Cambridge IGCSE

**Cambridge International Examinations**
Cambridge International General Certificate of Secondary Education

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*3063308436*

**PHYSICAL SCIENCE** **0652/42**

Paper 4 (Extended) **October/November 2018**

**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 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 **20** printed pages.


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**1** Fig. 1.1 shows a spring suspended from a clamp.

Fig. 1.2 shows the same spring with a mass of 0.25 kg attached.

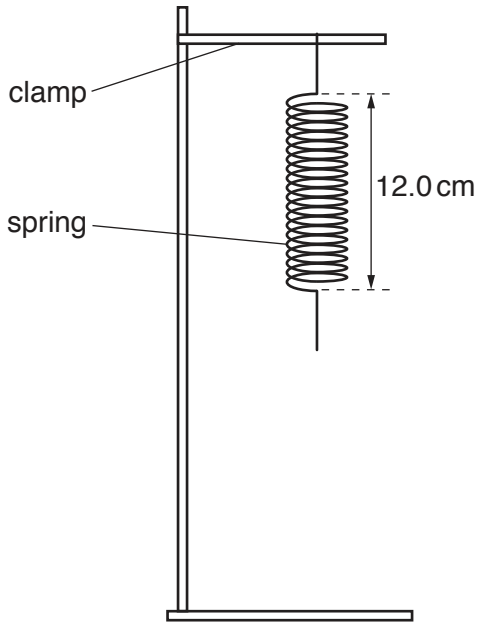


**Fig. 1.1**

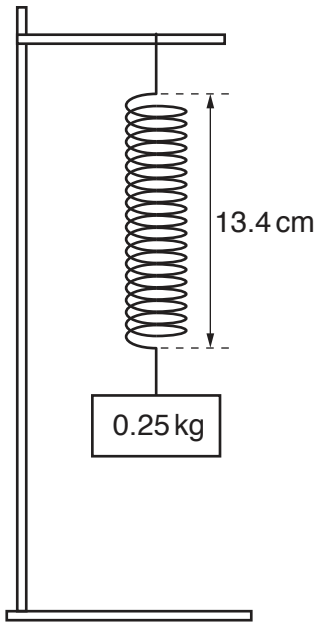


**Fig. 1.2**

The length of the spring in Fig. 1.1 is 12.0 cm.

The length in Fig. 1.2 is 13.4 cm.

**(a) (i)** Calculate the weight of the 0.25 kg mass. Use $g = 10$ N/kg.

weight = ..... N [1]

**(ii)** Calculate the extension of the spring when the 0.25 kg mass is attached to it.

extension = ..... cm [1]

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**(b)** The extension of the spring is proportional to the load attached.

Calculate the length of the spring when the 0.25 kg mass is replaced by a 0.10 kg mass.

Show your working

length = ..... cm [2]

**(c)** Fig. 1.3 shows a graph of load against extension for another spring.

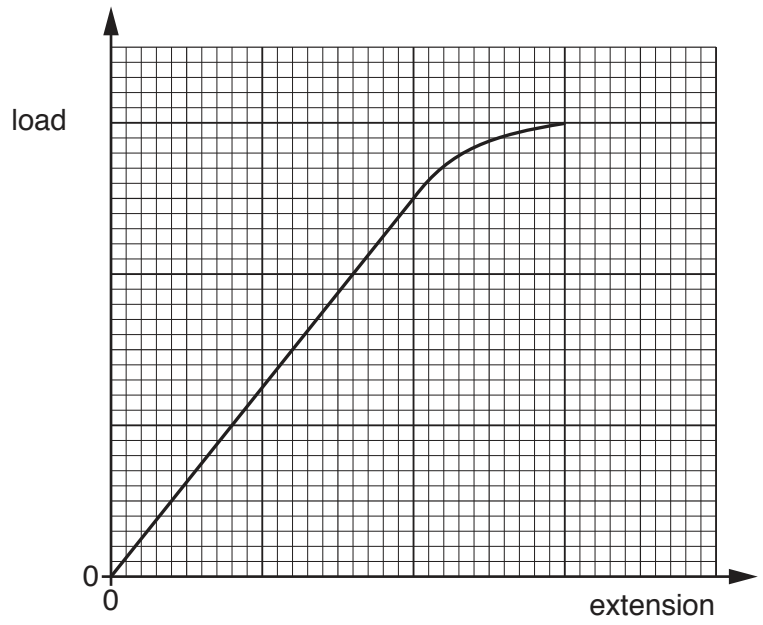


**Fig. 1.3**

On Fig. 1.3, mark, with an **X**, the limit of proportionality of the spring. [1]

[Total: 5]



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**2** Fig. 2.1 shows a mixture of two different metal atoms in a solid.

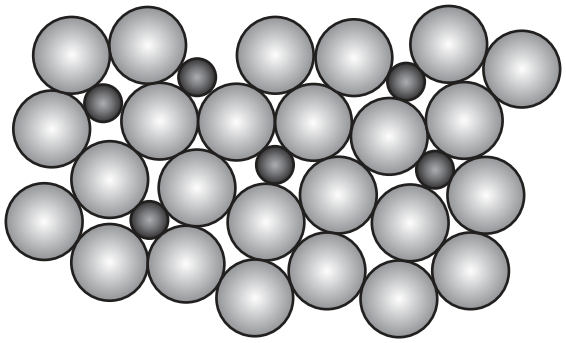

**Fig. 2.1**

**(a) (i)** State the name of this type of mixture of metals.

..... [1]

**(ii)** The arrangement of atoms shown in Fig. 2.1 makes the solid less malleable than a solid metal consisting of only one type of atom.

Explain why.

.....

.....

.....

..... [3]

**(b)** Copper is a metal.

State **one** use for copper and state which of its properties are related to this use.

use .....

property .....

.....

[2]

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**(c)** Chalcopyrite is the main ore of copper.

It contains copper, Cu, iron, Fe, and sulfur, S.

Table 2.1 shows the charges on the ions in chalcopyrite.

**Table 2.1**

| element | charge on the ion |
|---|---|
| Cu | 1+ |
| Fe | 3+ |
| S | 2– |

Suggest a possible formula of chalcopyrite.

..... [2]

[Total: 8]



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**3** Fig. 3.1 shows a crane lifting a tree trunk onto a lorry.

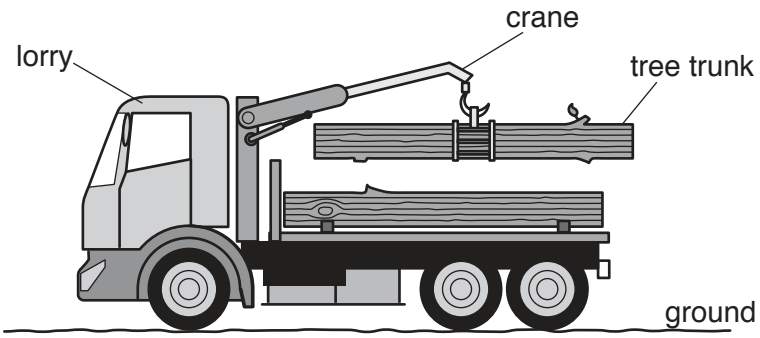


**Fig. 3.1**

**(a)** State the form of energy the tree trunk has gained when held stationary above the ground, as in Fig. 3.1.

..... [1]

**(b)** The tree trunk has a weight of 96 000 N.

The crane lifts the tree trunk to a maximum height of 3.2 m in 25 s.

**(i)** Calculate the work done by the crane against gravity in lifting the tree trunk.

Show your working and give the unit.

work done = ..... unit ..... [3]

**(ii)** Calculate the power output of the crane when lifting the tree trunk.

power = ..... W [2]

**(iii)** The power input to the crane when lifting the tree trunk is greater than the power output calculated in **(ii)**.

Suggest a reason for this.

.....

.....

..... [1]

[Total: 7]

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**4** A student tests four unidentified metals, labelled **W**, **X**, **Y** and **Z**, using water and dilute acid.

Table 4.1 shows the student's observations.

**Table 4.1**

| metal label | reaction with water or steam | reaction with dilute acid |
|---|---|---|
| **W** | reacts with steam, bubbles of gas produced | reacts quickly, bubbles of gas produced |
| **X** | no reaction | no reaction |
| **Y** | no reaction | slow reaction, bubbles of gas produced |
| **Z** | reacts vigorously with cold water, bubbles of gas produced | violent reaction, bubbles of gas produced |

**(a) (i)** Suggest how the observations show that **none** of the metals are caesium.

..... [1]

**(ii)** Suggest the pH of the solutions formed by the reaction of the metals **W** and **Z** with water or steam.

..... [1]

**(b)** The metals are identified as sodium, magnesium, zinc and copper.

Fig. 4.1 shows the order of reactivity for these metals.

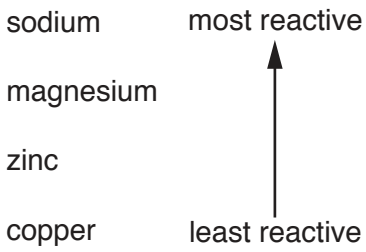


**Fig. 4.1**

Use Table 4.1 and Fig. 4.1 to deduce the identities of the metals, **W**, **X**, **Y** and **Z**.

**W** .....

**X** .....

**Y** .....

**Z** .....

[2]



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**(c)** The student investigates the reaction of aluminium and zinc with acid.

She puts same-sized pieces of zinc and aluminium into separate test-tubes of acid of the same concentration, as shown in Fig. 4.2.

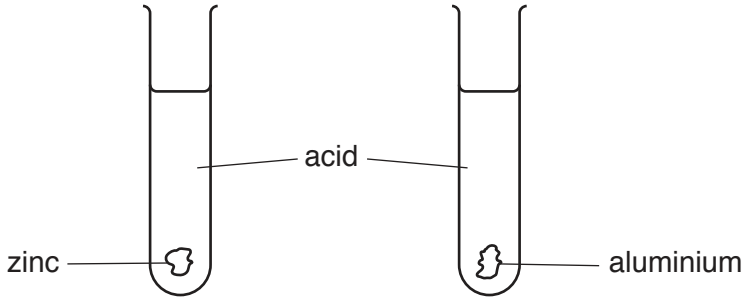


**Fig. 4.2**

She observes that aluminium takes more time to react than zinc.

**(i)** Aluminium is higher in the reactivity series than zinc.

State why aluminium takes **more** time to react than zinc. Give a reason for your answer.

.....

.....

..... [2]

**(ii)** Write the balanced symbol equation for the reaction of aluminium with hydrochloric acid, HC$l$, to form aluminium chloride, A$l$C$l_3$, and hydrogen gas, $H_2$.

..... [2]

[Total: 8]

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**5** Fig. 5.1 shows the construction of a simple solar panel used to produce hot water.

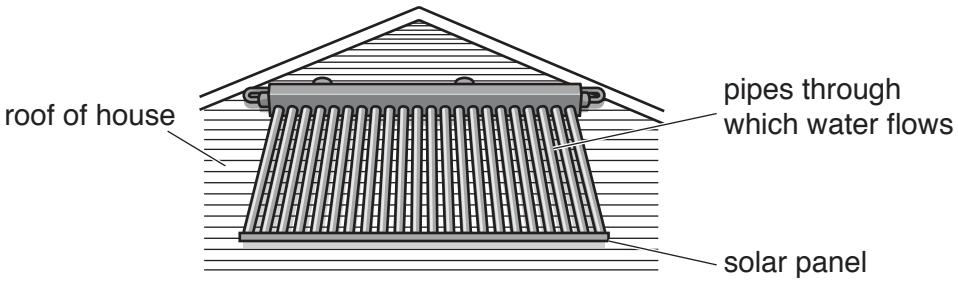


**Fig. 5.1**

**(a)** Name the process by which energy is transferred from the Sun to the Earth.

..... [1]

**(b)** The pipes in this type of solar panel are painted black.

Explain why.

.....

..... [1]

**(c)** **(i)** Name the process by which energy is transferred from the outside of the pipes to the inside of the pipes.

..... [1]

**(ii)** Use ideas about particles to describe how the energy is transferred through solids.

.....

.....

.....

.....

..... [2]

[Total: 5]



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**6** **(a)** Silver bromide decomposes in the presence of light to form silver and bromine, as shown by the word equation.

$$\text{silver bromide} \longrightarrow \text{silver} + \text{bromine}$$

**(i)** The chemistry of this reaction has many uses.

State **one** of these uses.

..... [1]

**(ii)** State what is reduced in this reaction.

..... [1]

**(b)** Bromine forms an ionic bond with sodium.

Describe how bromine and sodium form an ionic bond.

In your answer you should refer to:

- the outer shell electrons in both bromine and sodium atoms,
- the outer shell electrons in both bromide and sodium ions,
- the charge on a sodium and a bromide ion.

You may draw a **labelled** diagram to help explain your answer.

.....

.....

.....

.....

.....

.....

.....

..... [5]

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**(c)** Sodium bromide reacts with chlorine in a displacement reaction. The equation for the reaction is shown.

sodium bromide + chlorine ⟶ sodium chloride + bromine

Predict what will happen when iodine is added to sodium bromide.

Give a reason for your answer.

prediction .....

reason .....

.....

[1]

**(d)** Table 6.1 shows some physical properties of elements in Group VII.

**Table 6.1**

| | state at room temperature | melting point /°C | boiling point /°C |
|---|---|---|---|
| fluorine | gas | –219 | –188 |
| chlorine | gas | –101 | –34 |
| bromine | liquid | –7 | ..... |
| iodine | solid | 114 | 184 |
| astatine | ..... | 302 | 337 |

Complete Table. 6.1 to suggest the state of astatine and the approximate boiling point of bromine. [2]

[Total: 10]



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**7** Fig 7.1 shows a shallow tank of water.

Wavefronts on the surface of the water move towards a barrier.

There is a gap in the barrier.

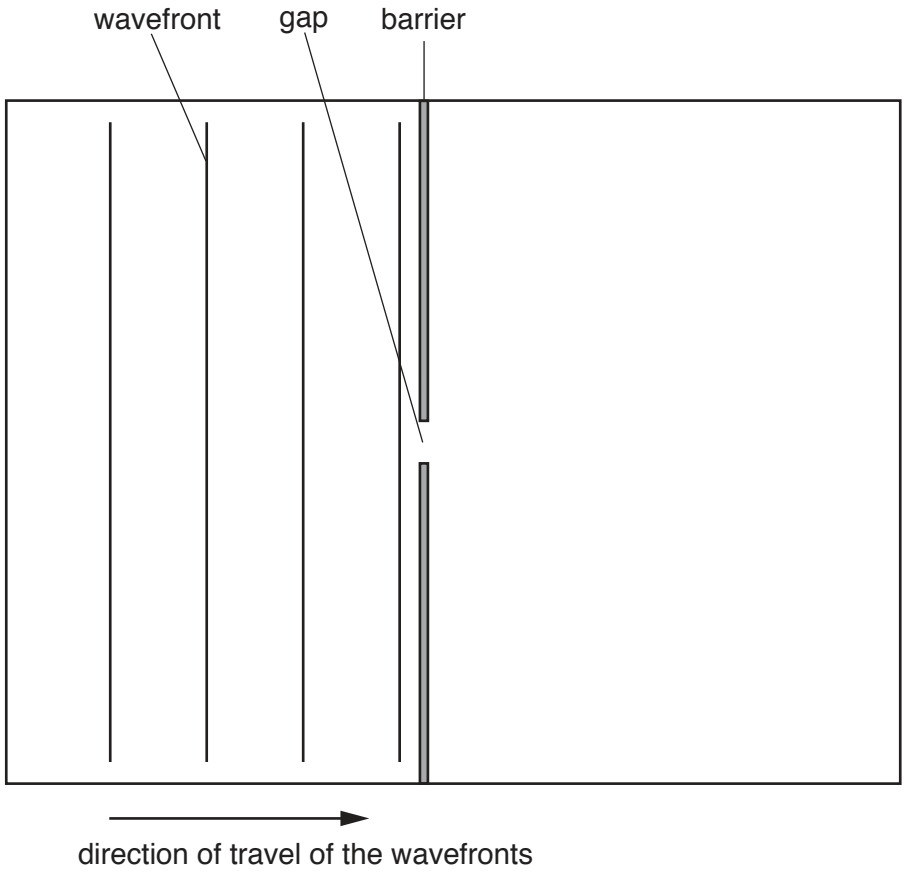


**Fig. 7.1**

**(a) (i)** On Fig. 7.1, draw three wavefronts after they pass through the gap. [3]

**(ii)** State the property of waves that this demonstrates.

..... [1]

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**(b)** The graph in Fig. 7.2 shows a side view of the waves at an instant in time.

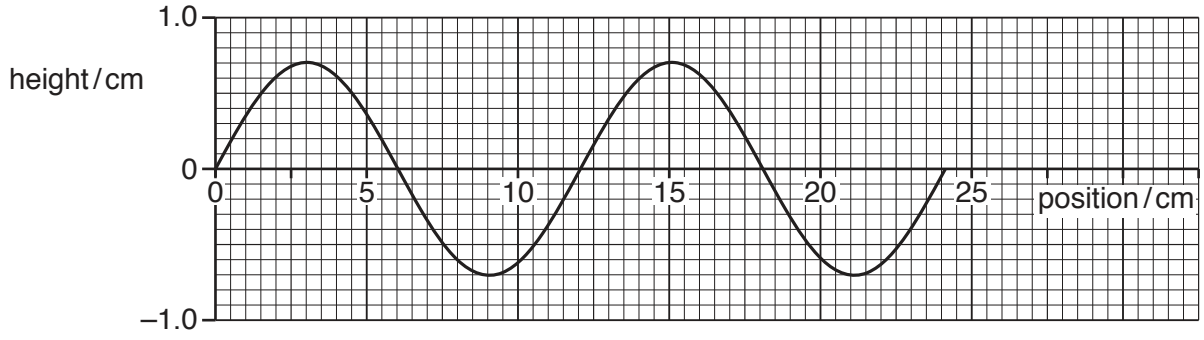


**Fig. 7.2**

**(i)** On Fig. 7.2, draw an arrow to show the amplitude of the wave. [1]

**(ii)** Determine the wavelength of the wave.

wavelength = ..... cm [1]

**(iii)** The wave travels at a speed of 64 cm / s.

Calculate the frequency of the wave.

Show your working.

frequency = ..... Hz [2]

[Total: 8]



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**8** Fig. 8.1 shows a circuit which contains a heater.

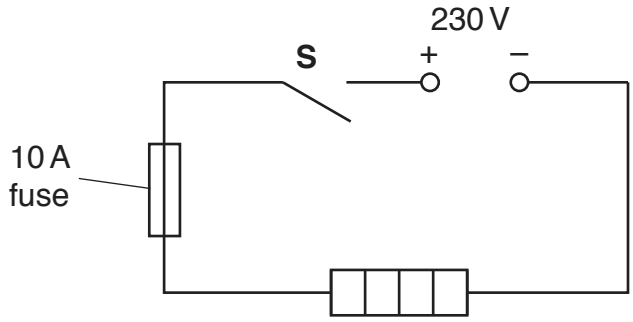


**Fig. 8.1**

The power supply has an e.m.f. of 230 V.

The heater is rated at 230 V, 1.5 kW.

The circuit contains a 10 A fuse.

**(a) (i)** Calculate the current in the circuit when switch **S** is closed.

current = ..... A [2]

**(ii)** Calculate the charge passing through the heater in 5 minutes.

charge = ..... C [2]

**(b)** An electrician connects a second identical heater into the circuit in Fig. 8.1.

**(i)** The two heaters are connected in series.

In series, the two heaters produce less power than one heater alone.

Explain why.

.....

.....

..... [2]

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**(ii)** The electrician then connects the two heaters in parallel.

He closes switch **S** and finds that the heaters do not work.

Explain why the heaters stop working.

.....

.....

..... [2]

[Total: 8]

**9** Use words from the box to complete the sentences about making an insoluble salt.

| | | | | |
|---|---|---|---|---|
| **cold** | **boiling** | **filtration** | **heat** | **hot** |
| **insoluble** | **liquid** | **precipitate** | **soluble** | |

You may use each word once, more than once or not at all.

Two ..... salts in solution are added to each other.

This forms a ..... .

The insoluble salt is separated by ..... .

The salt is washed with ..... water and dried.

[4]

[Total: 4]



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**10** Butane combusts in oxygen, as shown by the equation.

$$2C_4H_{10} + 13O_2 \longrightarrow 8CO_2 + 10H_2O$$

**(a)** Calculate the mass of water produced by the complete combustion of 3.5 kg of butane.

Show your working in the box.

[$A_r$: C, 12; H, 1; O, 16]

mass of water = ..... kg [3]

**(b)** Butane is a member of a homologous series.

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

.....

.....

..... [2]

**(ii)** Ethane is one product of the cracking of butane.

Complete the equation to show the other product formed during this reaction.

$C_4H_{10} \longrightarrow C_2H_6 +$ ..... [1]

**(iii)** State why a catalyst is used during the cracking.

.....

..... [1]

[Total: 7]

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**11** A student has a long thin wire, a horseshoe magnet and a sensitive, zero-centred voltmeter, as shown in Fig. 11.1.

The wire is placed between the poles of the magnet.

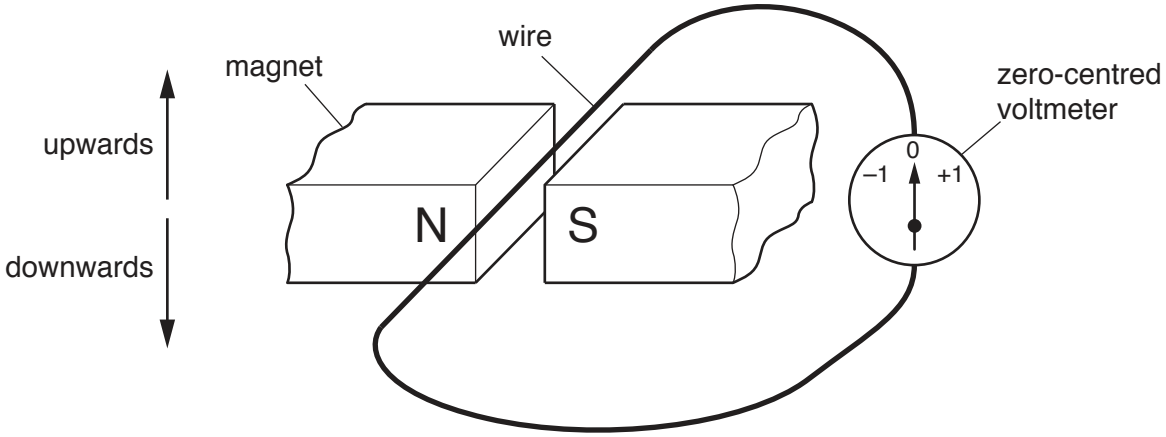


**Fig. 11.1**

**(a)** State what is observed on the voltmeter when the student moves the wire

from N to S, .....

.....

upwards, .....

.....

downwards. .....

.....

[4]



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**(b)** Fig. 11.2 shows a simple a.c. generator.

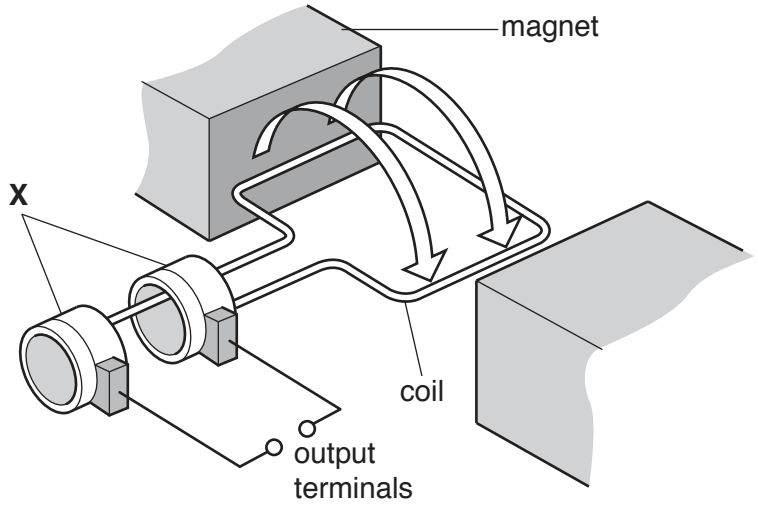


**Fig. 11.2**

**(i)** Name the parts labelled **X**.

..... [1]

**(ii)** Fig. 11.3 shows how the output voltage of the generator varies as the coil rotates through two turns.

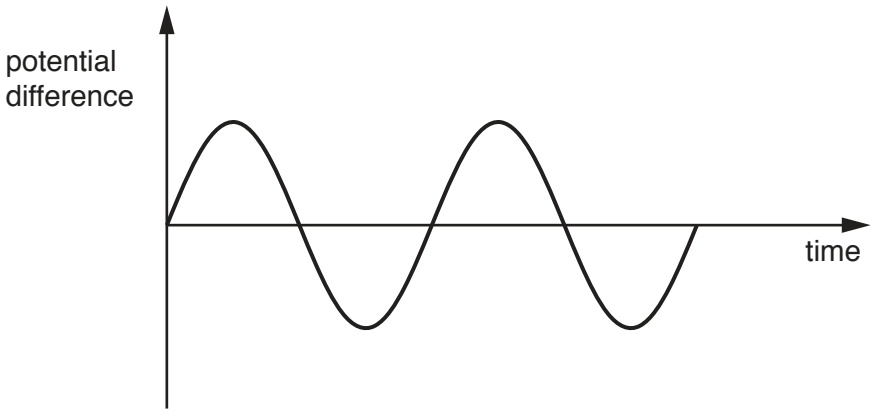


**Fig 11.3**

On the same axes in Fig. 11.3, draw the output voltage of the generator when the coil rotates at a greater speed through two turns. [2]

[Total: 7]

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**12** Hydrogen gas is used as fuel.

Hydrogen reacts with oxygen as shown by the equation.

$$2H_2 + O_2 \longrightarrow 2H_2O$$

**(a)** The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure.

Determine the volume of oxygen, measured at room temperature and pressure, needed for the complete combustion of 250 $cm^3$ of hydrogen.

volume of oxygen = ..... $cm^3$ [1]

**(b)** Suggest why using hydrogen as a fuel causes less harm to the environment than burning fossil fuels.

.....

.....

..... [2]

[Total: 3]

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## The Periodic Table of Elements

| Group I | Group II | | | | | | | | | | | Group III | Group IV | Group V | Group VI | Group VII | Group 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.).