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Tuesday 22 January 2013 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A152/02 Modules B5 C5 P5 (Higher Tier)

1517263570

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

MODIFIED LANGUAGE

A152/02

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

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

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

Explaining motion

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

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

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

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

Electric circuits

power = voltage × 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

energy = mass × [speed of light in a vacuum]^2

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Qualitative analysis

Tests for ions with a positive charge

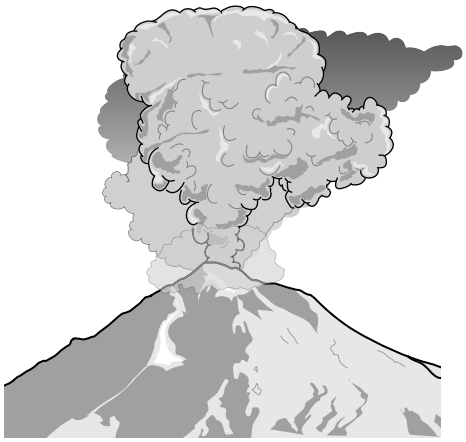
Ion	Test	Observation
calcium Ca^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper Cu^{2+}	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) Fe^{2+}	add dilute sodium hydroxide	a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(III) Fe^{3+}	add dilute sodium hydroxide	a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
zinc 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 CO_3^{2-}	add dilute acid	the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky)
chloride Cl^-	add dilute nitric acid, then add silver nitrate	a white precipitate forms
bromide Br^-	add dilute nitric acid, then add silver nitrate	a cream precipitate forms
iodide I^-	add dilute nitric acid, then add silver nitrate	a yellow precipitate forms
sulfate SO_4^{2-}	add dilute acid, then add barium chloride or barium nitrate	a white precipitate forms

Answer **all** the questions.

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



The clouds of ash spread across Europe, causing flights to be cancelled.

Information found on the internet says that:
- the volcano produced 150 000 tonnes of carbon dioxide each day
- 17 000 flights were cancelled each day
- a plane produces 20 tonnes of carbon dioxide for each flight.

(a) 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.

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..... **[3]**

(b) Look at the information from the internet.
Suggest reasons why the numbers may not be accurate.

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

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..... **[6]**

(c) Jet engines are hot enough to melt the silicon dioxide in the ash cloud from the volcano.
The melted silicon dioxide 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.

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

[Total: 11]

2 There are several aluminium refineries in Iceland.

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

(a) Aluminium **cannot** be made by reacting the aluminium oxide with carbon.

Explain why.

.....

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

(b) Aluminium ore contains aluminium oxide

(i) Show that the relative formula mass of aluminium oxide is 102.

[1]

(ii) How could you calculate the mass of aluminium that can be extracted from one tonne of aluminium oxide?
Put a (ring) around the correct answer.

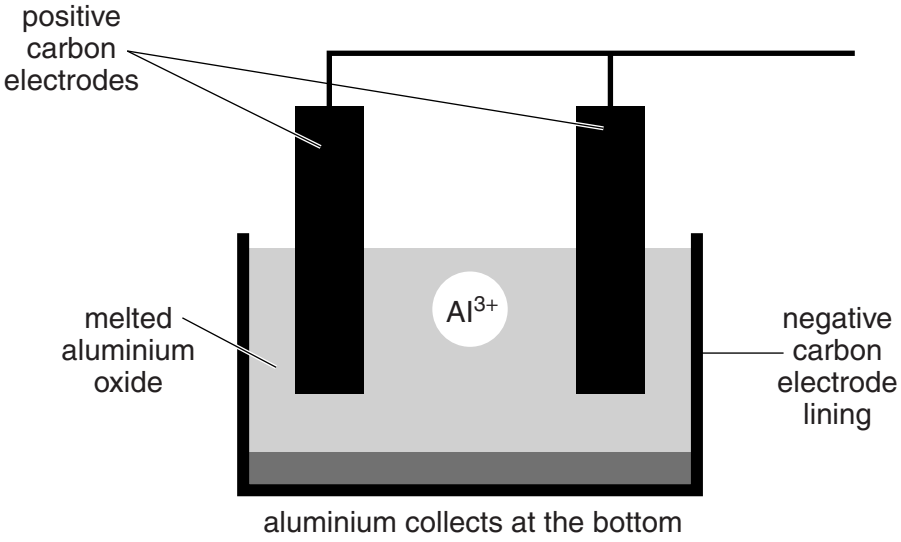
$\frac{1 \times 54}{102} = 0.53$ $\frac{1 \times 102}{54} = 1.89$ $\frac{1 \times 27}{102} = 0.265$ $\frac{1 \times 102}{27} = 3.78$

[1]

(iii) The refineries import the aluminium oxide from other countries.
A factory produces 4000 tonnes of aluminium each week.
What mass of aluminium oxide does the factory need to import each week?

..... tonnes **[1]**

(c) The diagram shows an electrolysis cell.



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

During electrolysis the aluminium oxide will conduct

only when solid.	
only when liquid.	
only when in solution.	
both when melted and when in solution.	

During electrolysis the ions

are made.	
move.	
precipitate.	
stop moving.	

At the negative electrode, positive ions

gain electrons.	
lose electrons.	
gain protons.	
lose protons.	

[3]

(d) During electrolysis the positive electrodes are burned away.
Explain why the positive electrodes are burned away.

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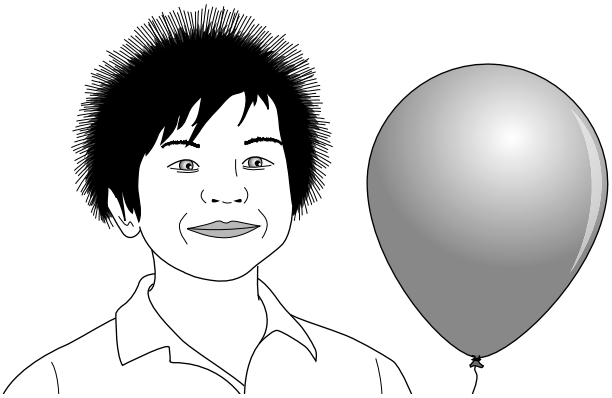
..... **[2]**

[Total: 9]

3 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 falls slowly down again.



Explain what happens to the balloon and to the hair.

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

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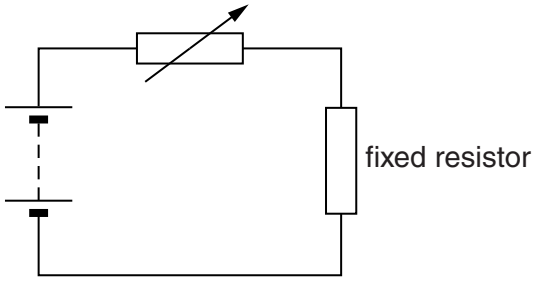
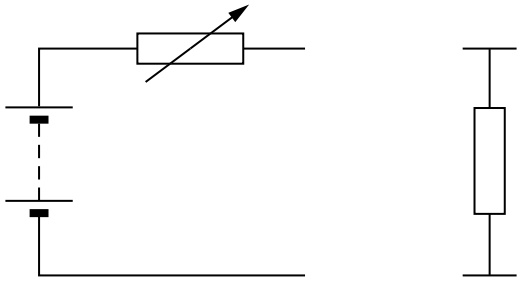
..... **[6]**

[Total: 6]

4 Jill uses this circuit to investigate a resistor.



(a) Complete the circuit diagram below to show how she should connect an ammeter and a voltmeter to measure the current in the fixed resistor and the potential difference across it.



[2]

(b) The resistor is labelled as 4.7 Ω. Jill sets the potential difference to 2.5 V.

(i) Calculate the expected current in the resistor.

current = ... A **[1]**

(ii) The actual current is less than the expected value.
Is the resistance more or less than 4.7 Ω? Justify your answer.

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.....

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

(c) Jill now makes three types of statement about the resistor.
Draw three straight lines to link each **statement** to its **type**.

statement	type
The resistance was not the expected value.	accepted theory
Current in a resistor transfers energy as heat.	experimental data
Resistance of the resistor might depend on its temperature.	suggested explanation
	best estimate

[2]

(d) Jill makes these measurements of the resistor.

Current (A)	Potential difference (V)	Resistance (Ω)	Power (W)
0.10	0.48	4.8	0.048
0.20	1.00		

How does the resistance and the power change as the current increases? Justify your answer.

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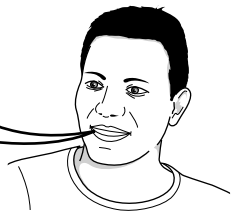
..... **[2]**

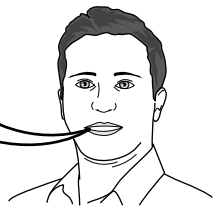
(e) Jill asks her friends to decide the **best** way of deciding that the change in resistance is due to its temperature change.

Allan
Repeat the experiment with different resistors at a constant temperature for the same two currents.



Bess
Repeat the experiment lots of times at different currents and temperatures.

Carlos
Repeat the experiment with the resistor held at a constant temperature.



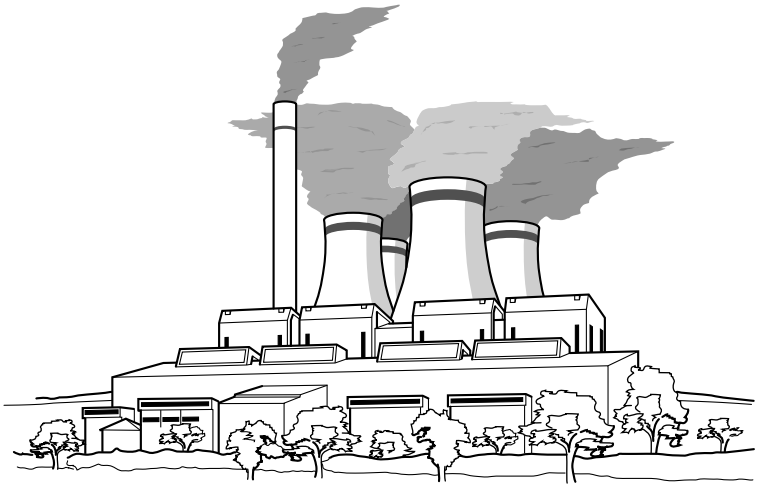
Davina
Repeat the experiment many times with the same two currents.

Who has the **best** way?

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

[Total: 10]

5 A power station contains several generators.



Each generator contains an electromagnet and a coil of wire.

(a) Draw straight lines to link the **start** of each sentence about the generator to its correct **end**.

start	end
The current ...	... is induced across the coil.
The voltage ...	... produces a changing magnetic field.
The electromagnet ...	... has a potential difference induced across it.
The coil of wire ...	... in the coil continually changes direction.

[2]

(b) Give reasons why power stations use generators that produce alternating current instead of direct current.

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

[Total: 4]

6 A friend gives Tony a cutting of a bush.

Tony grows the cutting to make a clone of the bush.

Use ideas about meristems to explain why the clone is genetically identical to the original bush.

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

[Total: 2]

7 Emperor penguins hatch their eggs on land.

The young birds are fed until they can dive in the sea to hunt food for themselves.

(a) Haemoglobin and myoglobin are proteins that can carry oxygen.

Haemoglobin is found in the blood and myoglobin is found in muscle cells.

The oxygen carried by these proteins allows the penguins to dive under water.

Scientists investigate the dive time of young emperor penguins compared to the dive time of adult penguins.

Here are their results.

Age of penguin	Maximum dive time in minutes	Amount of haemoglobin in the blood in g per 100 ml	Amount of myoglobin in the muscle in g per 100 g
3 months	0.5	10	0.1
4 months	2	12	1.0
6 months	4	17	2.0
adult	10	18	6.0

The scientists want to know which factor has the most significant effect on dive time, either:

- the percentage increase in haemoglobin from 3 months to adult

  or

- the percentage increase in myoglobin from 3 months to adult.

What conclusion are the scientists likely to reach? Use calculations to help justify your answer.

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..... **[3]**

(b) Describe how the genetic code in the DNA of penguin muscle cells leads to the production of myoglobin.

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

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..... **[6]**

(c) (i) Each body cell in an emperor penguin has 38 chromosomes.

These cells divide by mitosis to make new cells.

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

Each body cell produces

1	
2	
3	
4	

new cells per division.

Each new cell has

19	
38	
57	
76	

chromosomes.

Each new cell is genetically

different from all other body cells.	
identical to only new body cells.	
identical to only parent body cells.	
identical to both new and parent body cells.	

[2]

(ii) Emperor penguin brain cells do not produce myoglobin.

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

Brain cells and muscle cells contain different genes.	
Brain cells and muscle cells have all the same genes.	
Brain cells and muscle cells contain some of the same genes.	
Brain cells use the myoglobin gene to make different proteins.	
Brain cells have some genes switched off that muscle cells have switched on.	
Brain cells have no genes switched on to make proteins.	

[2]

[Total: 13]

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Question 8 begins on page 18

PLEASE DO NOT WRITE ON THIS PAGE

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

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.

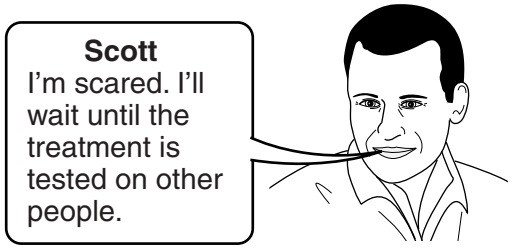
(a) If the procedure works in humans, two of the statements are correct.

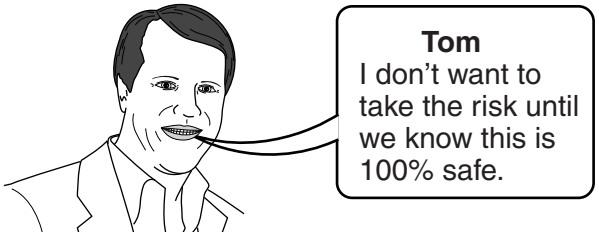
Put ticks (✓) in the boxes next to the **two** correct statements.

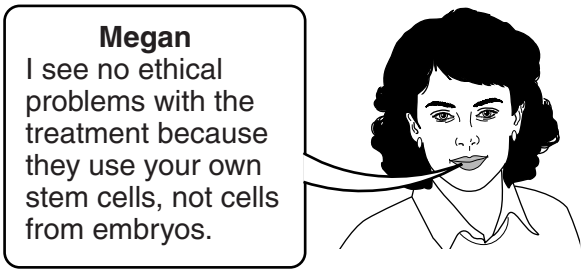
Embryonic stem cells cannot form insulating cells.	☐
Adult stem cells must be able to form new insulating cells.	☐
The stem cells must work by destroying damaged cells.	☐
The stem cells must switch off the immune system.	☐
After successful treatment, the continued action of the immune system could mean there is a need for more stem cells.	☐
Insulating cells must change back to stem cells.	☐

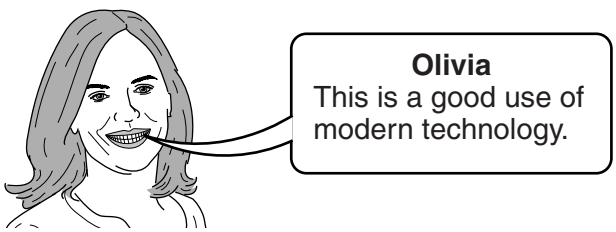
[2]

(b) Some patients discuss this treatment.









Which patient makes an unreasonable statement?

Justify your answer.

Name .....

Justification .....

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[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]

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.