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)

CUP/T63225

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)

Friday 23 January 2009
Morning

Duration: 40 minutes

A216O2

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

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.

FOR EXAMINER'S USE	
1	4
2	5
3	5
4	5
5	4
6	5
7	4
8	4
9	3
10	3
TOTAL	42

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

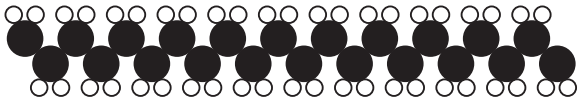
wave speed = frequency × wavelength

Answer **all** the questions.

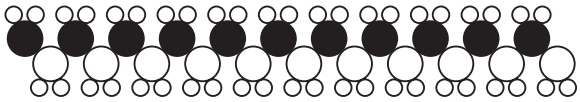
1 Mary draws some chemical structures **A**, **B**, **C**, **D** and **E**.

A

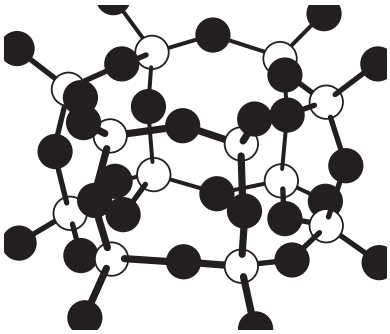
B



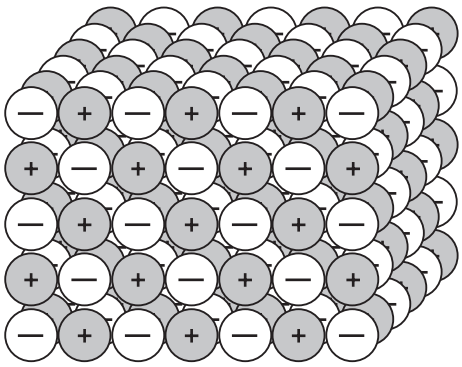
C



D



E



(a) Which structure, **A**, **B**, **C**, **D** or **E**, is most likely to contain a chain of carbon atoms?

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

(b) Which structure, **A**, **B**, **C**, **D** or **E**, will have the lowest boiling point?

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

(c) Which structure, **A**, **B**, **C**, **D** or **E**, is part of a covalent giant structure?

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

(d) Which structure, **A**, **B**, **C**, **D** or **E**, is part of an ionic giant structure?

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

[Total: 4]

2 Henry draws a table of some of the elements that might be in his body.

(a) Some of the elements in this table are very common in his body.
Others are only present in smaller amounts.

Put a tick (✓) in each row of the table to show how common each element is in his body.

element	very common	smaller amounts
carbon		
hydrogen		
nitrogen		
oxygen		
phosphorus		
sulfur		

[2]

(b) One type of compound is called an amino acid.

There are different ways of writing the formula of an amino acid.

amino acid	simplified structural formula	molecular formula
A	CH_3 | NH_2—CH—COOH	$C_3H_7O_2N$
B	 | NH_2—CH—COOH	$C_2H_5O_2N$
C	CH_2SH | NH_2—CH—COOH	
D	CH_2COOH | NH_2—CH—COOH	$C_4H_7O_4N$

(i) Complete the **simplified structural formula** of acid **B** in its box. **[1]**

(ii) Write the molecular formula of acid **C** in its box. **[1]**

(iii) Rotting hair smells of hydrogen sulfide, the smell of bad eggs.
The hydrogen sulfide comes from one of the amino acids **A**, **B**, **C** or **D** in the table.

Which one?

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

[Total: 5]

3 Electric wires are usually made of copper because copper is a good electrical conductor.

(a) How is electricity conducted through copper?

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

Anions move to the anode, cations to the cathode.	☐
Positive ions move through the lattice.	☐
Electrons move between ions in the lattice.	☐
Electrons move between atoms in the lattice.	☐
Atoms vibrate within the lattice.	☐

[1]

(b) Copper is extracted from its ore using a blast furnace.
The blast furnace melts all the reactants and allows them to react.
One reaction that takes place is that of molten copper sulfide with molten copper oxide to produce molten copper and sulfur dioxide gas.

Complete the reaction by putting state symbols into the brackets.

$$Cu_2S\ [.....] + 2Cu_2O\ [.....] \rightarrow 6Cu\ [.....] + SO_2\ [.....]$$

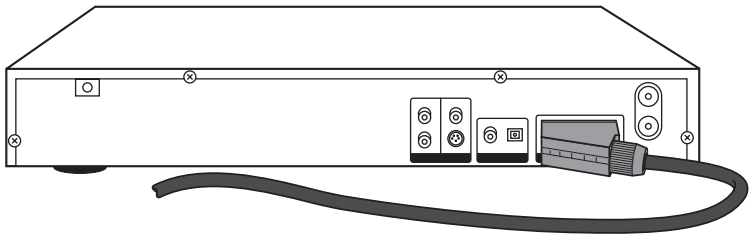
[1]

(c) Another of the reactions that takes place is

$$2Cu_2S + \square\ O_2 \rightarrow \square\ Cu_2O + \square\ SO_2$$

Complete the boxes to balance the equation. **[1]**

(d) The cable connecting a TV to a DVD player sometimes has gold plated contacts.



There are two different reasons why the gold is used for contacts.

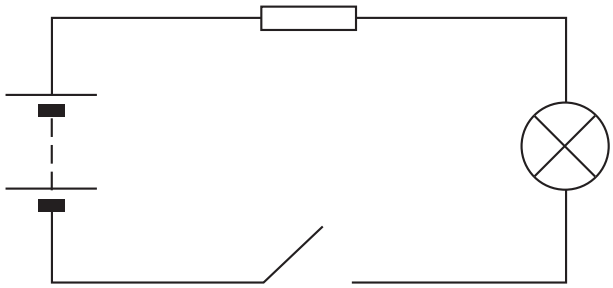
Put ticks (✓) in the boxes next to the **two** best reasons why gold is used for contacts.

Gold bends easily.	☐
Gold is a very unreactive metal.	☐
Gold is the same colour as copper.	☐
Gold is a rare metal.	☐
Gold can be plated very thinly.	☐
Gold holds its outer electrons quite weakly.	☐

[2]

[Total: 5]

4 Geoff builds this circuit.



(a) The lamp only lights when the switch is closed.

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

The open switch has a very low resistance.	☐
The switch is connected in parallel with the resistor.	☐
The closed switch allows the battery to make a voltage.	☐
The closed switch allows charge to flow through the lamp.	☐

[1]

(b) Complete the sentences below.

Choose words from this list.

current **moving** **oscillating** **power** **stationary** **voltage**

The lamp gets hotter when it has an electric ..... passing through it.

This is caused by collisions between ..... electrons and ..... atoms.

[2]

(c) Geoff's circuit has a resistance of 3.0 Ω and a current of 1.5 A.

How should Geoff calculate the voltage of the battery?

Put a (ring) around the answer.

$\frac{3.0}{1.5}$ **3.0 × 1.5** $\frac{1.5}{3.0}$

[1]

(d) Why is there a resistor in the circuit?

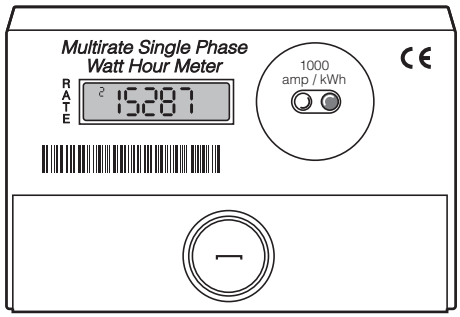
Put a tick (✓) in the box next to the correct reason.

The resistor keeps the current in the lamp at the correct value.	☐
The lamp needs more current than the battery can supply on its own.	☐
The battery doesn't have a big enough voltage to make the lamp light.	☐
The resistor stops the voltage from reaching the switch, making it safe to touch.	☐

[1]

[Total: 5]

5 Lucinda reads her electricity meter.



(a) Why is the energy transfer measured in kilowatt-hours instead of joules?

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

The joule is a very small amount of energy. ☐

It tells you how much electricity is being used moment by moment. ☐

Each type of energy transfer has its own special unit of measurement. ☐

The meter design can't be adapted to measure energy transfers in joules. ☐

[1]

(b) Lucinda uses her 2.1 kW heater for 3 hours. Each kilowatt-hour costs 8p.

(i) What is the correct way of calculating how many pence it costs to use the heater?

Put a (ring) around the answer.

2.1 x 3 x 8 $\qquad \frac{2.1}{3} \times 8 \qquad \frac{3}{2.1} \times 8$

[1]

(ii) The 2.1 kW heater produces 6 kWh of heat energy in 3 hours.

Who has the correct way of calculating the percentage efficiency of the heater?

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

(c) Complete the sentence. Choose a word from the list.

charge **power** **resistance** **voltage**

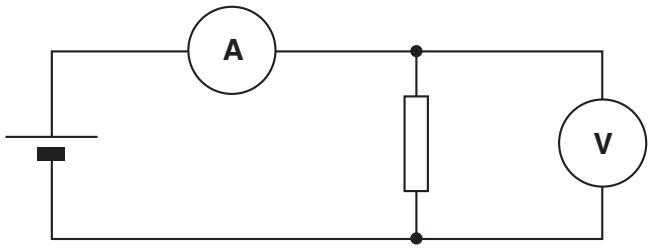
Lucinda's electricity meter measures the energy transferred as ..... passes through the heater.

[1]

[Total: 4]

6 Isla uses this circuit to test a resistor.

She measures the current and the voltage.



(a) The ammeter reads 0.3 A.
The voltmeter reads 1.2 V.

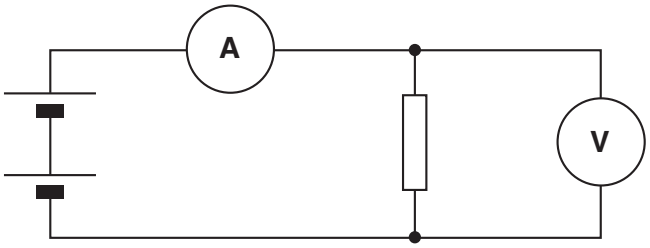
What is the power of the resistor?

Put a (ring) around the correct answer.

1.5 W **0.25 W** **0.36 W** **4.0 W**

[1]

(b) Isla puts another cell in her circuit, as shown below.



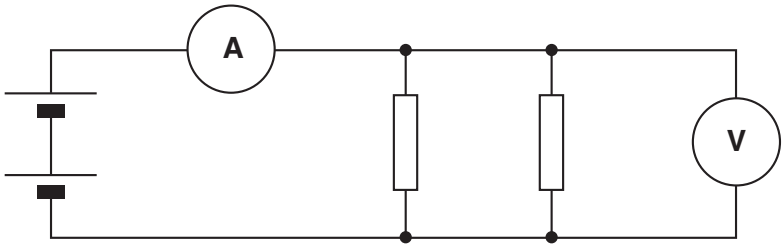
What is the effect of the extra cell?

Put a tick (✓) in the correct box for each row.

	decreases	**increases**	**stays the same**
effect on the potential difference			
effect on the current			

[1]

(c) Isla adds another identical resistor, as shown below.



(i) What is the effect of the extra resistor compared to the previous circuit?

Put a tick (✓) in the correct box for each row.

	decreases	**increases**	**stays the same**
effect on the potential difference			
effect on the current			

[1]

(ii) Which of these statements are true for the resistors?

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

The resistor nearest to the battery has the larger voltage across it. ☐

Both resistors have the same potential difference across them. ☐

The resistor furthest from the battery has the smaller current passing through it. ☐

Each electron from the battery goes through both resistors. ☐

Both resistors have the same current. ☐

Each resistor has half the voltage of the battery. ☐

[2]

[Total: 5]

7 This question is about the cell cycle.

(a) The statements **A** to **E** are about either mitosis or meiosis.

A produces cells identical to the parent cells

B produces cells with only half the number of chromosomes

C produces gametes

D produces cells with a full set of paired chromosomes

E is a process within the cell cycle

Put the letters **A**, **B**, **C**, **D**, and **E** in the correct column of the table to show whether they refer to **mitosis** or **meiosis**.

mitosis	meiosis

[2]

(b) These sentences are about the cell cycle.

They are in the wrong order.

A The cell divides to form two new cells.

B The numbers of organelles in the cell increase.

C Copies of the chromosomes separate and move to opposite ends of the cell.

D The two strands of DNA separate so that the chromosomes can be copied.

Put the letters **A**, **B**, **C** and **D** in the correct order in the boxes.

The first one has been done for you.

B			

[2]

[Total: 4]

8 DNA is the molecule that carries genetic information.

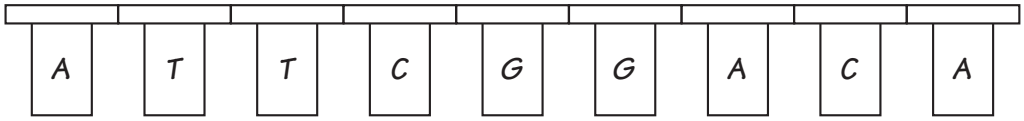
(a) Here are some statements about DNA.

Put ticks (✓) in the boxes to show whether the statements are **true** or **false**.

statement	true	false
DNA contains four different bases.		
The order of bases in DNA is not important.		
DNA is only found in the cytoplasm of cells.		
The bases in DNA can pair up randomly.		
A copy of a strand of DNA is carried into the cytoplasm.		
The order of bases determines the order of amino acids in a protein.		

[3]

(b) A small part of a strand of DNA has this sequence of bases.



Which of these sequences of bases will be found on the opposite strand of DNA?

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

A T T C G G A C A ☐

A C A G G C T T A ☐

T A A G C C T G T ☐

G C C T A A T T G ☐

[1]

[Total: 4]

9 A gardener takes cuttings from a plant to grow into new plants.

Complete the sentences to explain how the cuttings are able to grow.

Choose words from this list.

auxins

clones

light

meristems

phloem

seeds

xylem

zygotes

There are unspecialised cells in areas of plants.

These areas are called .....

These cells grow into root cells when they are acted on by .....

The new plants that grow will be .....

[3]

[Total: 3]

10 Here are some statements about genes, embryonic stem cells and adult stem cells.

Some statements are true and some are not.

Put a tick (✓) in the box next to **each** statement which is **true**, and a cross (✗) next to each statement which is **false**.

Embryonic stem cells are highly specialised cells.	
Up to the eight cell stage in a human embryo, all cells have the potential to be any kind of tissue.	
Specialised cells can become unspecialised and have the potential to replace damaged tissue.	
Adult stem cells are highly specialised cells.	
Some genes in the nucleus from a body cell can be reactivated and have the potential to replace damaged tissue.	
All the genes in adult cells are active all of the time.	
Both embryonic and adult stem cells have the potential to replace damaged tissue.	

[3]

[Total: 3]

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