

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

A216/02

Unit 2: Modules B5 C5 P5 (Higher Tier)

**Wednesday 27 January 2010
Afternoon**

Duration: 40 minutes

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)



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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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

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

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

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

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

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

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

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

Electric Circuits

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

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

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

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

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

The Wave Model of Radiation

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

Answer **all** the questions.

1 We use millions of tonnes of iron every year.

It is used to make an enormous number of things such as girders, chains and bridges.



(a) Iron is important because it is comparatively cheap and its properties are useful.

Draw straight lines to link each **property** to **why it is useful**.

You should draw four lines.

property

why it is useful

good electrical conductor

can be used to make roof supports

high melting point

can be hammered into different shapes

malleable

can be used to make lightning conductors

strong

can be used to make barbecues

can be used to make magnets

(b) Iron is extracted from iron ore.

Iron ore contains iron oxide.

There are different types of iron oxide.

Which of these formulae corresponds to the oxide with the highest **proportion** of iron atoms?

Put a (ring) around the correct answer.

FeO

Fe₂O₃

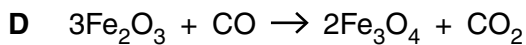
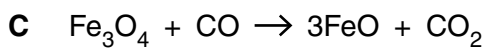
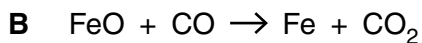
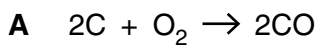
Fe₃O₄

[1]

(c) Iron is extracted from iron oxide in a blast furnace.

Iron forms through a sequence of reactions.

Here are the reactions, but they are not in the correct order.



Put the reactions into the correct order. The last one has been done for you.

start

			B
--	--	--	---

 end

[1]

(d) Use the Periodic Table to find the relative atomic masses of iron and oxygen.

What mass of iron is present in 72 g of FeO?

Put a (ring) around the correct answer.

16 g

26 g

36 g

56 g

[1]

(e) Carbon monoxide is a gas at room temperature.

What does this indicate about the structure and bonding of carbon monoxide?

.....

[2]

(f) Iron is a metal.

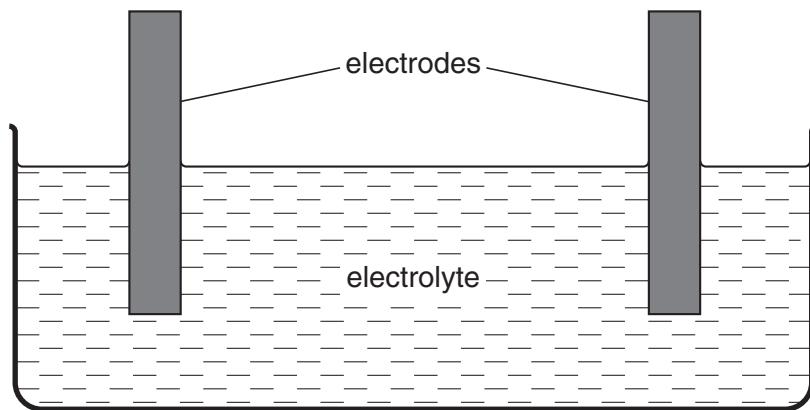
Solid metals have their own type of structure.

Put a tick (✓) in the **three** boxes next to descriptions that are true for solid metals.

- contains electrons
- contains positive ions
- contains negative ions
- some of the ions are free to move
- some of the electrons are free to move
- contains no ions

[2]

(g) Some metals are extracted by electrolysis rather than in a blast furnace.



Electrolysis only works for some liquids.

These are called electrolytes.

Explain why electrolytes can conduct electricity.

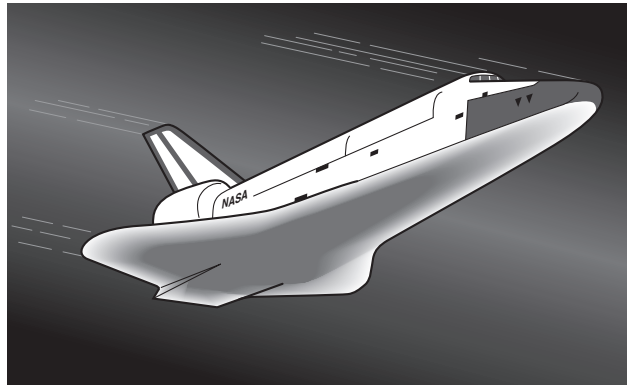
.....

.....

..... [3]

[Total: 13]

- 2 As the space shuttle re-enters the Earth's atmosphere it gets intensely hot.



- (a) The skin of the space shuttle is covered with silicon dioxide tiles to protect it.

Put ticks (✓) in the boxes next to the **three** properties of silicon dioxide that are most useful for withstanding re-entry.

	useful for re-entry
chemically unreactive	<input type="checkbox"/>
high melting point	<input type="checkbox"/>
good thermal insulator	<input type="checkbox"/>
good electrical insulator	<input type="checkbox"/>

[1]

- (b) Silicon dioxide is held together by covalent bonds.

Draw **one** line to link the **type of interaction** that holds the molecule together to the **particles involved**.

type of interaction	particles involved
<input type="text" value="electrostatic attraction"/>	<input type="text" value="electrons"/>
or	or
<input type="text" value="magnetic attraction"/>	<input type="text" value="nuclei"/>
or	or
<input type="text" value="electrostatic repulsion"/>	<input type="text" value="electrons and nuclei"/>

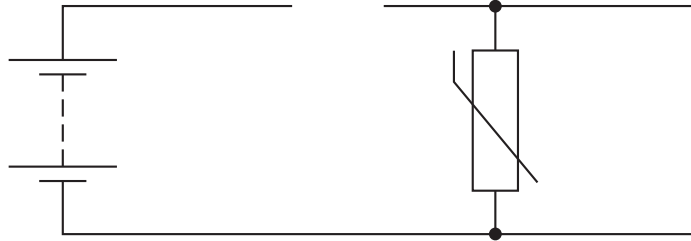
[1]

[Total: 2]

- 3 A student investigates the effect of temperature change on a thermistor.

The circuit diagram shows a battery and a thermistor.

The circuit diagram is not finished.



- (a) A voltmeter and ammeter are missing from the diagram.

Draw them in the correct places. Use the correct circuit symbols.

[2]

- (b) Complete the sentence. Choose words from this list.

decreases

increases

stays the same

When the temperature of the thermistor is **increased**

the resistance of the thermistor

and the reading of the ammeter

[1]

- (c) Put a ring around the words that correctly complete the sentence.

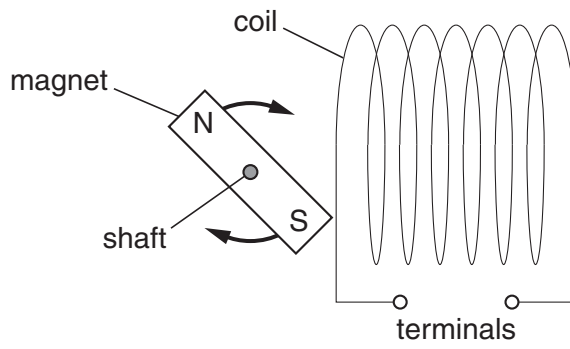
The ammeter measures the flow of **charge** / **power** in the thermistor

in units of **amperes** / **joules** / **volts**.

[1]

[Total: 4]

4 The diagram shows a magnet close to a coil of wire. The magnet can spin on the shaft.



(a) Explain why there is an alternating voltage across the terminals when the magnet spins round.

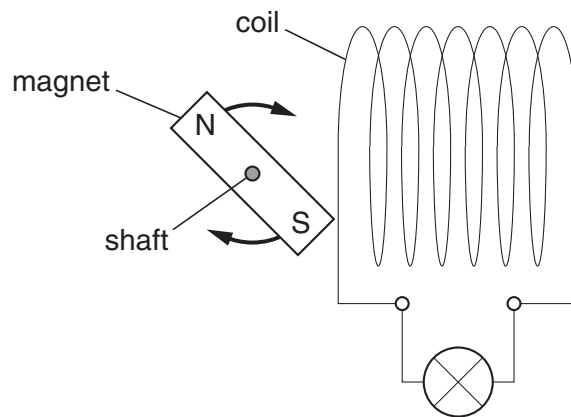
.....

.....

.....

..... [3]

(b) A lamp is connected across the terminals of the coil.



Put a **ring** around each term that correctly completes the sentences.

The current in the lamp is **a.c.** / **d.c.** / **p.c.**

The lamp filament heats up because atoms in the wire are hit by charges that are

expanding / **moving** / **spinning**.

[1]

(c) The glowing filament has a resistance of 4Ω .

What is the current in the filament when the voltage across it is 2V?

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

0.5 A

2 A

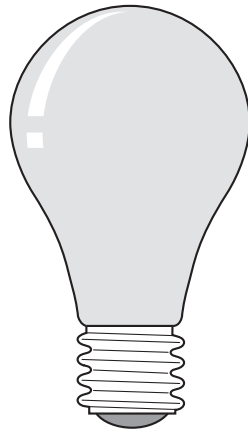
6 A

8 A

[1]

[Total: 5]

5 A mains lamp connected to a 230V supply has a power of 150W.



(a) Calculate the current in the lamp. Show your working.

current = A [2]

(b) The lamp is left on for 24 hours. 3.6kWh of electrical energy is transferred to it.
0.18kWh of light energy transfers out of the lamp in that time.

What is the efficiency of the lamp?

Put a ring around the correct answer.

- 0.05% 5% 20% 2000%

[1]

(c) The mains electricity supply is a.c., not d.c.

Put ticks (✓) in the boxes next to the **two** correct reasons for this.

- d.c. heats up wires more than a.c.
- a.c. is easier to generate than d.c.
- d.c. can only be produced by batteries
- there is less risk of electric shock with a.c.
- a.c. can be distributed more efficiently than d.c.

[1]

- (d) The 150W lamp is replaced with one that has a power of only 60W.

Draw straight lines from each **electrical property** to **how it changes** when the lamp is replaced.

electrical property

current

resistance

potential difference

how it changes

increases

decreases

stays the same

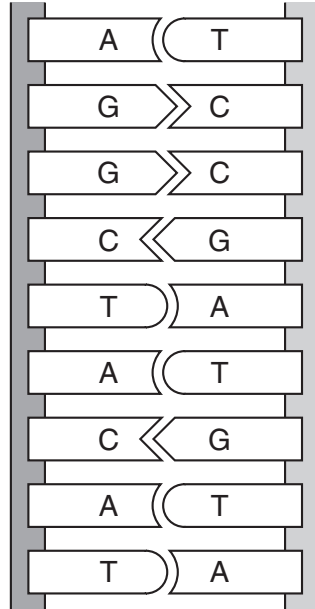
[1]

[Total: 5]

6 Chloe analyses a sample of DNA.

(a) Here is a short segment of DNA from the sample.

Chloe knows that it contains four bases, A, C, G, and T, arranged like this.



She finds the percentages of some of the bases in the whole DNA sample.

Complete the table to suggest how much of the other two bases Chloe will find in her sample.

base	% present
C	20
A	30
T	
G	

[1]

(b) DNA controls the making of proteins.

(i) Complete this sentence. Choose the answer from this list.

amino acids carbohydrates enzymes fats sugars

The sequence of bases in DNA determines the order of
in the protein which is made. [1]

(ii) Put ticks (✓) in the boxes next to the **two** correct statements.

Proteins are made in the cytoplasm.

Proteins are made in the nucleus.

DNA takes the genetic code to the cytoplasm.

A copy of the gene carries the genetic code to the cytoplasm.

Proteins are made out of DNA.

New DNA is made in the cytoplasm.

[2]

[Total: 4]

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Question 7 starts on page 15.

PLEASE DO NOT WRITE ON THIS PAGE

7 (a) All cells in a plant originate from the same cell.

Leaf cells contain chlorophyll, but root cells do not.

Explain why leaf and root cells in the same plant can develop differently.

Use ideas about genes in your answer.

.....
.....
..... [2]

(b) New plants can be made by taking cuttings.

Andrew takes a cutting of a plant stem.

There are no roots on the cutting.

State

- how to make a cutting produce roots
- which cells of the cutting develop into roots.

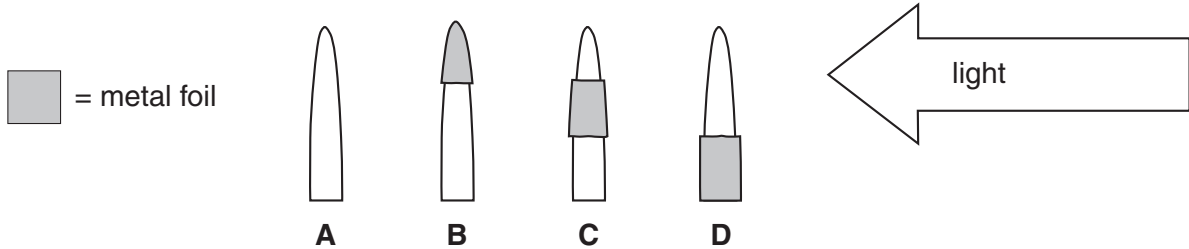
.....
.....
..... [2]

[Total: 4]

8 This question is about how plant shoots respond to light.

In an experiment, different parts of growing shoots are covered with metal foil.

Light is shone from one side only.



Some of the shoots bend towards the light.

(a) Which shoot, **A**, **B**, **C** or **D**, does **not** bend towards the light?

answer [1]

(b) Some of the following statements can be used to explain how shoots grow towards the light.

They are in the wrong order.

Select the correct statements, and put them in the correct order.

- A** Auxin makes the shoot cells expand on this side.
- B** Auxin makes the shoot cells shrink on this side.
- C** Auxin moves down the stem from the tip.
- D** Auxin moves up the stem to the tip.
- E** Auxin concentration becomes highest on the dark side of the stem.
- F** Auxin concentration becomes highest on the light side of the stem.

--	--	--

[2]

(c) The growth of shoots towards the light can be an advantage to the plant.

Some students were asked to explain why this is.

Amelia
Phototropism helps the shoots gain the most light for photosynthesis.

Cary
Geotropism helps the roots to spread out.

Martin
Growing towards the light helps plants to gain more carbon dioxide.

Sam
Growing towards the light increases the plant's chances of survival.

Jane
Phototropism helps transport sugars in the phloem.

Reena
Growing towards the light helps plants to gain more water.

Nicola
Bending towards the light helps the plant keep low to the ground.

Which **two** students gave the best reasons?

answer and [2]

[Total: 5]

END OF QUESTION PAPER

18
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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 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 O oxygen 8	16 F fluorine 9	17 Ne neon 10
19 K potassium 19	20 Ca calcium 20	23 Sc scandium 21	24 Ti titanium 22	25 V vanadium 23	26 Cr chromium 24	27 Mn manganese 25	28 Fe iron 26	29 Co cobalt 27
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77
87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	104 Rf rutherfordium 104	105 Db dubnium 105	106 Sg seaborgium 106	107 Bh bohrium 107	108 Hs hassium 108	109 Mt meitnerium 109
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
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
131 Xe xenon 54	127 I iodine 53	128 Te tellurium 52	119 Sn tin 50	122 Sb antimony 51	125 Te tellurium 52	128 Bi bismuth 83	129 Po polonium 84	131 Rn radon 86
209 Bi bismuth 83	210 At astatine 85	209 Po polonium 84	207 Pb lead 82	204 Tl thallium 81	201 Hg mercury 80	200 Fr francium 87	209 Bi bismuth 83	210 At astatine 85
65 Zn zinc 30	63.5 Cu copper 29	59 Ni nickel 28	59 Co cobalt 27	56 Fe iron 26	55 Mn manganese 25	54 Cr chromium 24	52 Cr chromium 24	51 V vanadium 23
70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	77 Se selenium 34	75 As arsenic 33	73 Ge germanium 32	70 Ga gallium 31	65 Zn zinc 30
115 In indium 49	112 Cd cadmium 48	106 Pd palladium 46	103 Rh rhodium 45	101 Ru ruthenium 44	100 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48
119 Sn tin 50	115 In indium 49	115 In indium 49	112 Cd cadmium 48	108 Ag silver 47	106 Pd palladium 46	103 Rh rhodium 45	101 Ru ruthenium 44	100 Rh rhodium 45
131 Xe xenon 54	127 I iodine 53	127 I iodine 53	125 Te tellurium 52	122 Sb antimony 51	120 Sb antimony 51	125 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
209 Bi bismuth 83	210 At astatine 85	209 Po polonium 84	207 Pb lead 82	204 Tl thallium 81	201 Hg mercury 80	200 Fr francium 87	209 Bi bismuth 83	210 At astatine 85
Elements with atomic numbers 112-116 have been reported but not fully authenticated								210 At astatine 85
Elements with atomic numbers 112-116 have been reported but not fully authenticated								210 At astatine 85

* 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.