Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

2416556628

PHYSICAL SCIENCE **0652/31**

Paper 3 Theory (Core) **October/November 2020**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Blank pages are indicated.

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[Turn over

1 A mixture contains four components.

Table 1.1 gives information about the four components of this mixture.

Table 1.1

component	information
ethanol	colourless liquid dissolves in water boils at 78 °C
salt	white solid soluble in water
sand	off-white solid does not dissolve in water or ethanol
water	colourless liquid boils at 100 °C

Fig. 1.1 shows a method of separating one component from the mixture.

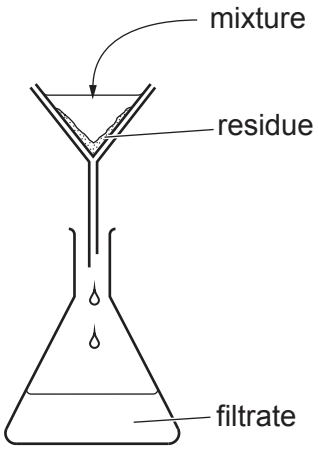

Fig. 1.1

(a) (i) Name the component collected as the residue on the filter paper.

..... [1]

(ii) One sample of the filtrate is distilled.

Name the first component collected from the distillation.

Give a reason for your answer.

component .....

reason .....

.....

[2]

(iii) Another sample of the filtrate is evaporated to dryness.

Name the component left behind.

..... [1]

(b) Describe a test to show that the original mixture contains water.

test .....

positive result .....
[2]

[Total: 6]

2 Fig. 2.1 shows the motion of a car on a straight horizontal road.

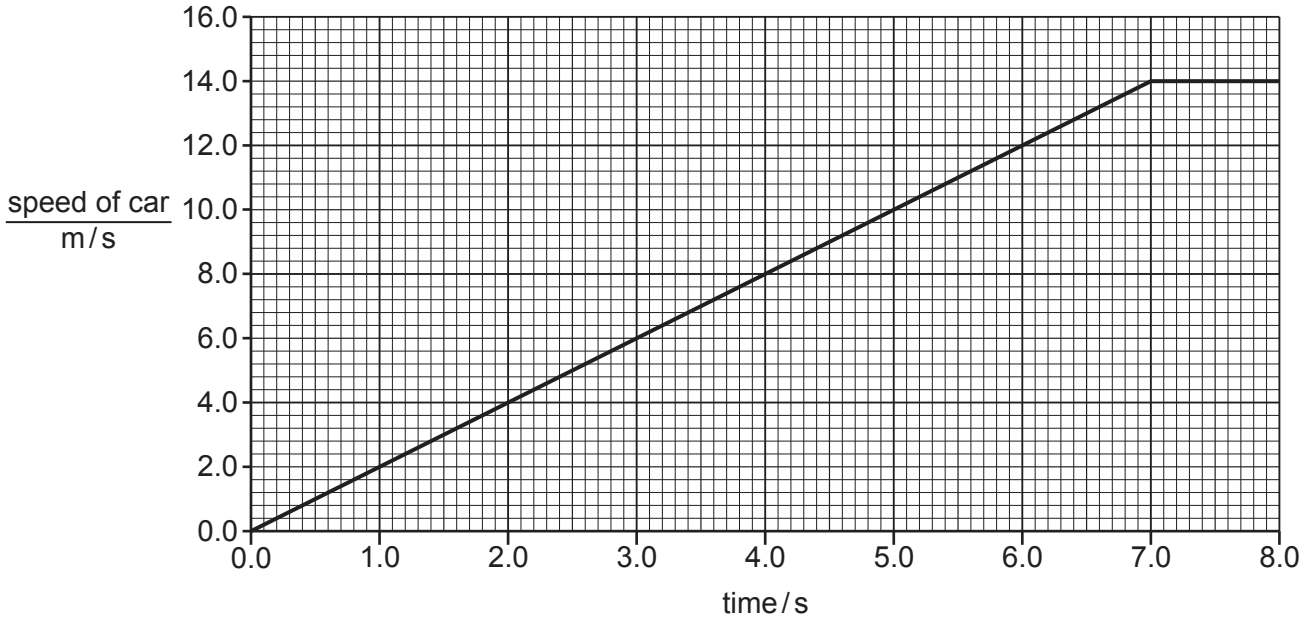

Fig. 2.1

(a) Describe the motion of the car during the first 7.0 s.

.....

..... [2]

(b) Use Fig. 2.1 to determine:

(i) the speed of the car at 5.0 s

speed = ... m/s [1]

(ii) the distance travelled by the car in the first 6.0 s.

distance = ... m [2]

(c) Lights are used to stop cars to allow people to cross the road safely.

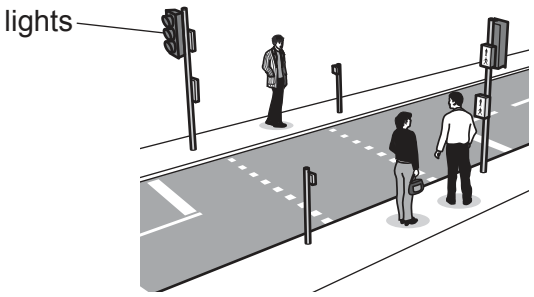

Fig. 2.2

Table 2.1 shows the walking speeds of four different people A, B, C and D.

Table 2.1

person	average walking speed m / s
A	1.6
B	1.4
C	0.8
D	1.0

(i) State which person takes most time to cross the road.

..... [1]

(ii) The road is 8.0 m wide.

Calculate the time taken for the person given in your answer to **(i)** to cross the road.

time = ... s [2]

(iii) Suggest why the lights stop the cars for more time than is needed for the slowest person to cross the road.

.....

..... [1]

[Total: 9]

3 Sodium is an element in Group I of the Periodic Table.

Table 3.1 gives some information about an atom of sodium.

Table 3.1

number of electrons	11
number of protons	.....
nucleon number	23
number of neutrons	.....

(a) Use the information in Table 3.1 to determine the values of the missing numbers.

Record these values in Table 3.1. [2]

(b) Write the electronic structure of an atom of sodium to show the number of electrons in each shell.

..... [2]

(c) Sodium reacts with chlorine to form the ionic compound, sodium chloride.

(i) Balance the equation for this reaction.

..... Na + ... Cl_2 $\rightarrow$ ..... NaCl

[1]

(ii) Complete Table 3.2 to give the names and formulae of the two ions in sodium chloride.

Table 3.2

name of ion	formula of ion

[2]

[Total: 7]

4 **(a)** A student observes a coin in a metal bowl.

A ray of light from the coin enters the student's eye, as shown in Fig. 4.1.

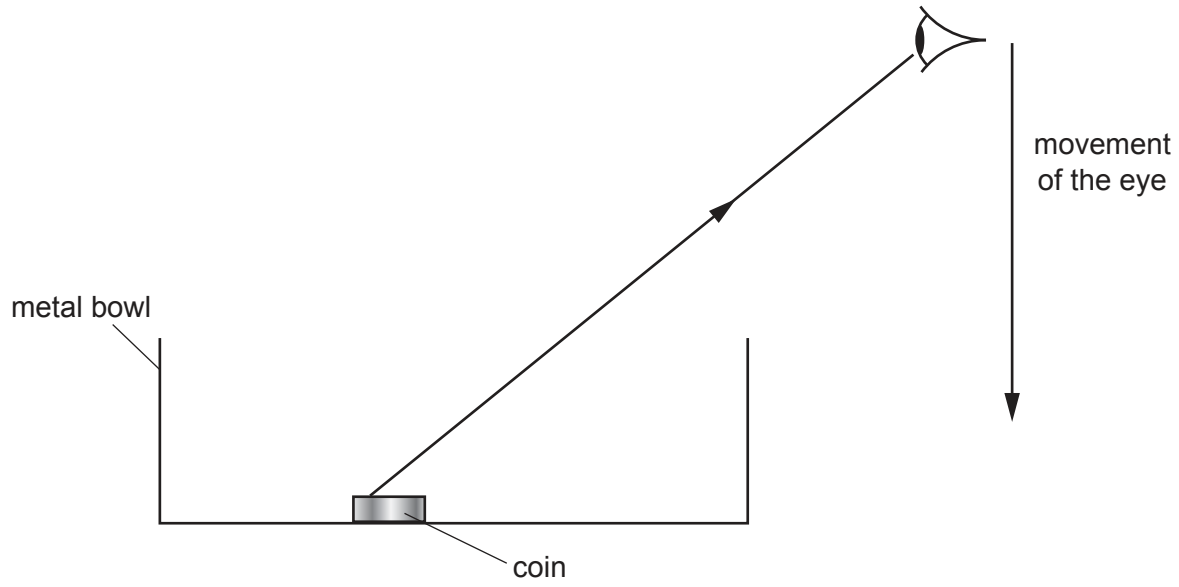

Fig. 4.1

The student moves his eye down until he can no longer see the coin.

On Fig. 4.1, draw another ray of light from the coin to the position of the eye just before the coin disappears from view. [1]

(b) The bowl is filled with water.

The ray of light **R** from the coin leaves the surface of the water as shown in Fig. 4.2.

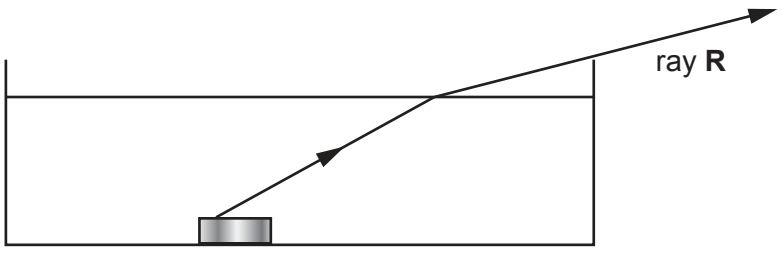

Fig. 4.2

On Fig. 4.2:

1. draw the normal where ray **R** leaves the water

2. label the angle of incidence with *i*.

[2]

(c) Fig. 4.3 shows an image of an object.

The image is produced by a lens.

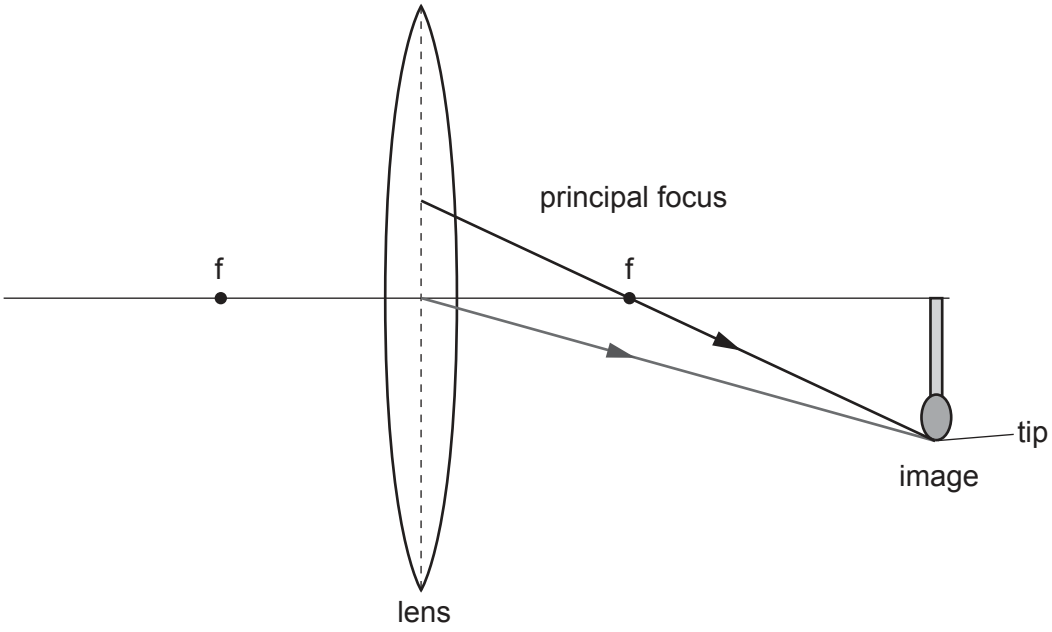

Fig. 4.3

(i) Name the type of lens shown.

..... [1]

(ii) On Fig. 4.3, extend the two rays backwards until they cross. [2]

(iii) On Fig. 4.3, draw the object and label it **O**. [2]

[Total: 8]

5 Carbon is an element which exists in different forms.

Graphite is one of these forms.

(a) **(i)** Describe the structure of graphite.

.....

.....

.....

..... [2]

(ii) Graphite is a good thermal conductor.

Describe **one** other property of graphite.

..... [1]

(b) Name another form of carbon.

..... [1]

(c) Carbon is used as a fuel when it burns in air.

(i) Name the gas found in air which reacts with carbon.

..... [1]

(ii) Write a word equation for this reaction.

..... [1]

(d) Name a metal that can be extracted from its ore using carbon.

..... [1]

(e) Carbon forms compounds with hydrogen.

(i) Give the name and formula of the compound of carbon and hydrogen which contains only one carbon atom.

name .....

formula .....
[2]

(ii) Give the name used to describe compounds which contain carbon and hydrogen only.

..... [1]

[Total: 10]

6 Four radioactive sources are investigated.

Each source is placed in front of a detector, as shown in Fig. 6.1, and left for one minute.

After one minute the count is recorded.

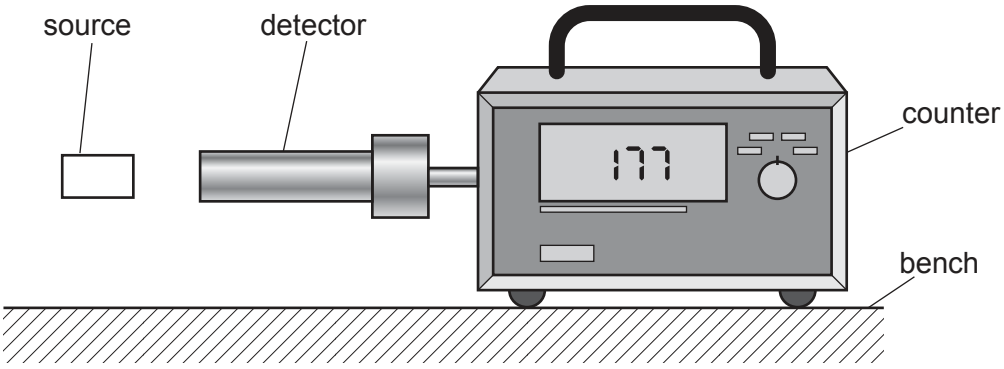

Fig. 6.1

The measurement is repeated with different absorbing materials placed between the source and the detector, as shown in Fig. 6.2.

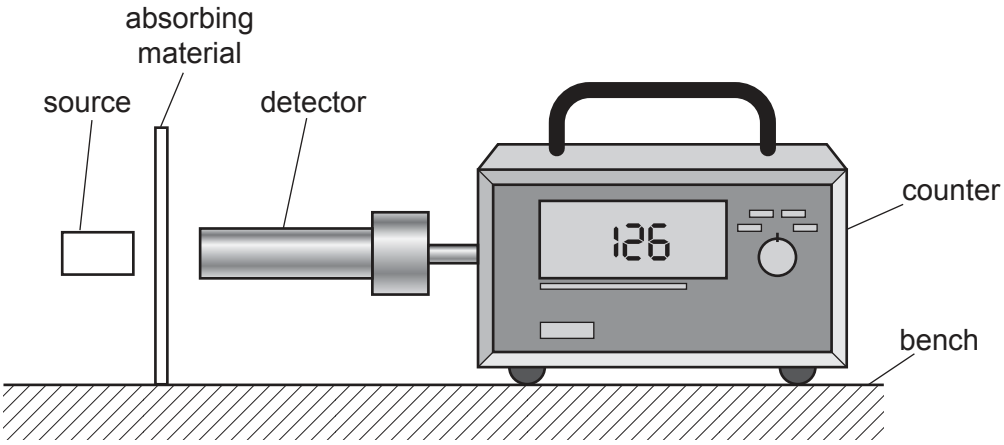

Fig. 6.2

The counts for one minute using different absorbing materials are shown in Table 6.1.

Table 6.1

source	count with no absorbing material	count for thin paper	count for thin metal foil	count for thick steel
A	902	899	26	24
B	906	524	522	130
C	900	25	22	28
D	909	912	901	247

(a) Three of the sources each emit **one** type of radiation only.

The other source emits **two** types of radiation.

Circle the letter corresponding to the source which emits:

- gamma radiation only **A** **B** **C** **D**
- alpha radiation only **A** **B** **C** **D**
- more than one type of radiation. **A** **B** **C** **D** [3]

(b) Use the data in Table 6.1 to deduce an approximate value for the background radiation.

..... [1]

(c) The experiment is repeated using exactly the same conditions.

All the counts are different in this repeated experiment.

Some are slightly higher and some are slightly lower.

State why the counts are different.

.....

..... [1]

[Total: 5]

7 **(a)** Electrolysis is used to break down ionic compounds.

Complete Table 7.1.

Table 7.1

Ionic compound electrolysed	anode product	cathode product
molten lead bromide	bromine	.....
dilute sulfuric acid	.....	hydrogen

[2]

(b) Fig. 7.1 shows how some metals react with dilute sulfuric acid.

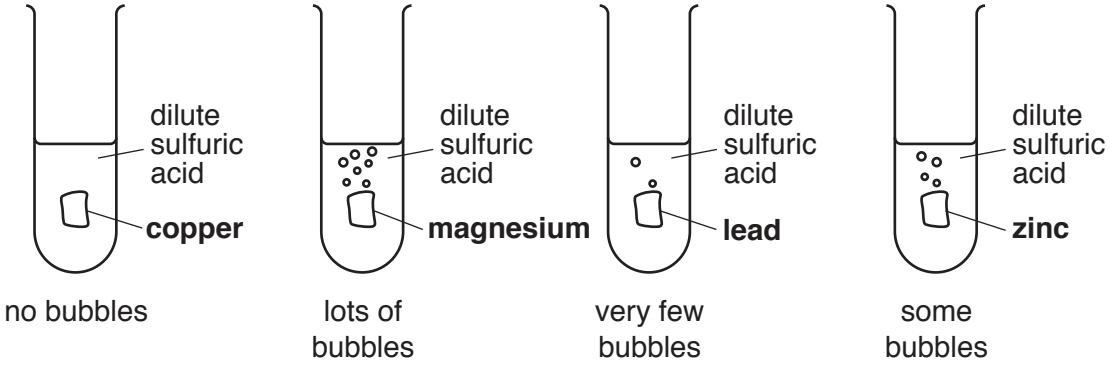

Fig. 7.1

Use Fig. 7.1 to determine the order of reactivity of these four metals.

most reactive .....

.....

.....

least reactive .....

[2]

[Total: 4]

8 Fig. 8.1 shows a dumper truck full of sand.

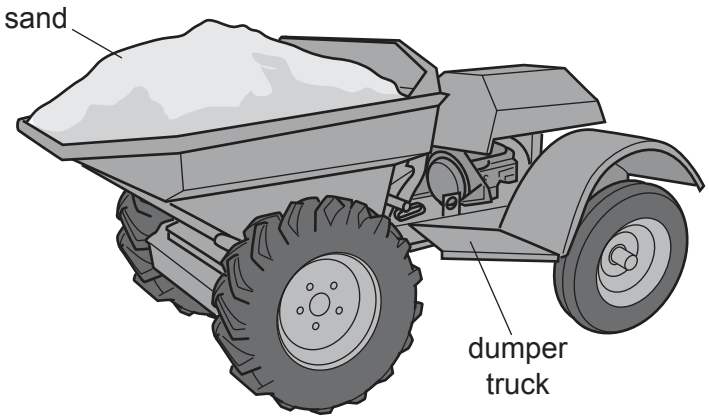

Fig. 8.1

The mass of the sand is 800 kg.

(a) **(i)** The density of sand is 1600 kg / m^3.

Calculate the volume of the sand.

volume of sand = ... m^3 [2]

(ii) Calculate the weight of the sand and state the unit.
[g = 10 N / kg]

weight of sand = ... unit ..... [2]

(b) The dumper truck carries the sand to the top of the hill.

(i) State the form of energy gained by the sand.

..... [1]

(ii) The dumper truck uses diesel fuel. State the type of energy stored in the fuel.

..... [1]

(c) Circle the correct underlined word or phrase to complete the following sentence.

When the dumper truck moves the same weight of sand to the top of the hill in less time, it uses (more / the same / less) power. [1]

[Total: 7]

9 **(a)** The formula of ammonium nitrate is NH_4NO_3.

(i) State the number of nitrogen atoms in the formula of ammonium nitrate.

..... [1]

(ii) State the total number of atoms in the formula of ammonium nitrate.

..... [1]

(b) Ammonium nitrate is made by neutralising an acid with aqueous ammonia.

(i) Name the acid used.

..... [1]

(ii) Describe a test to show the acid is neutralised.

test .....

positive result .....
[2]

(c) Ammonium nitrate is added to soil as a fertiliser.

Farmers also add limestone to soil even though it is **not** a fertiliser.

Explain why limestone is added to soil .

.....

.....

..... [2]

[Total: 7]

10 A girl rubs a balloon on her hair.

The balloon becomes negatively charged.

(a) Explain in terms of movement of particles why the balloon is negatively charged.

.....

..... [2]

(b) A second balloon is charged in the same way.

The two balloons are suspended near each other using nylon thread.

Fig. 10.1 shows some ways in which the balloons may hang when they are suspended.

(i) Circle the diagram which shows how the balloons hang. [1]

Fig. 10.1

(ii) Explain why the balloons hang in this way.

.....

..... [1]

(c) The girl's hair also becomes charged when she rubs the balloon on her hair. One of the negatively charged balloons is suspended near the girl's head.

Circle the diagram in Fig. 10.2 which shows how the balloon hangs and affects her hair.

Give a reason for your choice.

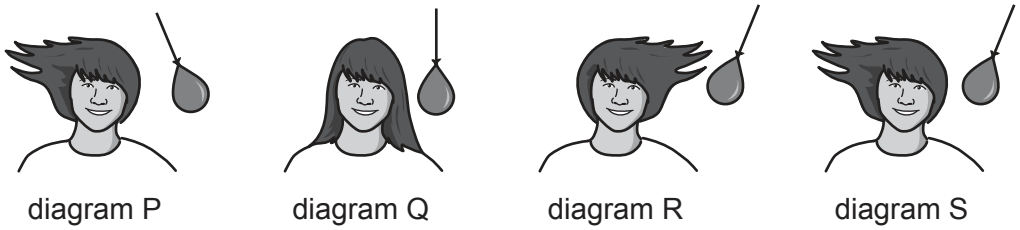

Fig. 10.2

Reason .....

..... [2]

[Total: 6]

11 Ethene, C_2H_4, is an unsaturated compound.

(a) State why ethene is described as an *unsaturated* compound.

.....

..... [2]

(b) Ethene is obtained from petroleum using a two stage process.

(i) **stage 1**: petroleum is separated into its components.

Name the process used in stage 1.

..... [1]

(ii) **stage 2**: one of the components from stage 1 is used to produce ethene.

Name the process used in stage 2.

..... [1]

(c) Draw the structure of ethene showing all of the atoms and all of the bonds.

[2]

[Total: 6]

12 Fig. 12.1 shows a simple loudspeaker.

A coil of insulated wire is taped to a plastic sheet. The sheet is then attached to a paper cup containing a bar magnet.

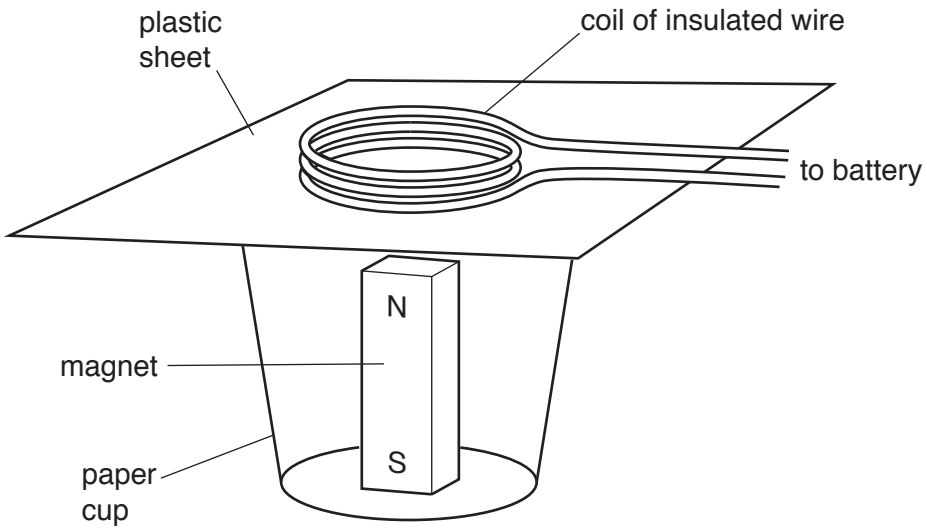

Fig. 12.1

(a) (i) When the coil is connected to a battery, the plastic sheet moves upwards.

Explain why the plastic sheet moves upwards.

.....

..... [2]

(ii) The connections to the battery are reversed so that the current is reversed.

Explain why the plastic sheet now moves down.

.....

..... [1]

(b) The coil is connected to an a.c. supply.

The current changes direction 50 times each second.

Explain how the plastic sheet produces a sound.

.....

..... [2]

[Total: 5]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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