Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

0464019838

PHYSICAL SCIENCE **0652/31**

Paper 3 (Extended) **October/November 2014**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 20.
Electronic calculators may be used.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **19** printed pages and **1** blank page.

DC (CW/CGW) 89044/4

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1 Methane burns according to the following equation.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

(a) **(i)** This reaction releases energy.

State the term used to describe a chemical reaction that releases energy.

....[1]

(ii) Use ideas about bond breaking and bond making to explain why energy is released in this reaction.

....

....

....

....[3]

(b) **(i)** Name the fossil fuel that consists mainly of methane.

....[1]

(ii) The main use of methane is as a fuel.

Suggest why methane has only a few other uses.

....

....[1]

2 A student needs to find the density of an irregular object **P**.

To find the mass of **P**, he suspends a spring and a metre ruler from a stand and clamp.

He hangs the object **P** from the spring as shown in Fig. 2.1.

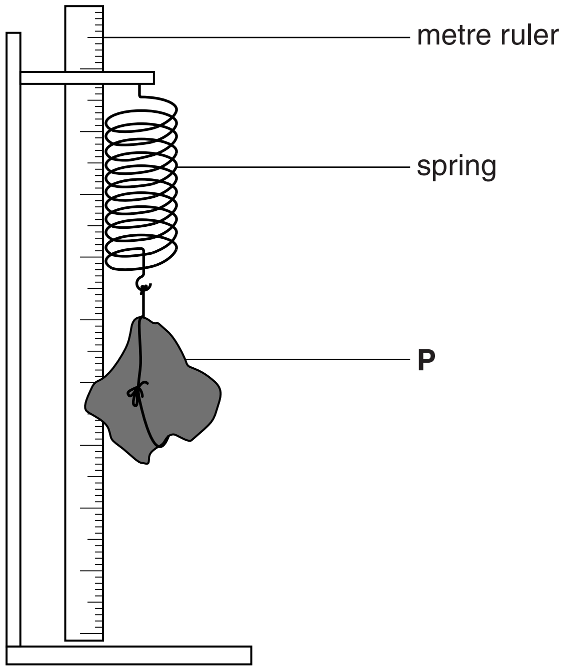


Fig. 2.1

He records the length of the spring with **P** hanging on it.

He removes **P**. He records the length of the spring with different weights added to it. He uses these results to plot the graph in Fig. 2.2.

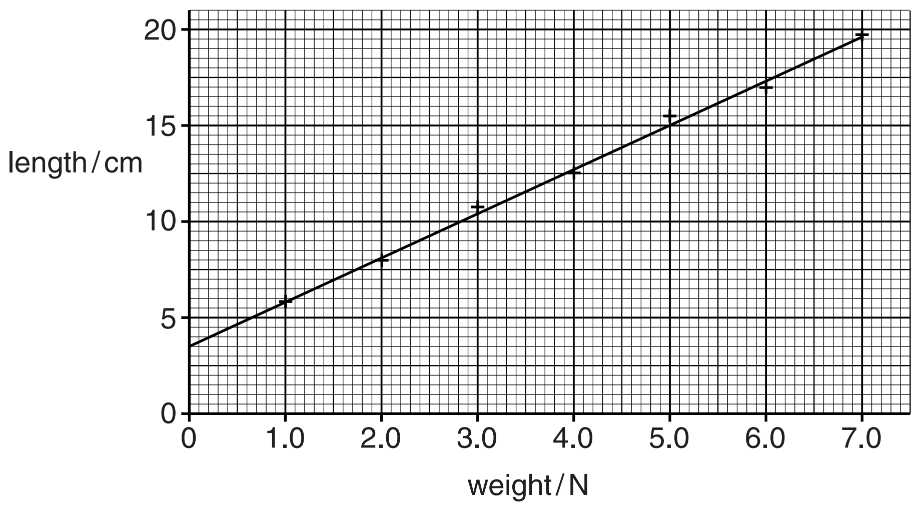


Fig. 2.2

The length of the spring with the body **P** hanging on it is 16.0 cm.

(a) **(i)** Determine the weight of body **P**.

weight = ... N [1]

(ii) Calculate the mass of **P** and state the unit.

mass = ... unit = ... [2]

(b) In order to calculate the density of **P**, the student needs to find its volume.

Describe how this can be found.

....

....

....

....[3]

(c) The volume of **P** is found to be 180 cm^3.

Calculate the density of **P** in g/cm^3.

density = ... g/cm^3 .... [2]

3 Crude oil contains hydrocarbons of different chain lengths.

These hydrocarbons are separated into useful fractions.

The bar chart in Fig. 3.1 shows how much of each fraction can be distilled from 100 tonnes of crude oil.

It also shows the demand for each fraction we need from 100 tonnes of crude oil.

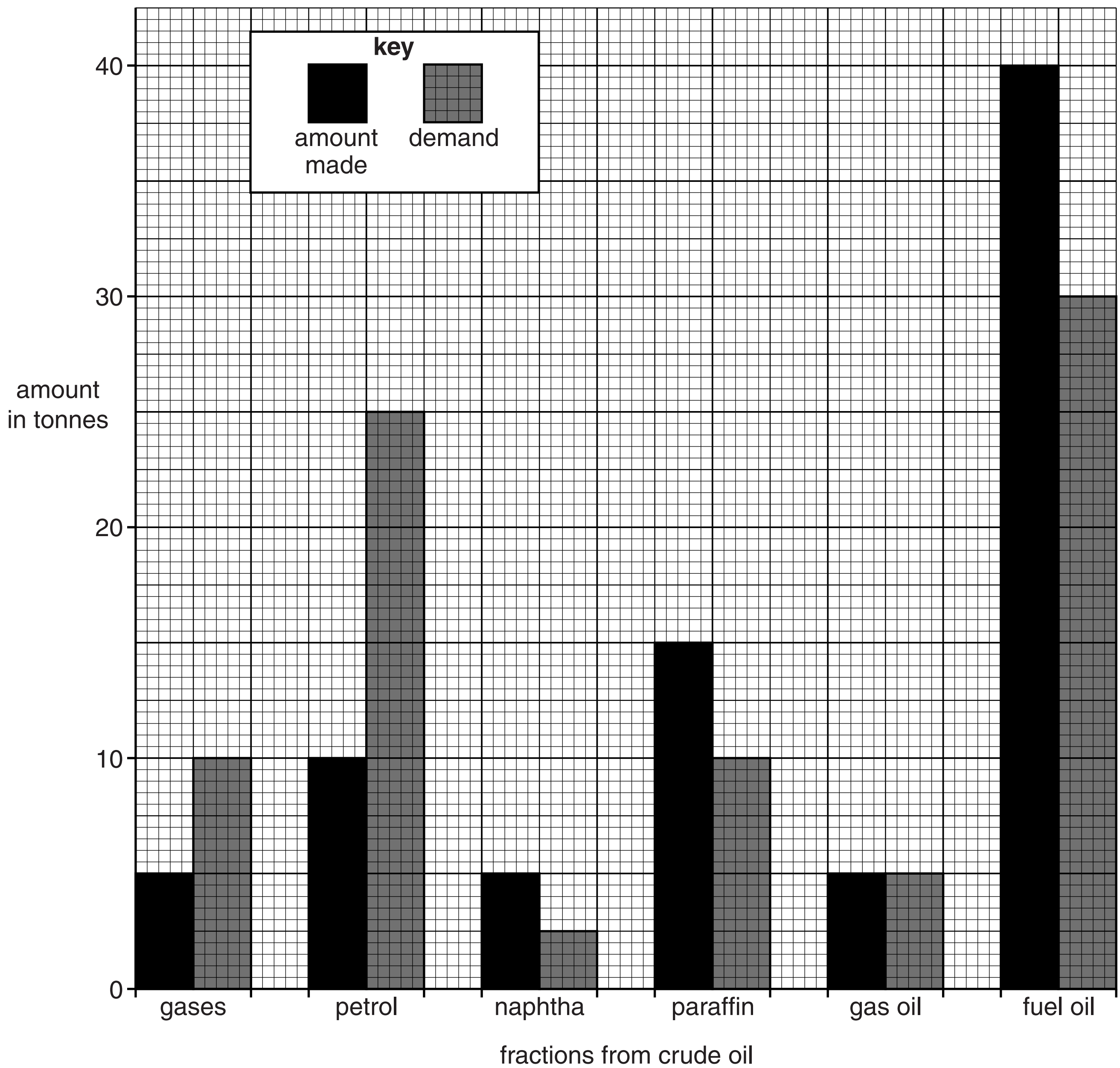


Fig. 3.1

(a) State the problem shown by the bar chart relating to the amount made and the demand for fractions from crude oil.

....

....[1]

(b) The problem shown by the bar chart is solved by the use of cracking.

(i) Explain what is meant by *cracking*.

....

....

....

....[3]

(ii) Explain how cracking solves the problem you stated in part **(a)**.

....

....

....[2]

(c) Cracking can be used to make ethene.

Ethene belongs to the homologous series of alkenes.

(i) Explain what is meant by the term *homologous series*.

....

....

....[2]

(ii) State why ethene is classified as an alkene.

....[1]

4 A teacher demonstrates the properties of waves using a ripple tank.

A barrier with a small gap is placed in the ripple tank.

Fig. 4.1 shows a view of the ripple tank from above.

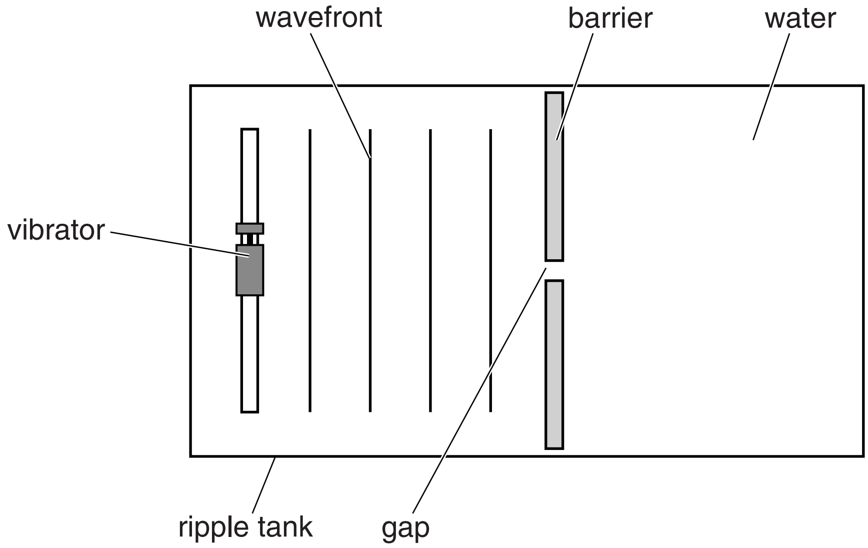


Fig. 4.1

The vibrator produces a series of waves of constant frequency. The waves move towards the barrier.

(a) Explain what is meant by the term *frequency*.

....

....

....[1]

(b) **(i)** Draw, on Fig. 4.1, **three** wavefronts after they pass through the gap. [3]

(ii) Name the property of waves shown by the movement of these wavefronts just after they have passed through the gap.

.... [1]

(c) The barrier is replaced by a similar barrier with a much wider gap.

Compare the waves after they have passed through the original gap with the waves that have passed through the wider gap. Describe **one** similarity and **one** difference.

similarity ....

....

difference ....

.... [2]

Question 5 begins over the page

5 Table 5.1 shows information about elements in Group III of the Periodic Table.

Table 5.1

element	symbol	melting point /°C	boiling point /°C	density in g/cm^3	electrical conductivity
boron	B	2300	3659	2.3	poor
aluminium	A*l*	661	2467	2.7	good
gallium	Ga	30	2400	5.9	fair
indium	In	156	2080	7.3	good
thallium	T*l*	304	1457	11.9	fair

(a) **(i)** State the number of outer shell electrons in atoms of elements in this group.

.... [1]

(ii) State the relationship between group number and outer shell electrons.

....

....[1]

(b) Describe two trends in properties of Group III elements shown in Table 5.1.

1 ....

....

2 ....

....[2]

(c) One of the elements in Group III is a non-metal and the others are metals.

(i) Describe the bonding in metals.

....

....

....[2]

(ii) Use ideas about metallic bonding to explain the electrical conductivity of aluminium.

....

....

....[2]

(iii) State which Group III element is a non-metal.

Explain how Table 5.1 shows this.

element ....

explanation ....

....[1]

6 The graph in Fig. 6.1 shows the variation of current with potential difference across a lamp **X**.

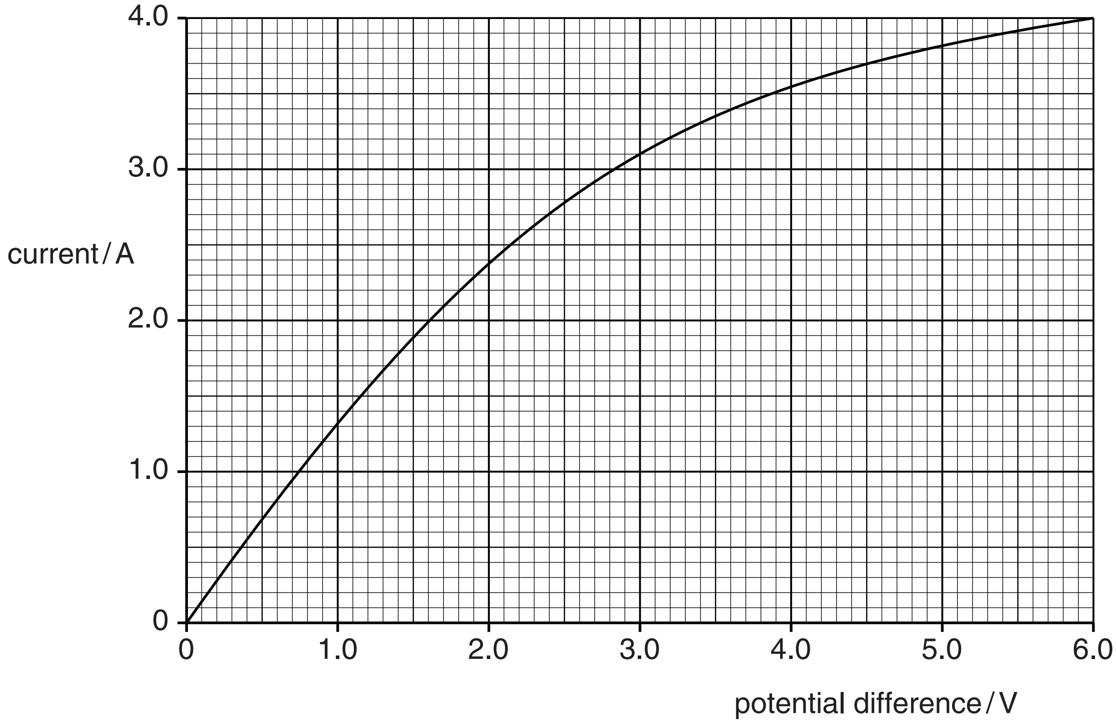


Fig. 6.1

(a) Use the graph to explain how the resistance changes as the current through the lamp is increased.

....

....

....[2]

(b) The circuit in Fig. 6.2 contains lamp **X** and a second lamp **Y**.
Lamp **Y** is rated 3.0V, 12.0W.

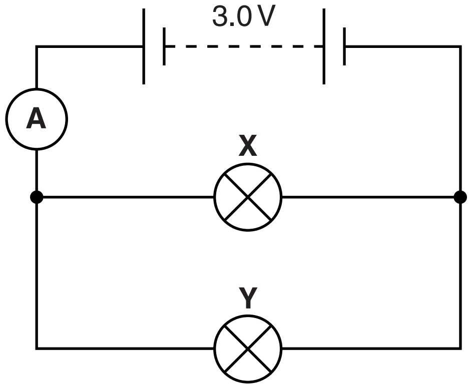


Fig. 6.2

(i) Use the graph to determine the current through lamp **X**.

current = ... A [1]

(ii) Calculate the current through lamp **Y**.

current = ... A [2]

(iii) Calculate the current through the ammeter.

current = ... A [1]

(iv) Calculate the combined resistance of the lamps in this circuit.

resistance = ... ohm [2]

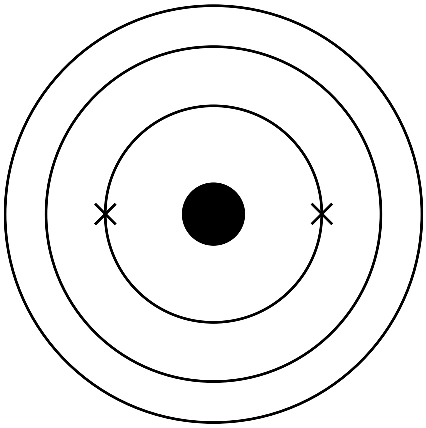
(v) Calculate the charge passing through the ammeter in 5 minutes.

charge = ... C [2]

7 **(a)** A sulfur atom has 16 protons and 16 electrons.

A sulfur ion has a 2- charge.

(i) Complete Fig. 7.1 to show the electron arrangement in a sulfur ion, S^{2-}.



[2]

Fig. 7.1

(ii) Sulfur forms an ionic compound sodium sulfide.

Predict the formula of sodium sulfide.

....[1]

(b) Methanethiol, CH_3SH, is a colourless gas with a smell of rotting vegetation.

It has similar bonding to that in methanol, CH_3OH.

Draw a dot and cross diagram to show the outer shell electrons in the atoms of a molecule of methanethiol.

[3]

8 The isotope $^{231}_{91}Pa$ is unstable and decays by emitting an alpha-particle.

(a) State the number of protons and neutrons in the nucleus of this isotope.

protons ....

neutrons .... [1]

(b) **(i)** Complete this equation to describe the decay of $^{231}_{91}Pa$.

$$^{231}_{91}Pa \rightarrow \,^{......}_{......}X + \,^{......}_{......}\alpha$$ [2]

(ii) Identify the element X. ....[1]

(c) The half-life of the isotope $^{231}_{91}Pa$ is 3.4×10^3 years.

(i) Explain what is meant by the term *half-life*.

....

....

....[1]

(ii) Calculate the time it would take for the activity of a sample of $^{231}_{91}Pa$ to fall to $1/8^{th}$ of its original value.

Show your working in the box.

time = ... years [2]

9 Three of the ores from which copper is extracted are cuprite, malachite and tenorite.

Each ore contains a different copper mineral.

Each mineral is reacted with carbon at high temperature to extract copper metal.

(a) Complete Table 9.1.

[Relative atomic masses: A_r: C, 12; Cu, 64; O, 16.]

Table 9.1

mineral in ore	formula	relative formula mass (RFM)	mass of copper in RFM	maximum mass of copper extracted from each tonne / tonne
cuprite	Cu_2O	144	128	
malachite	$CuCO_3$	124		0.52
tenorite	CuO		64	0.80

[3]

(b) The equation for the extraction of copper from copper carbonate (malachite) is shown below.

$$2CuCO_3 + C \rightarrow 2Cu + 3CO_2$$

Calculate the mass of copper that can be extracted from 5 tonnes of copper carbonate.

Show your working in the box.

mass of copper = ... tonnes [3]

(c) Deduce the balanced equation for the extraction of copper from cuprite.

....[2]

(d) Name a use of copper metal and explain this use by referring to a property of copper.

use ....

property ....[2]

10 Fig. 10.1a shows a toy train of mass 0.18 kg.
It is powered by clockwork. A spring is coiled tightly and then allowed to uncoil.

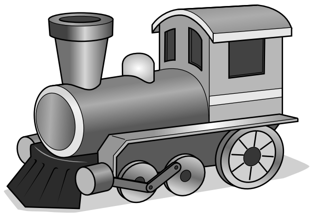


Fig. 10.1a

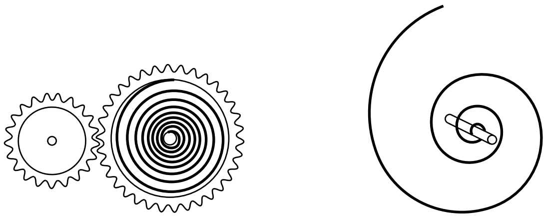


Fig. 10.1b

(a) Name the type of energy stored by the tightly coiled spring.

.... [1]

(b) The spring uncoils and it transfers energy to the wheels of the train.

The train accelerates to a speed of 0.76 m / s.

(i) Calculate the kinetic energy gained by the train.

kinetic energy = ... J [3]

(ii) The tightly coiled spring stores more energy than the energy calculated in **(b)(i)**.

Explain why not all the energy is transferred to kinetic energy of the train.

....

....

....[2]

11 A scientist studies the deflection of charged particles in a magnetic field.

Fig. 11.1 shows the tracks of two particles created in a single interaction at point **A**. Each particle leaves point **A** with the same velocity.

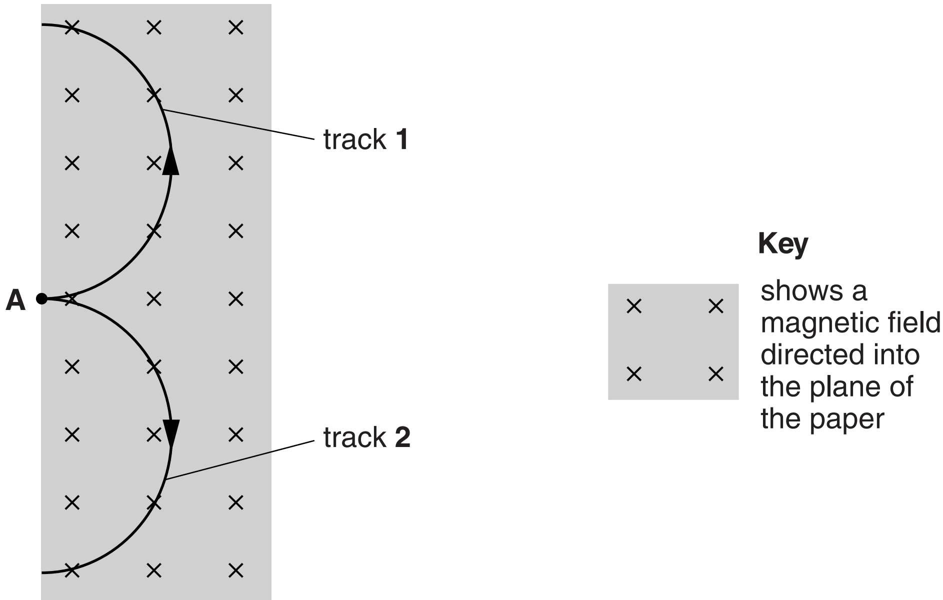


Fig. 11.1

Track **2** is produced by an electron. The particle producing track **1** has the same mass as an electron.

Suggest how the charge of the particle that produces track **1** compares with the charge of the electron producing track **2**.

....

....

.... [2]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	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	64 **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	**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 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	147 **Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	231 **Pa** Protactinium 91	238 **U** Uranium 92	237 **Np** Neptunium 93	244 **Pu** Plutonium 94	243 **Am** Americium 95	247 **Cm** Curium 96	247 **Bk** Berkelium 97	251 **Cf** Californium 98	252 **Es** Einsteinium 99	257 **Fm** Fermium 100	258 **Md** Mendelevium 101	259 **No** Nobelium 102	260 **Lr** Lawrencium 103

* 58–71 Lanthanoid series
† 90–103 Actinoid series

Key: a over **X** over b

a = relative atomic mass
X = atomic symbol
b = atomic (proton) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).