

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3440U10-1



S24-3440U10-1

MONDAY, 10 JUNE 2024 – MORNING

APPLIED SCIENCE (Single Award)
UNIT 1: Science in the Modern World
FOUNDATION TIER

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator, pencil and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

A Periodic Table is printed on page 20.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	12	
3.	6	
4.	6	
5.	6	
6.	5	
7.	15	
8.	19	
Total	75	

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Answer **all** questions.

1. The table gives some information about our solar system.

Object	Mean distance from Sun (AU)	Diameter (km)	Length of day i.e. time to spin once on axis (Earth days)	Length of year i.e. time to orbit Sun (Earth years)	Mean temperature (°C)
Mercury	0.4	5000	59	0.2	427
Venus	0.7	12 000	243	0.6	480
Earth	1.0	13 000	1	1	14
Mars	1.5	7000	1	2	−63
Asteroid belt	(1.3 / 3.6 / 7.6)				(−93 / −135 / −165)
Jupiter	5.2	143 000	0.4	12	−130
Saturn	9.5	120 000	0.4	29	−130
Neptune	30.0	50 000	0.7	165	−200

Use the information in the table to answer the following questions.

- (a) (i) Name the rocky planet with the largest diameter. [1]
- (ii) Name the coldest gas giant planet. [1]
- (iii) Name the gas giant planet not listed in the table. [1]
- (iv) Name the planet that has a year twice as long as Earth. [1]
- (b) **Complete the table** for the asteroid belt by circling the correct number in the brackets in each cell. [2]



2. A householder uses gas for heating.

On 1st of January 2018 the householder installed a solar panel, at a cost of £2000, to provide hot water for heating.

The table shows information about the householder's gas consumption.

Year	Units of gas used (kWh)
Jan 1 to Dec 31 2017	27 900
Jan 1 to Dec 31 2018	22 400
difference in units used	

(a) (i) Complete the table. [1]

(ii) The cost of 1 unit of gas in both years was 4p. Use the information above and the equation

annual savings = cost of one unit $\times$ difference in units used (kWh)

to calculate the annual savings in the gas bill. [2]

annual savings = p

(iii) Convert the annual savings into pounds (£). [1]

annual savings = £



(iv) Use the equation

$$\text{payback time (years)} = \frac{\text{£2000}}{\text{annual savings}}$$

to calculate the time it would take for his annual savings on gas to pay back the cost of the solar panel. [2]

payback time = years

(v) Complete the following sentences by underlining the correct word(s) in brackets.

I. If the number of sunlight hours in a year increases, the payback time
(***decreases / stays the same / increases***). [1]

II. If the cost of a unit of gas increases, the payback time
(***decreases / stays the same / increases***). [1]



- (b) The water pipes inside a solar panel are made from copper (Cu). Copper corrodes to copper oxide (CuO) and then combines with carbon dioxide to make copper carbonate (CuCO₃), which gives it a bluey-green colour.



- (i) Copper is an element.

Copper oxide and copper carbonate are compounds.

Tick (✓) boxes next to the **three** correct statements about these substances. [3]

Copper (Cu) contains one type of atom.

☐

Copper oxide (CuO) contains three different types of atoms.

☐

Copper carbonate (CuCO₃) contains three different types of atoms.

☐

Copper carbonate (CuCO₃) contains six different types of atoms.

☐

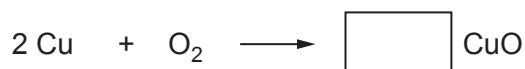
Compounds are made of different atoms that are chemically joined.

☐

Atoms are created when a compound is made.

☐

- (ii) Complete the balanced symbol equation for the reaction between copper and oxygen. [1]



3. The table gives some information about scientific terms.

Place **one** tick (✓) in each row underneath the correct scientific term that the information relates to.

[6]

One has been completed as an example.

Information	Seed banks	Bioaccumulation	Eutrophication	Nature reserve
preserves genetic variety	✓			
fish suffocate				
build-up of heavy metals				
algal bloom forms				
provides protection for animals				
poisons predators at the top of a food chain				
fertilisers wash into rivers				



4. Sodium chloride is obtained commercially in two ways: by mining rock salt; or from sea water. It can be produced in the laboratory by reacting sodium and chlorine.

Sodium is an alkali metal found in group 1 of the Periodic Table. It has an atomic number of 11. Chlorine is a halogen and is found in group 7 of the Periodic Table. It has an atomic number of 17.

- (a) The electronic configuration of sodium is 2,8,1.

Give the electronic configuration of chlorine. [1]

- (b) During the reaction to form sodium chloride, a sodium atom loses an electron and becomes a sodium ion.

The electronic configuration of a sodium ion is 2,8 and it has a positive charge.

Complete the following sentences by underlining the correct term in the bracket. [3]

When sodium and chlorine react to form sodium chloride, each chlorine atom (**gains** / **loses** / **shares**) an electron and becomes a chloride ion.

The electronic configuration of a chloride ion is (**2,8,7** / **2,8,8** / **2,8**) and it has a (**positive** / **neutral** / **negative**) charge.

- (c) **Circle** the correct chemical formula of sodium chloride. [1]

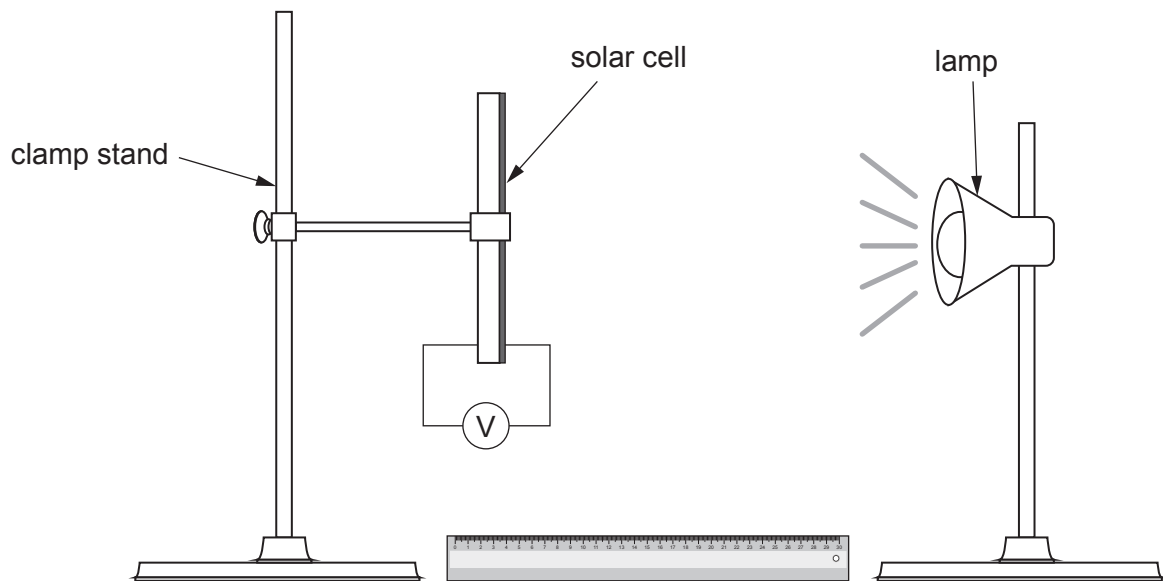
NaCl / NaCl₂ / NaCl / NaCl₂

- (d) Alkali metals react more violently if they are further down the group. Use the Periodic Table on page 20 to state the name of the most reactive alkali metal. [1]

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5. Describe how the apparatus shown below is used to investigate how the distance between the solar cell and the lamp affects the output voltage of the solar cell. [6 QER]



6. Aluminium is widely used in our homes. It is extracted by electrolysis of aluminium oxide after its ore has been purified.

- (a) Aluminium oxide does not conduct electricity when solid. State what must be done to aluminium oxide for electrolysis to occur. [1]

.....

- (b) The overall equation for the extraction of aluminium from aluminium oxide is:



Complete the word equation. [1]

Aluminium oxide $\longrightarrow$ +

- (c) Complete the table to find the relative formula mass of aluminium oxide (Al_2O_3). [3]

Element	Number of atoms	Relative atomic mass (A_r)	Total mass of each element in Al_2O_3
aluminium	2	27	54
oxygen		16	
Relative formula mass (M_r)			



7. Red squirrel populations have declined since the introduction of the grey squirrel in 1876.

- (a) The scientific name of the red squirrel is *Sciurus vulgaris*.
The scientific name of the grey squirrel is *Sciurus carolinensis*.

Their scientific classifications are shown in the table below.

	Red squirrel	Grey squirrel
Kingdom	Animalia	Animalia
Phylum	Chordata	Chordata
Class	Mammalia	Mammalia
Order		Rodentia
Family	Sciuridae	
Genus	<i>Sciurus</i>	<i>Sciurus</i>
Species	<i>vulgaris</i>	

- (i) Complete the classification table. [3]

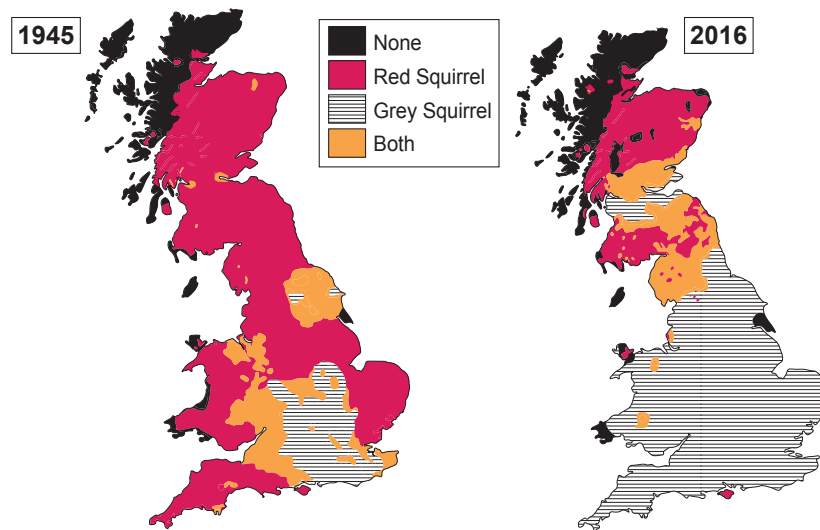
- (ii) Scientists all over the world use scientific names. State the advantage of using scientific names instead of common names. [1]

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- (b) The diagram below shows how the squirrel population in Great Britain has changed between 1945 and 2016.



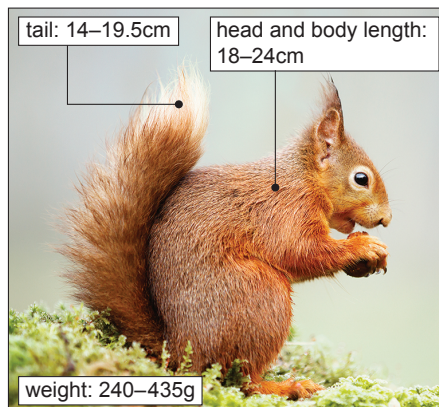
- (i) Describe how the population of red squirrels has changed between 1945 and 2016. [2]

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- (ii) Use the information in the pictures, and your own knowledge, to suggest **two** reasons why the grey squirrel population has been more successful when competing with red squirrels. [2]



1.

.....

2.

.....



- (c) One forest on Anglesey had an area of 244 hectares and grey squirrels were controlled by trapping. One method of estimating the number of squirrels involved counting the number of squirrel nests.

The mean number of **red squirrel nests** per hectare is **0.48** and the mean number of **grey squirrel nests** per hectare is **1.2**.

- (i) Use the equation

number of red squirrels in the forest = mean number of nests per hectare $\times$ 0.26 $\times$ 244

to calculate the number of **red squirrels** in the forest.

[2]

number of red squirrels =

- (ii) Use the equation

number of grey squirrels in the forest = mean number of nests per hectare $\times$ 0.74 $\times$ 244

to calculate the number of **grey squirrels** in the forest.

[1]

number of grey squirrels =

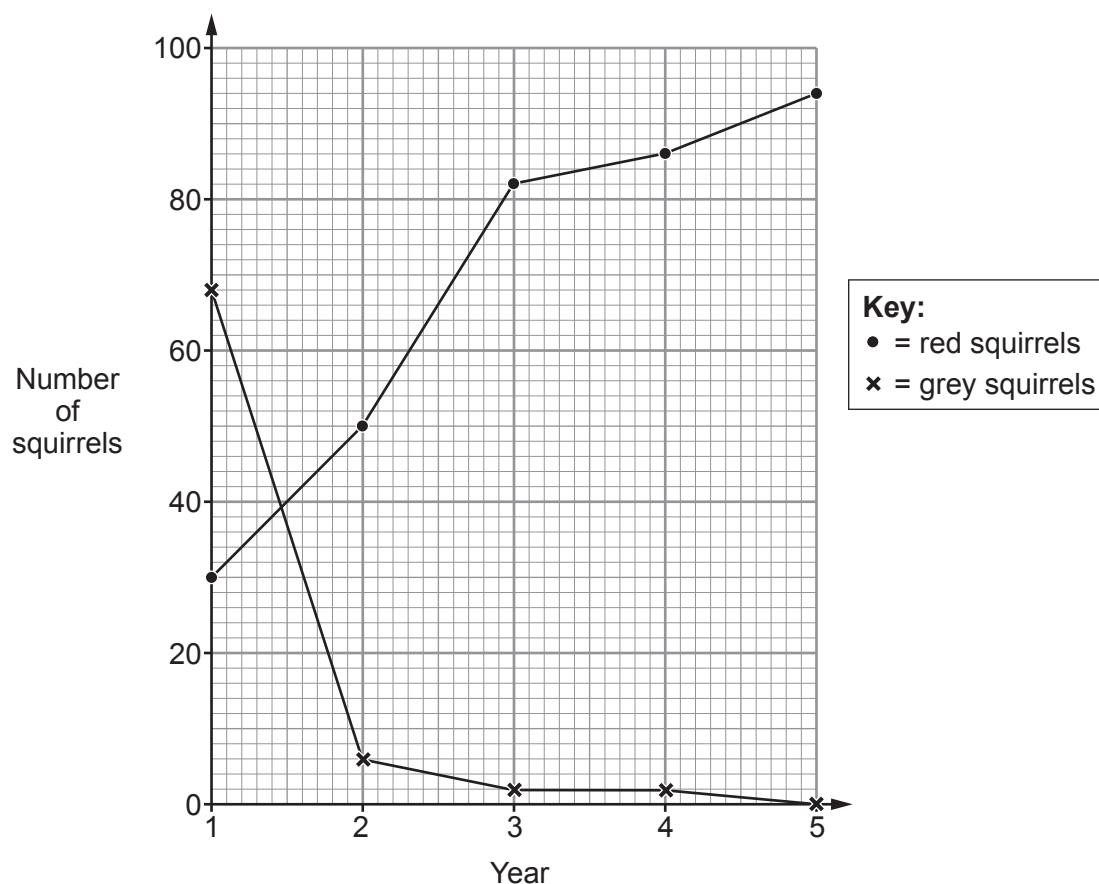
- (iii) Calculate the difference in population between the red and grey squirrels in this forest.

[1]

difference in population =



- (iv) The results of controlling grey squirrel numbers by trapping over five years in a different forest are shown in the graph.



It was claimed that the **total** number of red and grey squirrels would stay the same over time. Explain whether the graph shows the claim to be true. [3]

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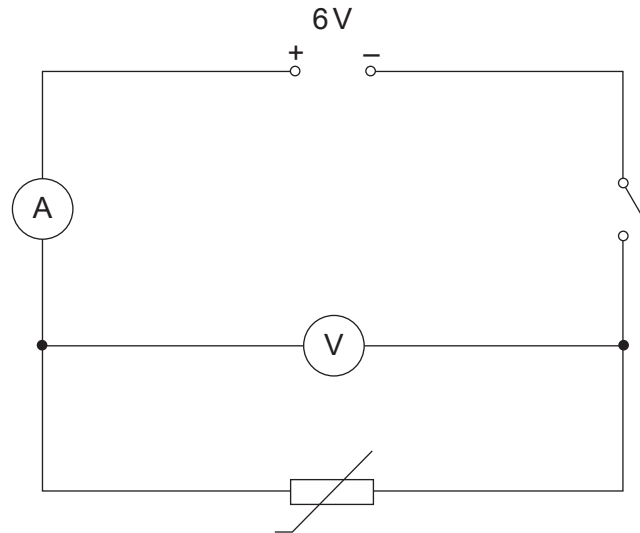
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8. Thermistors are used as temperature sensors in thermostats. A group of students investigate a thermistor at different temperatures. The circuit they use is shown below. They keep the voltage constant.



- (a) (i) State the purpose of the ammeter. [1]

.....

- (ii) State the purpose of the voltmeter. [1]

.....

- (b) The students' results are shown below.

Temperature (°C)	Current (mA)	Voltage (V)	Resistance (kΩ)
10	0.4	6.0	15.0
20	0.8	6.0	7.5
30	1.6	6.0	3.8
40	0.6	6.0	10.0
50	6.4	6.0	0.94

- (i) Jason says there are no anomalous current readings. Explain whether you agree with Jason. [2]

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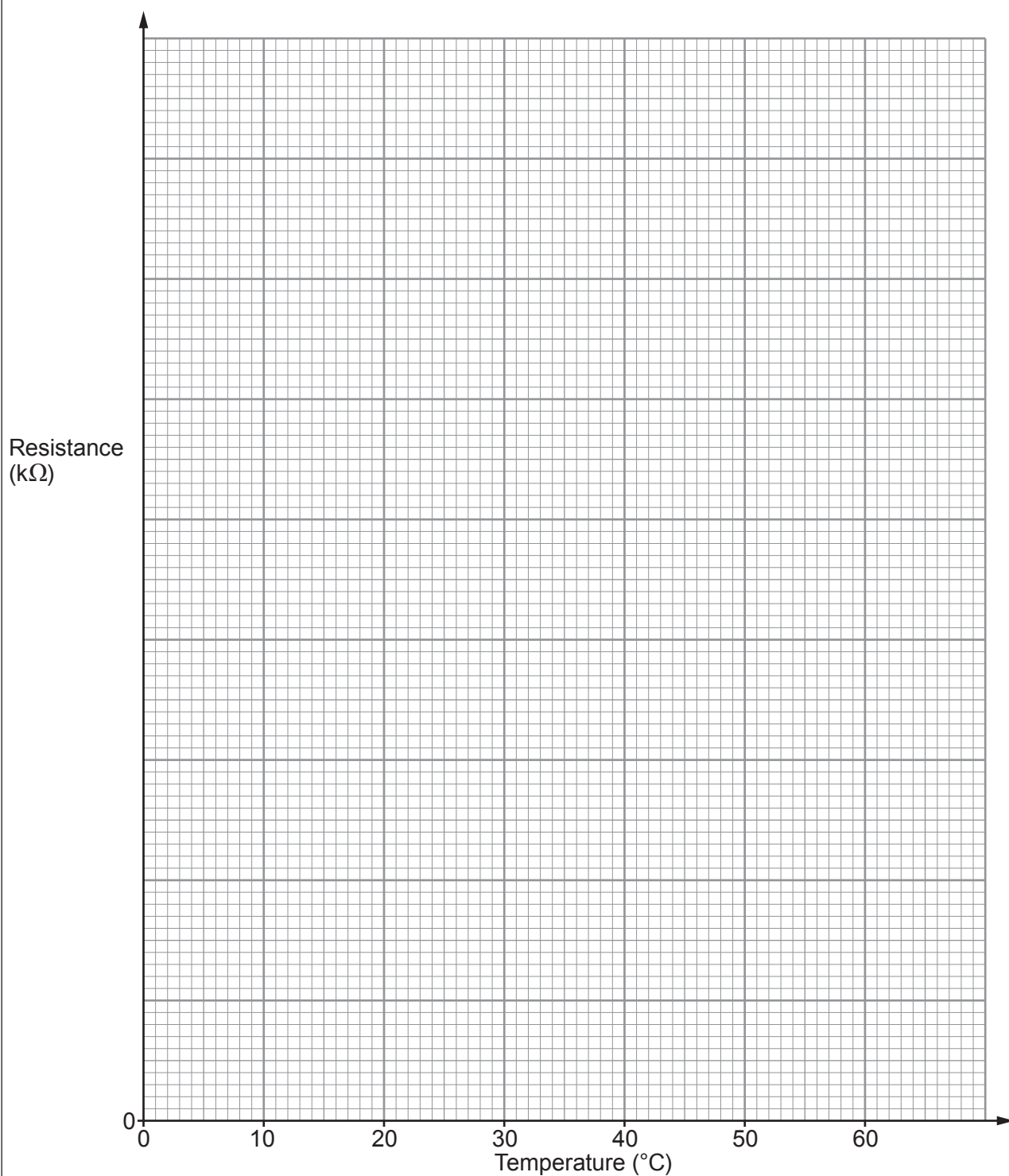
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(ii) Plot the data on the grid below and draw a suitable curved line.

[4]

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- (iii) Jason concluded that every time the temperature doubled the resistance of the thermistor halved. Use the data in the table to explain whether you agree with Jason. [3]

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- (iv) **Extend** your line on the graph to estimate the resistance of the thermistor at 60 °C. [2]

resistance = k Ω

- (v) A thermistor is used in a thermostat. The thermostat needs to increase in resistance by at least 12.5 k Ω when the temperature drops from 50 °C to 10 °C. Use the data in the table in (b) to explain whether the thermistor used in this investigation is suitable. [2]

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- (c) Describe how you would amend the investigation to find the current-voltage (I – V) characteristic of a thermistor. [4]

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END OF PAPER



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THE PERIODIC TABLE

Group 1 2 3 4 5 6 7 0

1 H Hydrogen 1															4 He Helium 2				
7 Li Lithium 3		9 Be Beryllium 4												19 F Fluorine 9	20 Ne Neon 10				
23 Na Sodium 11		24 Mg Magnesium 12												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
86 Rb Rubidium 37		88 Sr Strontium 38		89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86	
223 Fr Francium 87		226 Ra Radium 88		227 Ac Actinium 89															

Key

Key

A_r	relative atomic mass
Symbol	
Name	
Z	atomic number