OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A152/02

TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A
Modules B5 C5 P5 (Higher Tier)

TUESDAY 22 JANUARY 2013: Morning
DURATION: 1 hour
plus your additional time allowance

MODIFIED ENLARGED 18pt

Candidate forename		Candidate surname	

Centre number						Candidate number				

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

OCR SUPPLIED MATERIALS:

Periodic Table (inserted)

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (NF/CGW) 1460796422 71486/2

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. 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).**

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 pages 4–5.**
- **A list of qualitative tests for ions is printed on pages 6–7.**
- **An enlarged copy of the Periodic Table is inserted.**
- **The total number of marks for this paper is 60.**

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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

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

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

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

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

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

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

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

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

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 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.

_____

_____

_____

_____ **[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.
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: 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.

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

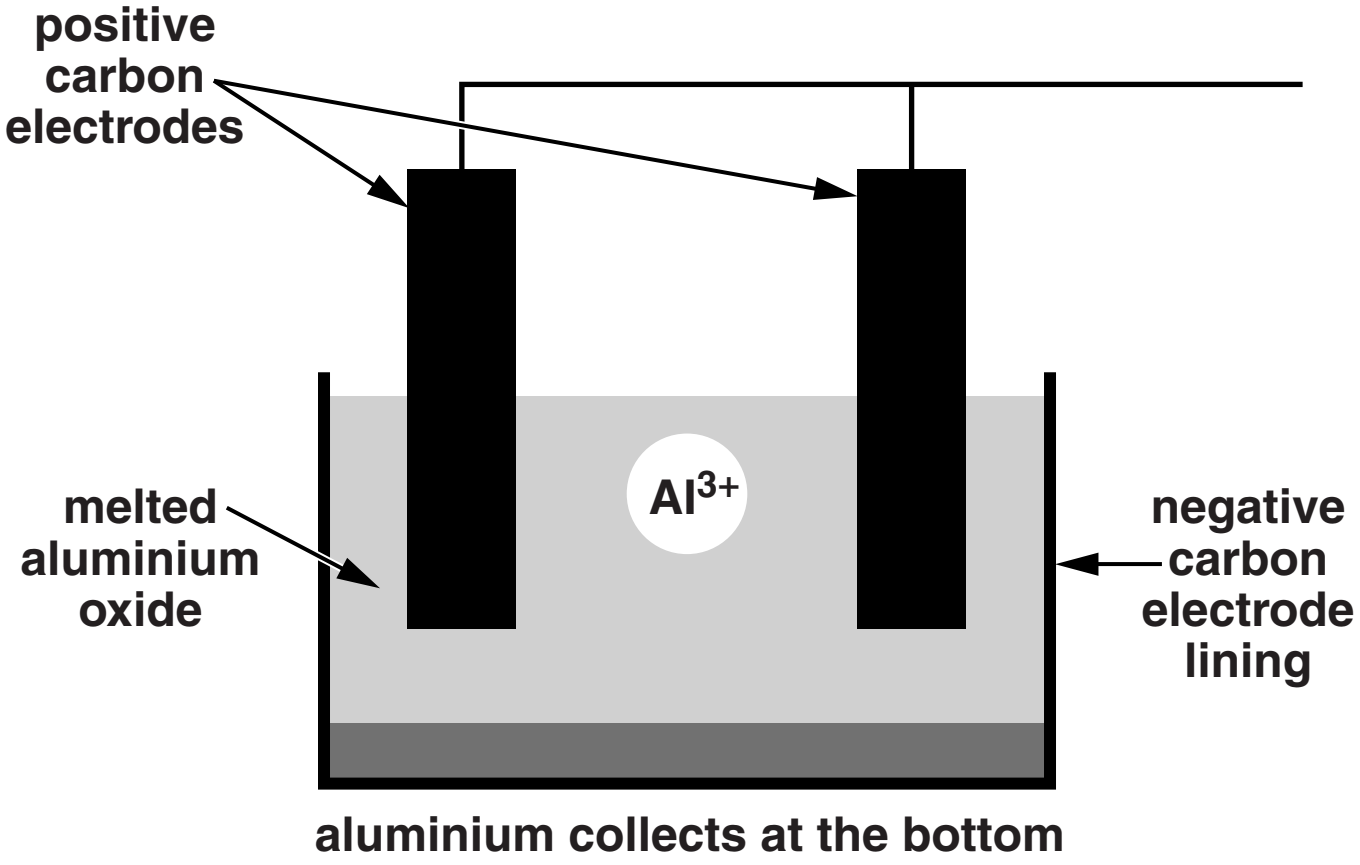
$\frac{1 \times 27}{102} = 0.265$ $\frac{1 \times 102}{27} = 3.78$

[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 it 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 they are burned away.

_____

_____

_____ **[2]**

[TOTAL: 9]

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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 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.

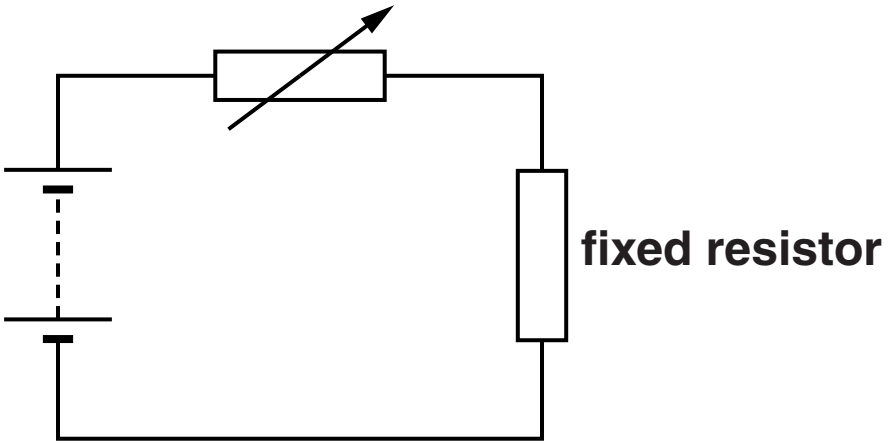
_____

_____

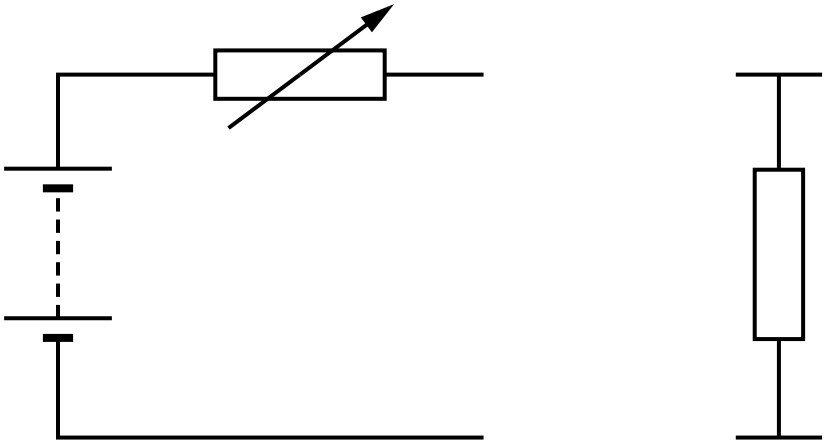
_____ **[6]**

[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.

_____

_____

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

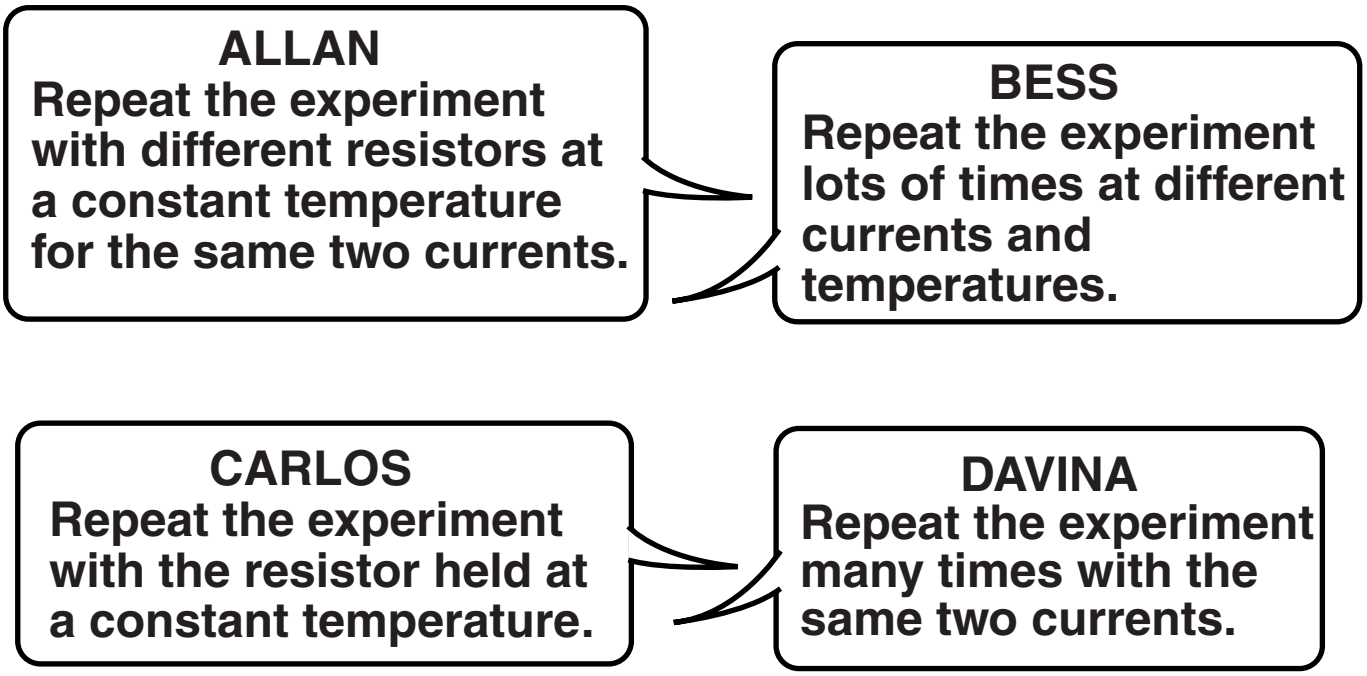
_____

_____

_____

_____ **[2]**

(e) Jack disagrees with Jill.
He thinks that the change in resistance is due to the change in current.
Jill asks her friends to decide the BEST way of deciding that the change in resistance is due to its temperature change.



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.

_____

_____

_____

_____ **[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.

_____

_____

_____

_____ **[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 how well young emperor penguins dive compared with adults.

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.

_____

_____

_____ **[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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[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]

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.

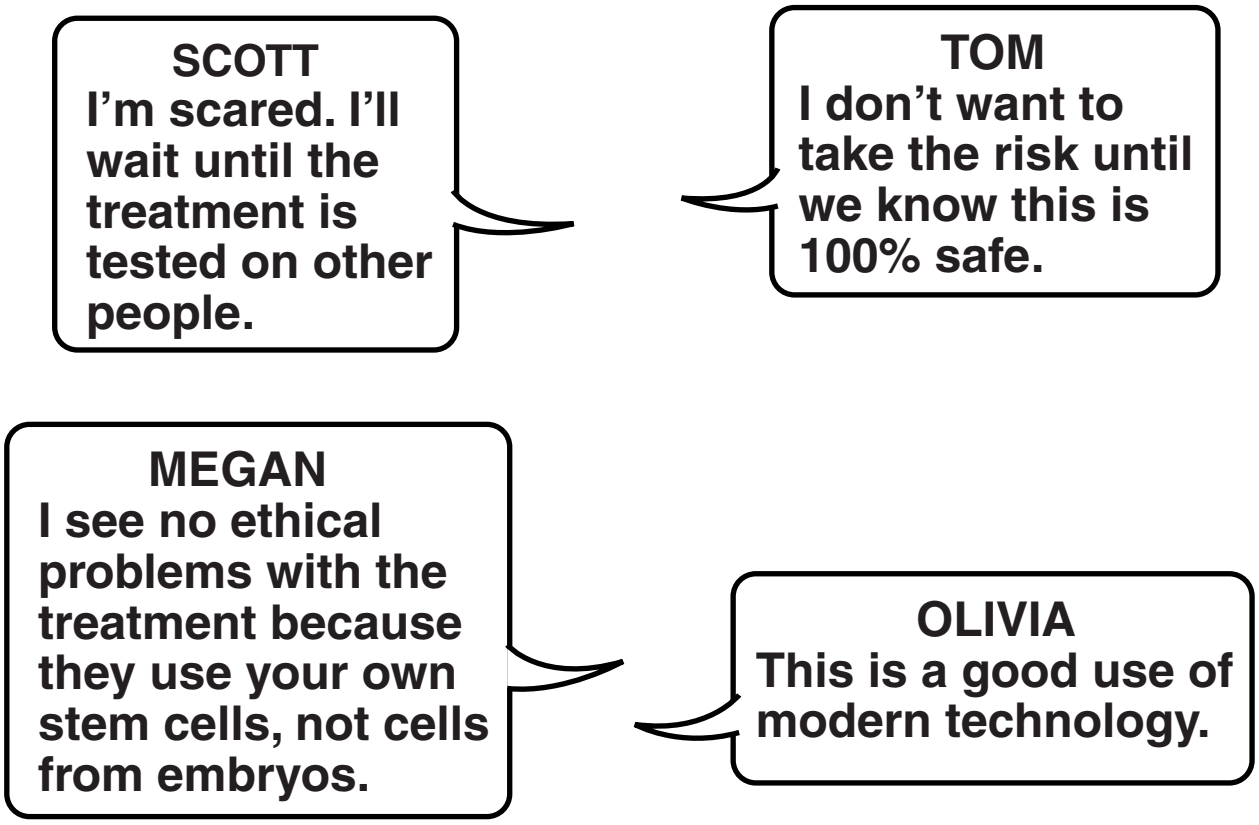
(a) If the procedure works in humans, two of the statements are correct.

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 _____

_____

[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.

_____

_____ **[1]**

[TOTAL: 5]

END OF QUESTION PAPER