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0653/21

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 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.

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 24.

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 **23** printed pages and **1** blank page.

1 Fig. 1.1 shows some cells. They are not drawn to scale.

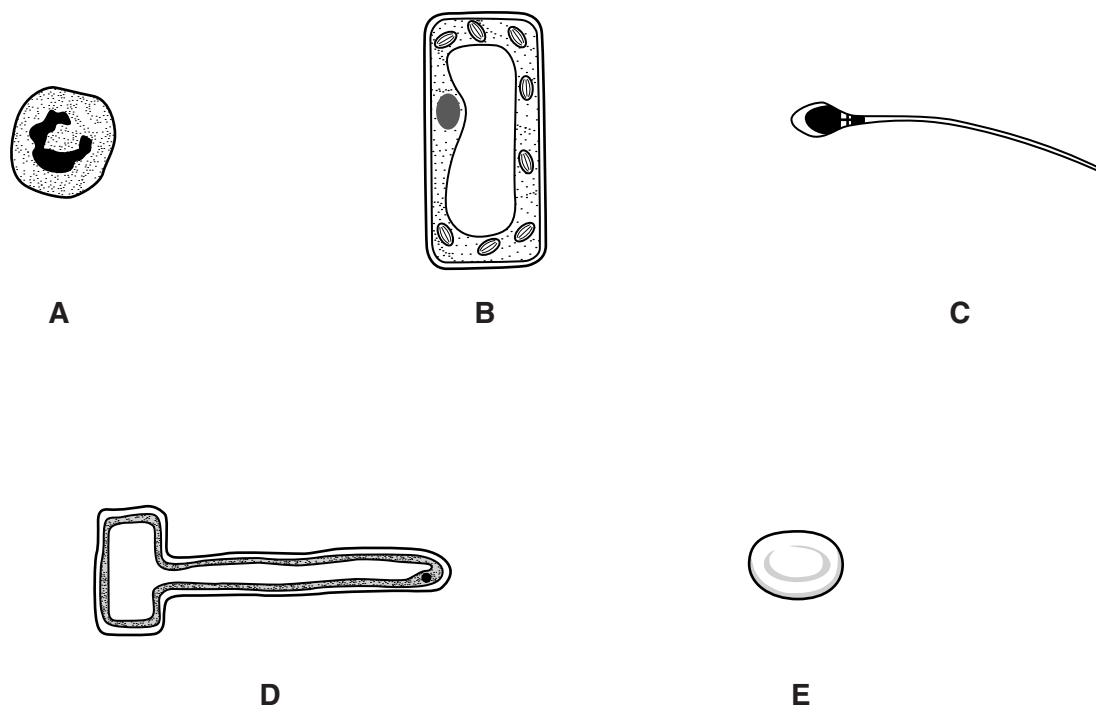


Fig. 1.1

(a) Write the letter or letters of the cell or cells

(i) that are plant cells,

.....[1]

(ii) with a haploid nucleus.

.....[1]

(b) On **one** plant cell in Fig. 1.1, use label lines and the correct names to label two parts of the cell that are present in plant cells but absent from animal cells. [2]

- (c) A student uses the apparatus in Fig. 1.2 to compare the rates of transpiration of two shoots, shoot 1 and shoot 2. The shoots are taken from the same tree. The stems of the shoots each have the same diameter and the same number of leaves.

However, one shoot has leaves of shape **X** and the other shoot has leaves of shape **Y**. This is shown in Fig. 1.2.

As each shoot transpires, the meniscus moves upwards in the capillary tubing.

For each shoot the student calculates the average distance the meniscus moves in one minute.

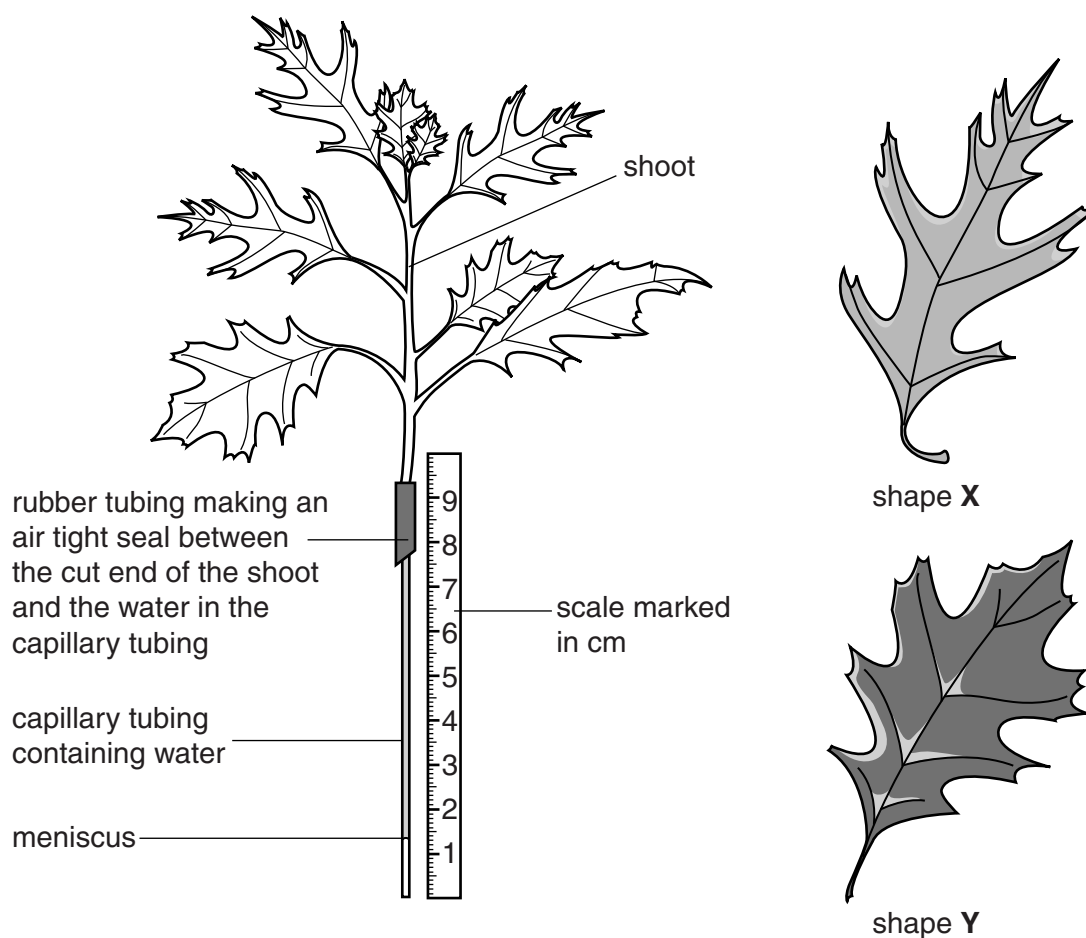


Fig. 1.2

results

Table 1.1

shoot	average distance moved by the meniscus in one minute/cm
1	5.8
2	4.6

- (i) Use the results to state the letter of the shape of leaves on shoot **2**.

Explain your answer.

shape of leaf on shoot **2** = ...

explanation

.....

.....

.....[2]

- (ii) If the same experiment is carried out under different environmental conditions the results obtained will be different from those shown in Table 1.1.

Explain why the average distance moved by the meniscus will change for both shoots when

the temperature increases,

.....

.....

.....

the humidity decreases.

.....

.....

.....

[2]

- 2 (a) Fig. 2.1 shows samples of some elements in Group VII of the Periodic Table at room temperature.

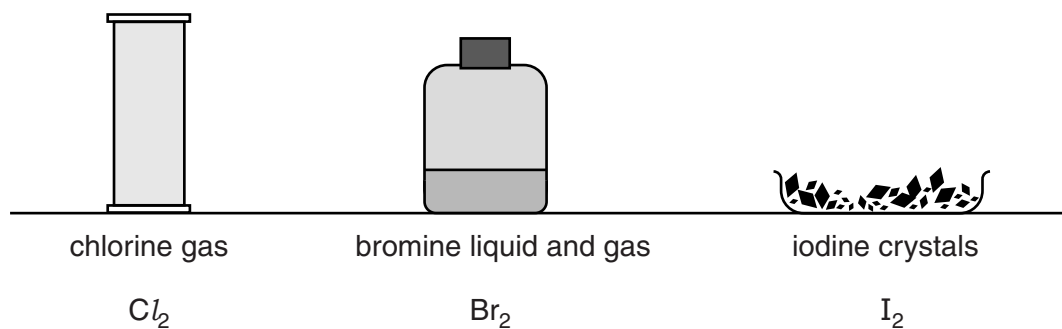


Fig. 2.1

Describe the trend in melting point down Group VII.

.....
[1]

- (b) A piece of burning sodium is lowered into bromine gas.

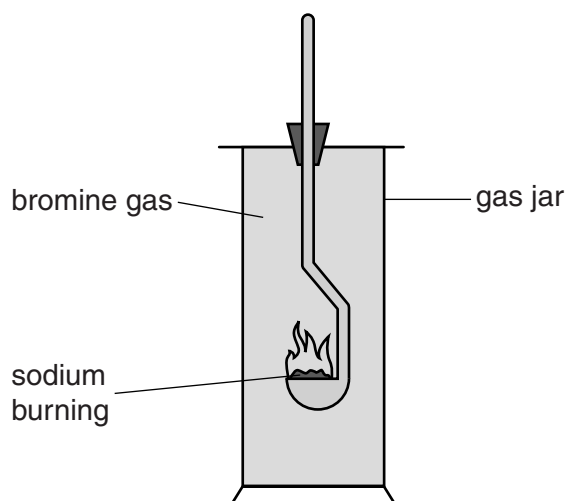
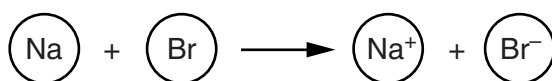


Fig. 2.2

The sodium and bromine react together to produce sodium bromide.

Sodium bromide is made of sodium ions and bromide ions.

The change from atoms to ions in this reaction can be represented as follows:



Explain how the ions are formed in terms of the movement of electrons.

.....

[2]

- (c) Fig. 2.3 shows what happens when a student adds colourless chlorine solution to colourless sodium bromide solution.

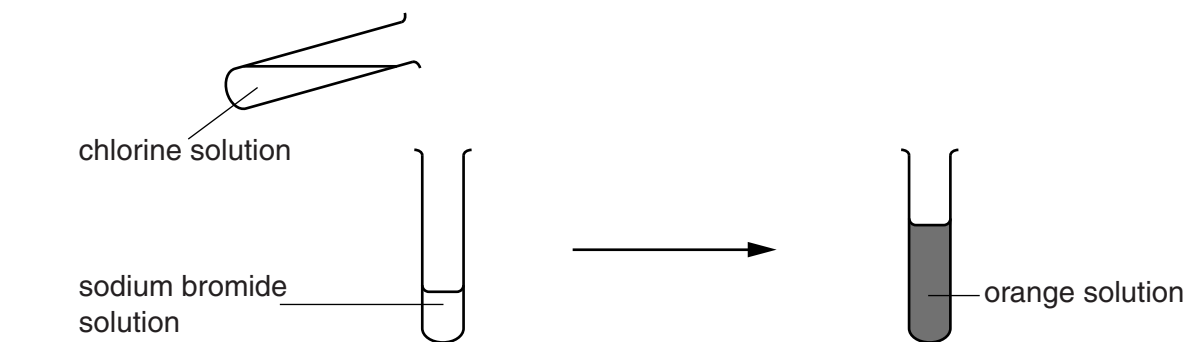


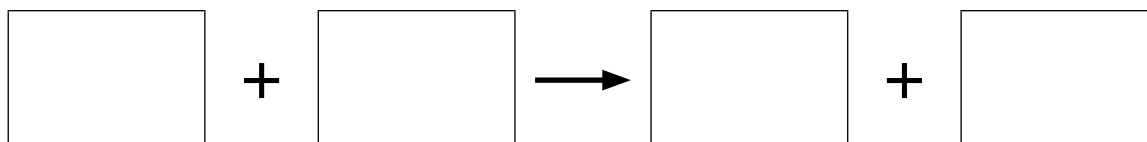
Fig. 2.3

The resulting mixture is orange.

- (i) State the name of the substance formed which gives the final mixture this colour.

.....[1]

- (ii) Write a word equation for the reaction that occurs.



[2]

- (iii) The reactivity of the halogens decreases down the group.

most reactive chlorine

 bromine

least reactive iodine

Explain why sodium bromide reacts with chlorine but does not react with iodine.

.....

[2]

- 3 Fig. 3.1 shows a man bungee jumping. He is attached to a long elastic rope as he jumps off a bridge.

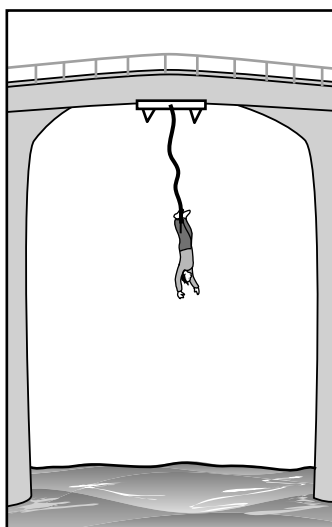


Fig. 3.1

Fig. 3.2 shows the jump at several stages from the time the man jumps off the bridge.

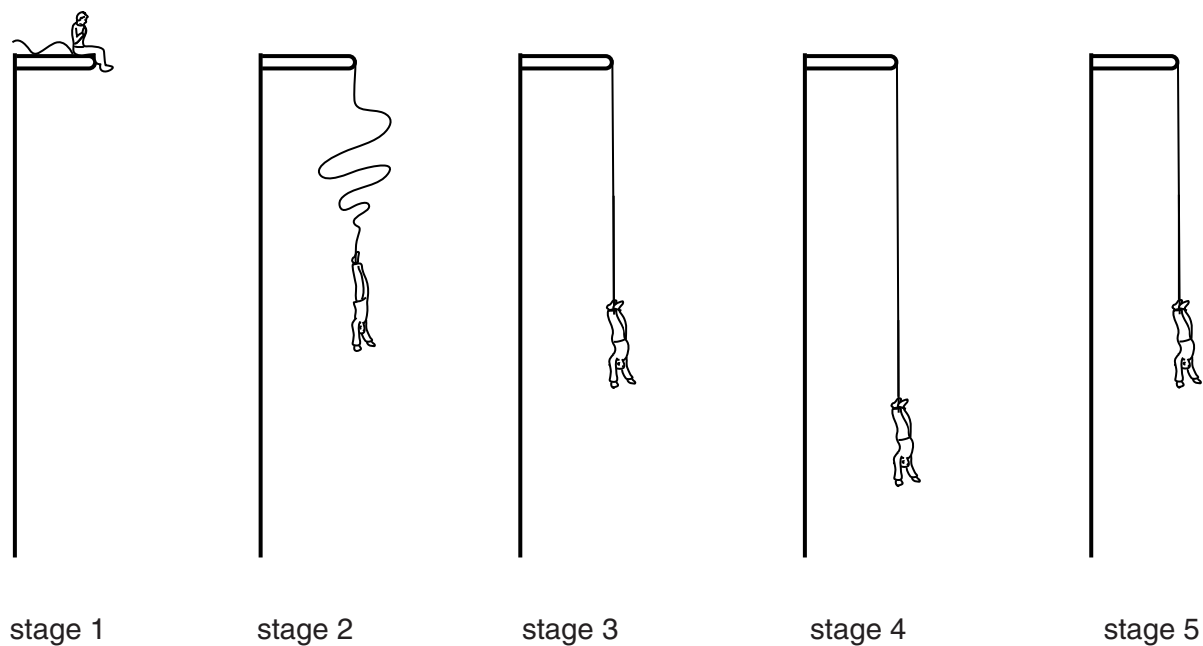


Fig. 3.2

- (a) State the energy transformation occurring between stage 1 and stage 2.

from energy to

..... energy.

[1]

- (b) (i) Identify the main force acting on the man just after he jumps off the bridge.

.....[1]

- (ii) As the man falls, another force, air resistance, acts on the man to slow him down. On Fig. 3.3, draw an arrow to show the direction in which air resistance is acting on the man.



Fig. 3.3

[1]

- (iii) State the **name** of the unit in which force is measured.

..... [1]

- (c) As the man falls, the rope begins to stretch.

On the axes below, sketch a speed/time graph to show how his speed changes as the rope stretches until he reaches the lowest point.



[2]

- (d) The man then rises up again. He bounces up and down a few times before hanging from the rope at rest.

The unstretched length of the elastic rope is 25 m.

At the lowest point, the length of the rope is 40 m.

Estimate a value for the length of the rope when the man is hanging from the rope at rest.

Give a reason for your answer.

Length of rope: m

Reason for your estimate:

.....

.....

.....[2]

- (e) Before the jump, the temperature of the rope is 20°C . The rope is now used for several jumps by different people. At the end of all of the jumps, the temperature of the rope is 25°C .

Suggest where the energy has come from to heat the rope.

.....

.....[1]

Please turn over for Question 4.

- 4 (a) Fig. 4.1 shows the male reproductive system.

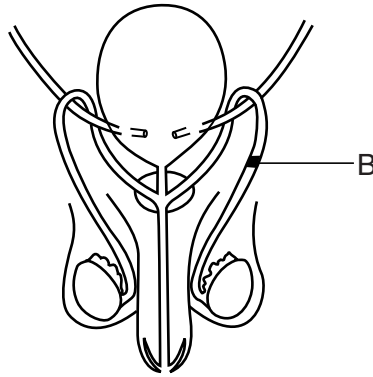


Fig. 4.1

- (i) On Fig 4.1 use lines to label and name

the urethra,

the prostate gland.

[2]

- (ii) A man's reproductive system is found to have a blockage at the point marked with a **B**.

Predict whether this man would still be able to have children.

Explain your answer.

.....

.....

.....

.....

.....

.....[3]

(b) Fig. 4.2 shows how the thickness of the lining of a woman's uterus changes with time.

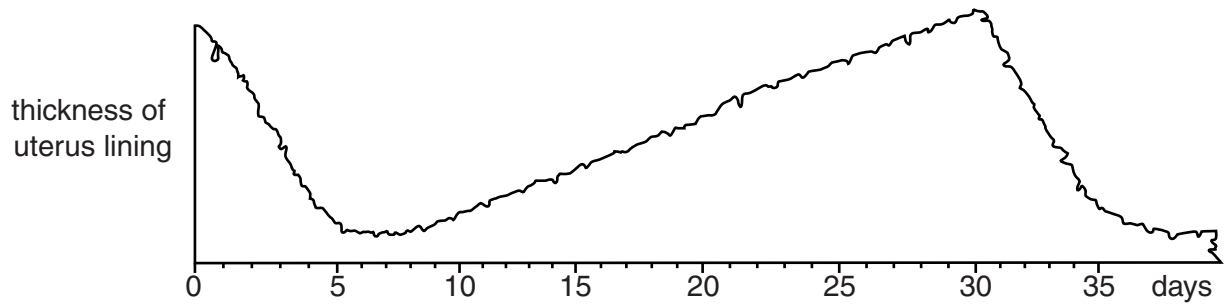


Fig. 4.2

(i) State the days during which menstruation is taking place. Explain your answer.

days

explanation

.....

.....[2]

(ii) Suggest on which day an egg cell is most likely to be fertilised.

.....[1]

(iii) At certain times of the menstrual cycle the lining of the uterus becomes thicker.

Describe what causes this to occur.

.....

.....[1]

(iv) Explain the importance of this thickened uterus lining.

.....

.....[1]

5 Methane is a hydrocarbon which is used as a fuel to heat homes.

(a) State one source of methane.

.....

[1]

(b) Fig. 5.1 shows a demonstration of an explosion caused when methane burns.

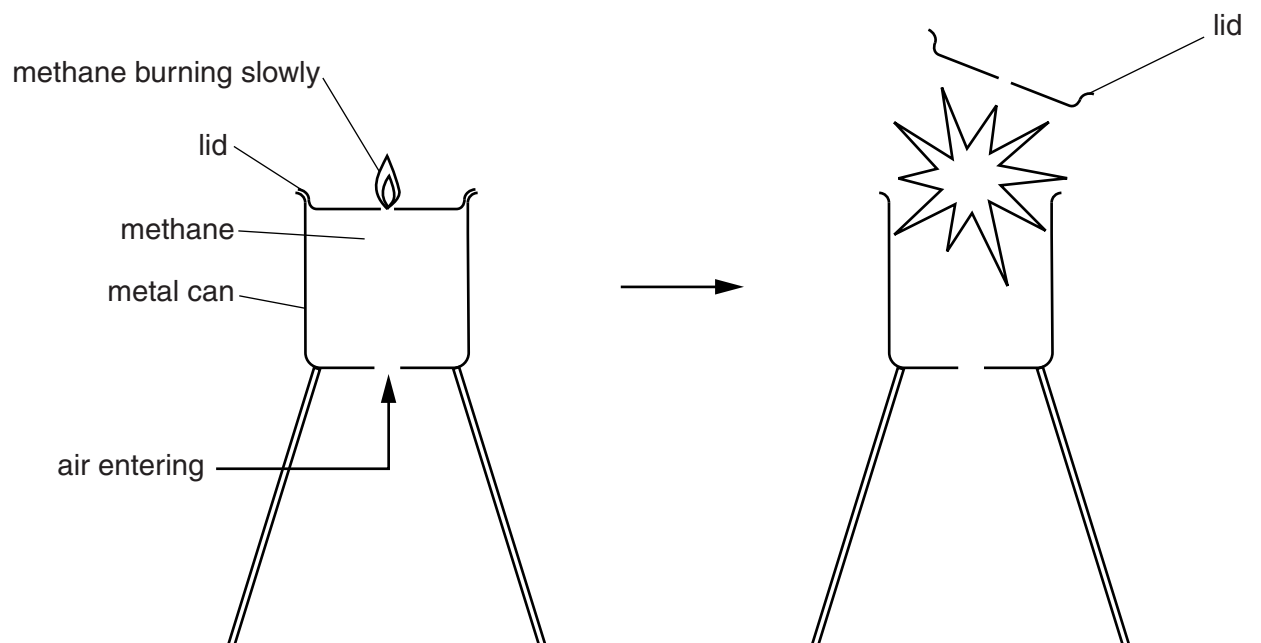


Fig. 5.1

- At first, methane escapes through the hole in the lid and burns slowly.
- As methane leaves the can, air enters through the hole in the base.
- When enough air has entered an explosion occurs.

(i) Table 5.1 compares the three main gases in the can just before and just after the explosion.

Table 5.1

gases present just before the explosion		gases present just after the explosion
methane	→	
oxygen		
nitrogen		

Complete Table 5.1 showing the main gases present just before and just after the explosion. [2]

(ii) The explosion occurs when the rate of combustion of methane suddenly increases. This causes a rapid increase in temperature of the gases in the can.

State the term used to describe a chemical reaction which causes an increase in temperature.

.....

[1]

- (c) Gasoline (petrol) is a mixture of hydrocarbons which includes a compound called nonane.

One nonane molecule contains 20 hydrogen atoms and 9 carbon atoms.

- (i) State the chemical formula of a nonane molecule.

..... [1]

- (ii) State the type of bonding between the carbon and hydrogen atoms in a nonane molecule. Explain your answer.

type of bonding

explanation

..... [2]

- (d) Gasoline is obtained from petroleum (crude oil) by fractional distillation.

Fig. 5.2 summarises the process.

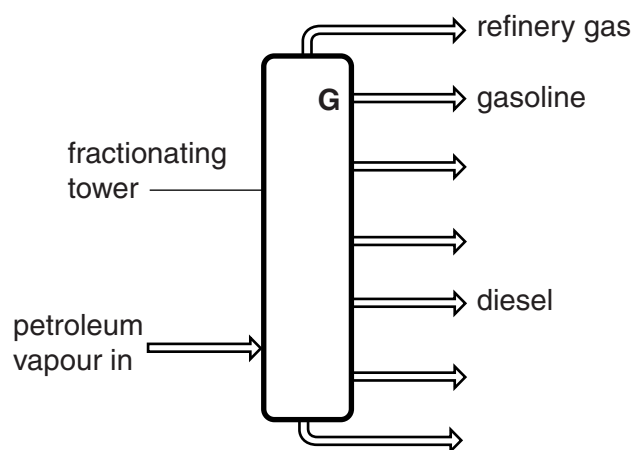


Fig. 5.2

The petroleum is vaporised before it enters the fractionating tower and rises.

The gasoline fraction separates from the mixture at point **G** in the tower.

- (i) State what change happens to the gasoline vapour at point **G**.

..... [1]

- (ii) Explain why gasoline and diesel separate at different points in the tower.

.....

..... [1]

- 6 (a) Fig. 6.1 shows a ray of light passing through a glass block.

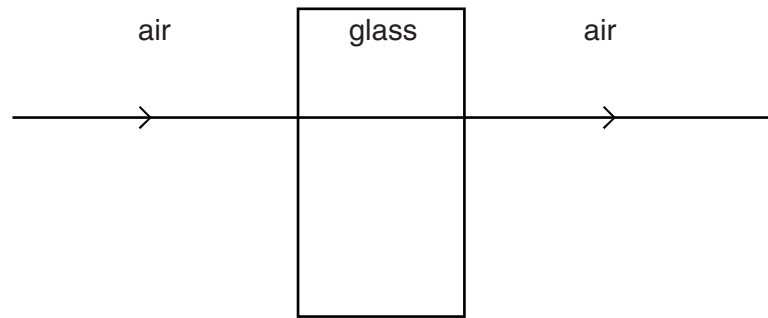


Fig. 6.1

Fig. 6.2 shows the block now turned at an angle to the ray of light.

On Fig. 6.2 draw the path of the ray of light as it enters and passes through the block, and out of the other side.

On your diagram, indicate clearly the angle of incidence i and the angle of refraction r as the ray passes into the block.

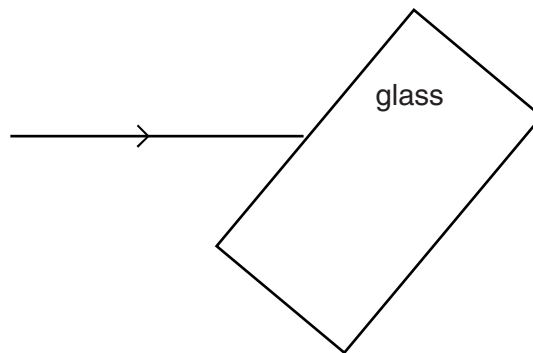


Fig. 6.2

[3]

- (b) (i) Light is a form of electromagnetic radiation. Fig. 6.3 shows the electromagnetic spectrum.

gamma radiation	X-rays	ultra-violet	visible light	infra-red	microwaves	radio waves
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Fig. 6.3

All electromagnetic radiations are refracted as they travel from one material to another.

The shorter the wavelength of an electromagnetic radiation, the more it is refracted.

From Fig. 6.3 state one form of electromagnetic radiation that is refracted more than light.

.....[1]

- (ii) Electromagnetic radiation from the Sun warms the Earth.

State the form of electromagnetic radiation mainly responsible for this energy transfer from the Sun.

.....[1]

- (c) (i) Fig. 6.4 shows a graph of a light wave. On Fig. 6.4, draw labelled arrows to indicate
1. one wavelength of this light wave,
 2. the amplitude of this light wave.

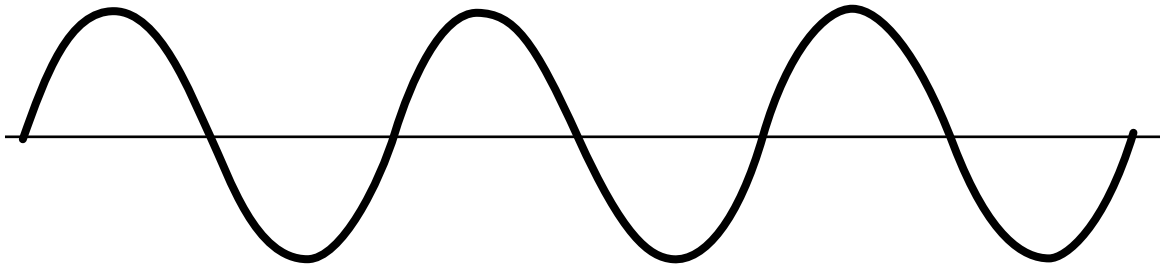


Fig. 6.4

[2]

- (ii) The amplitude of a light wave determines the brightness of the light.

State the property of sound determined by the amplitude of a sound wave.

.....[1]

- 7 (a) Use lines to connect the boxes on the left with the correct boxes on the right. One line has been done for you.

component of blood	function
plasma	transport of oxygen
platelets	clotting of blood
red blood cells	defence against disease
white blood cells	transport of dissolved substances

[2]

- (b) As blood travels through an organ, substances diffuse into and out of the blood to exchange materials with the cells.

Table 7.1 shows the relative concentrations of some substances in the blood and in the cells of a part of the body called the adrenal gland.

Table 7.1

substance	concentration of substance	
	in the blood	in the cells of the adrenal gland
oxygen	higher	lower
carbon dioxide	lower	higher
glucose	higher	lower
adrenaline	lower	higher

- (i) The oxygen diffuses from the blood into the cells of the adrenal gland.

Explain why this happens.

.....
[1]

- (ii) Describe what happens to the oxygen inside the cells.

.....

.....

.....

.....[2]

- (iii) The adrenal gland releases the hormone adrenaline into the blood stream in certain situations. Describe one situation a human may be in that would cause an increase of adrenaline to be released from cells.

.....

.....[1]

- (iv) State **two** effects of adrenaline on the body.

1

2[2]

- 8** A student investigates the speed of reaction between metals and a dilute acid.

He knows that adding dilute acid to iron wire produces hydrogen gas.

- (a)** Fig. 8.1 shows the apparatus the student uses to carry out the reaction.

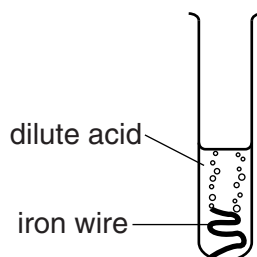


Fig. 8.1

The temperature of the acid is 20 °C.

- (i)** Describe the test for hydrogen gas.

test

result[2]

- (ii)** The rate of bubbling slows down and then stops. There is still some iron wire left in the test-tube.

Explain these observations.

.....

[2]

- (iii)** The student thinks that the test-tube now contains a solution of iron chloride.

Describe a test and the result that shows that the solution contains chloride ions.

test

result[2]

- (b)** The student repeats the experiment using acid at a temperature of 40 °C.

Describe and explain the difference in what the student observes at this higher temperature.

.....

[2]

- (c) Describe and explain what the student notices when he uses copper wire instead of iron.

.....

.....

.....

.....[2]

- 9 Fig. 9.1 shows a circuit used to investigate the resistance of pieces of wire. The pieces of resistance wire are connected to the circuit between **X** and **Y**.

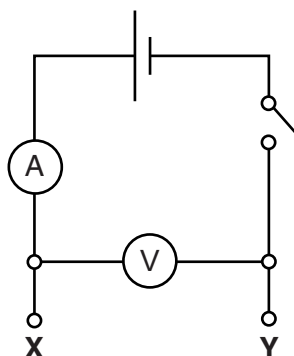


Fig. 9.1

A piece of resistance wire of length 100 cm is connected between **X** and **Y**.

The reading on the ammeter is 0.6 A.

The reading on the voltmeter is 1.2 V.

- (a) (i)** Complete the formula.

$$\text{resistance} = \frac{\quad}{\text{current}}$$

[1]

- (ii)** The piece of resistance wire is cut in half. One length of 50 cm has half the resistance of the wire of 100 cm length.

The 50 cm wire is connected between **X** and **Y**.

Explain why the reading of the ammeter increases.

.....[1]

- (iii)** The second half of the resistance wire is connected in parallel with the first half between **X** and **Y**.

Predict the effect this has on the ammeter reading. Give a reason for your answer.

.....

[2]

- (iv) 100 cm of the resistance wire has a resistance of 2Ω .

Calculate the total resistance when four lengths of 100 cm each are connected in series.

Show your working:

resistance = ... Ω [1]

- (b) The names of some circuit components are given in the left hand column. Some circuit symbols are given in the right hand column.

Complete Table 9.1 to show the missing component name and symbols. One has been done for you.

Table 9.1

circuit component	symbol
direct current source	
fuse	
	
fixed resistor	

[2]

- (c) Most of the stored chemical energy in the cell is changed to thermal energy in the wire. Some of this thermal energy is then transferred to the air surrounding the wire.

- (i) Name the method of thermal energy transfer by the heated air to the surroundings.

.....[1]

- (ii) Describe an experiment to show this method of thermal energy transfer. You may wish to draw a diagram.

.....

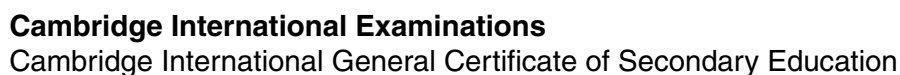
.....

.....

.....[2]

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

PAPA CAMBRIDGE



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0653/22

October/November 2015

1 hour 15 minutes

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This document consists of **24** printed pages.

- 1 Fig. 1.1 shows a van being driven along a flat road at a constant speed. The arrows on the diagram represent the four main forces acting on the van.

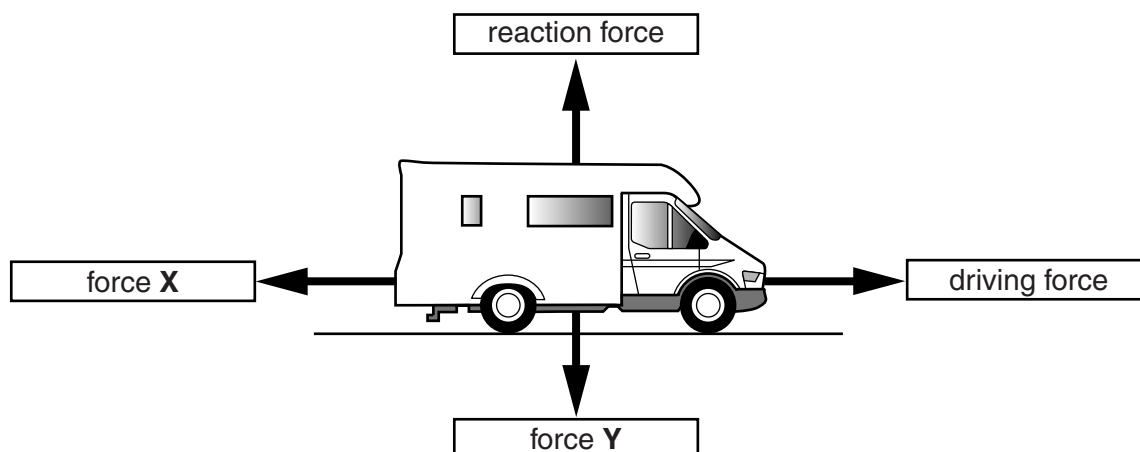


Fig. 1.1

- (a) (i) Use words from the list below to name forces **X** and **Y**.

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

friction	kinetic	gravity
mass	pressure	weight

force **X**

force **Y**

[2]

- (ii) The driving force is 750 N.

State the value of force **X**. Give a reason for your answer.

force **X** = ... N

reason

.....[2]

(b) Fig. 1.2 shows a speed/time graph for the van for two minutes of its journey.

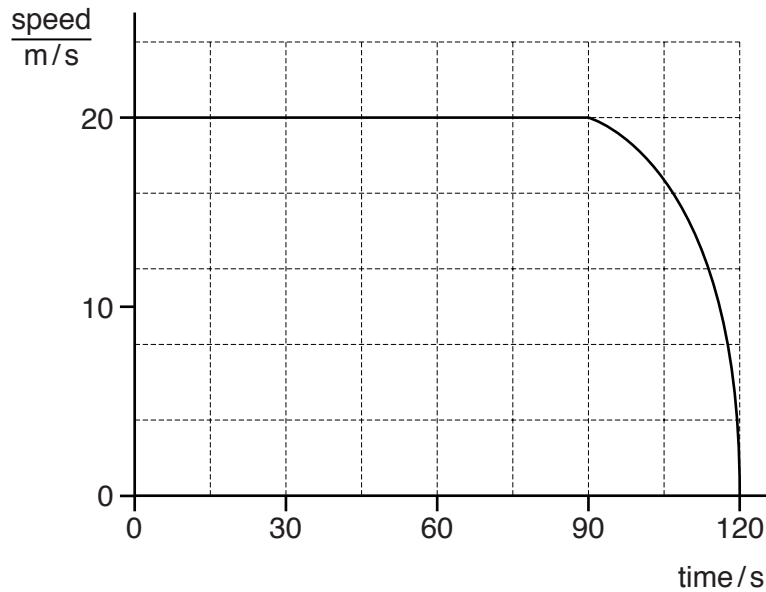


Fig. 1.2

(i) Describe the motion of the van between

1. 30 s and 90 s, ...
2. 90 s and 120 s.[2]

(ii) The van is travelling at 20 m/s.

Calculate the speed of the van in km/h. Show your working.

working

speed = ... km/h [2]

2 Petroleum (crude oil) is a mixture of compounds.

Some of these compounds are used as fuels.

- (a) (i)** Name the process used to separate the petroleum mixture into useful fractions.

.....[1]

- (ii)** Explain why this process involves a physical change but not a chemical change.

.....

.....[1]

- (b)** Fig. 2.1 shows how petroleum fractions can be separated in the laboratory.

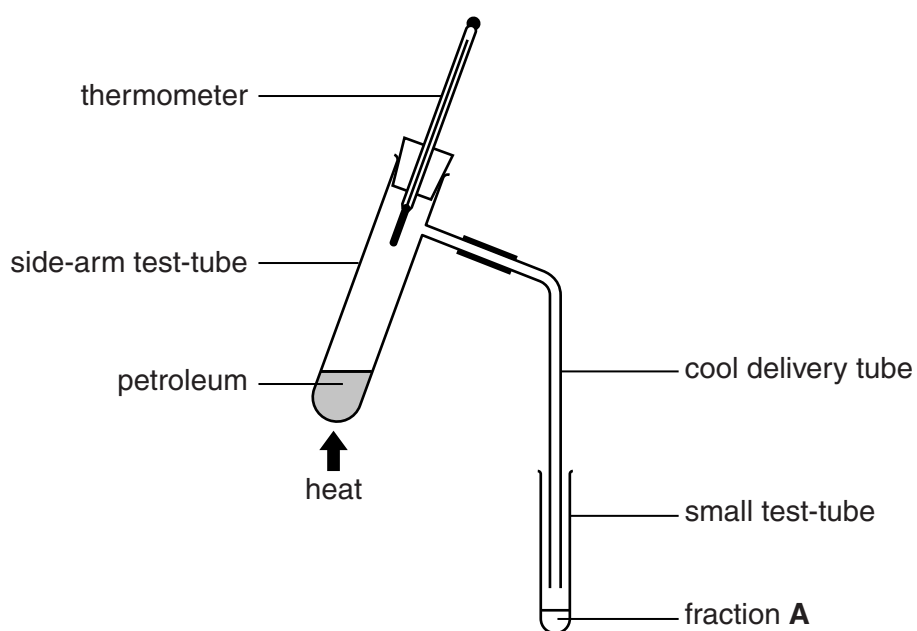


Fig. 2.1

The petroleum is heated until the temperature shown by the thermometer reaches 100°C.

Fraction **A** collects in the small test-tube.

- (i)** Describe the processes involved in moving substances from the petroleum to the small test-tube.

.....

.....

.....[2]

- (ii) The small test-tube used to collect the fraction is replaced with a fresh test-tube. Heating is continued, and three further fractions, **B**, **C**, and **D**, are collected. All four fractions are shown in Fig. 2.2.

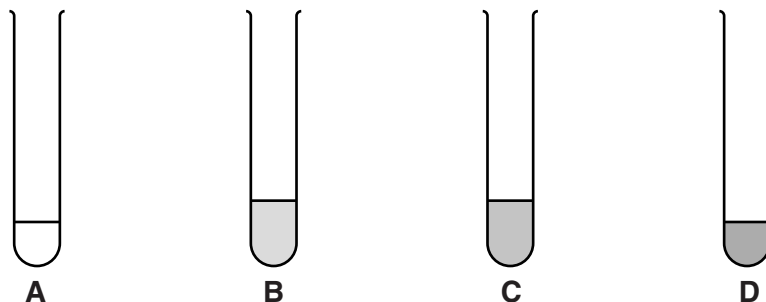


Fig. 2.2

The fractions become darker from **A** to **D**.

The fractions are collected over the temperature ranges shown in Table 2.1.

Table 2.1

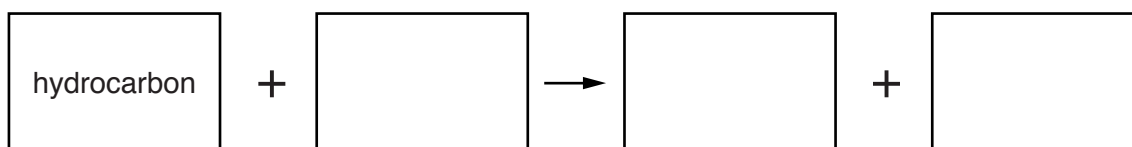
fraction	temperature range/°C
A	room temperature to 100
B	100 to 150
C	150 to 200
D	200 to 250

Use the information in Table 2.1 to state **one** trend in the physical properties of the fractions **A** to **D** apart from colour.

.....
[1]

- (c) Petroleum fractions contain hydrocarbons.

Complete the word equation for the complete combustion of a hydrocarbon.



[2]

- 3 (a) Use lines to connect the boxes on the left with the correct boxes on the right.

Use each description **once** only.

One line has been drawn for you.

chemical		description
fats		can be joined together to make starch or glycogen
glycogen		turns purple with the biuret test
protein		made from fatty acids and glycerol
sugars		storage carbohydrate not found in plants

[2]

- (b) Table 3.1 gives some information about the nutrients contained in 100cm³ of three different types of milk.

Table 3.1

nutrient	milk A	milk B	milk C
protein/g	3.4	3.6	3.6
carbohydrate/g	4.7	4.8	4.9
fat/g	3.6	2.4	0.1
calcium/mg	122	124	129

Energy can be released in cells from the carbohydrate, fat and protein in the milk.

- (i) Name the process by which energy is released in cells.

.....[1]

- (ii) Explain why milk A would be the best choice of milk for an athlete.

.....

[2]

- (iii) The RDA (recommended daily allowance) for calcium is 900 mg per day for most adults.

Calculate the volume of milk **C** needed to provide the recommended daily allowance of calcium.

Show your working.

volume = ... cm^3 [2]

- (iv) Suggest one group of adults who should take in more than the normal RDA of calcium in their diet.

Explain your answer.

group of adults

explanation

.....[2]

4 Fig. 4.1 shows an electric fan heater used to keep people warm.

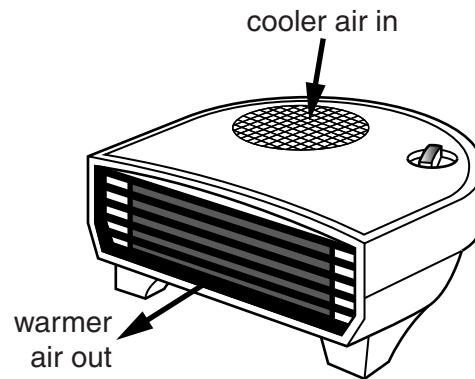


Fig. 4.1

Fig. 4.2 shows the circuit symbols for an electric heater, and for an electric motor to drive the fan.

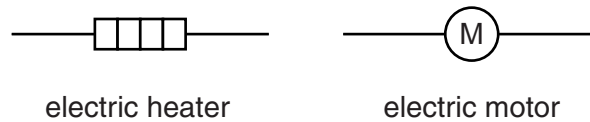


Fig. 4.2

Fig. 4.3 shows part of the circuit diagram for the fan heater.

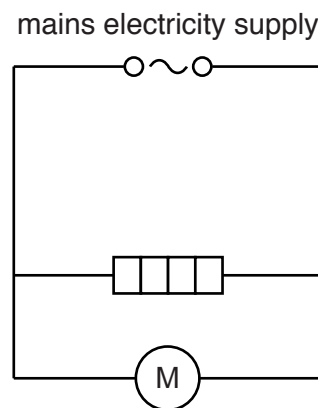


Fig. 4.3

(a) On Fig. 4.3 complete the circuit diagram using the correct symbols for

- an on-off switch to control the electricity supply to the fan heater,
- a fuse to protect the circuit against electrical overload.

[3]

- (b) Another type of switch is also needed in the circuit as a safety device to cut off the heater if the temperature rises too much. This is called a thermal cut-out.

The thermal cut-out must switch off the heater but not the fan. The fan must continue to operate to reduce the temperature.

Fig. 4.4 shows the structure of this switch.

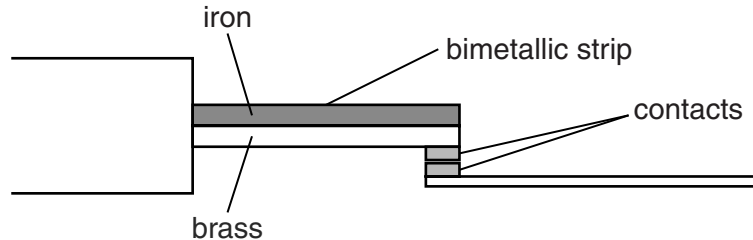


Fig. 4.4

- (i) On Fig. 4.3 in (a), mark with an **X** a point in your completed circuit where this switch could be put into the circuit to switch off the heater but not the fan. [1]
- (ii) Use words from the list to complete the description of how the thermal cut-out operates to switch off the heater. Each word may be used once, more than once or not at all.

bend	broken	contract	cooled
heated	made	magnetised	stretch

When metals are, they expand. Brass expands more than iron.

This causes the bimetallic strip to

The contacts are by this change. [3]

- (iii) Suggest a suitable position inside the fan heater to place the thermal cut-out so that it responds to the temperature in the room, not to the temperature of the heater.

Give a reason for your answer.

.....

.....

.....[2]

- 5 Table 5.1 shows some elements placed in order of reactivity.

Table 5.1

most reactive	potassium
	sodium
	calcium
	magnesium
	zinc
	iron
least reactive	hydrogen
	copper

- (a) Table 5.2 shows the reactions of some of the elements when added to dilute hydrochloric acid.

Table 5.2

element added to acid	observation
calcium	bubbles of hydrogen given off quickly
zinc	
copper	no reaction

- (i) Complete Table 5.2 by adding the observation you would expect when zinc is added to the acid. [1]
- (ii) Explain your answer to (a)(i) by referring to the reactivity series.

.....

.....

.....[2]

(b) Sodium and potassium are in Group I of the Periodic Table.

(i) Describe the trend in reactivity down Group I.

.....[1]

(ii) The reactivities of sodium and potassium can be compared by placing a piece of each element into water.

Fig. 5.1 shows a piece of sodium being placed into water.

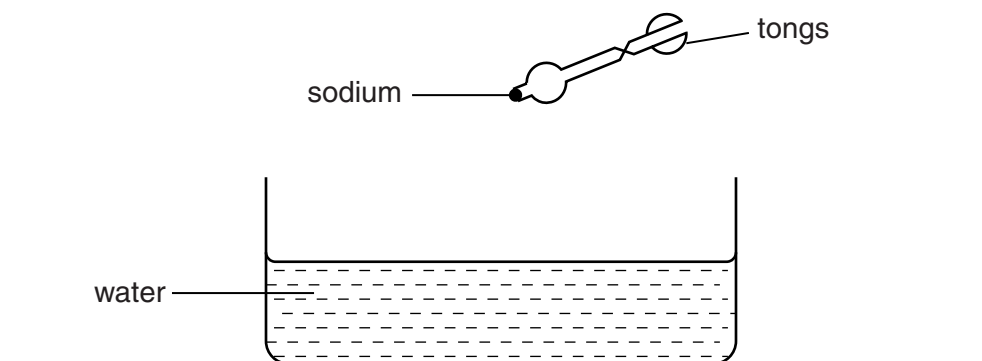


Fig. 5.1

Describe **two** similarities and **one** difference observed between this reaction and the reaction when potassium is placed into water.

similarity 1

similarity 2

difference[3]

- 6 (a) Fig. 6.1 shows a female aphid and some of her offspring. The aphid can reproduce both sexually and asexually.

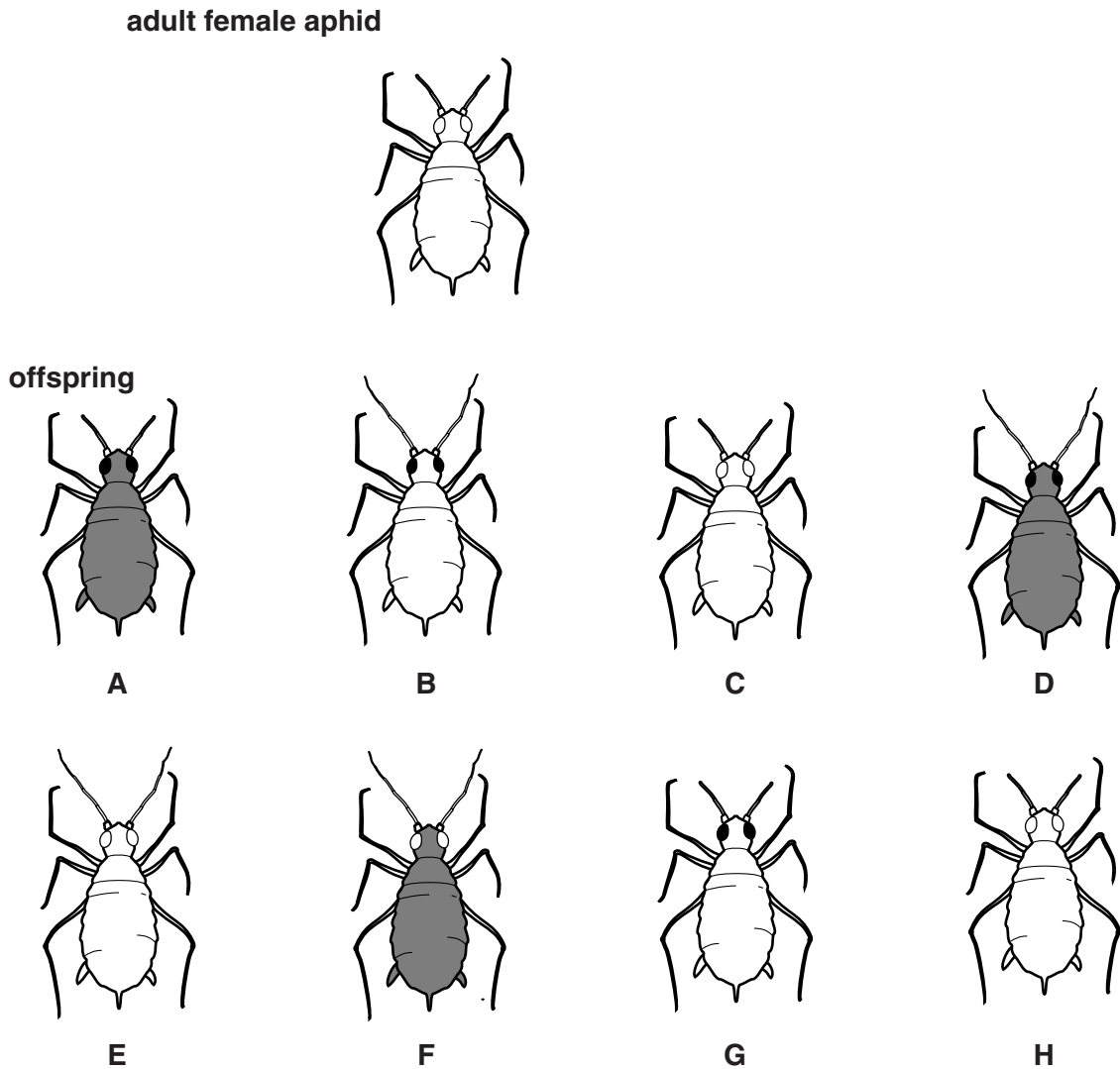


Fig. 6.1

- (i) Only offspring **C** and **H** were produced asexually.

State how the information in Fig. 6.1 supports this.

.....
[1]

- (ii) Describe how the genetic information in the cells of offspring **C** and **H** compares with that of the adult female.

.....
[1]

- (iii) Describe how the genetic information in the cells of offspring **A** compares with that of the adult female and with that of the rest of the offspring.

.....

[2]

- (b) The aphid feeds on young shoots of plants by putting its sharp mouthparts into stems. It obtains dissolved food substances which are being transported through the plant.

- (i) Suggest which plant tissue the aphid reaches with its mouthparts.

Explain your answer.

.....
[2]

- (ii) Fig. 6.2 shows a cross-section of the stem of a plant.

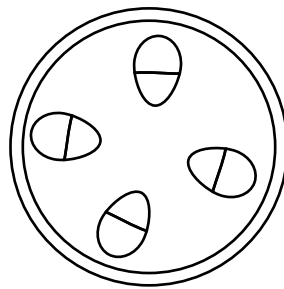


Fig. 6.2

On Fig. 6.2, shade in **one** area where you would find the tissue that transports dissolved food substances. [1]

(c) The shoots of the plants make their food by photosynthesis.

(i) Complete the word equation for photosynthesis.

carbon dioxide + ... $\longrightarrow$ sugar + ... [1]

(ii) The plant shown in Fig. 6.3 has all the necessary conditions for photosynthesis.

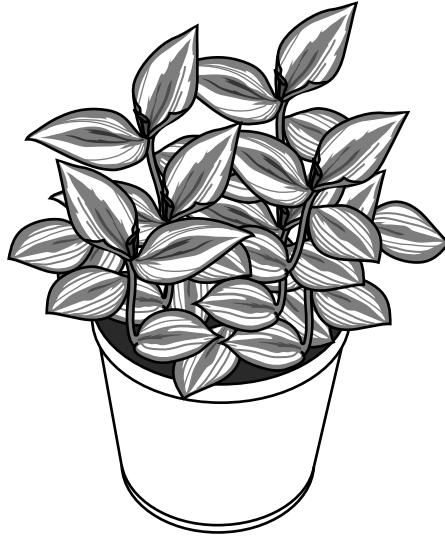


Fig. 6.3

Give **two** environmental conditions needed for photosynthesis.

1

2 [2]

(d) A student took a leaf from the plant shown in Fig. 6.3. He made a drawing of the leaf. His drawing is shown in Fig. 6.4.

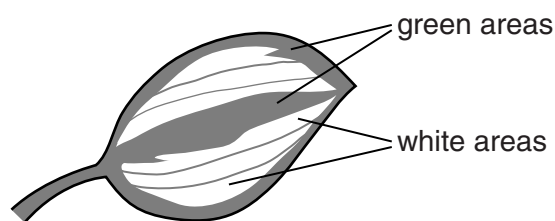


Fig. 6.4

He then tested the leaf for starch.

(i) Predict the results of the starch test on this leaf in the different areas.

green areas

white areas [1]

(ii) Explain the reason for your predictions in part (d)(i).

.....

..... [1]

Please turn over for Question 7.

- 7 (a) A motorcyclist needs to see other vehicles and pedestrians.

Fig. 7.1 shows a motorcyclist from above and a taxi some distance behind him.

The motorcyclist looks in his rear view mirror to see the taxi.



Fig. 7.1

- (i) Fig. 7.2 shows how a ray of light travels from the taxi to the mirror, then to the motorcyclist so he can see the taxi behind.

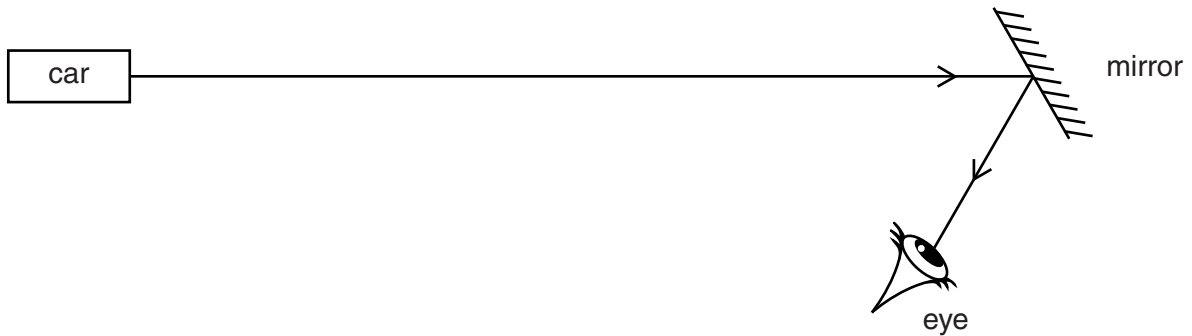


Fig. 7.2

The ray strikes the mirror at an angle of 30° to the normal.

On Fig. 7.2

1. draw the normal to the mirror at the point the ray hits the mirror,
2. write in the value of the angle of reflection.

[2]

- (ii) Fig. 7.3 shows the view in the mirror seen by the motorcyclist.

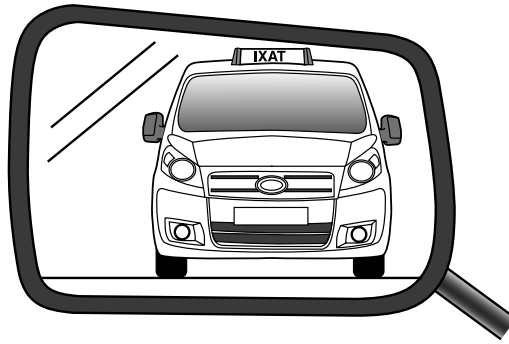


Fig. 7.3

Explain why the word on the taxi behind is seen the wrong way round.

.....
[1]

- (b) The motorcyclist follows directions to his destination using his satellite navigation system (Satnav). The Satnav uses signals from satellites orbiting the Earth to show the position of the motorcycle on a map displayed on the Satnav screen in front of him.

State the type of electromagnetic wave used by satellites sending signals to Earth.

.....[1]

- (c) The motorcyclist is travelling at night along a street. The street is lit by lamps which emit yellow light.

- (i) Fig. 7.4 shows a graph of a yellow light wave. On Fig. 7.4 draw a labelled arrow to indicate the amplitude of this light wave.

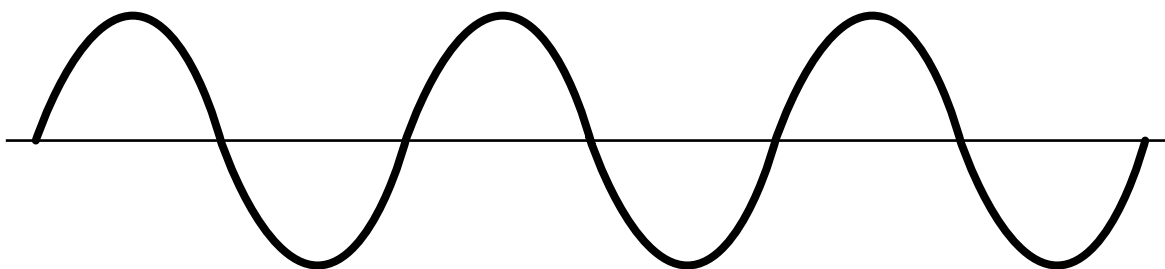


Fig. 7.4

[1]

- (ii) The amplitude of a light wave determines the brightness of the light.

State the property of sound determined by the amplitude of a sound wave.

.....[1]

- (d) The motorcyclist stops in a long narrow street with a tall building at one end. He sounds his horn and hears an echo from the tall building 2 seconds later.

The speed of sound in air is 330 m/s.

Calculate the distance of the motorcyclist from the building when he sounds his horn.

State any formula that you use and show your working.

formula

working

distance = ... m [2]

- (e) At the end of his journey, the motorcyclist enters the tall building and walks over carpeted floors before arriving at a door. When he touches the metal door handle, he gets a mild electric shock!

Explain why the motorcyclist has become electrically charged and then receives a shock when he touches the door handle.

.....

.....

.....

.....[2]

Please turn over for Question 8.

- 8 (a) Atoms are made up of three types of particle. The three particles are listed below.

electrons

neutrons

protons

Complete the following sentences using the names of the three particles. Each name may be used once, more than once, or not at all.

..... and have the same mass, but have much smaller mass.

..... and have opposite charges but have no charge.

[2]

- (b) The proton number of a chlorine atom is 17.

- (i) State the number of electrons in a chlorine atom.

Explain your answer.

.....
[1]

- (ii) The nucleon number of a chlorine atom is 35.

State the number of neutrons in this chlorine atom.

Explain your answer.

.....
[1]

- (iii) A copy of the Periodic Table is printed on page 24.

State how the position of chlorine in the Periodic Table shows that it is a non-metal.

.....
[1]

- (c) Hydrogen and chlorine react to form hydrogen chloride gas.

In this reaction a chlorine atom forms a covalent bond with a hydrogen atom to make a hydrogen chloride molecule.

- (i) State what is meant by a *covalent* bond.

.....
[1]

- (ii) State why hydrogen and chlorine form a covalent bond rather than an ionic bond.

.....
[1]

- (d) Fig. 8.1 shows apparatus used to dissolve hydrogen chloride gas in water to form hydrochloric acid.

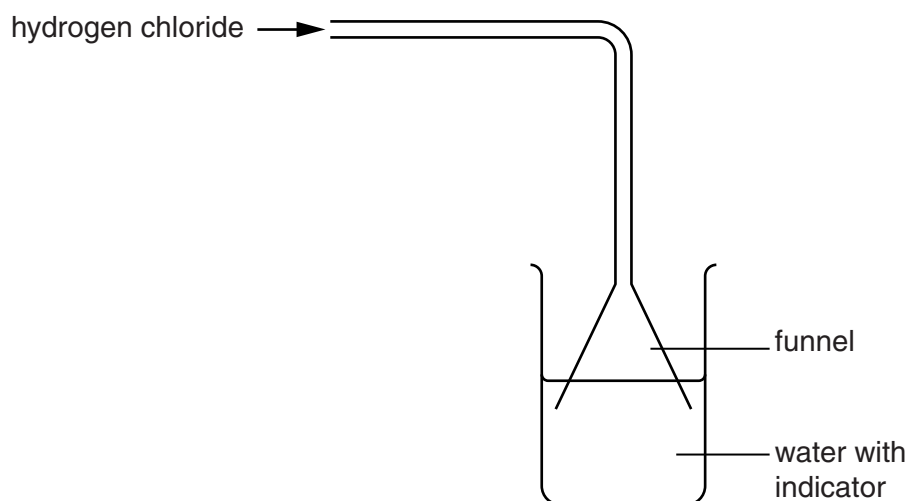


Fig. 8.1

The water contains full-range indicator (Universal Indicator) added before the hydrogen chloride dissolves.

- (i) State the colour of the indicator in pure water.

..... [1]

- (ii) The indicator turns red. Suggest the change in pH.

from pH to pH [1]

- (e) An old copper coin has corroded and become coated with a green layer of copper carbonate.

Fig. 8.2 shows a corroded copper coin being cleaned in dilute hydrochloric acid.

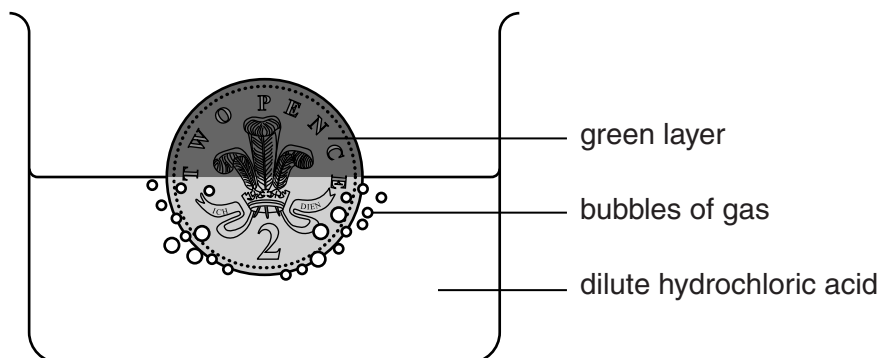
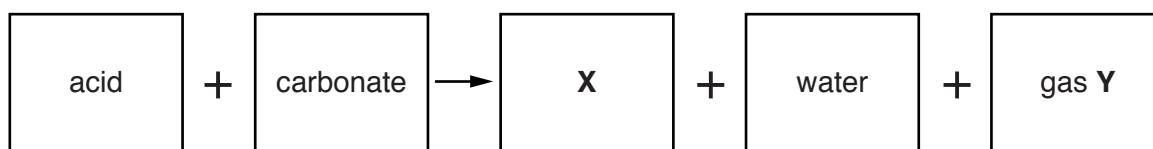


Fig. 8.2

The acid reacts with the green layer to form a blue solution.

The word equation for the reaction between an acid and a carbonate is shown below.



- (i) What type of compound is **X**?

.....

[1]

- (ii) Name gas **Y**.

Describe a test for it.

name of gas

test

.....

result[3]

- 9 (a) Fig. 9.1 shows part of a simple food chain in a field of wheat.

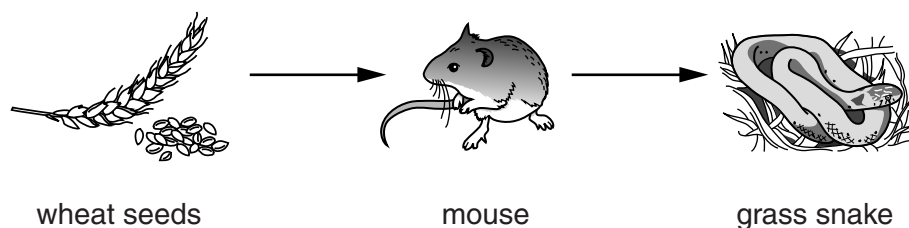


Fig. 9.1

- (i) Define the term *food chain*.

.....

[2]

- (ii) A badger also lives in the habitat. The badger eats all of the organisms in the food chain. The badger and these organisms form a food web.

Complete Fig. 9.2 to show the food web.

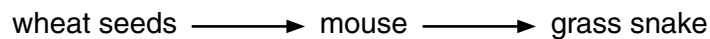


Fig. 9.2

[2]

- (b) The wheat is harvested. Suggest **one** possible way in which the mice respond to the removal of their food supply.

.....
[1]

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																					20 Ne Neon 10										
23 Na Sodium 11	24 Mg Magnesium 12																					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	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 Cesium 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	210 Po Polonium 84	222 Rn Radon 86																
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																														

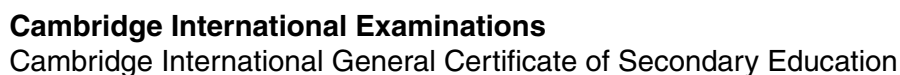
* 58–71 Lanthanoid series
† 90–103 Actinoid series

Key

a	X
b	

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

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



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0653/23

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 24.

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 **23** printed pages and **1** blank page.

- 1 (a) Fig. 1.1 shows the human gas exchange system.

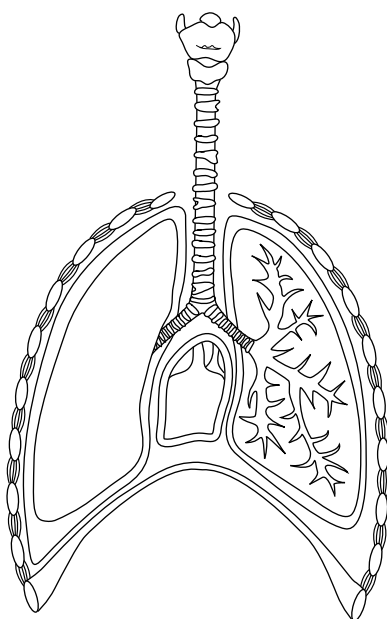


Fig. 1.1

On Fig. 1.1, draw label lines with names to show

the larynx,

the trachea,

a bronchus.

[3]

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

Fig. 1.2 shows cross sections of a normal bronchiole and a bronchiole of a person who has asthma.

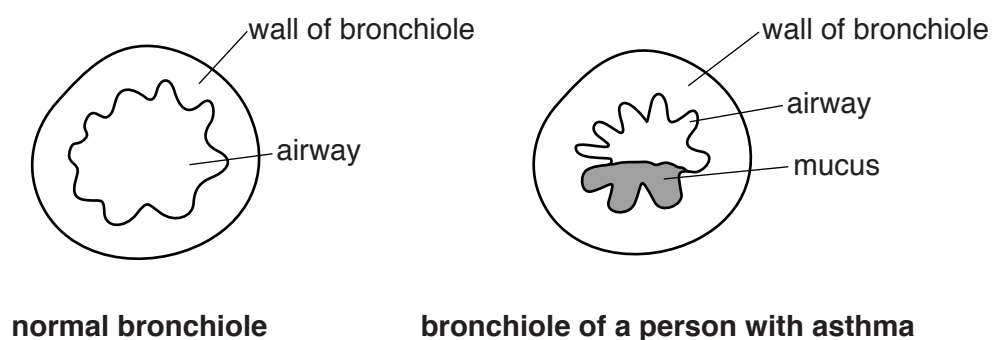


Fig. 1.2

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

Describe **two** features visible in Fig. 1.2 which could reduce the airflow in the bronchiole of the person suffering from asthma.

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 for both groups.

Both groups of people are tested while resting.

Results

average volume inhaled by a healthy person = $5.8 \text{ dm}^3/\text{minute}$.

average volume inhaled by a person with asthma = $12.5 \text{ dm}^3/\text{minute}$.

- (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) Suggest two ways in which the breathing of an asthmatic person is likely to be different from a normal person's breathing in order to inhale a greater volume of air.

1

2[2]

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

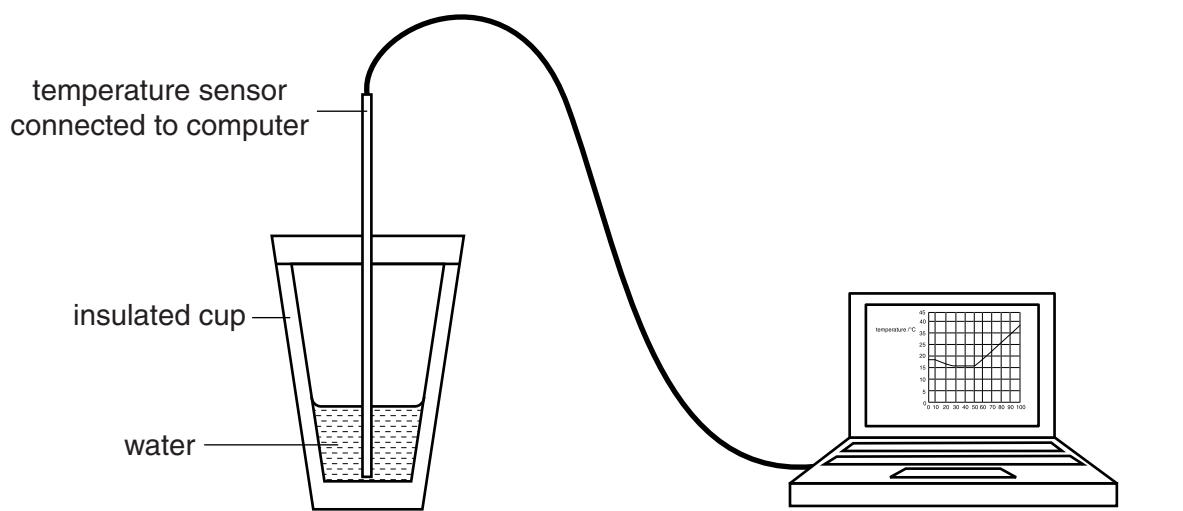


Fig. 2.1

A citric acid solution can be made by dissolving citric acid crystals in water.

The temperature sensor is placed in the water and the computer starts to log data. After 10 seconds some citric acid crystals are added to the water in a cup. The mixture is stirred until the crystals dissolve.

After another 40 seconds some magnesium ribbon is placed in the solution.

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

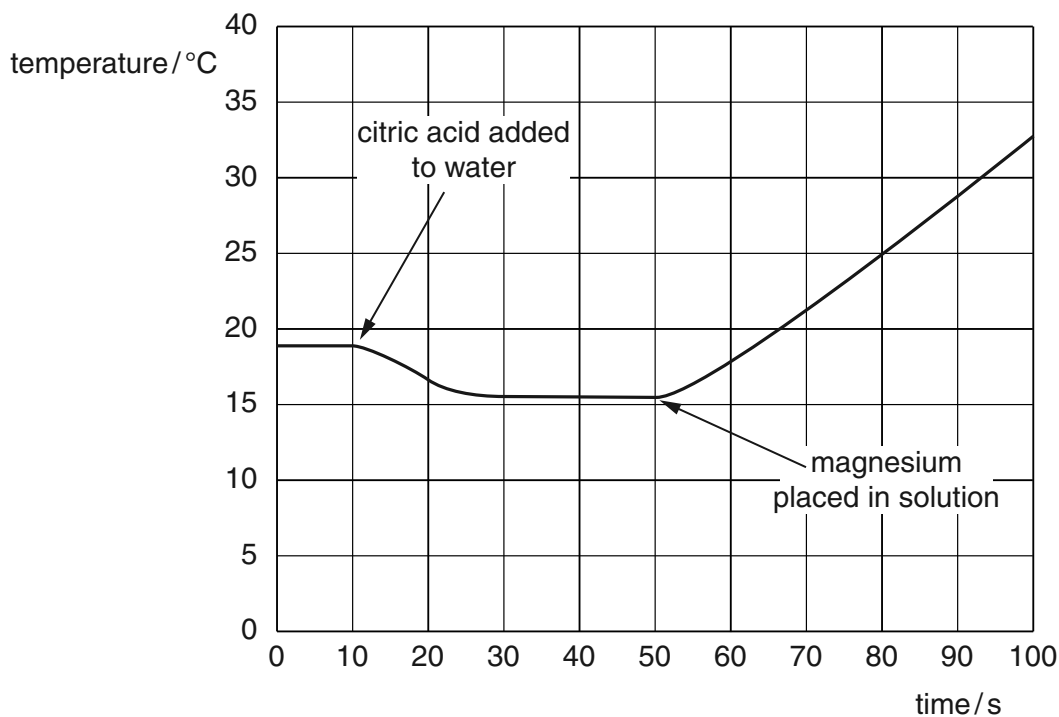


Fig. 2.2

- (a) Complete the following sentences, choosing from the words below.

decreases **exothermic** **oxidation**
endothermic **increases** **stays the same**

As the citric acid dissolves in the water the temperature

This is an process. [1]

- (b) Fig. 2.3 shows the appearance of the contents of the cup during the experiment.

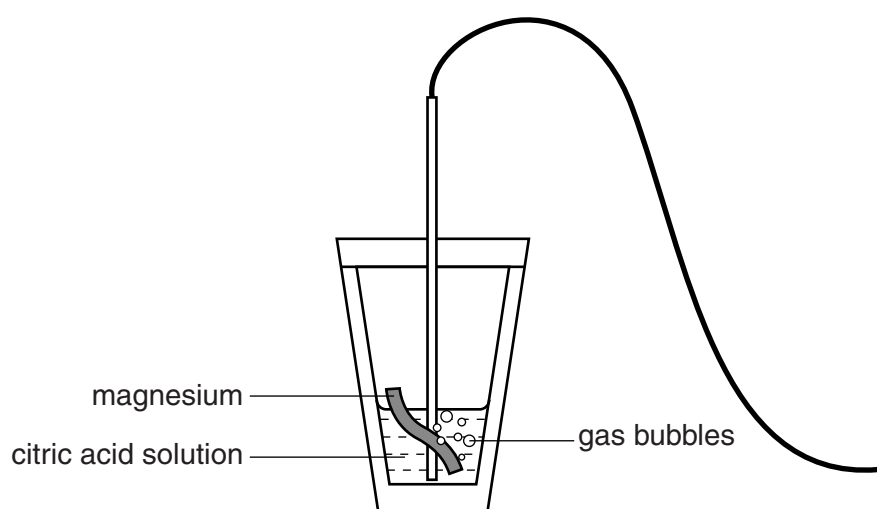


Fig. 2.3

Gas bubbles rise from the surface of the magnesium.

Name the gas produced.

.....[1]

- (c) The experiment is repeated using a greater mass of citric acid dissolved in the same mass of pure water. This increases the concentration of the citric acid.

Describe the effect on the reaction with magnesium caused by increasing the concentration of the citric acid.

.....
[1]

- (d) By referring to the reactivity series, explain how the results of these experiments would change if copper was used instead of magnesium.

.....

[2]

3 Fig. 3.1 shows a girl on a skateboard track.

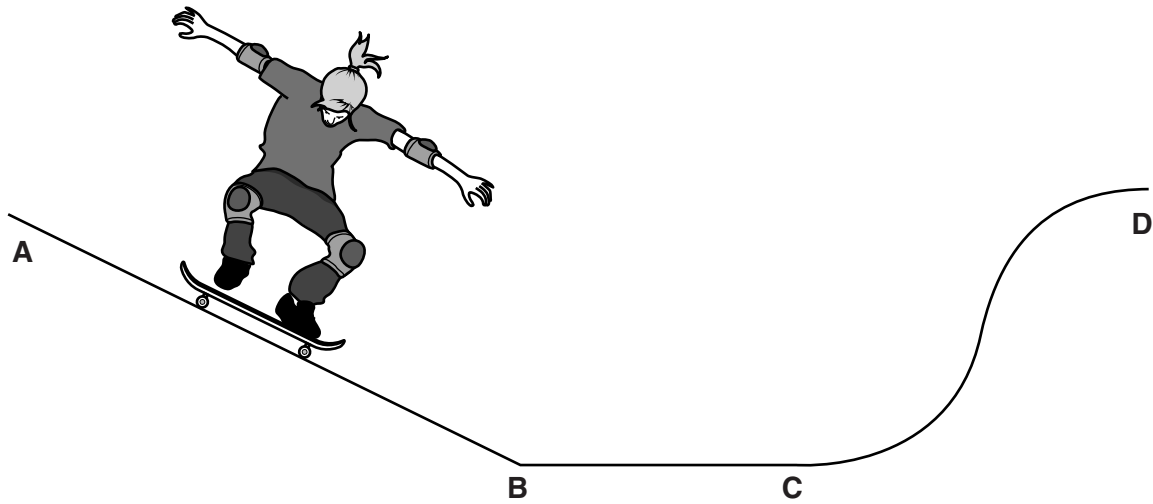


Fig. 3.1

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

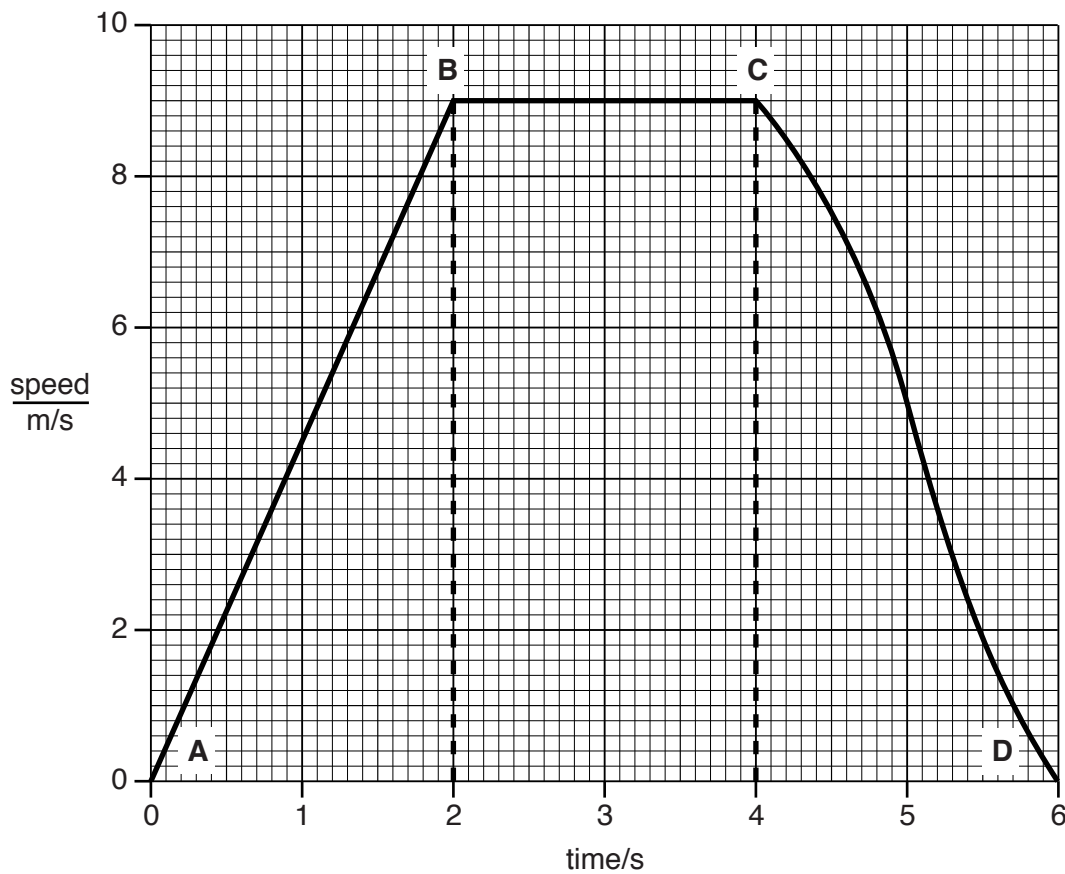


Fig. 3.2

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

.....[1]

- (ii) The force acting on the girl has a value of 500 N.

State the name of the unit whose symbol is N.[1]

- (b) State the main energy transformations as the girl travels from **A** to **D**.

from energy

to energy

to energy.

[2]

- (c) Describe the motion of the girl between points

A and **B**, ...

B and **C**.[2]

- (d) Use Fig. 3.2 to calculate the distance travelled by the girl between points **B** and **C**.

State the formula you use and show your working.

formula

working

distance = ... m [2]

- 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) Explain why we need vitamin C in our diet.

.....
[1]

(iii) Suggest why vitamin C does **not** need to be digested.

.....

[2]

(b) Table 4.1 gives details about the vitamin C content of some fruits.

Table 4.1

fruit	mass of vitamin C in 100 g fruit/mg	mass of vitamin C in an average portion/mg
apple	6	8
kiwifruit	98	74
mango	28	57
orange	53	70
watermelon	10	27

The recommended daily allowance (RDA) of vitamin C for humans is 60 mg.

(i) State which of the fruits listed in Table 4.1 provide the RDA of vitamin C in just one portion.

Explain your answer.

.....

[2]

- (ii) Calculate the mass of mango needed to supply a full RDA of vitamin C.

Show your working.

answer = ... g [2]

- (c) Citrus fruits provide a good source of vitamin C. However, many of them are weakly acidic.

- (i) Explain why the acid in the citrus fruits could be harmful for teeth if a lot of fruit is eaten.

.....

.....[1]

- (ii) Describe what a person can do to reduce the effects on the teeth of eating the acidic fruit.

.....

.....[1]

- 5 (a) On Fig. 5.1 draw one line from each property to show whether it describes metals or non-metals.

One line has been drawn for you.

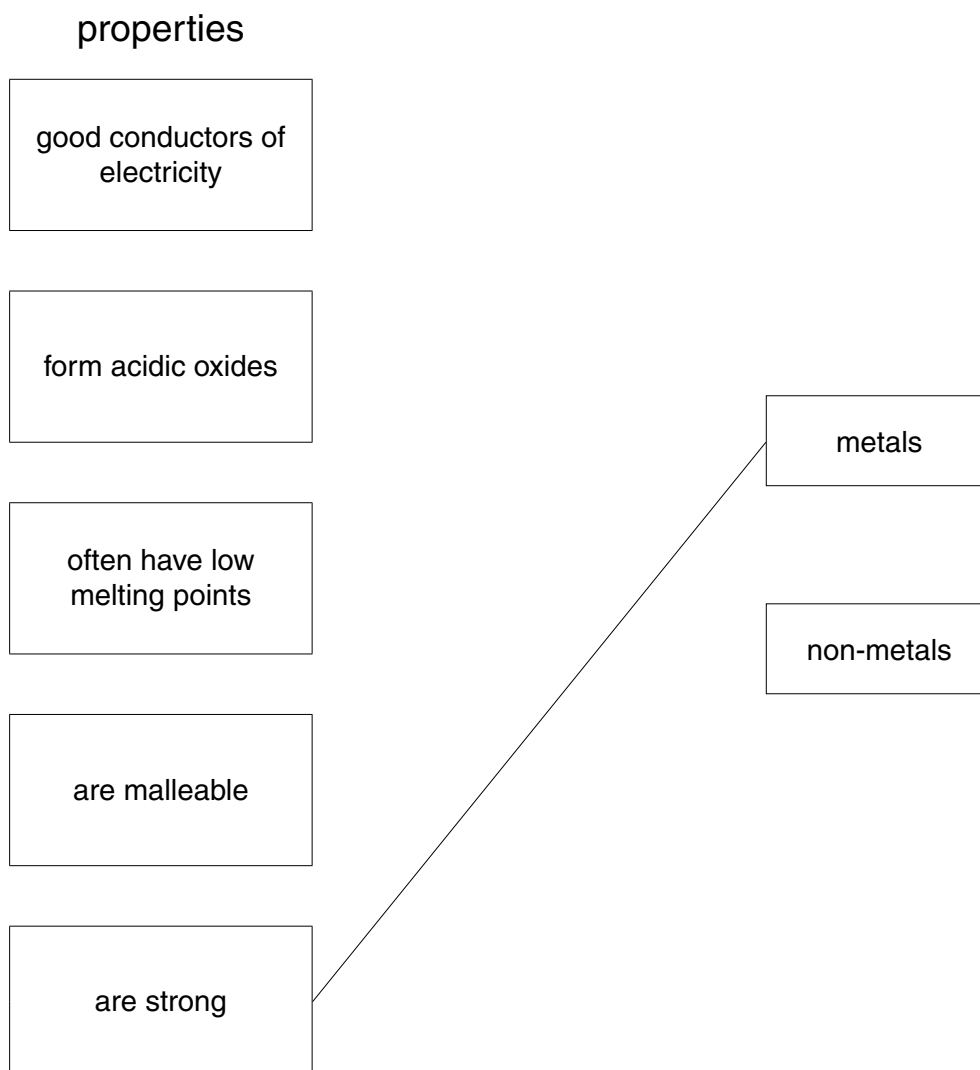


Fig. 5.1

[2]

- (b) Fig. 5.2 shows Period 3 of the Periodic Table.

A								
23 Na Sodium 11	24 Mg Magnesium 12		27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	36.5 Cl Chlorine 17	40 Ar Argon 18

Fig. 5.2

Draw an arrow in box **A** which points towards the metals and away from the non-metals. [1]

- (c) Table 5.1 shows some observations made after a piece of sodium is dropped into some water containing 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]

- (d) Sodium reacts with chlorine to form sodium chloride.

- (i) Fig. 5.3 shows diagrams that represent the particles in each substance.

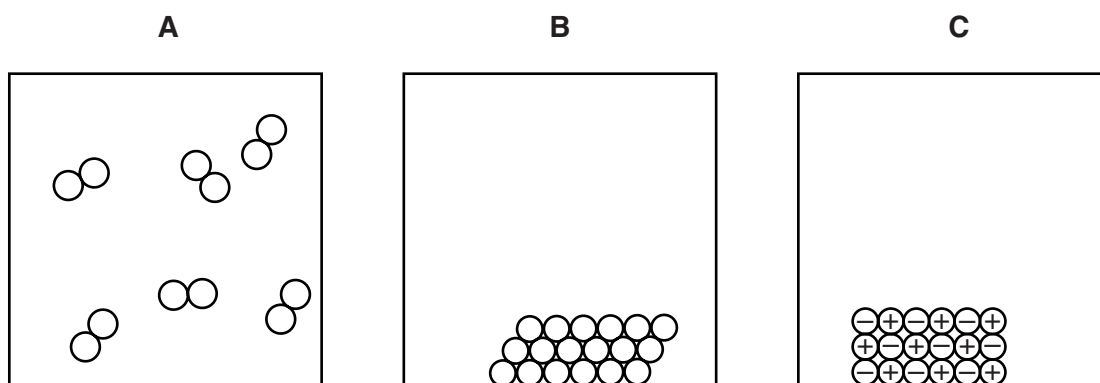


Fig. 5.3

Complete Table 5.2 to show which diagram, **A**, **B** or **C**, represents each substance.

Table 5.2

substance	diagram
chlorine	
sodium	
sodium chloride	

[2]

- (ii) Describe, in terms of the loss or gain of electrons, how sodium and chloride ions are formed from sodium and chlorine atoms.

.....
.....
.....[2]

- (iii) Describe how the sodium ions and chloride ions are held together.

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

- (iv) Zinc chloride can be made by reacting zinc with chlorine.
Zinc chloride contains half as many zinc ions as chloride ions.

State the chemical formula of zinc chloride.

.....[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.

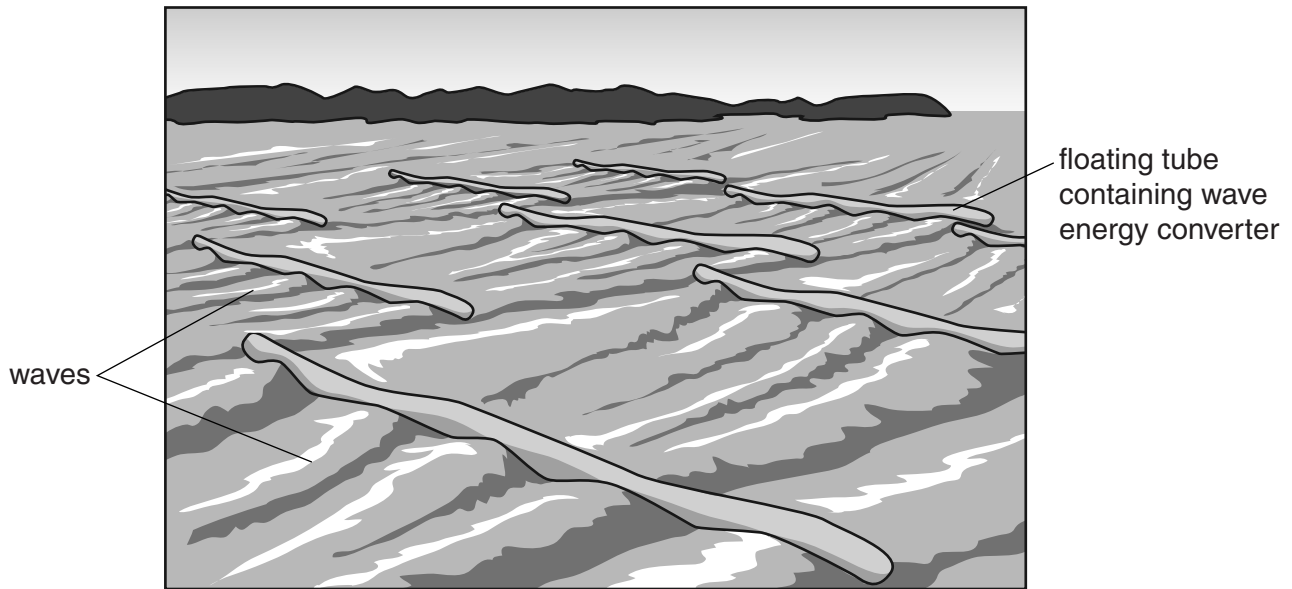


Fig. 6.1

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

- (a) (i) 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]

- (ii) 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]

- (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]

- (d) Engineers believe wave generators will be important for supplying electrical energy in the future. These generators have advantages over older methods such as coal-fired power stations.

Give **one** advantage of wave generators for the supply of electrical energy.

.....
[1]

- 7 (a) In some areas of the world large areas of forest are cleared to use the land for agriculture.

However, sometimes not all of the trees are cleared from an area. Some of the largest trees are left standing and the areas in between them are cleared. This is called partial deforestation.

- (i) Describe and explain why partial deforestation is better than complete deforestation for the soil in the forest.

.....

[2]

- (ii) Describe **two** advantages of partial deforestation compared with complete deforestation for the animal life in the forest.

1

 2
[2]

- (b) In some areas of the world raw sewage is discharged into rivers or lakes. This can cause problems for plants and animals that live in the water.

- (i) Explain why the sewage reduces the amount of dissolved oxygen in the water.

.....

[2]

- (ii) When sewage is added to water it can affect the transparency of the water by making it cloudy.

Explain why this reduces the growth of aquatic plants.

.....

[2]

8 A student extracts some copper from a sample of copper carbonate.

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

Bubbles of carbon dioxide gas appear and a solution of copper chloride is formed.

Fig. 8.1 shows the experiment during and after the reaction.

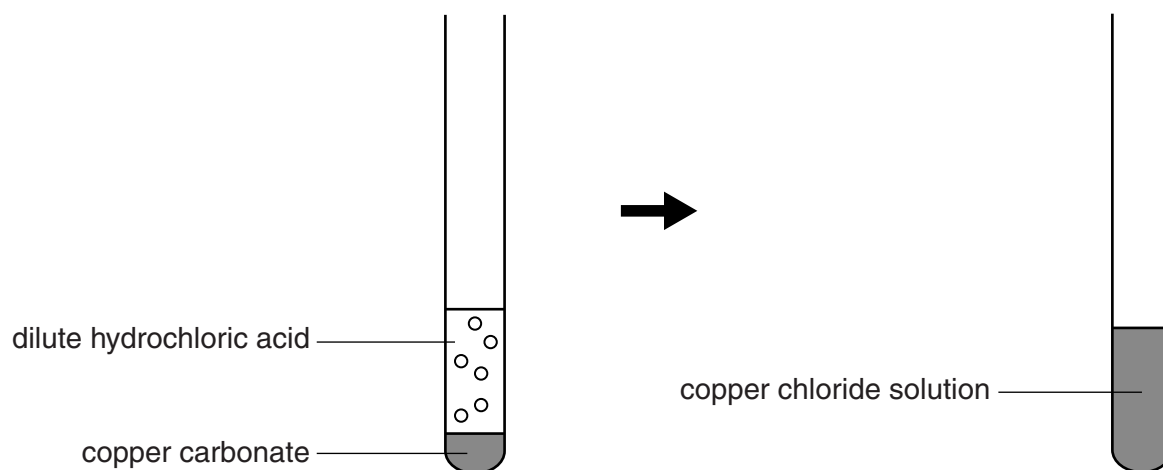
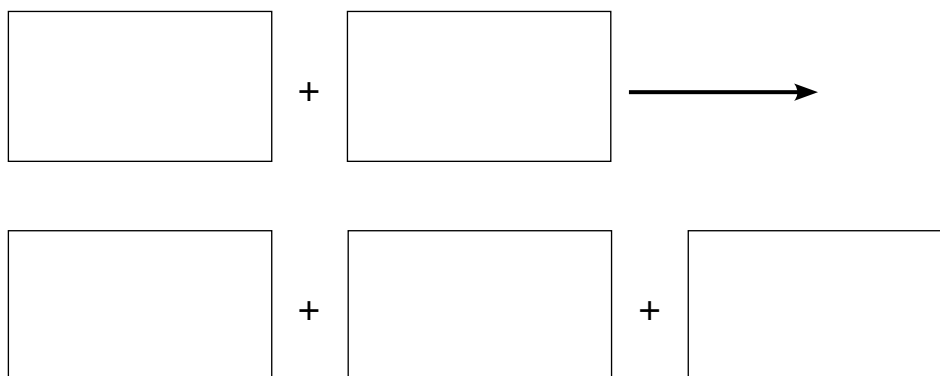


Fig. 8.1

(i) Write a word equation for the 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**.

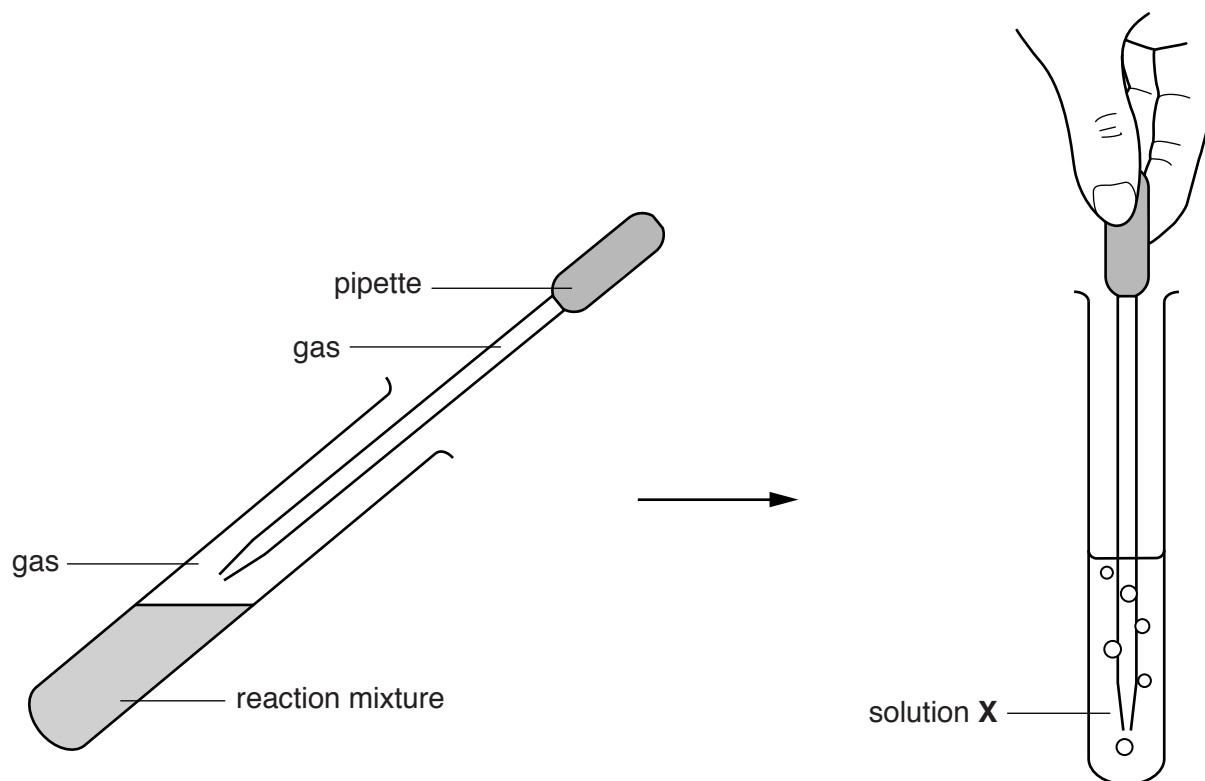


Fig. 8.2

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.

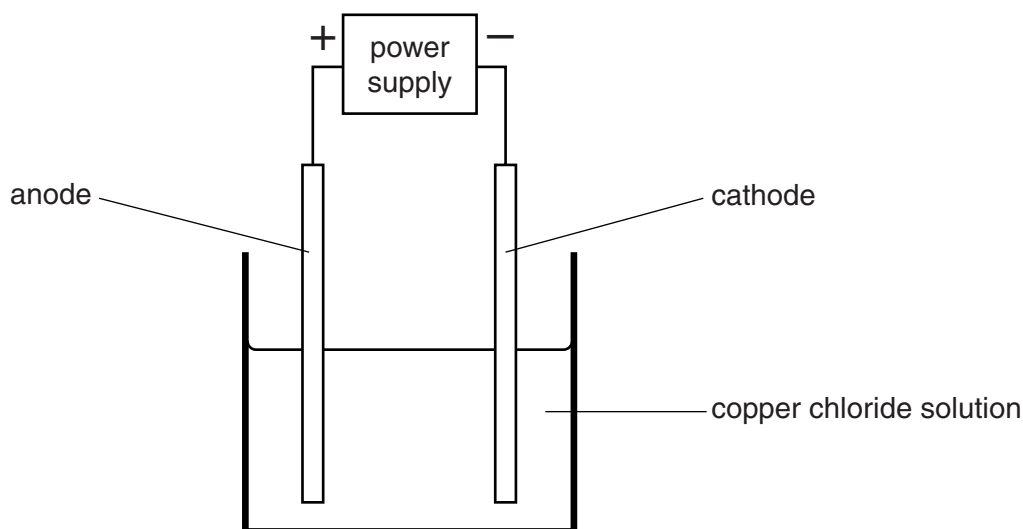


Fig. 8.3

- (i) Complete Fig. 8.3 by labelling each electrode to show the product formed. [2]
- (ii) Choose from the following phrases to complete the sentences about electrolysis.

a covalent compound

an element

a hydrocarbon

an ionic compound

a mixture

Copper chloride solution is the electrolyte because copper chloride is

.....

During electrolysis copper chloride breaks up into simpler substances each of which is

.....

Pure water does not undergo electrolysis because it is

.....

[3]

- 9 Fig. 9.1 shows a small electrical immersion heater for heating a drink in a cup.

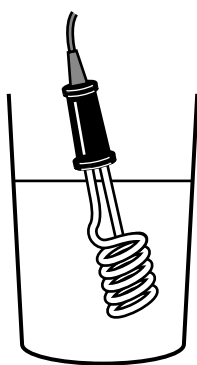


Fig. 9.1

- (a) As the drink is heated, the liquid level in the cup rises slightly.

Describe what is happening that causes the liquid level to rise.

.....
[1]

- (b) State the main method of thermal energy transfer involved in

- (i) transferring thermal energy from the hot wire inside the electrical heater to the liquid,

.....[1]

- (ii) distributing the thermal energy throughout the liquid.

.....[1]

- (c) As the drink gets hot, water vapour escapes from the surface of the liquid before the drink boils.

- (i) State the name of this process.

.....[1]

- (ii) Explain why this happens in terms of the molecules in the liquid.

.....

[2]

- 10 (a) Fig. 10.1 shows a negatively charged plastic plate mounted on a plastic handle and held by a student.

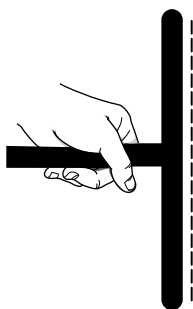


Fig. 10.1

Describe a method of producing a charge on a plastic object.

.....
[1]

- (b) Fig. 10.2 shows a charged metal plate mounted on a plastic handle.

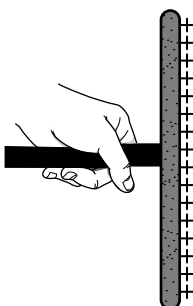


Fig. 10.2

Explain why the handle should be made of plastic rather than metal.

.....

[2]

- (c) Fig. 10.3 shows a circuit diagram for an electric heater, supplied with 12V from a car battery.

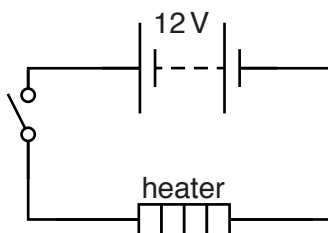


Fig. 10.3

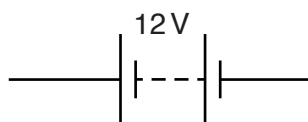
- (i) When the switch is closed, there is an electric current in the heater.

State the meaning of *electric current*.

.....[1]

- (ii) The heater circuit is changed to include a second identical heater and two switches to switch each heater on independently. The heaters must be connected in parallel to work.

Complete the circuit diagram below to include both heaters and the switches, connected so that both the heaters work and can be switched on independently.



[3]

DATA SHEET
The Periodic Table of the Elements

Group																									
I	II											III	IV	V	VI	VII	0								
		1 H Hydrogen																							
3	4	9									11	12	14	16	19	20									
Li Lithium	Be Beryllium	He Helium									B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon									
11	12	24									27	28	31	32	35.5	40									
Na Sodium	Mg Magnesium										Al Aluminium	Si Silicon	P Phosphorus	S Sulfur	Cl Chlorine	Ar Argon									
19	20	38	40	45	48	51	52	55	56	59	59	64	65	73	75	79	80	84							
K Potassium	Ca Calcium	Sr Strontium	Sc Scandium	Ti Titanium	V Vanadium	Cr Chromium	Mn Manganese	Fe Iron	Ru Ruthenium	Rh Rhodium	Pd Palladium	Cd Cadmium	Zn Zinc	Ge Germanium	As Arsenic	Se Selenium	Br Bromine	Kr Krypton							
37	38	88	89	91	93	96	101	106	108	112	115	119	122	127	128	131	131	131							
Rb Rubidium	Sr Strontium	Y Yttrium	Zr Zirconium	Nb Niobium	Ta Tantalum	Mo Molybdenum	Tc Technetium	Ru Ruthenium	Ag Silver	Cd Cadmium	In Indium	Sn Tin	Sb Antimony	I Iodine	Te Tellurium	Xe Xenon	Xe Xenon	Xe Xenon							
55	56	137	139	178	181	184	186	190	197	201	204	207	209	210	209	222	222	222							
Cs Cesium	Ba Barium	La Lanthanum	Hf Hafnium	Ta Tantalum	W Tungsten	Re Rhenium	Os Osmium	Ir Iridium	Au Gold	Hg Mercury	Tl Thallium	Pb Lead	Bi Bismuth	At Astatine	Po Polonium	Rn Radon	Rn Radon	Rn Radon							
87	88	57	72	73	74	75	76	77	79	80	81	82	83	85	84	86	86	86							
		226	227																						
Fr Francium	Ra Radium	Ac Actinium																							
											* 58–71 Lanthanoid series † 90–103 Actinoid series														
											140	141	144	147	150	152	157	159	162	165	167	169	173	175	
											Ce Cerium	Pr Praseodymium	Nd Neodymium	Pm Promethium	Sm Samarium	Eu Europium	Gd Gadolinium	Tb Terbium	Dy Dysprosium	Ho Holmium	Er Erbium	Tm Thulium	Yb Ytterbium	Lu Lutetium	
											58	59	60	61	62	63	64	65	66	67	68	69	70	71	
											232	231	238	237	244	243	247	247	251	252	257	258	259	260	
											Th Thorium	Pa Protactinium	U Uranium	Np Neptunium	Pu Plutonium	Am Americium	Cm Curium	Bk Berkelium	Cf Californium	Es Einsteinium	Fm Fermium	Md Mendelevium	No Nobelium	Lr Lawrencium	
											90	91	92	93	94	95	96	97	98	99	100	101	102	103	
Key																									
aXb											a = relative atomic mass X = atomic symbol b = atomic (proton) number														

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

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

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