Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/33**

Paper 3 (Extended) **October/November 2015**

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 a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 28.

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 **28** printed pages.

CAMBRIDGE International Examinations

1 **(a)** Use words from the list to complete the sentences about the human gas exchange system.

Each word can be used once, more than once, or not at all.

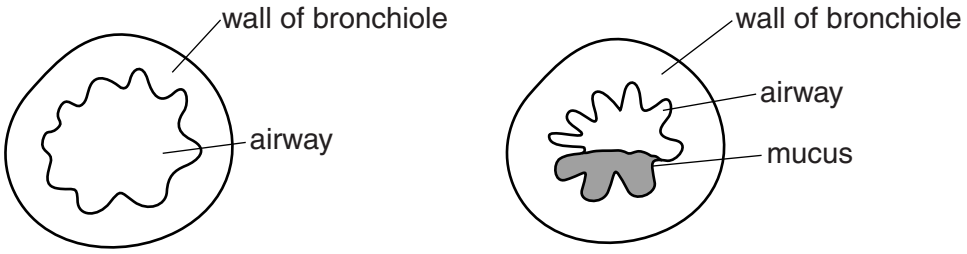
arteries **capillaries** **into** **large** **long**

out of **small** **veins**

The alveoli have a ..... surface area for the diffusion of oxygen ..... the blood. There is a good supply of blood flowing in ..... close to the alveoli which provides a short diffusion pathway for gases. [3]

(b) Some people suffer from asthma which affects the bronchioles of the gas exchange system.

Fig. 1.1 shows a cross section of a healthy bronchiole, and a bronchiole of a person with asthma.



healthy bronchiole **bronchiole of a person with asthma**

Fig. 1.1

The airflow towards the alveoli is reduced if a person has asthma.

Describe **two** features visible in Fig. 1.1 which could reduce the airflow to the alveoli.

1 .....

2 .....[2]

(c) A study is carried out to compare the breathing of people with asthma with the breathing of healthy people.

The volumes of air inhaled in one minute are measured and an average is calculated.

Both groups of people are tested while resting.

Results

average volume inhaled by a healthy person = 5.8 dm^3 / minute

average volume inhaled by a person with asthma = 12.5 dm^3 / minute

(i) Calculate the average percentage of **extra** air the person with asthma inhales per minute compared with a healthy person.

Show your working.

answer = ...% [2]

(ii) The person with asthma needs to breathe a greater volume of air per minute by breathing more quickly and more deeply. The same changes occur to the breathing of all people when they exercise.

Explain why these breathing changes are needed during exercise.

.....

.....

.....

.....[2]

(d) The tar in tobacco smoke affects the gas exchange system.
Two of these effects are listed below.

cilia become paralysed
more mucus is produced

Choose **one** of the effects above and explain why it is **especially** harmful for a person with asthma to smoke. State which change you are choosing.

change .....

explanation .....

.....

.....

.....[2]

2 Fig. 2.1 shows the apparatus used to investigate the temperature changes which occur during some chemical processes.

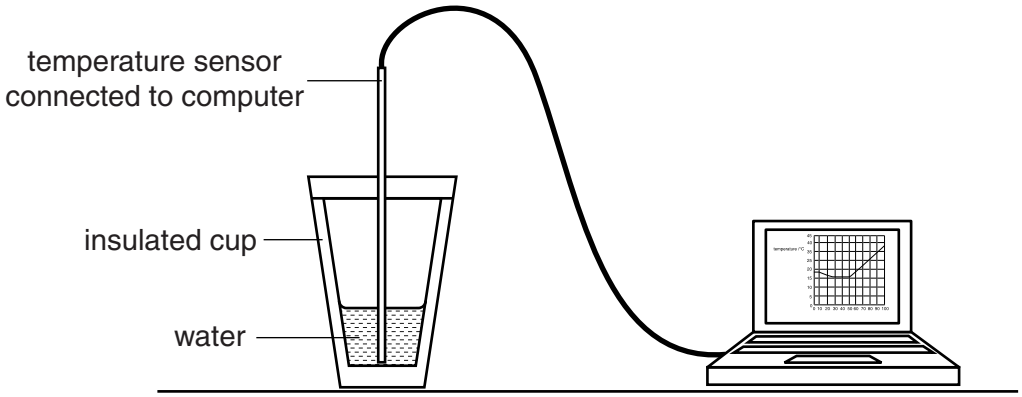


Fig. 2.1

The temperature sensor is placed in the water and the computer starts to log data. After 10 seconds some solid silver nitrate is added to the water in the cup. The mixture is stirred until the solid dissolves.

After another 40 seconds a length of copper wire is placed in the solution.

Fig. 2.2 shows the computer display of temperature change for the first 100 seconds.

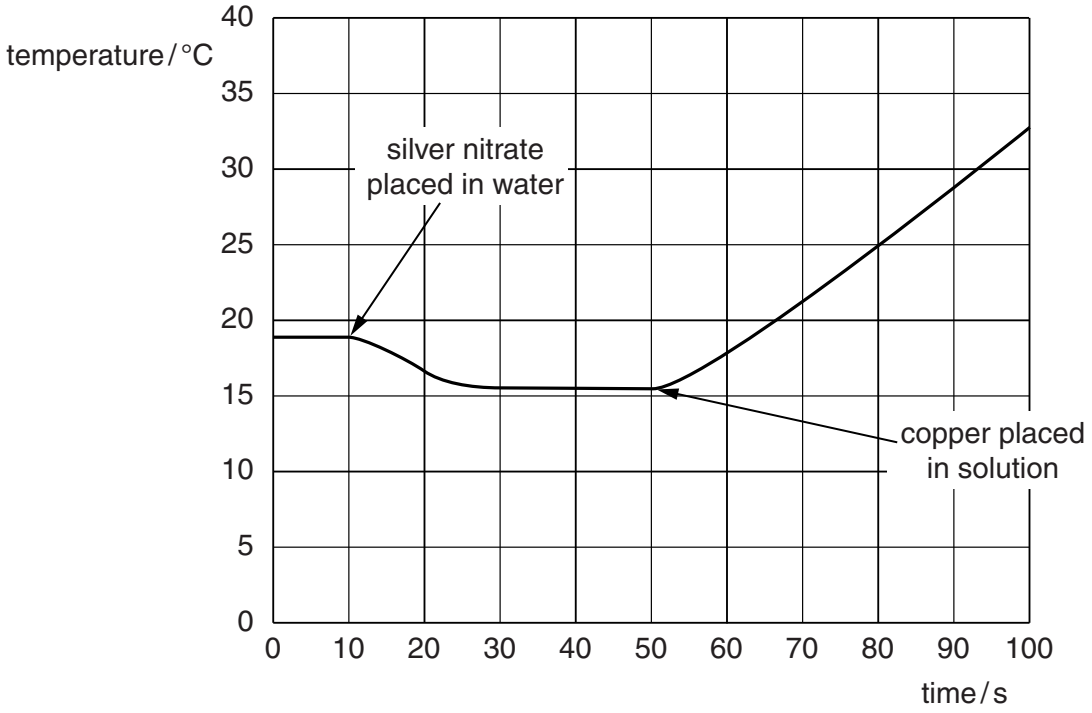


Fig. 2.2

(a) Describe the **energy change** taking place as the silver nitrate dissolves.

.....[1]

(b) The experiment shown in Fig. 2.2 is **experiment 1**.

The procedure is repeated, using twice the mass of silver nitrate in the same volume of pure water. This is **experiment 2**.

The same length of copper wire is added at 50 seconds.

Fig. 2.3 shows part of the computer display with the results of both experiments.

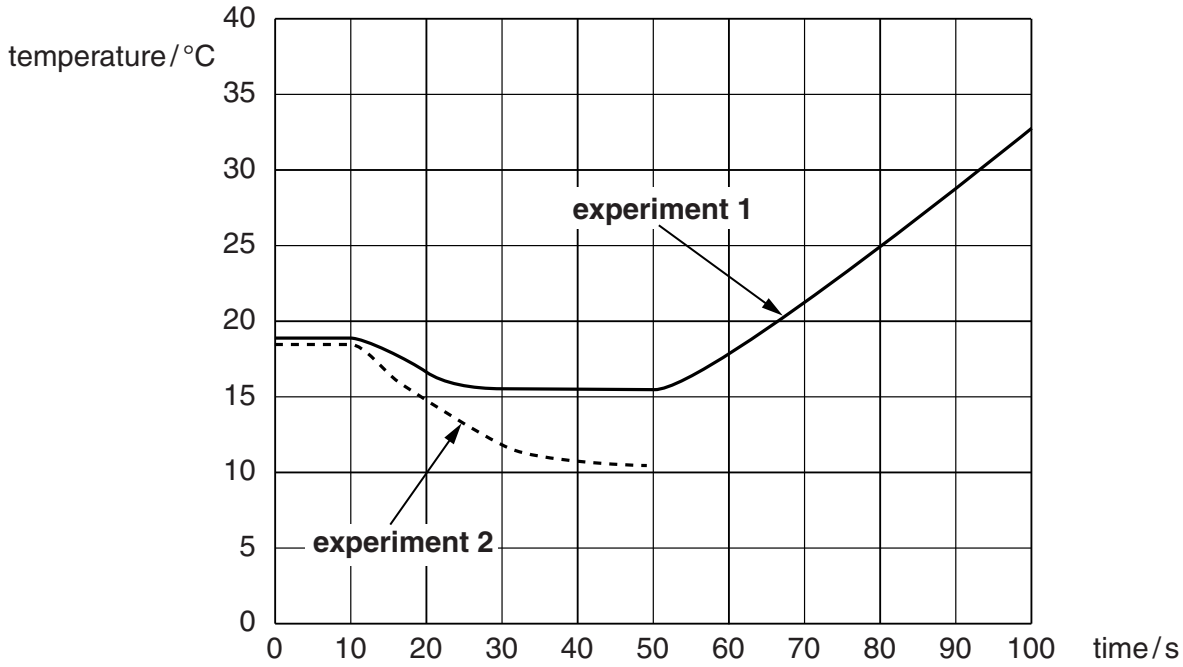


Fig. 2.3

(i) Complete the graph for **experiment 2** on Fig. 2.3 to show the change in temperature as copper reacts. [1]

(ii) Explain, in terms of the collision of particles, how increasing concentration affects the rate of reaction.

.....

.....

.....[2]

(c) Fig. 2.4 shows the appearance of the contents of the cup at the end of the experiment.

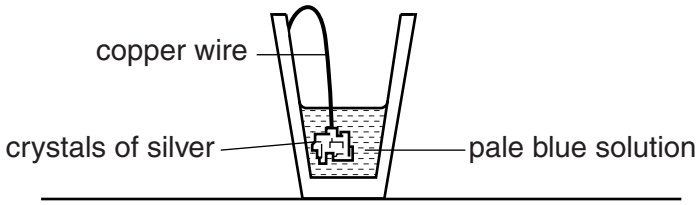


Fig. 2.4

Crystals of metallic silver coat the copper wire and the liquid is now a pale blue solution.

(i) Use the words **atoms** and **ions** to complete the sentences which explain what happens during the reaction. Each word may be used once or more than once.

Copper ..... in the wire become copper ..... in the solution.

Silver ..... in the solution become silver ..... in the crystals. [1]

(ii) Table 2.1 shows a list of metals in order of reactivity.

Table 2.1

potassium
sodium
calcium
magnesium
zinc
iron
copper

Write silver in its correct position in the list in Table 2.1. [1]

(iii) Suggest how the reactivity of a metal depends on how easily its atoms change into ions in a chemical reaction.

.....

.....

.....[1]

Please turn over for Question 3.

3 Fig. 3.1 shows a girl on a skateboard track which ends in a shallow pool of water.

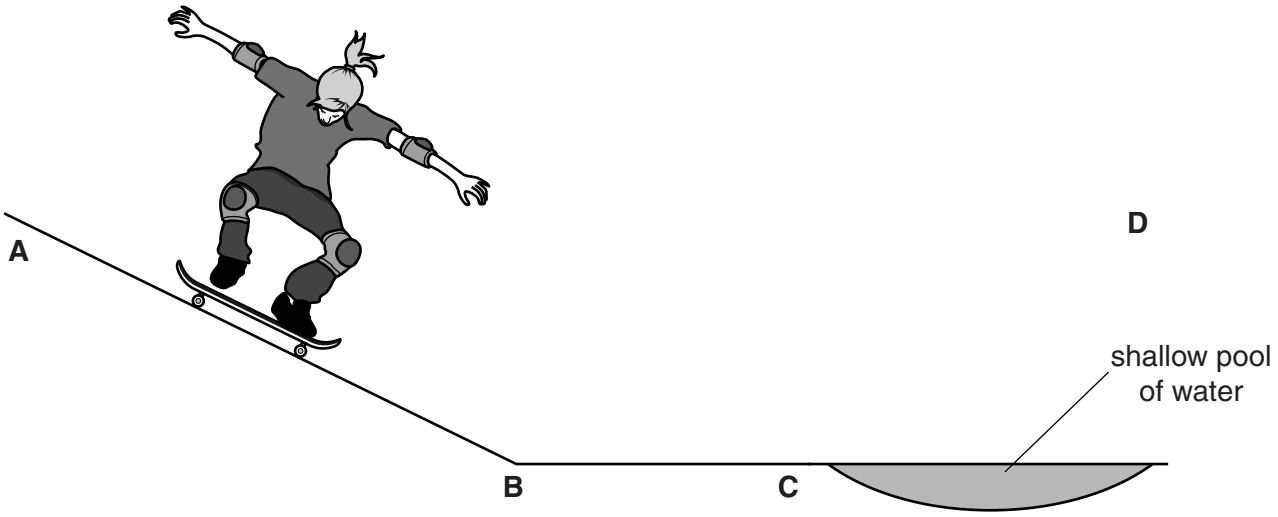


Fig. 3.1

(a) Name the force that causes the girl to move down the skateboard track from **A** to **B**.

.....[1]

(b) State the main energy transfer as the girl travels from **A** to **B**.

from ..... energy

to ..... energy [1]

(c) Fig. 3.2 shows a speed/time graph of the girl as she travels.

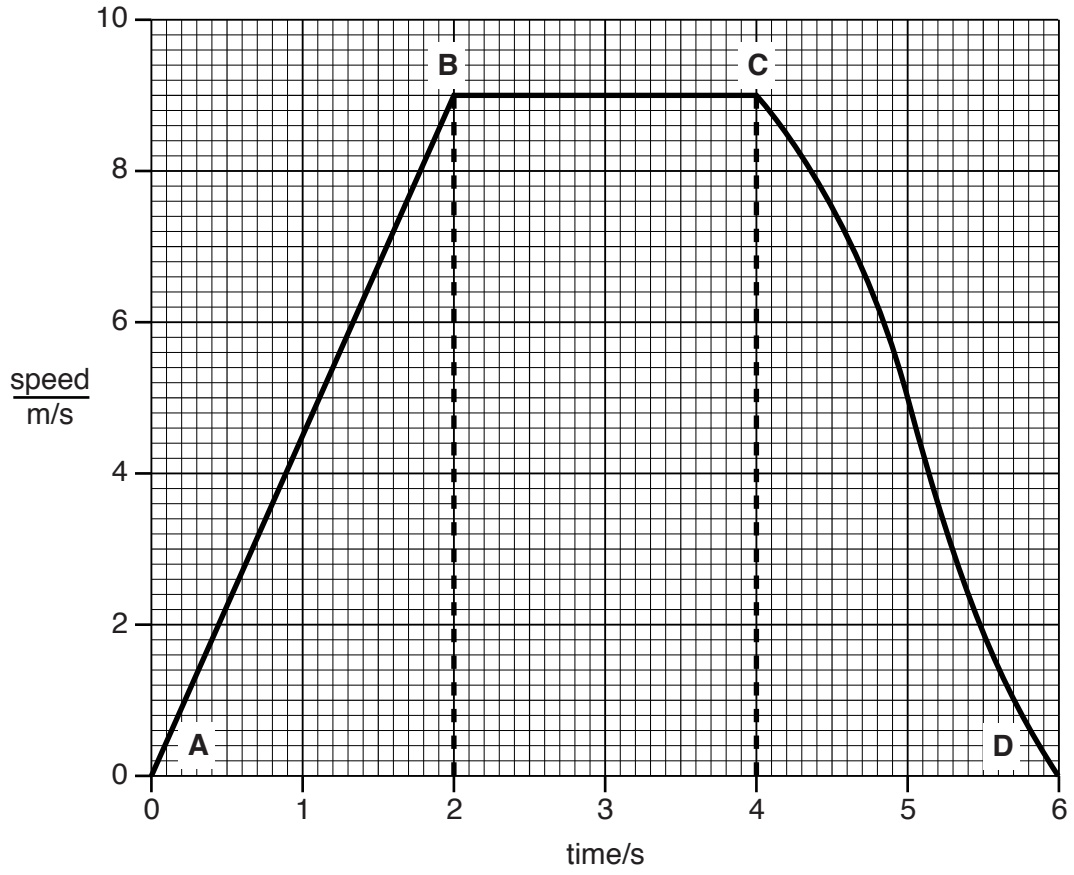


Fig. 3.2

(i) Describe the motion of the girl between points

A and **B**, ...

B and **C**. .....[2]

(ii) Use Fig. 3.2 to calculate the distance travelled by the girl between points **A** and **C**.

Show your working.

distance = ... m [2]

[Turn over

(d) The girl crouches low on the skateboard to minimise air resistance. When she enters the shallow pool of water, the water resistance stops her quickly.

Explain, in terms of the particle theory of matter, why water resistance is more effective than air resistance at stopping the skateboarder.

You may wish to draw diagrams to help your explanation.

.....

.....

.....

.....

.....

.....[3]

Please turn over for Question 4.

4 **(a)** Vitamins are needed in small quantities as part of a balanced diet. One vitamin is vitamin C.

(i) State what is meant by the term *balanced diet*.

.....

.....

.....[1]

(ii) State why we need vitamin C in our diet.

.....

.....[1]

(b) A student does an experiment to find if temperature affects the vitamin C content of a citrus fruit juice.

The fruit juice is freshly made and then 10 cm^3 samples of the juice are stored for four days at the temperatures shown in the table.

At the start, a 10 cm^3 volume of fruit juice contains 5 mg of vitamin C.

Table 4.1 shows the average mass of vitamin C in each 10 cm^3 sample of juice at the end of the four days.

Table 4.1

temperature / °C	mass of vitamin C / mg in 10 cm^3 of juice
4 (in refrigerator)	4.9
20	3.8
30	3.5
40	2.8
50	1.4

(i) Describe the effect of increasing temperature on the vitamin C content of the juice.

.....

.....[1]

(ii) Suggest an explanation for the effect you described in **(b)(i)**.

.....

.....[1]

(iii) When the experiment was repeated in different parts of the world, the initial masses of vitamin C in the 10 cm^3 samples were found to be very different.

Suggest and explain a reason for this observation.

.....

.....

.....

.....[2]

(c) Many new mothers feed their babies on formula milk which is made up with warm water and given to the baby from a bottle.

Using the information in Table 4.1 suggest why boiling water should not be used to make up formula milk.

.....

.....

.....[1]

(d) A new mother was deciding whether to bottle-feed her baby.

Explain one advantage and one disadvantage of bottle feeding.

advantage .....

.....

disadvantage .....

.....[2]

[Turn over

5 **(a)** Fig. 5.1 shows Period 3 of the Periodic Table.

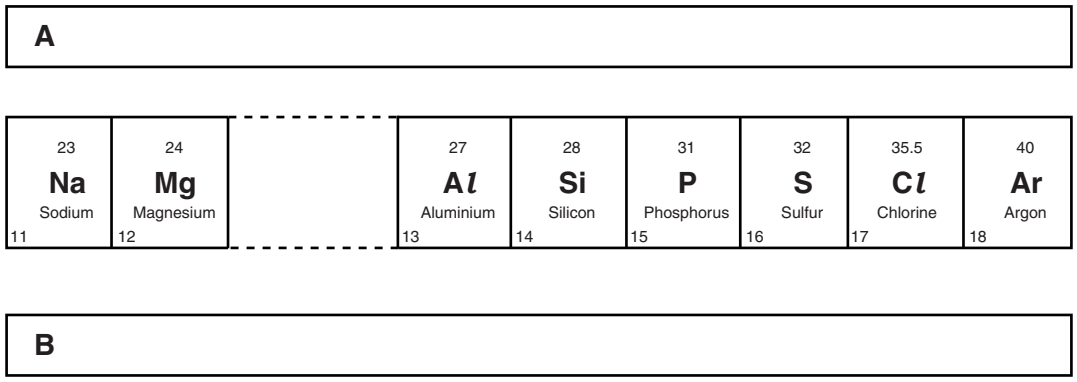


Fig. 5.1

Draw an arrow in box **A** to show the direction of increasing metallic character of the elements across the period.

Draw an arrow in box **B** to show the direction of increasing number of outer shell electrons in atoms of the elements across the period. [1]

(b) **(i)** Table 5.1 shows some observations made after a piece of sodium is dropped into water containing some full-range indicator (Universal Indicator).

Complete Table 5.1 to explain each observation.

Table 5.1

observation	explanation
bubbles of gas	
indicator changes from green to purple	

[2]

(ii) Fig. 5.2 shows part of Group I of the Periodic Table.

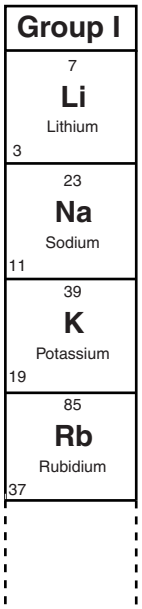


Fig. 5.2

Predict **one** way in which the reaction between rubidium and water differs from the reaction between sodium and water.

Explain your answer.

difference .....

explanation .....

.....

.....[2]

(iii) Fig. 5.3 shows the outer electron shell in a sodium atom.

Complete the diagram of the outer shell of a rubidium atom to suggest how many electrons there are in the outer shell of a rubidium atom.

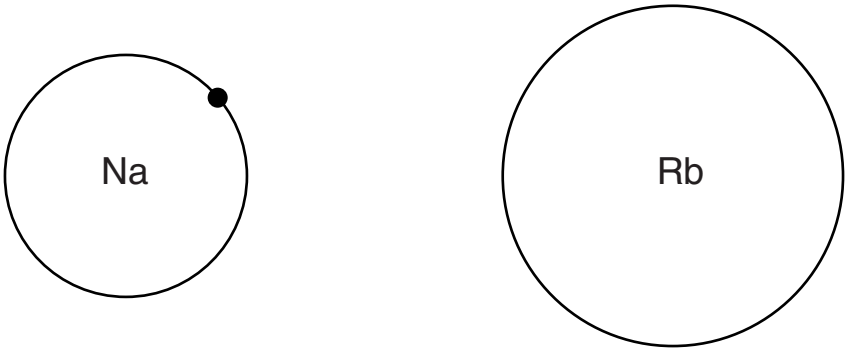


Fig. 5.3

Describe how you used the Periodic Table to make this suggestion.

.....

.....

.....[2]

Please turn over for Question 6.

6 Electric power can be generated using the energy of waves on the sea. Fig. 6.1 shows a group of small wave energy converters which are anchored to the sea floor below.

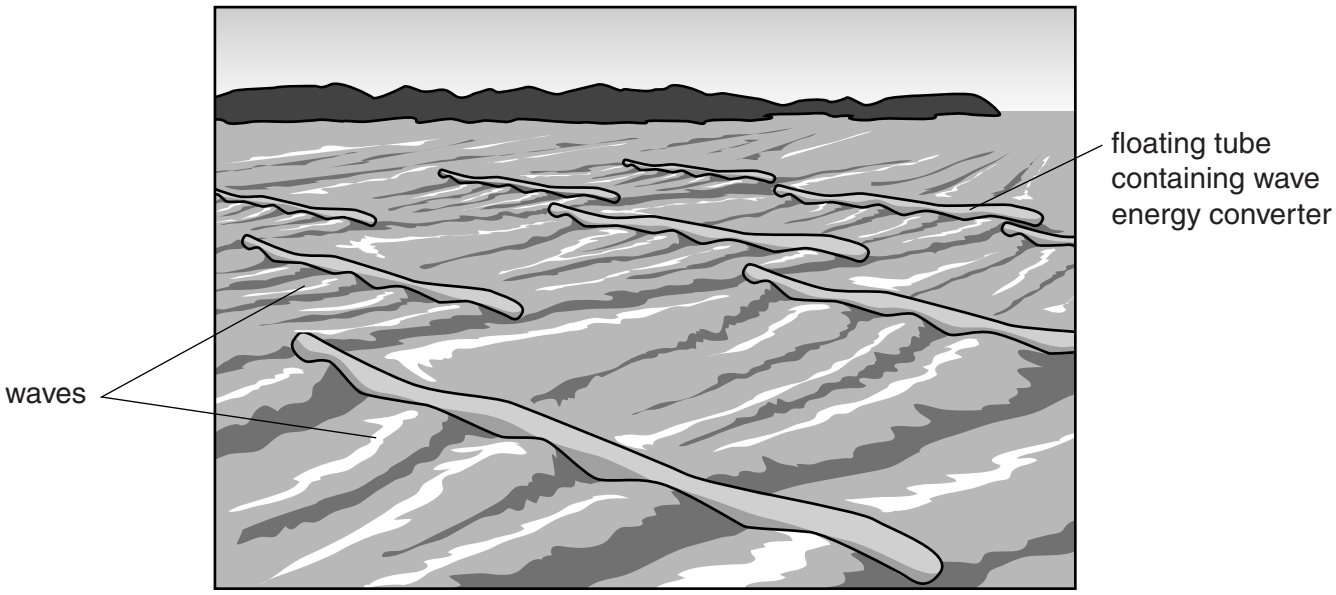


Fig. 6.1

Inside each floating tube there are several generators that convert the wave movement energy into electrical energy.

(a) (i) A total of 10 waves passed one end of a container in 20 seconds.

Calculate the frequency of the waves. Show your working and state the unit of your answer.

frequency = ... unit ..... [2]

(ii) Each floating container is 30 m long. In Fig. 6.1 each sea wave takes 10 seconds to pass along each floating container from end to end.

Calculate the speed of the waves across the sea.

speed = ...m/s [1]

(iii) Use your answers to **(a)(i)** and **(ii)** to calculate the wavelength of the waves.

State the formula that you use and show your working.

formula

working

wavelength = ... m [2]

(b) The amplitude of the waves on one day was 0.5 m.

State the vertical distance that each container will move through as a wave passes.

distance = ... m [1]

(c) The generators are controlled by radio signals. A radio signal is sent from a control centre 100 km away.

Fig. 6.2 shows an incomplete diagram of the electromagnetic spectrum.

gamma radiation			visible light			

Fig. 6.2

Write an **R** in the box for the part of the spectrum where radio waves are found. [1]

[Turn over

(d) Fig. 6.3 shows a tidal energy turbine, which is placed on the sea-bed. The flow of the tide turns the turbine.

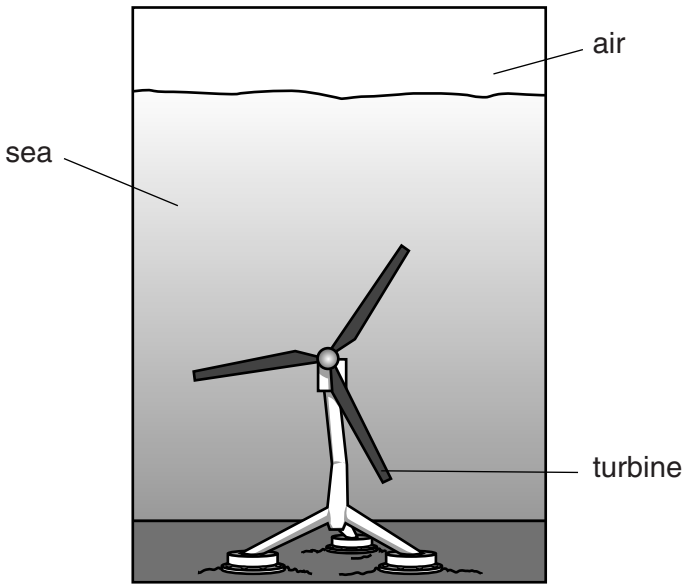


Fig. 6.3

Engineers believe wave generators and tidal generators will be important for supplying electrical energy in the future.

(i) Give **one** advantage, other than cost, that tidal generators have over wave generators for the supply of electrical energy.

.....

.....[1]

(ii) The water flow through a tidal generator delivers energy at 500 kW. The electrical output from this turbine is 150 kW.

Calculate the efficiency of the tidal turbine.

State the formula that you use and show your working.

formula

working

efficiency = ... % [1]

7 Fig. 7.1 shows what happens to most of the solar radiation reaching the Earth.

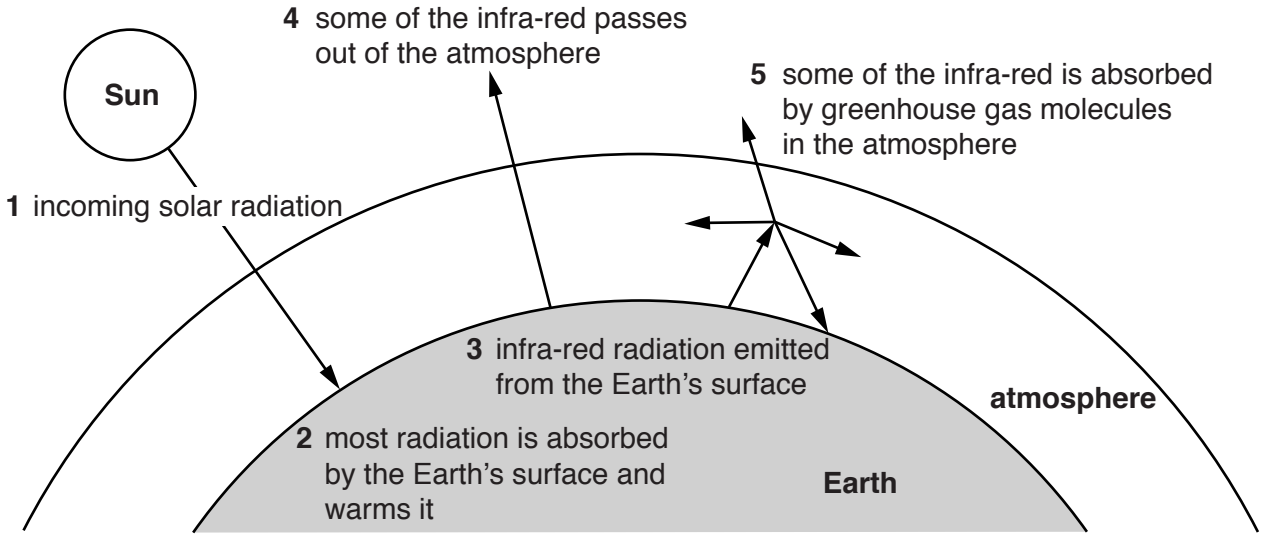


Fig. 7.1

Use Fig. 7.1 to

(a) Describe the role of the atmosphere in keeping the Earth warm.

.....

.....

.....[2]

(b) Name **two** greenhouse gases.

.....and..... [1]

(c) Describe **two** ways in which human activities cause the concentrations of these greenhouse gases to increase.

1 .....

.....

2 .....

.....[2]

(d) State one measure that can be taken to reduce the levels of greenhouse gases in the atmosphere.

.....

.....[1]

[Turn over

8 A student extracts some copper from a sample of green copper carbonate, $CuCO_3$.

(a) He adds dilute hydrochloric acid to the copper carbonate until it is all dissolved.

A blue solution of copper chloride, $CuCl_2$, is formed.

Fig. 8.1 shows that bubbles of gas appear.

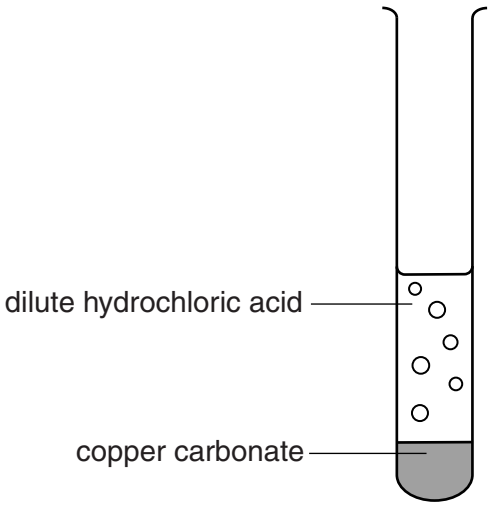


Fig. 8.1

(i) The word equation for the reaction is:

hydrochloric acid + copper carbonate ⟶ copper chloride + carbon dioxide + water

Write the balanced chemical equation for this reaction.

.....[2]

(ii) The student checks that the gas is carbon dioxide.

When the reaction is complete, he collects some of the gas in a pipette.

Fig. 8.2 shows how he collects the gas and then passes it through a solution **X**.

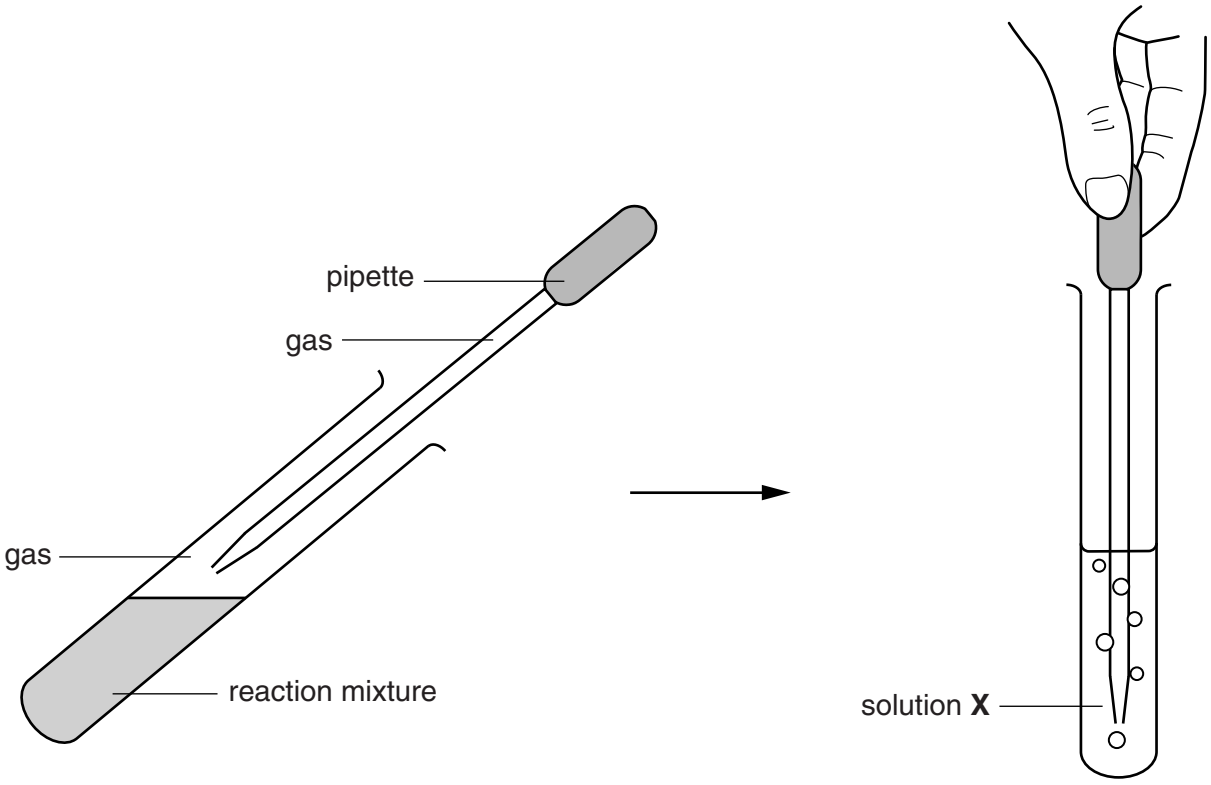


Fig. 8.2

State the name of solution **X** and describe the effect of carbon dioxide on its appearance.

name .....

effect .....

.....[2]

(b) The student places the copper chloride solution that he has made into the electrolysis cell shown in Fig. 8.3.

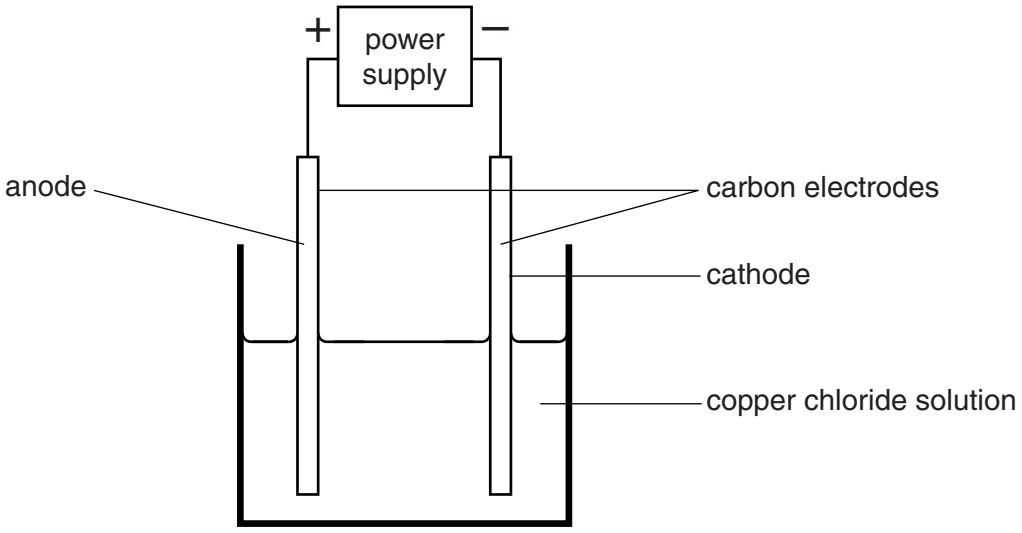


Fig. 8.3

(i) Complete Fig. 8.3 by labelling each electrode to show the product formed. [2]

(ii) The electrolyte contains copper ions and chloride ions. Describe the direction of movement of these particles when the switch in the circuit is closed.

copper ions (Cu^{2+})

.....

chloride ions (Cl^{-})

.....[2]

(c) Another compound of copper and chlorine exists, with a different formula.

It contains copper ions which have only one positive charge, Cu^+.

(i) Deduce the formula of the copper chloride compound containing the ion Cu^+.

Explain your answer.

formula .....

explanation .....

.....

.....[2]

(ii) Copper is a transition metal.

The ability to form more than one compound with another element is typical of transition metals.

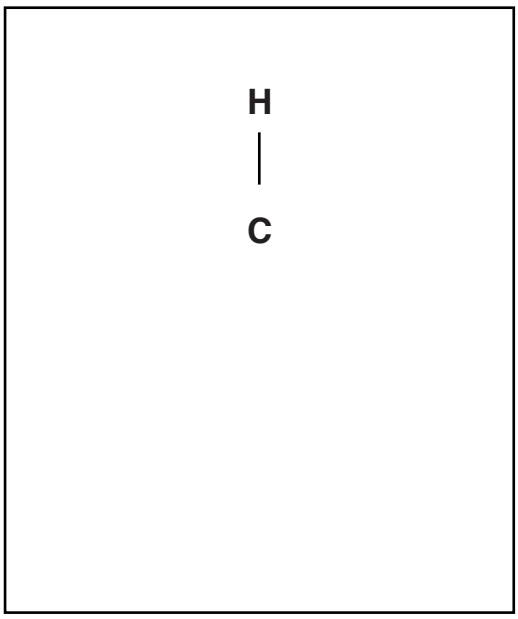
State another property which is typical of transition metals but **not** of other metals.

.....[1]

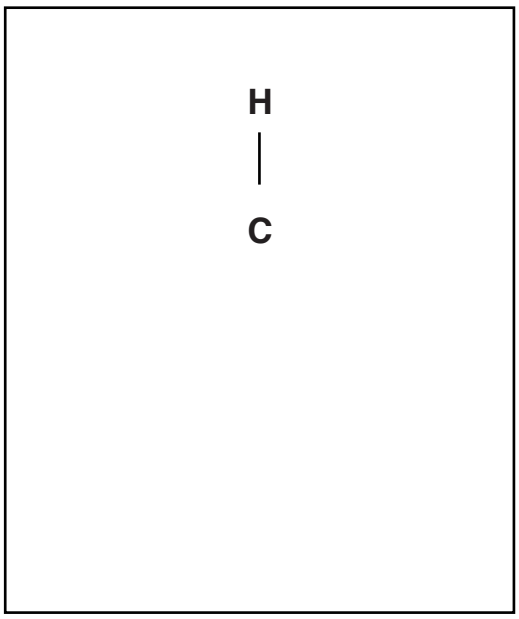
(d) Carbon is an element that forms different compounds with the element hydrogen.

Draw the structures of molecules of the carbon compounds methane and ethene in the boxes.

methane



ethene



[2]

9 **(a)** Fig. 9.1 shows two oppositely charged metal plates.

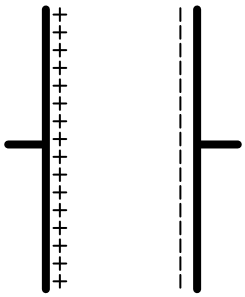


Fig. 9.1

The two oppositely charged plates are free to move.

State what will happen. Give a reason for your answer.

.....

.....

.....[2]

(b) **(i)** Complete the following sentence:

An electric field is a region in which an electric charge experiences a ..... . [1]

(ii) Fig. 9.2 shows an electron entering the electric field between two oppositely charged plates.

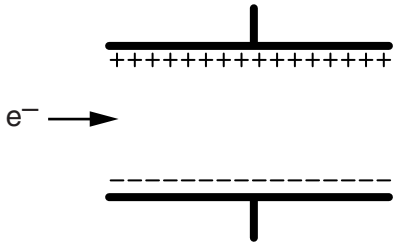


Fig. 9.2

An electron carries a negative charge.

On Fig. 9.2 draw a line to show the path the electron might take after it enters the electric field. [1]

(c) Fig. 9.3 shows a circuit diagram for an electric heater, supplied with 12V from a car battery.

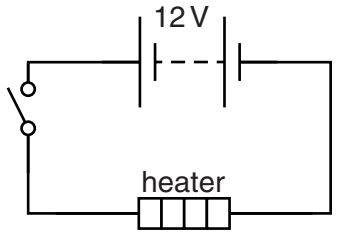
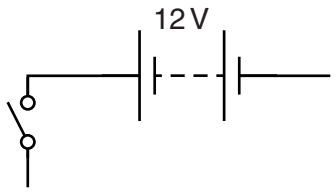


Fig. 9.3

(i) The heater circuit is changed to include a second identical heater and a lamp to show when the heaters are switched on. The heaters must be connected in parallel to work.

Complete the circuit diagram below to include both heaters and the lamp connected so that the circuit works when the switch is closed.



[3]

(ii) The heater transfers thermal energy to some water. This causes convection in the water.

Explain why the thermal energy causes convection in the water.

.....

.....

.....[2]

DATA SHEET
The Periodic Table of the Elements

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 **X** 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.).