Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3440U10-1

S17-3440U10-1

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

WEDNESDAY, 14 JUNE 2017 – MORNING

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**12**	
3.	**5**	
4.	**8**	
5.	**12**	
6.	**14**	
7.	**19**	
Total	**75**	

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01

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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.

INFORMATION FOR CANDIDATES

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

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

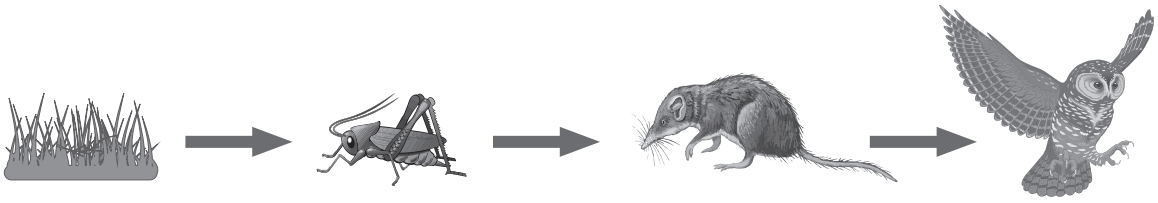
You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

A periodic table is printed on page 24.

Examiner only

Answer **all** *the questions in the spaces provided.*

1. The diagram below shows a food chain for a grassland habitat.



(a) Name the **producer** in this food chain. [1]

.....

(b) Name the **energy source** in all food chains. [1]

.....

(c) Name a **carnivore** in this food chain. [1]

.....

(d) Describe what would happen to the numbers of grasshoppers if the shrews died out. Give **one** reason for your answer. [2]

.....

.....

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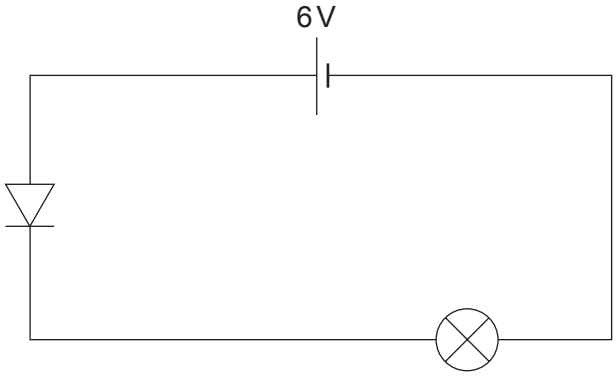
2. Part of the circuit used to investigate the voltage-current characteristics of a diode is shown in the circuit diagram below.



(a) (i) **Add** an ammeter to the circuit diagram. [1]

(ii) State the purpose of an ammeter. [1]

.....

(iii) **Add** a voltmeter to the circuit diagram to measure the voltage across the diode. [1]

(iv) **Add** a variable resistor to the circuit diagram. [1]

(v) State the purpose of a variable resistor. [1]

.....

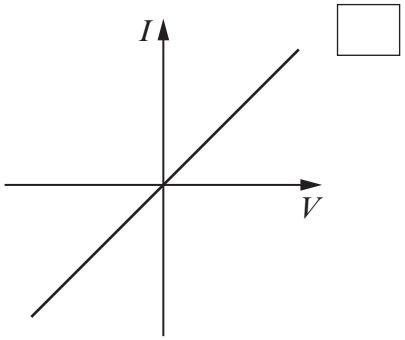
(vi) State what happens to the lamp if the diode is reversed. Give **one** reason for your answer. [2]

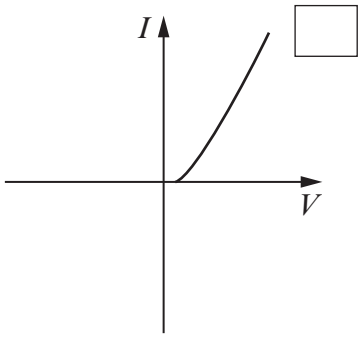
.....

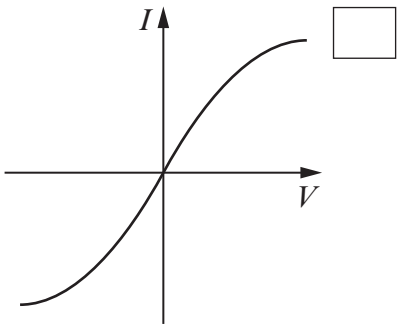
.....

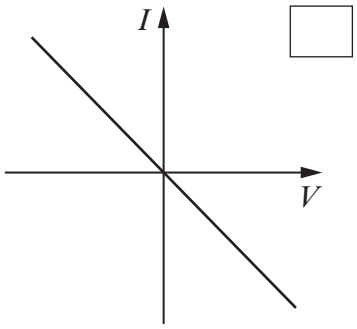
Examiner only

(b) **Tick** (✓) the box next to the graph below that shows the voltage-current characteristics of a diode. [1]









(c) (i) Use the information from the circuit diagram and the equation:

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

to calculate the total circuit resistance when the current is 0.5 A. [2]

resistance = ... Ω

(ii) Use the information from the diagram and the equation:

power = voltage × current

to calculate the battery power when the current is 0.5 A. [2]

power = ... W

3. Sodium hydroxide solution can be used to detect certain metal ions in water. The results are shown below.

Positive ion	Test	Observation
aluminium	add dilute sodium hydroxide solution	white precipitate that dissolves if more sodium hydroxide solution is added
copper	add dilute sodium hydroxide solution	pale blue precipitate
iron(II)	add dilute sodium hydroxide solution	pale green precipitate
iron(III)	add dilute sodium hydroxide solution	red-brown precipitate
lead	add dilute sodium hydroxide solution	white precipitate that dissolves if more sodium hydroxide solution is added
magnesium	add dilute sodium hydroxide solution	white precipitate

Chemical tests for some negative ions are shown below.

Negative ion	Test	Observation
carbonate	add dilute hydrochloric acid	bubbles of colourless gas given off
chloride	add dilute nitric acid then silver nitrate	white precipitate
sulfate	add solution of barium chloride	white precipitate
iodide	add dilute nitric acid then silver nitrate	yellow precipitate
bromide	add dilute nitric acid then silver nitrate	cream precipitate

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(a) A drum containing an unknown powder has been found near a stream. Some powder from the drum was dissolved in water and the following chemical tests were carried out on the solution.

Test	Observation	Conclusion
hydrochloric acid added	no change	.....
barium chloride solution added	white precipitate	.....
sodium hydroxide solution added	pale green precipitate	.....

(i) **Complete** the table. [3]

(ii) State the name of the chemical found in the drum. [1]

.....

(b) A flame test can also be used for identification. State what is identified by a flame test. [1]

.....

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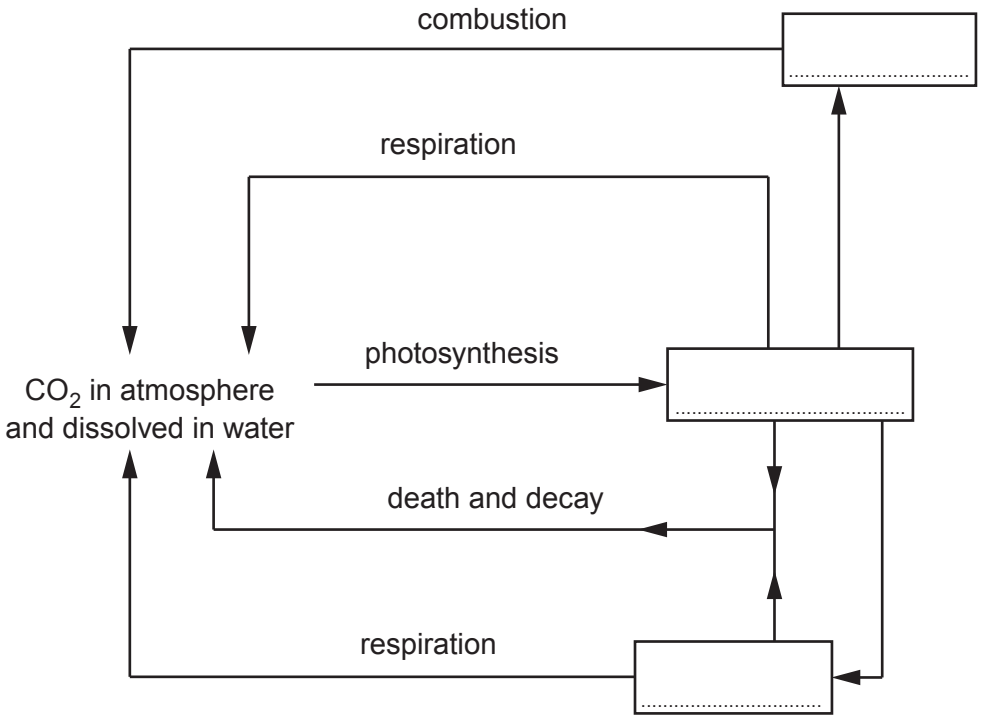
4. *(a)* The diagram below shows the carbon cycle. **Complete the diagram** using words from the box. [3]

animals	fuel	green plants	soil



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(b) The following table shows how global temperature and atmospheric carbon dioxide concentrations changed between 1890 and 1970.

Year	Atmospheric carbon dioxide concentration (ppm)	Mean global temperature change since 1890 (°C)
1890	295	0.00
1900	297	0.18
1910	298	0.20
1920	298	0.22
1930	299	0.43
1940	300	0.54
1950	312	0.48
1960	325	0.43
1970	335	0.40

(i) Describe whether global temperature changes have always followed changes in carbon dioxide concentration. [2]

.....

.....

.....

(ii) **Tick** (✓) the boxes next to the correct statements about how the greenhouse effect occurs. [3]

The surface of the Earth emits visible light. ☐

The surface of the Earth absorbs the Sun's rays. ☐

Ultra-violet waves emitted from the Earth's surface get trapped in the atmosphere. ☐

Molecules of gas in the atmosphere absorb infra-red waves that have been emitted from the surface of the Earth. ☐

The atmosphere absorbs all the rays from the Sun and heats up. ☐

The surface of the Earth emits infra-red waves. ☐

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5. *(a)* Use words from the box to complete the following paragraph about Darwin's theory of Natural Selection. [4]

survive	variations	evolved	reproduce	adapted

The species in a population have small differences or ..... .

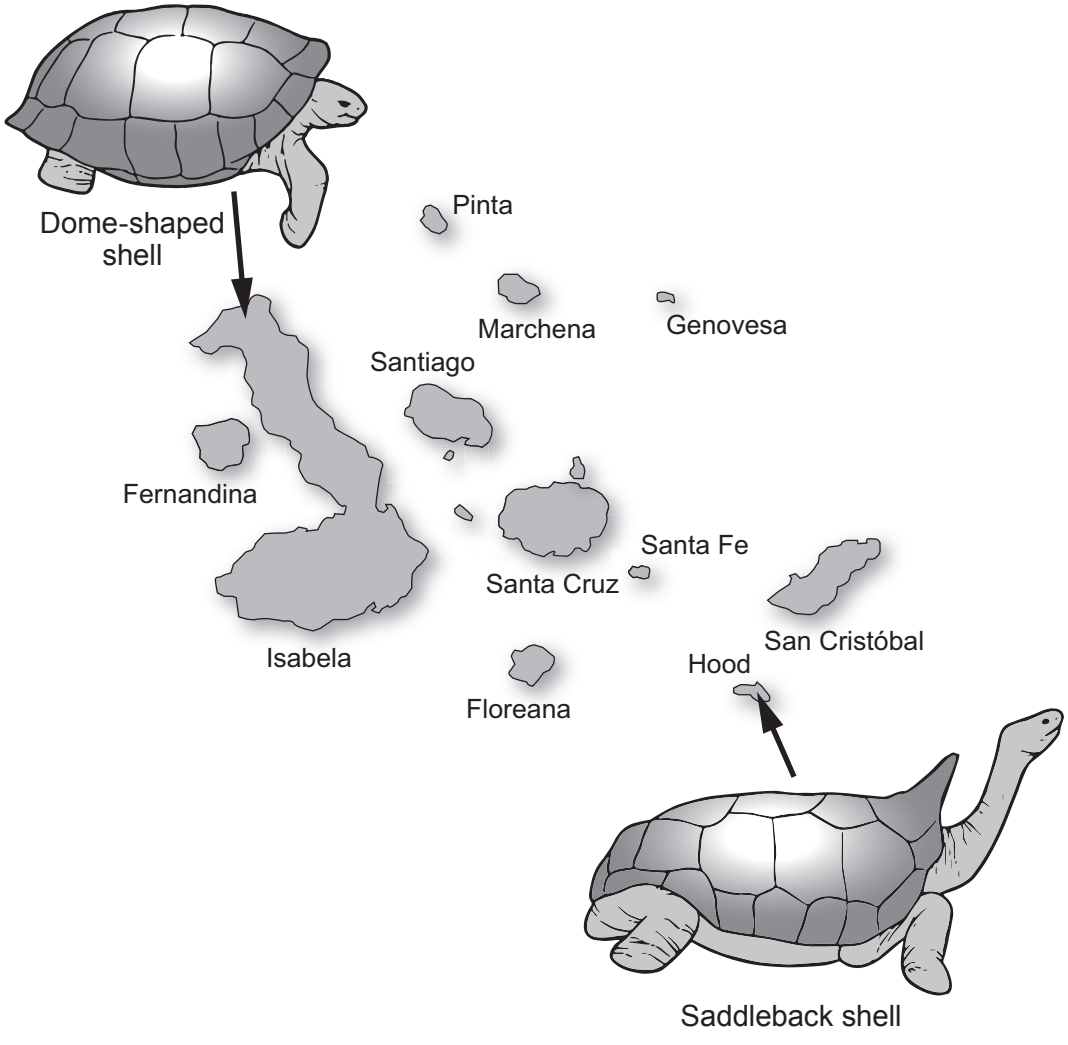
These differences make some organisms better ..... to their environment.

The best suited organisms ..... .

They can now ..... and pass on the useful feature. Over time, many of the organisms in the population have the feature. The population has changed or

..... .

(b) Biologists have discovered different types of giant tortoise living in the Galapagos Islands. They are shown in the diagram below.



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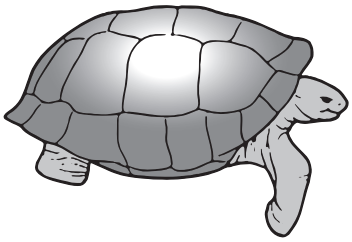
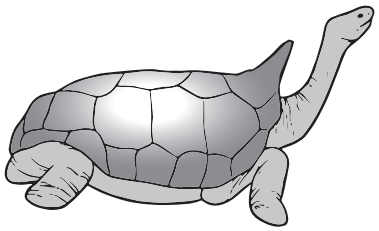
Some parts of the Galapagos Islands have drier climates with little ground vegetation. Other parts have wetter climates with more ground vegetation.

Island	Isabela	Hood
Tortoise		
Shell shape	domed	saddleback
Neck	short	long
Climate	wet	dry

Use the information above to explain why tortoises living on Isabela and Hood islands have different adaptations. [6 QER]

Examiner only

(c) The original ancestor of the tortoises was probably small in size and evolved into the present-day giants after its arrival in the Galapagos. This is because there was no longer any need to hide from predators or competition for food. Once the tortoises spread, they evolved on their isolated islands into the different species we see today. More recently the human population on these islands has increased and animals such as goats have been introduced.

(i) State **one** reason why goats will affect the tortoise population. [1]

.....

.....

(ii) State **one** reason why the growing human population on the islands will affect the habitats of the tortoises. [1]

.....

.....

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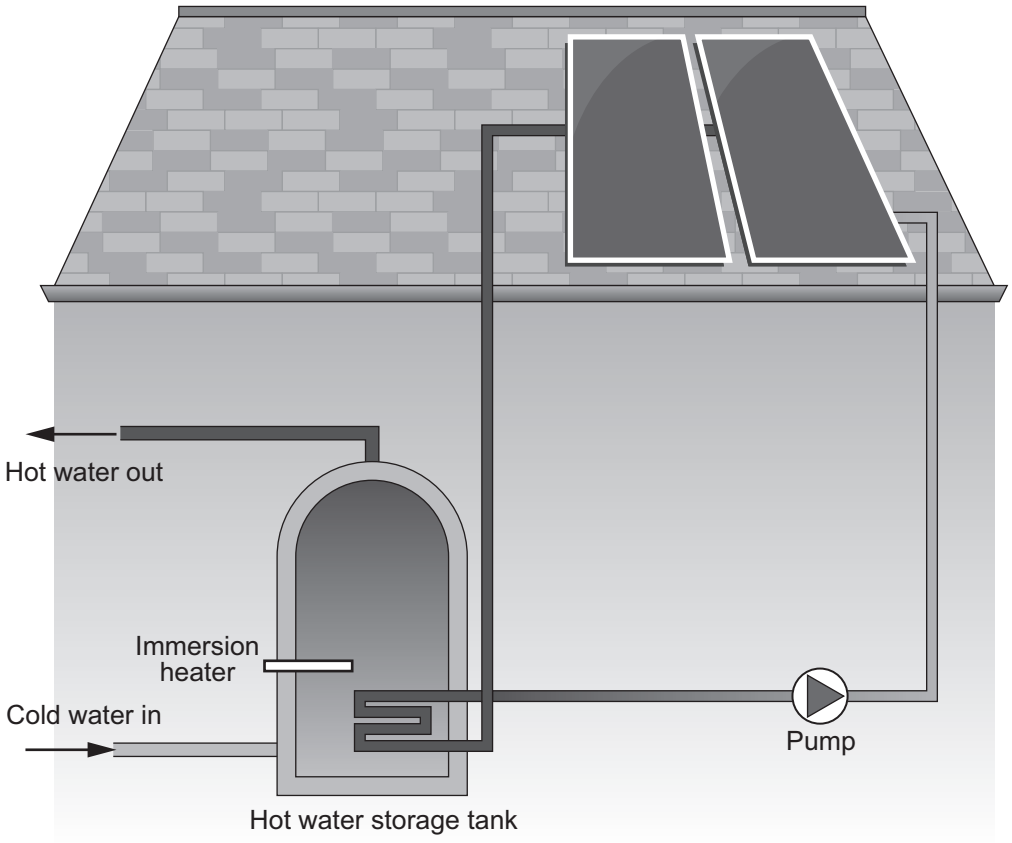
6. Solar water heating systems use energy from the Sun to heat domestic hot water. An immersion heater can be used to make the water hotter, or to provide hot water when solar energy is unavailable.



Solar water heating systems can help save money on energy bills.

Householders receive payments for the heat they generate from a solar water heating system through the government's Renewable Heat Incentive (RHI). Payments are shown in the table below.

Number of people per household	Solar panel area (m^2)	RHI payment (£/year)
2	2	195
3	3	265
4	4	335
5	6	435

Examiner only

(a) The power input per m^2 from sunlight is 500 W.

(i) Calculate the total power input received by a solar panel for a 5 person household. [2]

power = ... W

(ii) The useful power output from the panel is 1 200 W. Use the equation:

$$\% \text{ efficiency} = \frac{\text{useful power output}}{\text{power input}} \times 100$$

to calculate the % efficiency of the panel. [2]

% efficiency = ...

(b) Before the solar panel was fitted to the roof, a 2.5 kW immersion heater provided hot water for the house. The immersion heater was switched on for 20 hours a week.

(i) Use the equation:

energy used (kWh) = power (kW) $\times$ time (h)

to calculate the energy used by the immersion heater during this time. [2]

energy used = ... kWh

(ii) Use the equation:

total cost = energy used (kWh) $\times$ cost per unit (p)

to calculate the cost of using the immersion heater for 20 hours.
One unit of energy costs 18p.

[2]

total cost = ...

Examiner only

(c) The solar panel was installed in a five person household. The homeowner did not use the immersion heater for as long and saved £2.25 a week.

(i) Calculate how much the homeowner saved in energy costs in a year. [2]

saving in energy costs = £ .....

(ii) Use the table and the equation:

total saving = RHI payment + saving in energy costs

to calculate the total savings made by the homeowner every year. [2]

= £ .....

(iii) The cost of installing the system is £6 000. The installer claims that the payback time for the system will be less than 10 years. Using the information above, determine whether this claim is true. [2]

.....

.....

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7. The table gives some information about the first four alkali metals in Group 1 of the periodic table. Use this information to answer the questions that follow.

Element	Number of particles in nucleus	Number of electrons	Melting point (°C)	Boiling point (°C)	Density (g/cm^3)
lithium	7	3	181	1 347	0.54
sodium	23	11	98	881	0.98
potassium	39	19	63	766	0.86
rubidium	85	37	39	688	1.50

(a) (i) Write down the symbol for potassium in the form ${}^{A}_{Z}\mathrm{X}$. [1]

.....

(ii) Calculate the number of neutrons in a rubidium nucleus. [1]

.....

(iii) State which alkali metal is solid at 100°C. [1]

.....

(iv) Caesium is the next alkali metal in the series. Estimate its melting point. [1]

melting point = ... °C

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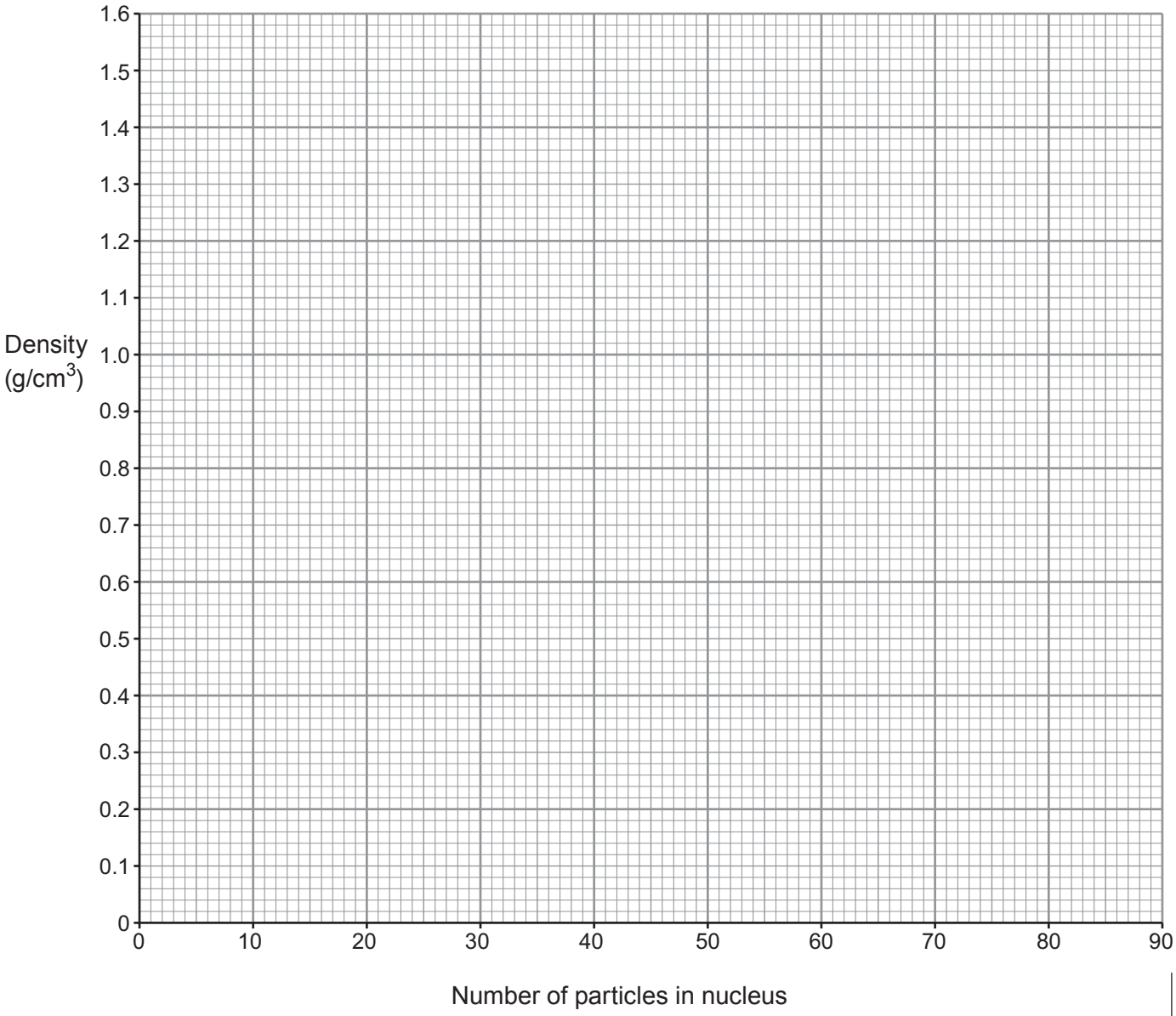
(b) (i) On the grid below, plot a graph to show how the density of the element depends on the number of particles in the nucleus.
Draw a suitable line. [3]



(ii) Explain whether or not the data agrees with the prediction that density increases with the number of particles in the nucleus. [2]

.....

.....

(iii) State what further information would help to reach a more definite conclusion. [1]

.....

Turn over.

Examiner only

(c) (i) The electronic structure of potassium is 2,8,8,1. Write down the electronic structure of sodium. [1]

.....

(ii) State **one** reason why all the alkali metals have the same chemical properties. [1]

.....

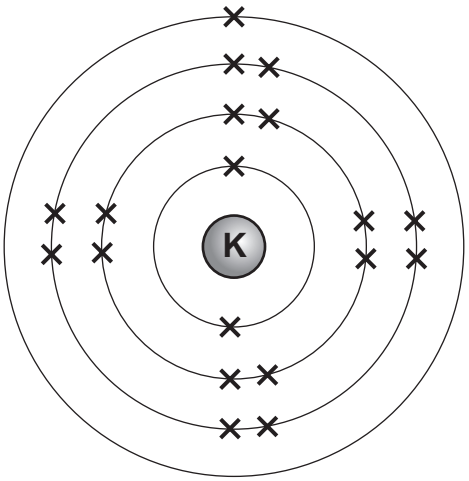
(iii) Name the most reactive alkali metal in the table. [1]

.....

(d) Potassium reacts with fluorine to produce potassium fluoride.

(i) The electronic structure of a potassium atom is shown below.
Draw a similar diagram to show the electronic structure of a fluorine atom. [1]

Potassium



Fluorine

(ii) Describe how the electronic structure of the potassium and fluorine atoms change during the reaction between potassium and fluorine. [2]

.....

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(e) Potassium is extracted from potassium fluoride by electrolysis.

(i) Complete the balanced symbol equation for the reaction shown below. [2]

potassium fluoride ⟶ potassium + fluorine

$\square$ ..... ⟶ $\square$ ..... + F_2

(ii) Potassium has been reduced in the reaction above. State what is meant by the term **reduction**. [1]

.....

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THE PERIODIC TABLE

1	2	Group										3	4	5	6	7	0
																	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
K Potassium	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	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	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