

**Monday 10 June 2013 – Afternoon**

**GCSE TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL SCIENCE A**

**A152/01** Modules B5 C5 P5 (Foundation Tier)

Candidates answer on the Question Paper.  
A calculator may be used for this paper.

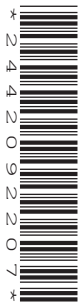
**OCR supplied materials:**  
None

**Other materials required:**

- Pencil
- Ruler (cm/mm)
- Calculator

**Duration: 1 hour**

**MODIFIED LANGUAGE**



Candidate forename		Candidate surname	
Centre number		Candidate number	

**INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

**INFORMATION FOR CANDIDATES**

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets [ ] at the end of each question or part question.
- A list of physics equations is printed on page 2.
- A list of qualitative tests for ions is printed on page 3.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

## TWENTY FIRST CENTURY SCIENCE EQUATIONS

### Useful relationships

#### The Earth in the Universe

$$\text{distance} = \text{wave speed} \times \text{time}$$

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

#### Sustainable energy

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

$$\text{power} = \text{voltage} \times \text{current}$$

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

#### Explaining motion

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

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

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

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

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

$$\text{amount of energy transferred} = \text{work done}$$

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

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

#### Electric circuits

$$\text{power} = \text{voltage} \times \text{current}$$

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

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

#### Radioactive materials

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

# TWENTY FIRST CENTURY SCIENCE DATA SHEET

## Qualitative analysis

### Tests for ions with a positive charge

Ion	Test	Observation
calcium $\text{Ca}^{2+}$	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper $\text{Cu}^{2+}$	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) $\text{Fe}^{2+}$	add dilute sodium hydroxide	a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(III) $\text{Fe}^{3+}$	add dilute sodium hydroxide	a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
zinc $\text{Zn}^{2+}$	add dilute sodium hydroxide	a white precipitate forms; the precipitate dissolves in excess sodium hydroxide

### Tests for ions with a negative charge

Ion	Test	Observation
carbonate $\text{CO}_3^{2-}$	add dilute acid	the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky)
chloride $\text{Cl}^-$	add dilute nitric acid, then add silver nitrate	a white precipitate forms
bromide $\text{Br}^-$	add dilute nitric acid, then add silver nitrate	a cream precipitate forms
iodide $\text{I}^-$	add dilute nitric acid, then add silver nitrate	a yellow precipitate forms
sulfate $\text{SO}_4^{2-}$	add dilute acid, then add barium chloride or barium nitrate	a white precipitate forms

Answer **all** the questions.

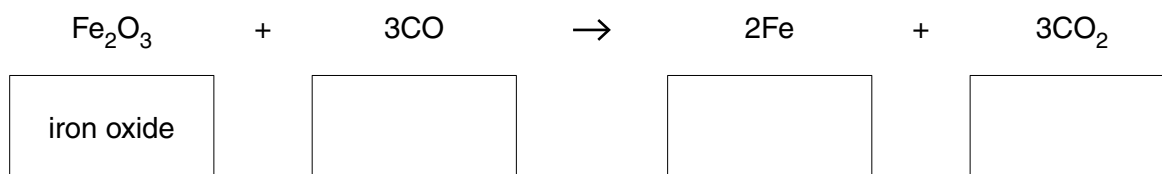
- 1 The Vikings dug out small amounts of impure iron from peat bogs. Iron oxide was in the 'bog iron'.

The Vikings heated the bog iron in a charcoal fire to extract the iron. The fire makes carbon monoxide, which reacts with the iron oxide.

- (a) There are four chemicals in one of the reactions in the fire.

iron  
iron oxide  
carbon dioxide  
carbon monoxide

Write the name of each chemical in the box under its formula. One has been done for you.



[1]

- (b) How many atoms of iron are in each formula of  $\text{Fe}_2\text{O}_3$ ? Put a ring around the correct answer.

1      2      3      5      6

[1]

- (c) The relative atomic mass of carbon is 12. The relative atomic mass of oxygen is 16.

Calculate the relative formula mass of CO.

answer = ..... [1]

- (d) The relative atomic mass of Fe is 56. What mass of Fe is in one gram formula mass of  $\text{Fe}_2\text{O}_3$ ?

answer = ..... g [2]

- (e) What happens to the metal oxide when it is changed into the metal? Put a ring around the correct answer.

combustion      oxidation      precipitation      reduction

[1]

- (f) There are traces of aluminium oxide in the 'bog iron'.  
Why does the carbon monoxide **not** extract the aluminium with the iron?  
Use ideas about reactivity in your answer.

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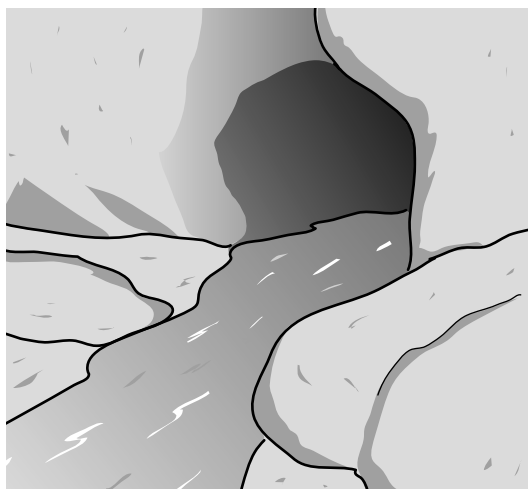
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[Total: 8]

Question 2 begins on page 6

- 2 Julie takes samples of water from a disused mine.



She adds different chemicals to the samples of water to see if any of them make a precipitate.

- (a) Which statement is true?  
Put a tick (✓) in the box next to the best answer.

A precipitate is:

an element.	
insoluble.	
a mineral.	
soluble.	

[1]

- (b) Julie wants to know what ions are dissolved in the mine water.

- (i) When she adds sodium hydroxide solution to the water a white precipitate appears.

This shows that some ions might be present.

Put (rings) around the ions that might be present. Use the data sheet to help you.

**carbonate      sulfate      calcium      copper      iron(II)      iron(III)      zinc**

[1]

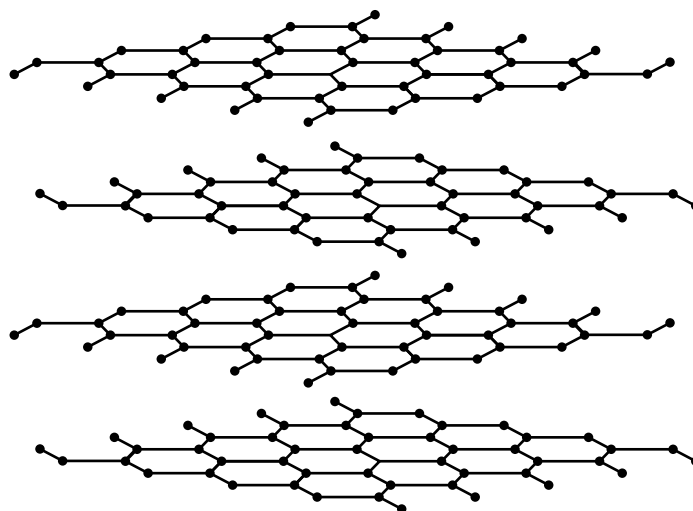
- (ii) She then adds more sodium hydroxide and the white precipitate disappears.  
This shows Julie that only one ion is present.

Put a (ring) around the ion that is present.

**carbonate      sulfate      calcium      copper      iron(II)      iron(III)      zinc**

[1]

[Total: 3]



It is also used for lubricating moving parts in door locks and hinges.

Use ideas about the structure and properties of graphite to explain why graphite will do both these jobs.



*The quality of written communication will be assessed in your answer.*

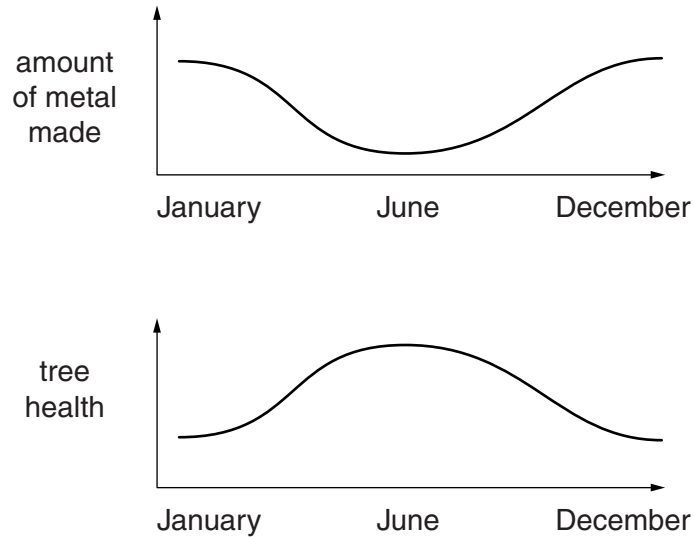
..... [6]

**[Total: 6]**

4 A factory extracts metal.

The factory gives out acidic fumes of sulfur dioxide.

Scientists have been measuring how healthy the trees are in the area near the factory.



George and Maria look at the graphs.

This is what they think.



Both George and Maria could be right.

Explain why.

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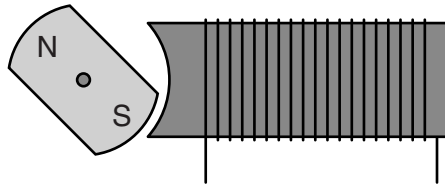
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..... [3]

[Total: 3]



- 5 This diagram shows part of a generator of alternating current in a power station.



The generator transfers energy from a spinning turbine into electricity.

Describe how the generator works. You may label the diagram.



*The quality of written communication will be assessed in your answer.*

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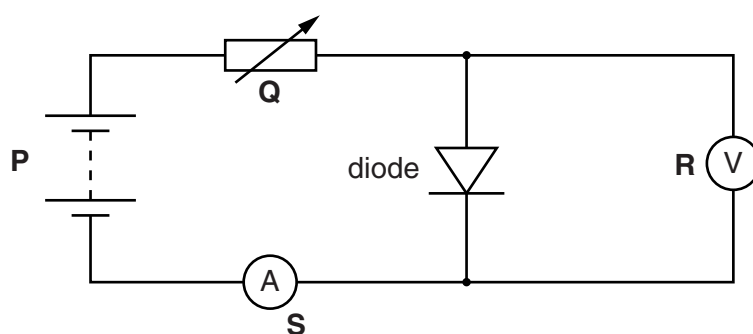
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[Total: 6]

- 6 Sally uses this circuit to investigate an electrical component called a diode.



- (a) Draw straight lines to link each labelled **component**, **P**, **Q**, **R** and **S**, in the circuit with its **function**. One has been done for you.

component	function
<b>P</b>	measures the current in the diode
<b>Q</b>	pushes electrons around the circuit
<b>R</b>	is used to change the current in the circuit
<b>S</b>	measures the potential difference across the diode

[2]

- (b) Sally measures the potential difference across the diode for two different currents. Here are her results.

Current in amps	Potential difference in volts
0.12	0.60
0.45	0.90

What can she conclude about the effect of changing the current on the resistance of the diode?

Justify your answer. You may use calculations.

.....

.....

.....

..... [3]

- (c) Sally's friends talk about her experiment.

**Alan**  
The current correlates with the voltage.

**Bess**  
Increasing the voltage makes the charges go faster through the diode.

**Carlos**  
Sally ought to take the measurements again.

**Davina**  
Sally needs to record the meter readings to more decimal places.

- (i) Who suggests an **explanation** for Sally's results?

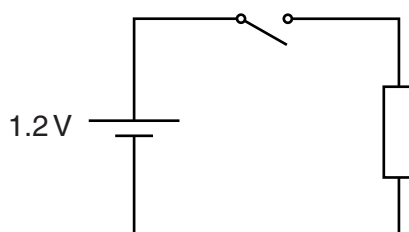
answer ..... [1]

- (ii) Who talks about **checking** Sally's data?

answer ..... [1]

[Total: 7]

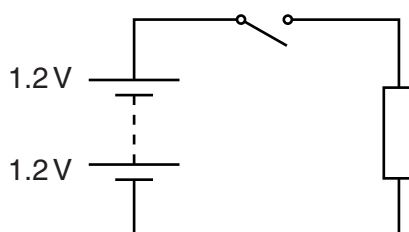
- 7 Dave keeps insects in a cage. He uses this circuit to keep the cage warm.



- (a) When the switch is closed, the current in the circuit is 0.2 A.  
Calculate the heating power of the circuit.

heating power = ..... W [1]

- (b) Dave adds an extra cell to increase the heating power of the circuit.



Complete the sentences by putting a **ring** around the correct choice.

The extra cell **doubles / halves / does not change** the potential difference across the resistor.

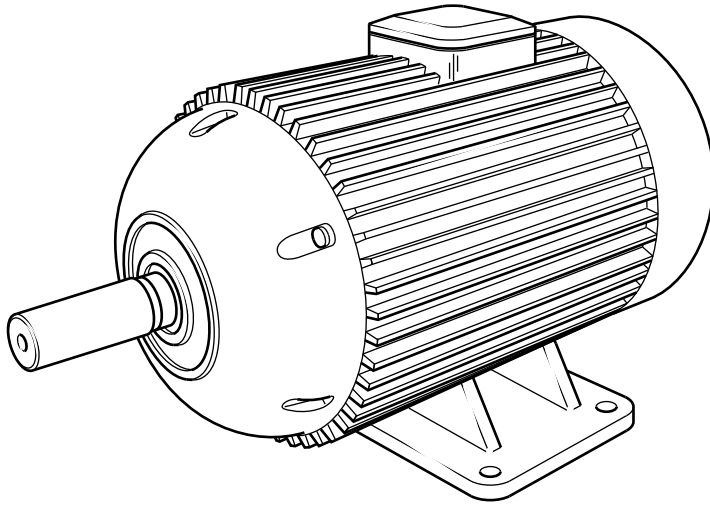
The resistance of the fixed resistor **doubles / halves / does not change**.

The current in the fixed resistor **doubles / halves / does not change**.

[2]

[Total: 3]

- 8 Electric motors are used in many modern appliances.



- (a) State the name of an appliance which contains an electric motor. Describe what that motor does.

name: .....

description: .....

.....

..... [2]

- (b) Explain how the current in an electric motor makes it spin round.  
Use these words in your answer.

**coil**

**field**

**force**

**magnet**

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..... [2]

[Total: 4]

- 9 Dystrophin is a protein found in healthy muscle cells.

The gene for dystrophin is found in the nucleus.

The gene is made of DNA.

- (a) Put a tick (✓) in the box next to the correct word to complete each sentence.

DNA has a	<b>single</b>		helix structure.
	<b>double</b>		
	<b>triple</b>		

Strands of DNA are made of four different bases.

The base <b>T</b> always pairs with the base	<b>A.</b>	
	<b>C.</b>	
	<b>G.</b>	

The code for dystrophin is in the	<b>order</b>		of the bases.
	<b>pairing</b>		
	<b>shape</b>		

[2]

- (b) People who cannot make dystrophin have the medical condition called Duchenne muscular dystrophy (DMD).

The incidence of DMD is 2.86 in 10 000 births.

One city in England has 5000 births in one year.

- (i) Calculate how many new cases of DMD can be expected in this city in this one year.

Show your working.

answer = ..... [2]

- (ii) A doctor has found a protein that she thinks is only present in people with DMD.

She has tested six children who have DMD. They all have the protein.

She concludes that the protein is a good test for DMD.

Suggest **two** ways the doctor could increase her confidence in her conclusion.

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..... [2]

[Total: 6]

10 Gary uses a microscope to study mitosis in a plant root.

(a) Which processes occur during mitosis?

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

number of organelles increases

☐

chromosomes are copied

☐

chromosomes separate

☐

nucleus divides

☐

number of chromosomes halves

☐

[2]

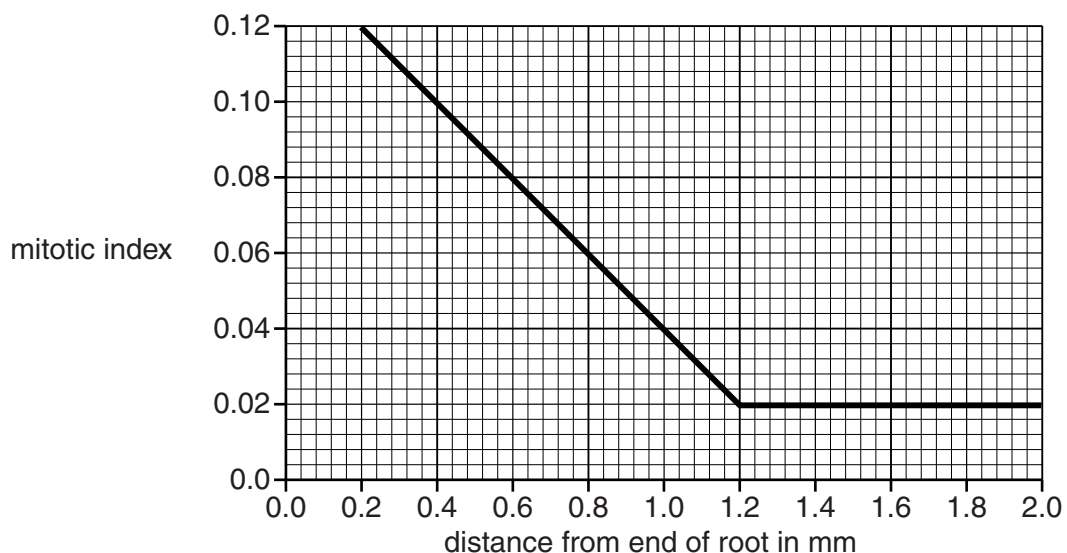
(b) Gary counts how many cells he can see.

He then counts how many of these cells are undergoing mitosis.

He works out the mitotic index using this equation:

$$\text{mitotic index} = \frac{\text{number of cells showing mitosis}}{\text{total number of cells in view}}$$

Gary calculates the mitotic index at different distances from the end of the root. He plots his results on this graph.





Gary uses his microscope to look at one section of the root.

He sees that 16 out of 200 cells are undergoing mitosis.

- (i) Calculate the mitotic index for this section.

answer = ..... [1]

- (ii) Meristem tissue has a mitotic index of more than 0.1.

Is this section from the meristem?

Justify your answer.

.....

.....

..... [1]

- (iii) Use your answer to part (i) and Gary's graph to suggest how far this section is from the end of the root.

answer = ..... [1]

[Total: 5]

- 11 Dutch elm disease has killed many elm trees in England.



Some elm trees are resistant to the Dutch elm disease.

Land owners want to plant new elm trees that are resistant.

They use cuttings from the resistant elms. They do not use elm seeds.

Describe the process of using cuttings, and explain why they choose this method.



*The quality of written communication will be assessed in your answer.*

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..... [6]

[Total: 6]

**12** This question is about stem cells.

Use words from the list to complete the sentences.

Each word may be used **once**, **more than once** or **not at all**.

**activated**

**deactivated**

**genes**

**proteins**

**specialised**

**unspecialised**

At the four cell stage in human embryos all of the cells are .....

After the eight cell stage most of the cells become ..... to form different types of tissue.

All of the cells in a person have the same .....

Cells in adult tissues make only some of the ..... coded for.

This means that tissue cells must have some.....that are switched off.

**[3]**

**[Total: 3]**

**END OF QUESTION PAPER**



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\* 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.