

THIS IS A NEW SPECIFICATION

**F****Tuesday 22 January 2013 – Morning****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)

**Duration:** 1 hour

|                       |  |                      |  |
|-----------------------|--|----------------------|--|
| Candidate<br>forename |  | Candidate<br>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<br>$\text{Ca}^{2+}$   | add dilute sodium hydroxide | a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide      |
| copper<br>$\text{Cu}^{2+}$    | add dilute sodium hydroxide | a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide |
| iron(II)<br>$\text{Fe}^{2+}$  | add dilute sodium hydroxide | a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide      |
| iron(III)<br>$\text{Fe}^{3+}$ | add dilute sodium hydroxide | a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide  |
| zinc<br>$\text{Zn}^{2+}$      | 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<br>$\text{CO}_3^{2-}$ | add dilute acid                                             | the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky) |
| chloride<br>$\text{Cl}^-$       | add dilute nitric acid, then add silver nitrate             | a white precipitate forms                                                                                    |
| bromide<br>$\text{Br}^-$        | add dilute nitric acid, then add silver nitrate             | a cream precipitate forms                                                                                    |
| iodide<br>$\text{I}^-$          | add dilute nitric acid, then add silver nitrate             | a yellow precipitate forms                                                                                   |
| sulfate<br>$\text{SO}_4^{2-}$   | add dilute acid, then add barium chloride or barium nitrate | a white precipitate forms                                                                                    |

4

Answer **all** the questions.

- 1 In 2010 a volcano erupted in Iceland.  
Gases from the volcano pushed clouds of ash into the air.



- (a) The gases inside the volcano were mainly carbon dioxide and steam.  
Complete the table to show the formulas of these two gases.

|                |  |
|----------------|--|
| carbon dioxide |  |
| steam          |  |

[2]

- (b) Molten lava also came out of the volcano.  
The lava contains a lot of silicon dioxide.  
Suggest why the lava contains silicon dioxide.  
Put a tick (✓) in the box next to the correct answer.

Silicon dioxide is present in large quantities in the Earth's crust.

☐

Silicon dioxide has a high melting point.

☐

All minerals are made of silicon dioxide.

☐

Silicon dioxide is only found in Iceland.

☐

[1]

- (c) The clouds of ash spread thousands of miles.  
Many flights across Europe were cancelled.

Information found on the internet says that:

- scientists think that the volcano gave off an estimated 150 000 tonnes of carbon dioxide each day
- about 17 000 flights were cancelled each day because of the volcano
- on average, a modern plane produces about 20 tonnes of carbon dioxide per flight.

- (i) Some people say that the volcanic eruption meant that less carbon dioxide was put into the atmosphere each day.

Use the information above to explain if this is true. You should include a calculation in your answer.

.....

.....

.....

..... [3]

- (ii) Look at the information above from the internet.  
Some of the numbers may not be accurate.  
Explain why some of the numbers may not be accurate.



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

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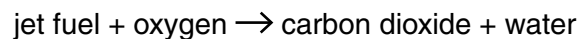
.....

..... [6]

6

- (d) Jet fuel is made of hydrogen and carbon.

The equation shows what happens when jet fuel burns.



The mass of the products is more than the mass of the fuel.

Explain why.

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

- (e) Jet engines are hot enough to melt the silicon dioxide in the ash cloud from the volcano.

This damages the engines.

Silicon dioxide has a very high melting point.

Use your understanding of bonding and structure to suggest why silicon dioxide has a high melting point.

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

[Total: 16]

7

- 2 There are several aluminium refineries in Iceland.

The refineries use an electric current to break down melted aluminium oxide.

- (a) What do we call this process?  
Put a (ring) around the correct answer.

**electrolysis**

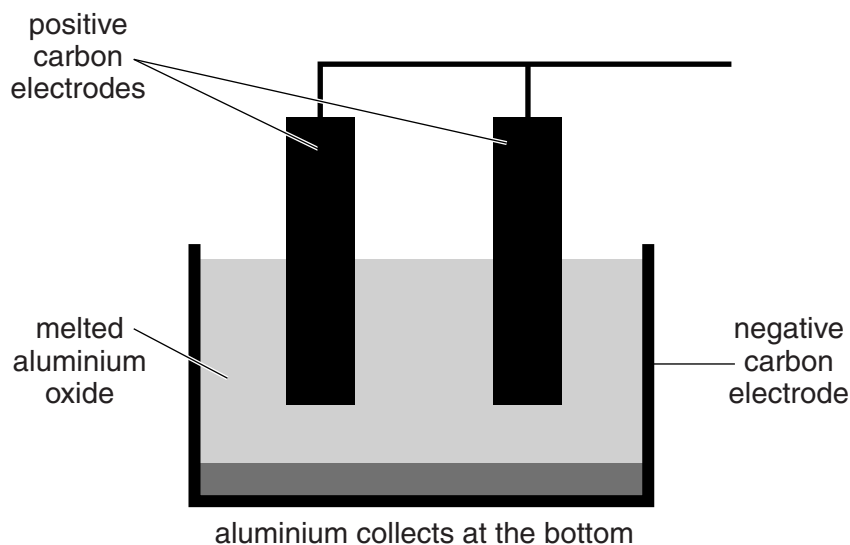
**electromagnetism**

**precipitation**

**solubility**

[1]

- (b) The diagram shows a cell used in this process.



Put ticks (✓) in the correct boxes to complete these sentences.

Melted aluminium oxide conducts electricity

|             |  |
|-------------|--|
| better than |  |
| the same as |  |
| worse than  |  |

solid aluminium oxide.

When the electric current is turned on, aluminium is formed at

|                         |  |
|-------------------------|--|
| the negative electrode. |  |
| the positive electrode. |  |
| both electrodes.        |  |

At the positive electrode

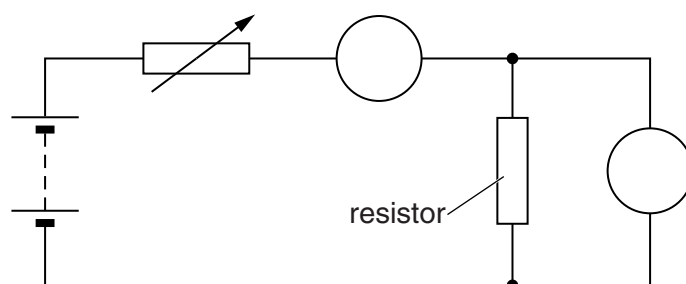
|                                           |  |
|-------------------------------------------|--|
| aluminium gas is formed.                  |  |
| hydrogen gas is formed.                   |  |
| oxygen gas is formed.                     |  |
| the aluminium in the electrode dissolves. |  |

[3]

[Total: 4]

8

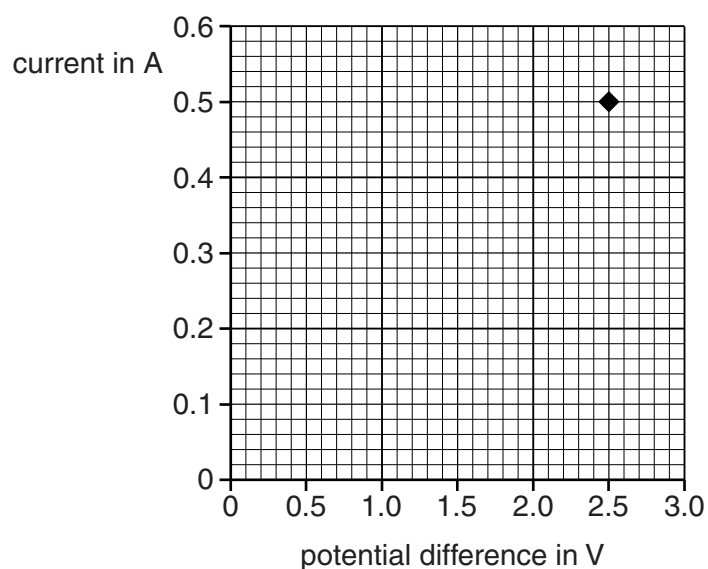
- 3 Jill uses this circuit to investigate a resistor.



- (a) Both of the meter symbols are incomplete.  
Complete the symbols for the two meters in the circuit.

[2]

- (b) Jill sets the current in the resistor to 0.50 A.  
The potential difference across the resistor is 2.5 V.  
Jill plots this first point on a current-voltage graph.



- (i) Jill makes some more measurements with different values of current.  
Draw the line on the graph that the remaining points should lie on.

[1]

- (ii) Jill notices the writing 4R7 on the resistor.  
She thinks this means that its resistance is  $4.7\ \Omega$ .  
Does this agree with her measurement? Justify your answer.

.....

.....

..... [2]

- (c) Jack is another student.  
He repeats Jill's experiment immediately with the same resistor.  
Jack's results give the resistance as  $4.5\ \Omega$ .

(i) Suggest why this is **not** the same as Jill's value.

.....  
..... [1]

(ii) What further evidence is needed to find the correct value of the resistance?

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

[Total: 8]

10

- 4 This question is about how an electric motor works.

Draw straight lines to link the **start** of each sentence about a simple electric motor to its correct **end**.

**start****end**

The coil spins ...

... the coil of wire.

The magnet provides ...

... a steady magnetic field.

The commutator reverses ...

... the current in the coil.

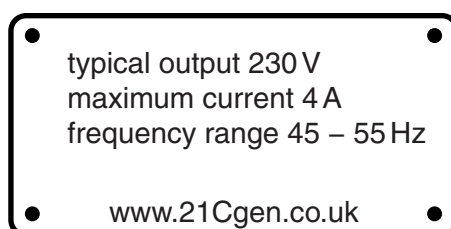
The current passes through ...

... as the field pushes on the wire.

[3]

[Total: 3]

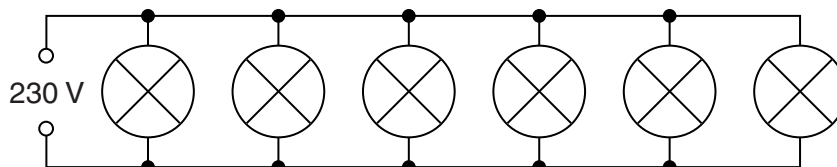
- 5 Priyanka buys a generator to run her caravan lights. She finds this information plate on the generator.



- (a) Calculate the maximum power output of the generator.

power = ..... W [1]

- (b) Priyanka's caravan has six lamps connected in parallel.



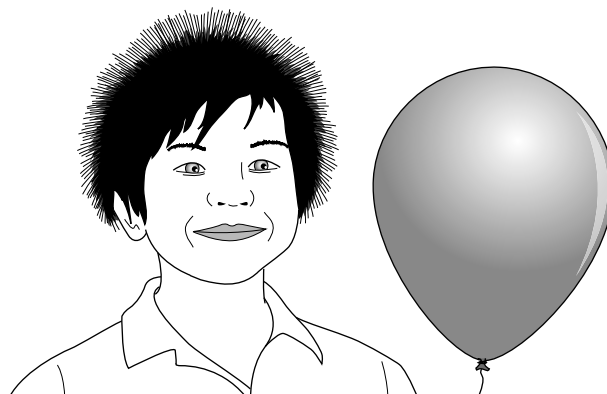
Each 230V lamp needs a current of 0.5A.

Will the generator be able to run the lamps? Justify your answer.

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

[Total: 3]

- 6 Jackie rubs a balloon against Sam's hair.  
The hair sticks to the balloon.  
When Jackie removes the balloon, Sam's hair stands on end for a few minutes.  
His hair then slowly falls back down again.



Explain what happens to the balloon and the hair.



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

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..... [6]

[Total: 6]

12

- 7 (a) This question is about DNA and the genetic code.

Complete the sentences.

Choose words from the list.

**double**      **five**      **four**      **order**      **single**      **six**  
                          **size**      **structure**      **triple**

DNA has a ..... helix structure.

Both strands of the DNA molecule are made of ..... different bases.

The genetic code is in the ..... of the bases.

[2]

- (b) Which chemicals are made from the instructions in the genetic code?  
 Put a tick (✓) in the box next to the correct answer.

|               |                          |
|---------------|--------------------------|
| bases         | <input type="checkbox"/> |
| carbohydrates | <input type="checkbox"/> |
| fats          | <input type="checkbox"/> |
| proteins      | <input type="checkbox"/> |

[1]

- (c) Ben reads about two different parts of an animal cell, part **A** and part **B**.

Part **A** contains DNA, but part **B** does not.

Copies of genes move from part **A** to part **B**.

What can you conclude about part **A** and part **B**?

Put a (ring) around the correct choice to complete each sentence.

Part **A** is the cell **cytoplasm** / **membrane** / **nucleus** / **vacuole**.

Part **B** is the cell **cytoplasm** / **membrane** / **nucleus** / **vacuole**.

[2]

[Total: 5]

13

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**Question 8 begins on page 14**

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- 8 Scientists are trying to use stem cells to treat multiple sclerosis, a disease that damages nerve cells.

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

|                |                       |  |
|----------------|-----------------------|--|
| Stem cells are | <b>meiotic.</b>       |  |
|                | <b>specialised.</b>   |  |
|                | <b>unspecialised.</b> |  |

|                 |             |  |                                           |
|-----------------|-------------|--|-------------------------------------------|
| Stem cells have | <b>all</b>  |  | of the same genes as damaged nerve cells. |
|                 | <b>none</b> |  |                                           |
|                 | <b>some</b> |  |                                           |

|                  |             |  |                             |
|------------------|-------------|--|-----------------------------|
| Nerve cells have | <b>all</b>  |  | of their genes switched on. |
|                  | <b>none</b> |  |                             |
|                  | <b>some</b> |  |                             |

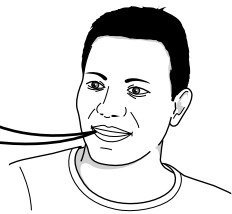
[2]

- (b) In multiple sclerosis the body's immune system attacks insulating cells in the brain and spinal cord.

Experiments in test tubes and on laboratory animals suggest that stem cells from bone marrow may offer an effective treatment.

The next stage is to try using stem cells in people with multiple sclerosis.

Some patients discuss this treatment.

|                                                                                                                                    |                                                                                    |                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <p><b>Scott</b><br/>I'm scared. I'll wait until the treatment is tested on other people.</p>                                       |   | <p><b>Tom</b><br/>I don't want to take the risk until we know this is 100% safe.</p> |
| <p><b>Megan</b><br/>I see no ethical problems with the treatment because they use your own stem cells, not cells from embryos.</p> |  | <p><b>Olivia</b><br/>This is a good use of modern technology.</p>                    |

Which patient makes an unreasonable statement?

Justify your answer.

Name .....

Justification .....

[2]

- (c) In the tests on laboratory animals there was one case where the stem cells did not work.

Does this mean that the treatment should not be tried on people?

Explain your answer.

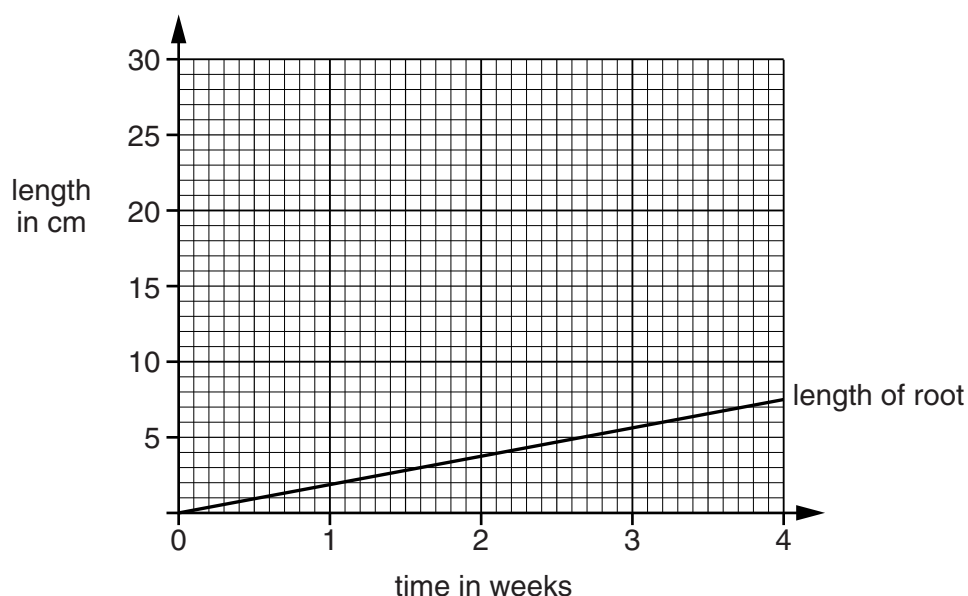
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..... [1]

[Total: 5]

- 9 Tony sees a bush in his friend's garden.  
He takes a cutting to make a clone of the bush to grow in his own garden.

Tony measures the length of the root every week and plots his data on a graph.



He then measures the length of the **stem** every week so that he can plot a second line on his graph.

| Week | Length of stem in cm |
|------|----------------------|
| 0    | 15                   |
| 1    | 15                   |
| 2    | 16                   |
| 3    | 20                   |
| 4    | 25                   |

- (a) Plot the length of the stem on the same graph and include a curve of best fit for the stem. [2]  
(b) Tony concludes that this plant is **not** growing during the first week.

Explain how Tony came to this conclusion and explain why the conclusion is wrong.

.....

.....

.....

.....

..... [2]

[Total: 4]

- 10 In humans, sperm cells and skin cells are made by different types of cell division.

Sperm cells have a different number of chromosomes to skin cells.

Compare the types of cell division that make sperm cells and skin cells in order to explain why it is important for sperm cells to be formed by a different type of cell division.



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

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..... [6]

[Total: 6]

**END OF QUESTION PAPER**

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# The Periodic Table of the Elements

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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.