Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A216/02

TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A

Unit 2: Modules B5 C5 P5 (Higher Tier)

WEDNESDAY 27 JANUARY 2010: Afternoon
DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

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)

READ INSTRUCTIONS OVERLEAF

DC (SLM/SW) MEP10220 24324/1

INSTRUCTIONS TO CANDIDATES

Write your name clearly in capital letters, your Centre Number and Candidate Number on the first page.

- 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.
- 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 pages 4–5.
- A copy of the Periodic Table is provided.

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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

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

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

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

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

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

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
	can be used to make roof supports
good electrical conductor	
	can be hammered into different shapes
high melting point	
	can be used to make lightning conductors
malleable	
	can be used to make barbecues
strong	
	can be used to make magnets

[3]

(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 Fe_2O_3 Fe_3O_4

[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.

A $2C + O_2 \rightarrow 2CO$

B $FeO + CO \rightarrow Fe + CO_2$

C $Fe_3O_4 + CO \rightarrow 3FeO + CO_2$

D $3Fe_2O_3 + CO \rightarrow 2Fe_3O_4 + CO_2$

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.

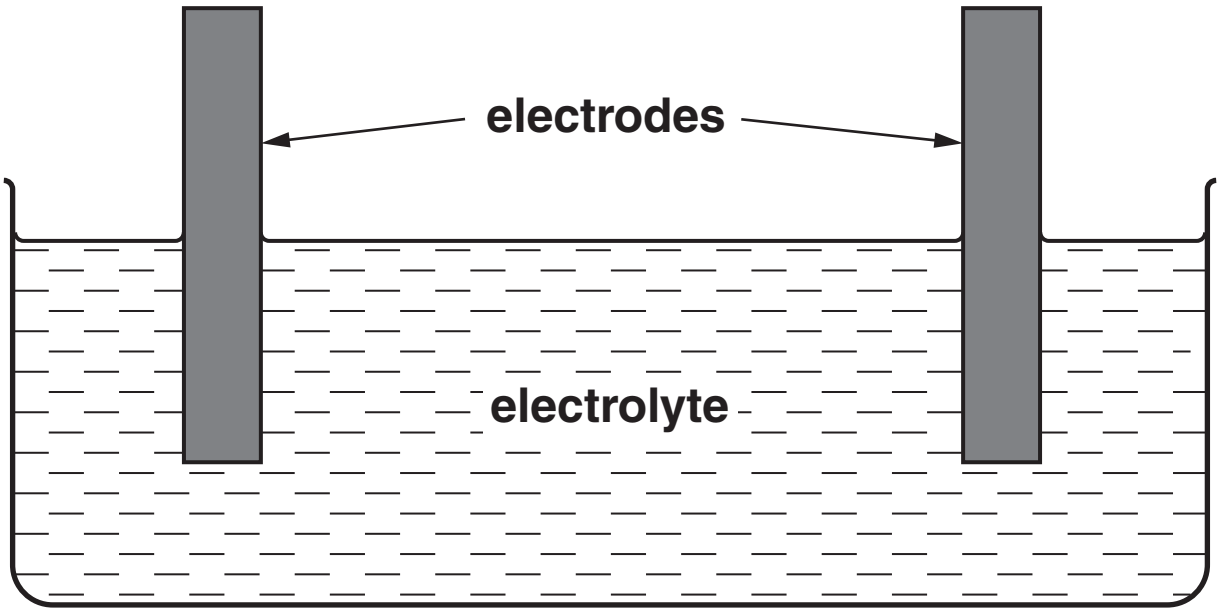
Solid metals have their own type of structure.

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	☐
high melting point	☐
good thermal insulator	☐
good electrical insulator	☐

[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
electrostatic attraction	electrons
or	or
magnetic attraction	nuclei
or	or
electrostatic repulsion	electrons and nuclei

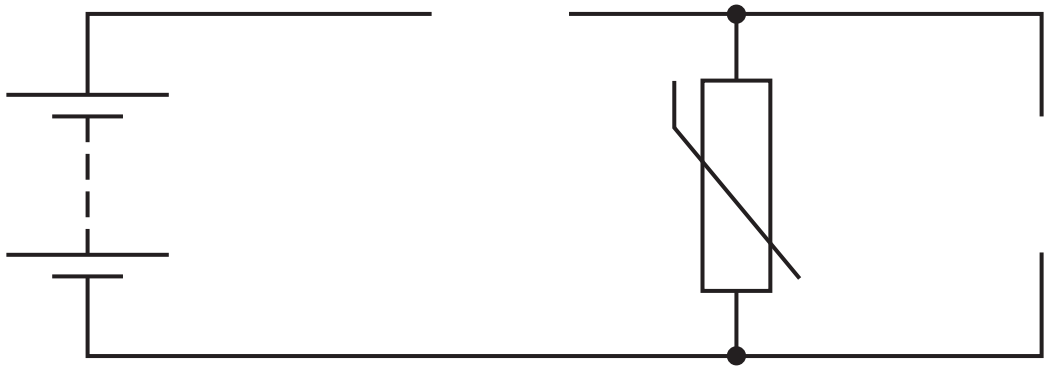
[1]

[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

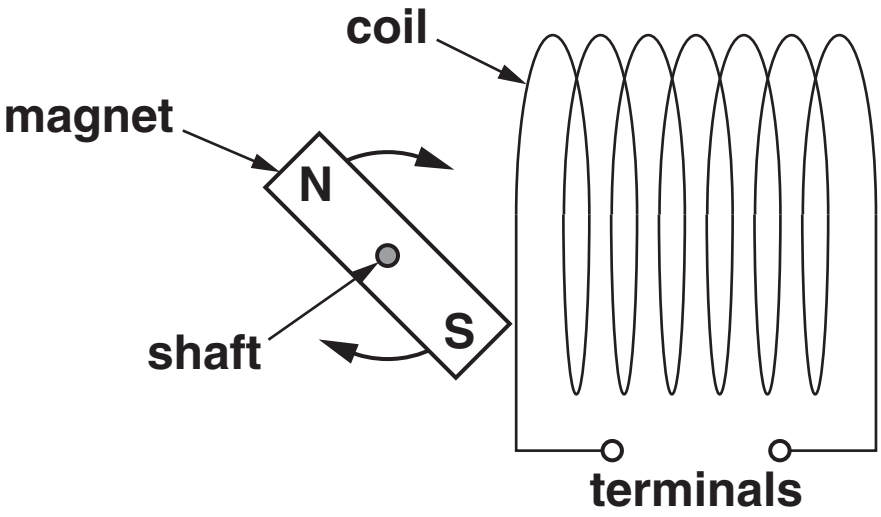
of CHARGE / POWER in the thermistor

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.

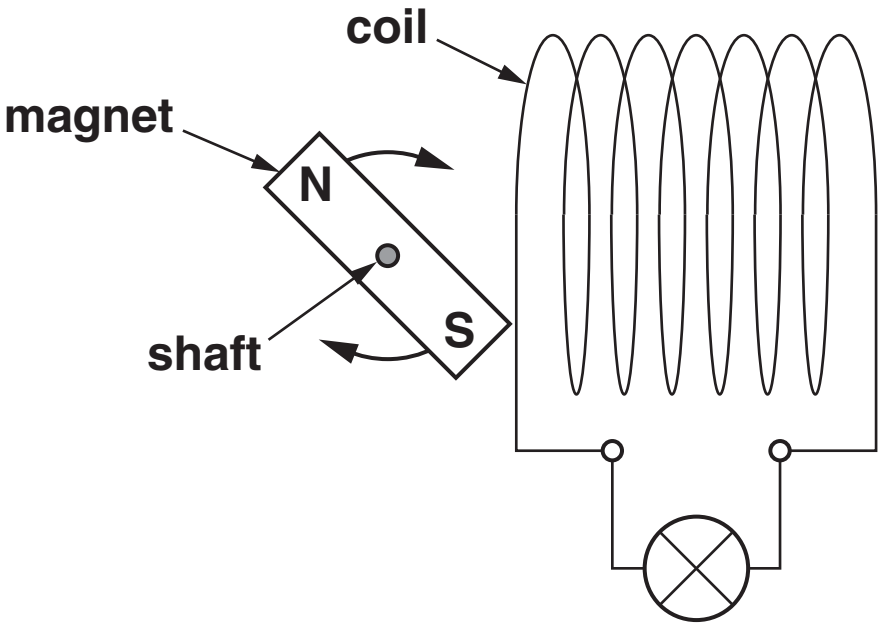
_____

_____

_____

_____ [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 4 Ω.

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. 3.6 kWh of electrical energy is transferred to it.

0.18 kWh 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	HOW IT CHANGES
current	increases
resistance	decreases
potential difference	stays the same

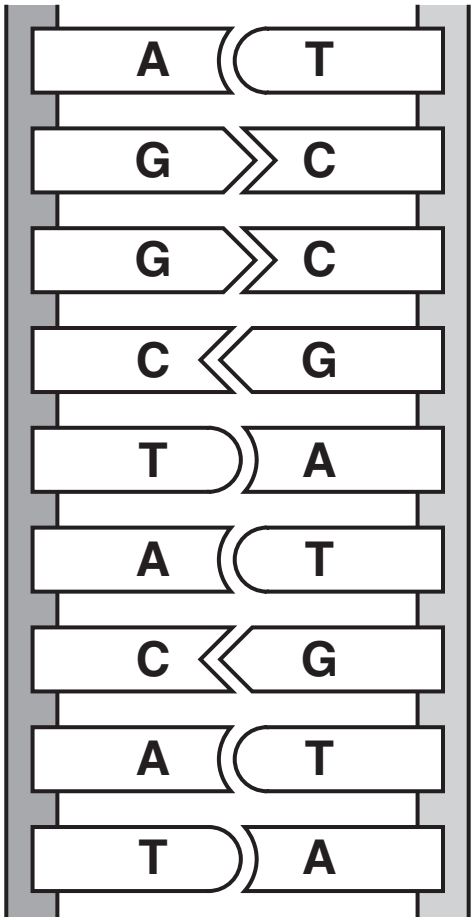
[1]

[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]

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.

_____

_____

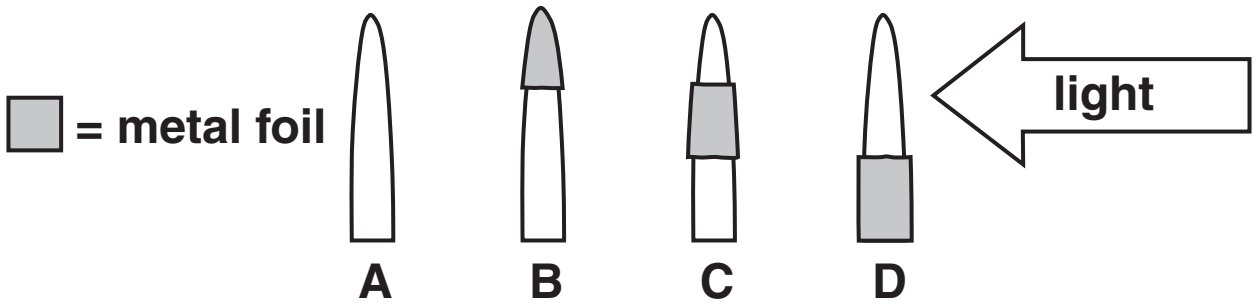
_____ [2]

[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.

REENA

Growing towards the light helps plants to gain more water.

JANE

Phototropism helps transport sugars in the phloem.

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

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.