2: Modules B5 C5 P5
(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 24 June 2009
Morning

Duration: 40 minutes

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use 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.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

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

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

Electric Circuits

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

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

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

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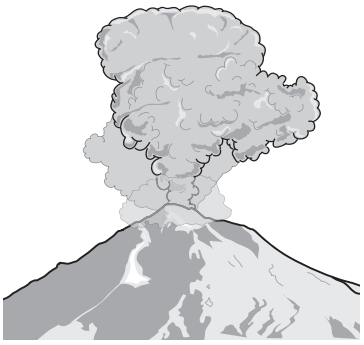
Question 1 starts on page 4.

PLEASE DO NOT WRITE ON THIS PAGE

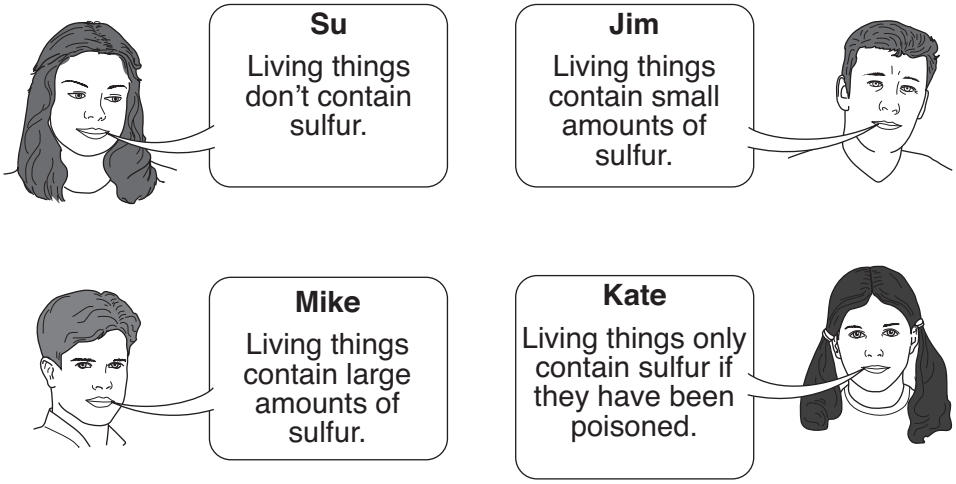
Answer **all** the questions.

1 Erupting volcanoes give out a mixture of gases.



(a) Some of the gases from a volcano are sulfur compounds.

Mary asks her friends if sulfur is in living things.



Who gives the **best** answer?

answer ..... **[1]**

(b) Sulfur dioxide is just one of the sulfur compounds emitted by volcanoes.
Sulfur dioxide is made of small SO_2 molecules.

Put a (ring) around each of the correct terms in this passage.

The atoms in sulfur dioxide molecules are held together by **ionic** **covalent** **metallic** bonding.

These bonds are formed when electrons are **shared** **totally transferred** between atoms.

The bonds between the atoms in a sulfur dioxide molecule are **strong** **weak**.

Each nucleus is attracted to **another nucleus** **the electrons in between**. **[2]**

(c) Mary knows that sulfur compounds move between the atmosphere and the lithosphere in a cycle. She uses the information in the statements below to draw a sulfur cycle.

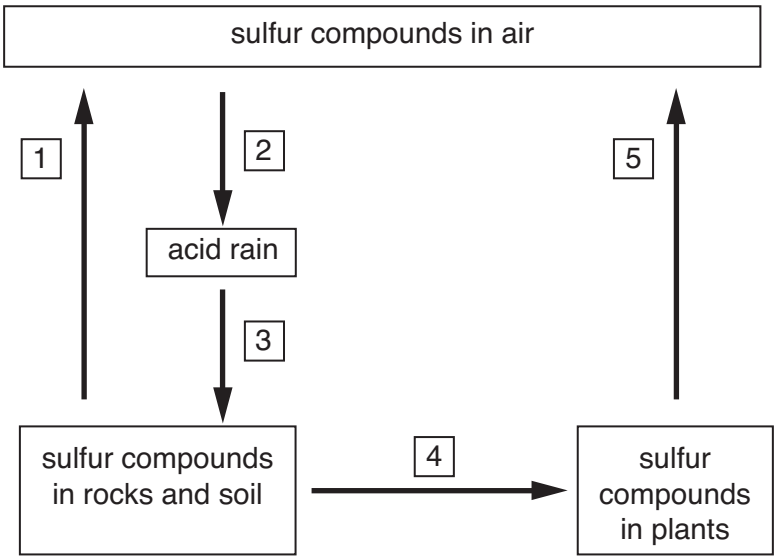
A Sulfur compounds in sediments are taken up by plants.

B Sulfur compounds get into the air from erupting volcanoes.

C Sulfur compounds in acid rain end up in sediments, which form solid rock.

D Sulfur compounds get into the air when we burn fuels such as wood or coal.

E Sulfur compounds in the air dissolve in rainwater to make acid rain.



Fill in the table below to show which statement letter **A**, **B**, **C**, **D** or **E** fits which arrow number **1**, **2**, **3**, **4** or **5**.

arrow number	1	2	3	4	5
statement letter					

[2]

(d) Sulfur is present in two of the amino acids that make up proteins.
These are cysteine and methionine.
Cysteine contains a higher percentage of sulfur by mass than methionine.

cysteine	methionine
$C_3H_7NO_2S$	$C_5H_{11}NO_2S$
26.4% sulfur	**21.5% sulfur**

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

A molecule of cysteine contains more sulfur atoms than a molecule of methionine. ☐

The mass of sulfur atoms in a molecule of cysteine is greater than the mass of sulfur atoms in a molecule of methionine. ☐

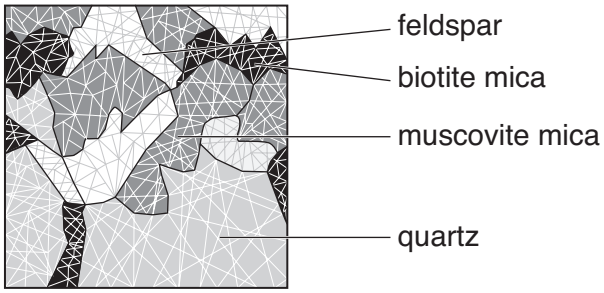
The formula mass of cysteine is greater than the formula mass of methionine. ☐

A molecule of cysteine contains fewer carbon and hydrogen atoms than a molecule of methionine. ☐

[1]

[Total: 6]

2 Molten rock sometimes cools to form granite.



(a) Granite contains crystals of different minerals.

One of these minerals is mainly made of silicon dioxide.

The other minerals are more complicated compounds of silicon.

Put a (ring) around the **one** mineral that is mainly made of silicon dioxide.

biotite mica **feldspar** **muscovite mica** **quartz** **[1]**

(b) Here are some statements about silicon dioxide.

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

It is soft.	☐
It has a low boiling point.	☐
It has a high melting point.	☐
It does not dissolve in water.	☐
It conducts electricity when solid.	☐

[2]

[Total: 3]

3 Mark knows that carbon will take the oxygen away from many metal oxides.

(a) Put numbers in the boxes to balance the equation for the formation of zinc from zinc oxide.

$$\square\ ZnO + C \rightarrow \square\ Zn + CO_2$$ **[1]**

(b) Mark finds that the reaction does **not** work for magnesium oxide.

Put a tick (✓) in the box next to each of the **two** most likely reasons for this.

He doesn't heat the reactants enough to make the reaction start.	☐
Magnesium is too reactive to be extracted this way.	☐
Magnesium oxide is too reactive to be extracted this way.	☐
Magnesium has too high a melting point.	☐
Magnesium oxide has too low a melting point.	☐
The surface area of the magnesium oxide is too great.	☐
The magnesium oxide is too hot.	☐
Carbon is not reactive enough.	☐

[2]

(c) He finds out that magnesium can be extracted by electrolysis.

One way might be to electrolyse molten magnesium oxide.

Choose terms from this list to complete the sentences.

molecules ions atoms giant structures gain lose share

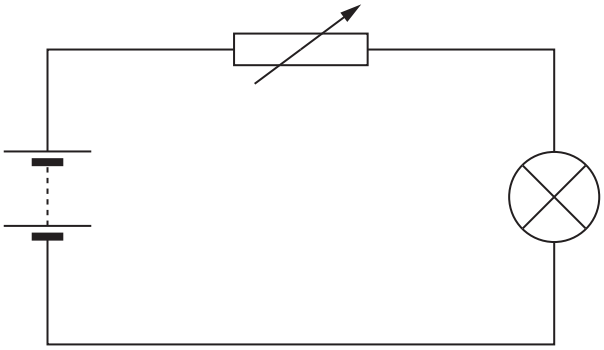
The oxygen particles in the electrolyte are in the form of ..... .

They move to an electrode where they .....electrons to form neutral atoms.

The neutral atoms then combine to form ..... . **[2]**

[Total: 5]

4 Sylvia sets up this circuit.

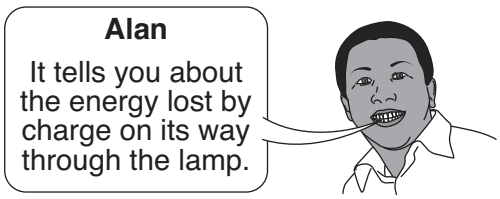


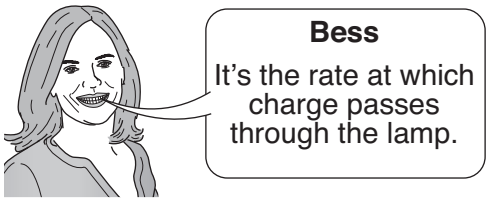
(a) Sylvia decides to measure the potential difference **across the lamp**.

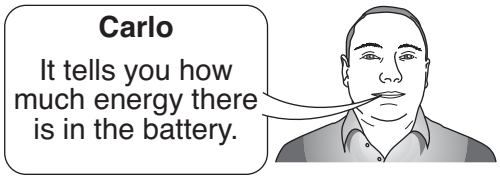
Draw on the circuit diagram to show how she connects a voltmeter.

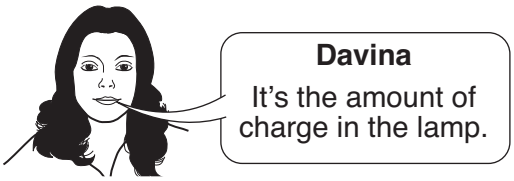
Use the correct symbol. **[1]**

(b) The voltmeter across the lamp reads 4 V. Sylvia asks her friends what this means.









Who has the **best** answer?

answer ..... **[1]**

(c) (i) Sylvia adjusts the variable resistor.

These four sentences explain why the brightness of the lamp changes.

They are in the **wrong** order.

A The lamp gets dimmer.

B The power of the lamp decreases.

C The current in the resistor decreases.

D The resistance of the circuit increases.

Put the sentences in the **correct** order. The last one has been done for you.

			A

[1]

(ii) Complete the sentences for the variable resistor.

Choose words from this list.

decreases **increases** **stays the same**

Sylvia adjusts the variable resistor.

The current in the variable resistor decreases.

The voltage across the variable resistor ..... .

The voltage across the battery ..... . **[1]**

[Total: 4]

5 Brian has an electric toothbrush.

He connects it to the mains supply through a transformer.

(a) Here is a description of a transformer.

Put a (ring) around the correct word in each pair.

A transformer has two coils of wire.

The wire is made of **copper** **iron** and is coated with a layer of **conductor** **insulator**.

The wire is wound around a core made of **copper** **iron**.

The core should have the shape of a **ring** **rod**. **[1]**

(b) The transformer reduces the 230 V mains supply to 4.6 V for the toothbrush.

The primary coil has 460 turns of wire.

How should Brian calculate the number of turns of wire in the secondary coil?

Put a (ring) around the correct answer.

$\frac{230}{460} \times 4.6 = 2$ $\frac{4.6}{230} \times 460 = 9$ $\frac{230}{4.6} \times 460 = 23\,000$ $460 \times 230 \times 4.6 = 486\,680$

[1]

(c) The sentences below explain how a transformer works.
They are in the **wrong** order.

A There is a current in the toothbrush motor.

B The current in the primary coil changes.

C The magnetic field in the core changes.

D The voltage across the primary coil changes.

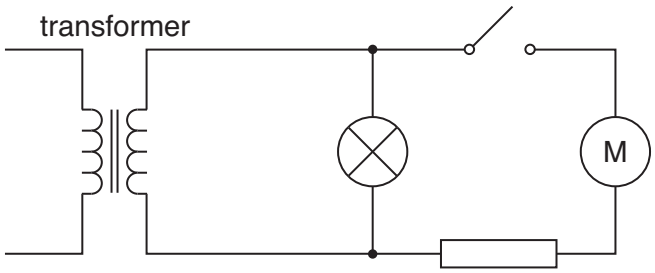
E A voltage is induced across the secondary coil.

Put the sentences in the correct order.
The last one has been done for you.

				A

[2]

(d) Here is the circuit diagram for Brian's toothbrush.



The table shows the current in some of the components when the switch is open and closed.
Not all of the readings have been filled in.

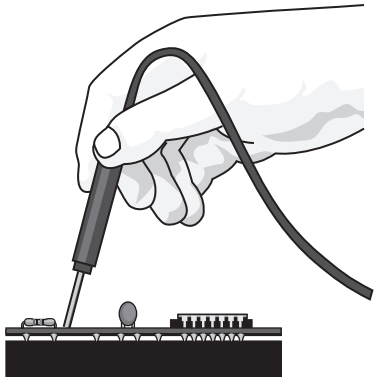
Complete the table to show the three missing readings.

state of switch	resistor current in amps	motor current in amps	lamp current in amps
open			0.3
closed	0.5		0.3

[1]

[Total: 5]

6 Joe tests a circuit from his computer.



He needs to be careful. The chips in the circuit are easily damaged by static electricity.

(a) Complete the sentences. Choose the **best** words from the list.

atoms

conductors

electrons

insulators

particles

placed

pushed

rubbed

transformers

Objects can become charged when they are ..... against each other.

This allows ..... to be transferred from one to another.

For this to happen, both objects must be ..... .

[2]

(b) Joe becomes negatively charged when he walks across the floor to his circuit.

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

Joe is now a source of alternating voltage.	☐
The floor has become positively charged.	☐
Joe is now surrounded by a magnetic field.	☐
The floor must be made of a conducting material.	☐
Joe now repels other objects which are negatively charged.	☐

[1]

(c) Joe now touches his circuit and damages it.

Use straight lines to connect each **start** of a sentence to its correct **end**.

start	end
The flow of charge from Joe is…	… a voltage in the circuit.
	… no electrons free to move.
The insulators in the circuit have …	… plastic coating around them.
	… lots of electrons free to move.
The conductors in the circuit have …	… an electric current in the circuit.

[2]

[Total: 5]

7 **(a)** The cell cycle can be divided into **cell growth** and **mitosis**.

Put a (ring) around the **best** word to complete each sentence.

During cell growth, the number of **nuclei** **organelles** **cells** increases.

The **chromosomes** **proteins** **nuclei** are copied.

During mitosis, pairs of chromosomes **fuse** **separate** **fragment**.

Each cell forms **two** **four** **eight** new cells.

[3]

(b) **Meiosis** is another way that cells can divide.

Here are some statements about the results of mitosis and meiosis.

Put **one** tick (✓) in each row in the correct box.

statement	true for mitosis	true for meiosis	true for both
number of chromosomes in daughter cells decreases			
daughter cells are identical to parent cell			
can produce gametes			
the number of cells increases			
daughter cells are identical to each other			

[4]

[Total: 7]

8 Cells contain the genetic code for making proteins.

(a) Why does a hair cell produce the protein keratin but not the protein haemoglobin?

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

The gene for haemoglobin has been destroyed.	☐
The gene for keratin is more dominant than the gene for haemoglobin.	☐
The gene for haemoglobin is not active.	☐
The cell does not contain the haemoglobin gene.	☐

[1]

(b) DNA contains four different bases.

These bases control which protein is made.

Which three statements **best** explain this.

A Each base reacts with an acid.

B Each amino acid is coded for by three bases.

C Proteins are coded for by three amino acids.

D The protein made depends on the order of amino acids.

E The bases make a copy of the protein and then reproduce it.

F The order of the amino acids depends on the order of the bases.

G The order of the bases can change depending on the conditions.

H A DNA molecule changes its base order in order to make different proteins.

statements ..... and ..... and ..... **[2]**

[Total: 3]

9 New plants can be grown from cuttings.

(a) Complete the sentences to explain how this happens.

Choose words from the list.

auxins
dormant
enzymes
fertilisers
organ
specialised
tissue
unspecialised
xylem

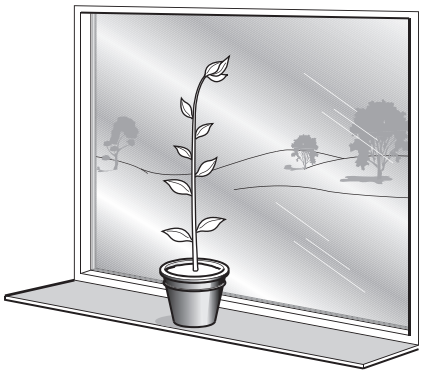
To grow a plant from a cutting the gardener first cuts off part of a plant shoot.

The cut end of the shoot is dipped into hormones called ..... .

The hormones act on ..... cells within the stem to make them develop into roots. Roots are just one type of ..... within a plant. **[3]**

(b) The hormones can also control the direction of growth.

This plant is receiving light from only one side.



Which statement correctly explains why the shoot tip grows towards the light?

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

The side nearest the light has more hormone so it grows slower. ☐

The side nearest the light has less hormone so it grows faster. ☐

The side furthest from the light has more hormone so it grows faster. ☐

The side furthest from the light has more hormone so it grows slower. ☐ **[1]**

[Total: 4]

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.