



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

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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.

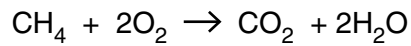
The number of marks is given in brackets [] at the end of each question or part question.

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



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- 1 Methane burns according to the following equation.



- (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]

4

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.

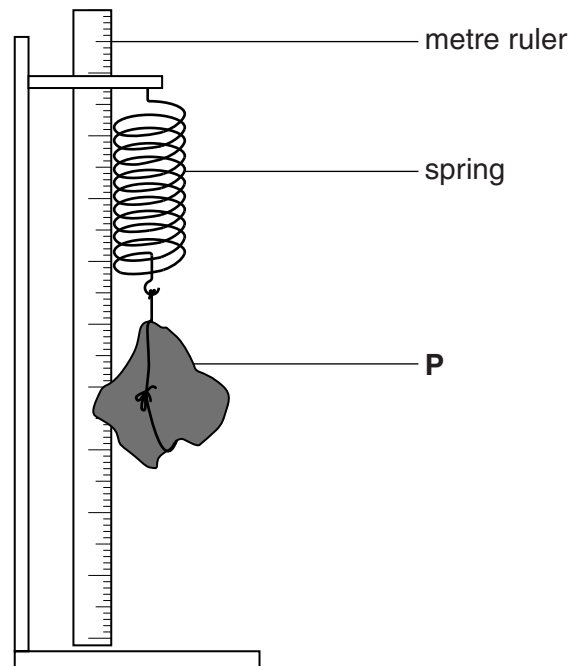


Fig. 2.1

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.

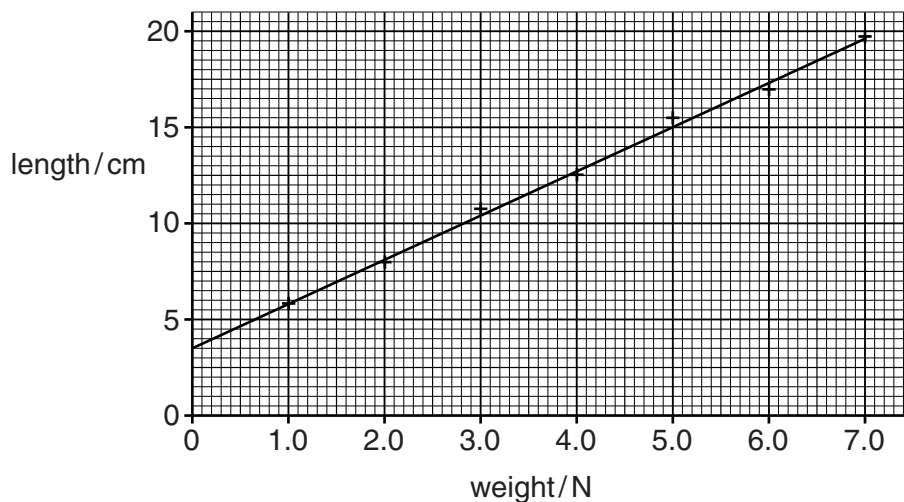


Fig. 2.2

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.

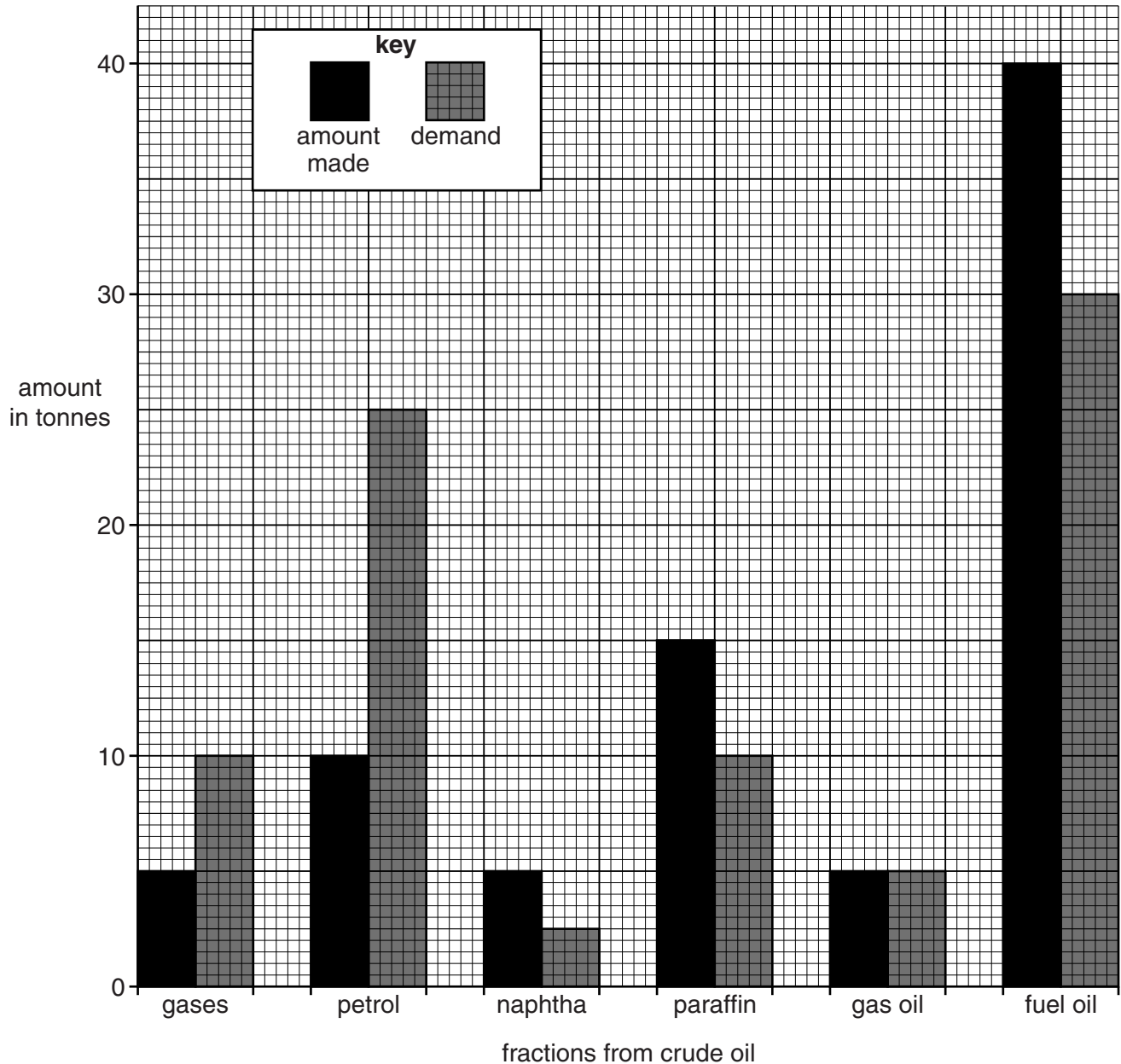


Fig. 3.1

- (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.

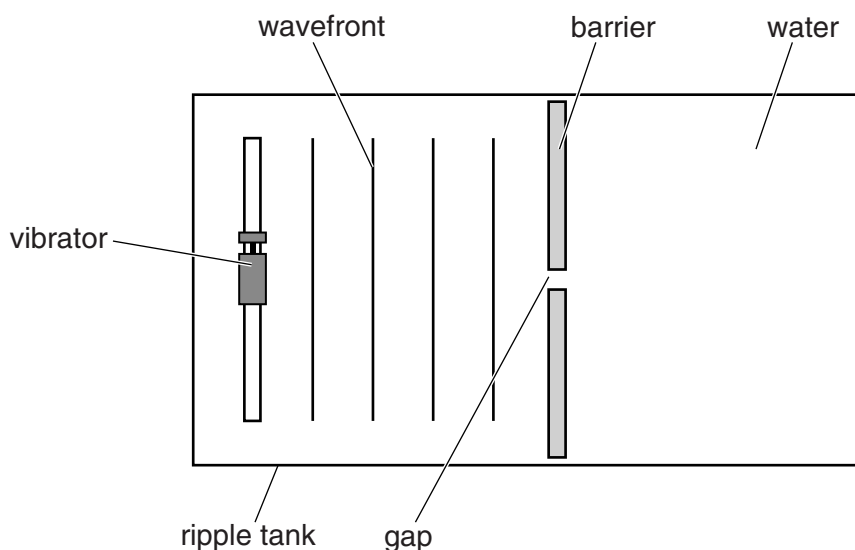


Fig. 4.1

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	Al	661	2467	2.7	good
gallium	Ga	30	2400	5.9	fair
indium	In	156	2080	7.3	good
thallium	Tl	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.

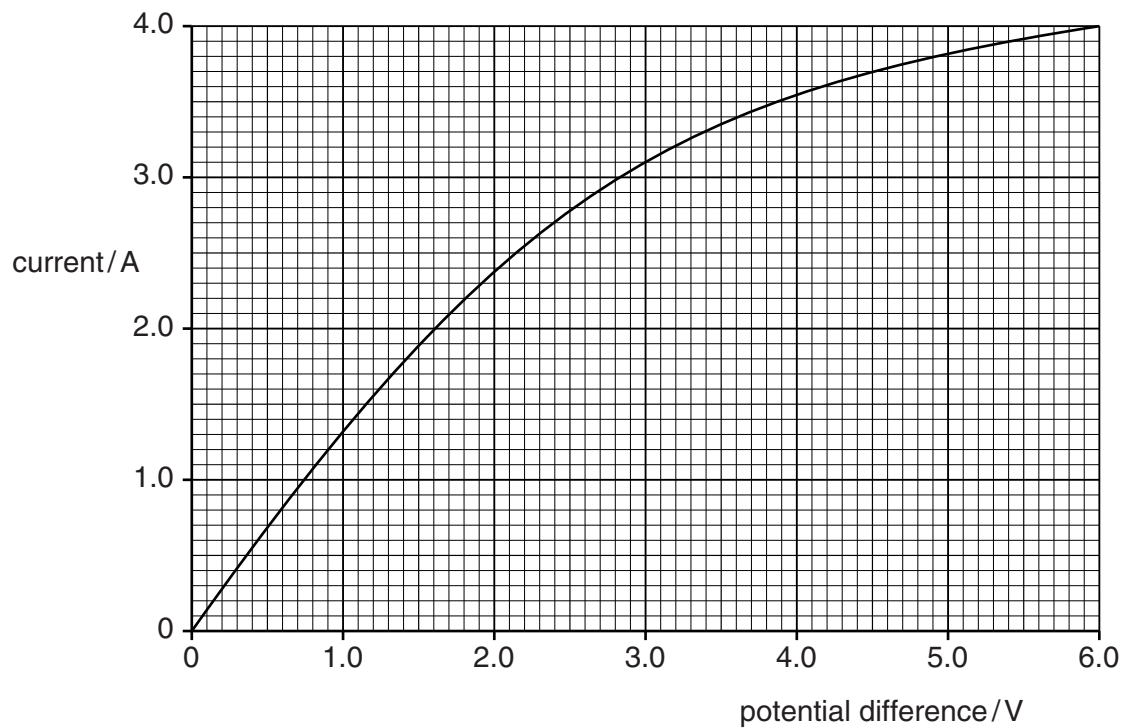


Fig. 6.1

- (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.

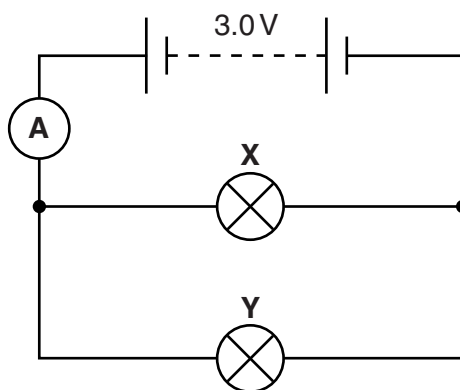


Fig. 6.2

- (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-} .

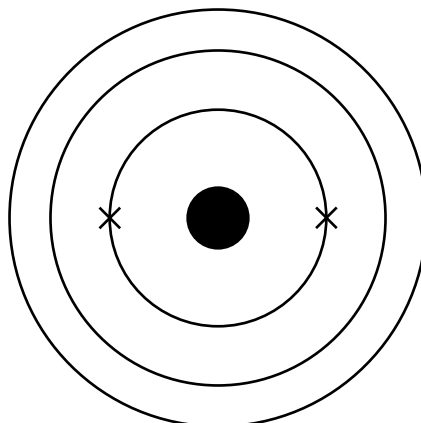


Fig. 7.1

[2]

- (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]

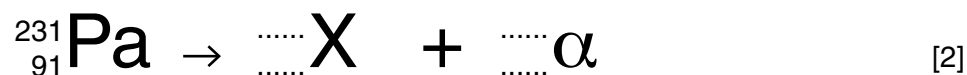
8 The isotope ${}_{91}^{231}\text{Pa}$ is unstable and decays by emitting an alpha-particle.

(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 ${}_{91}^{231}\text{Pa}$.



(ii) Identify the element X.[1]

(c) The half-life of the isotope ${}_{91}^{231}\text{Pa}$ 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 ${}_{91}^{231}\text{Pa}$ to fall to $1/8^{\text{th}}$ 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.

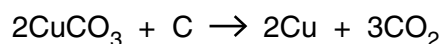
[Relative atomic masses: A_r : C, 12; Cu, 64; O, 16.]

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.



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.

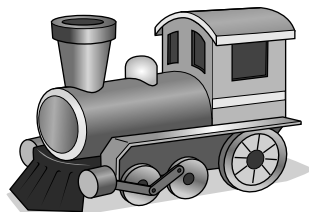


Fig. 10.1a

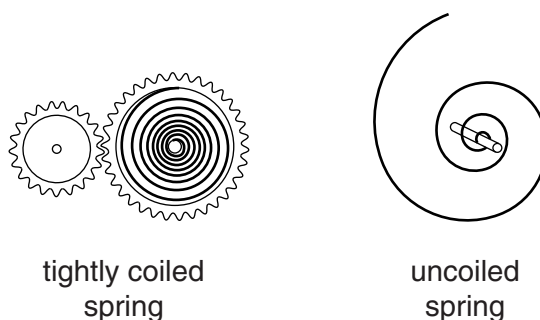


Fig. 10.1b

- (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.

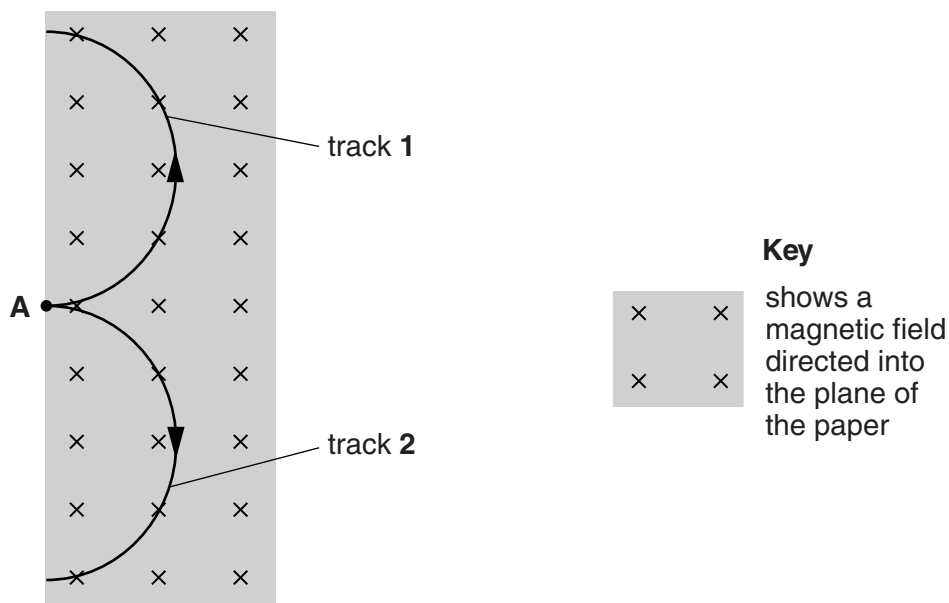


Fig. 11.1

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		Group																									
		I	II	III	IV	V	VI	VII	0																		
		1 H Hydrogen 1																									
7 Li Lithium 3	9 Be Beryllium 4																										
23 Na Sodium 11	24 Mg Magnesium 12																										
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	101 Ru Ruthenium 44	101 Ru Ruthenium 44	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	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																									
		* 58–71 Lanthanoid series † 90–103 Actinoid series																									
Key		a	X	a = relative atomic mass	X	X = atomic symbol	b	b = atomic (proton) number																			
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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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