Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/22**

Paper 2 (Core) **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 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 **24** printed pages.

CAMBRIDGE International Examinations

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.

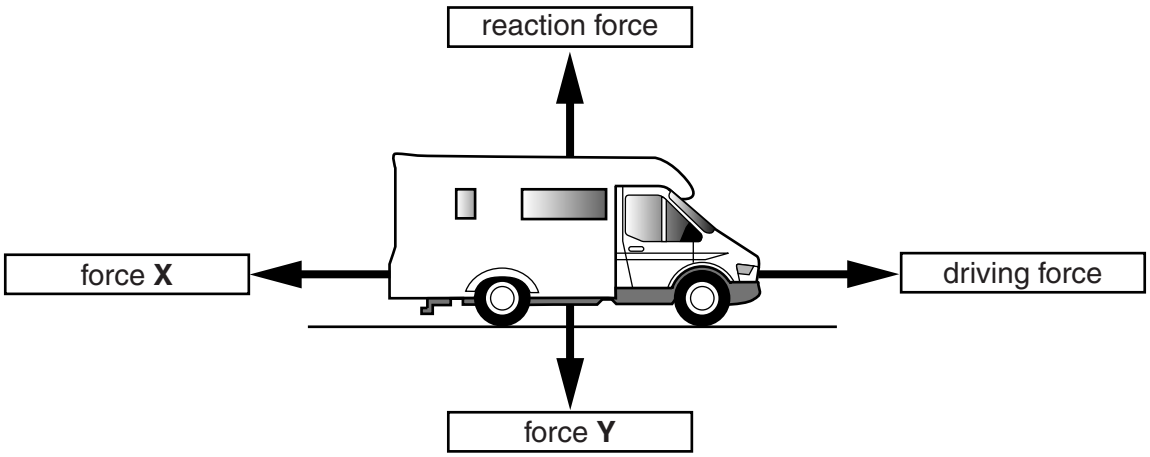


Fig. 1.1

(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.

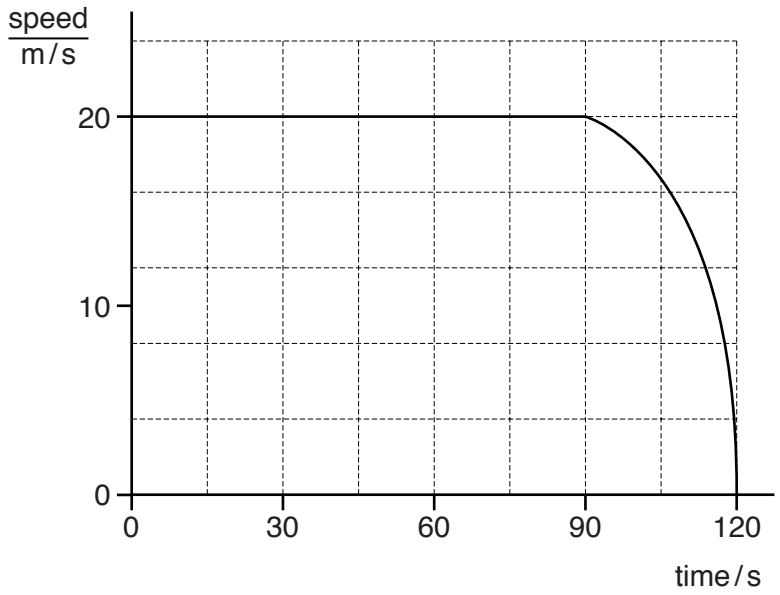


Fig. 1.2

(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.

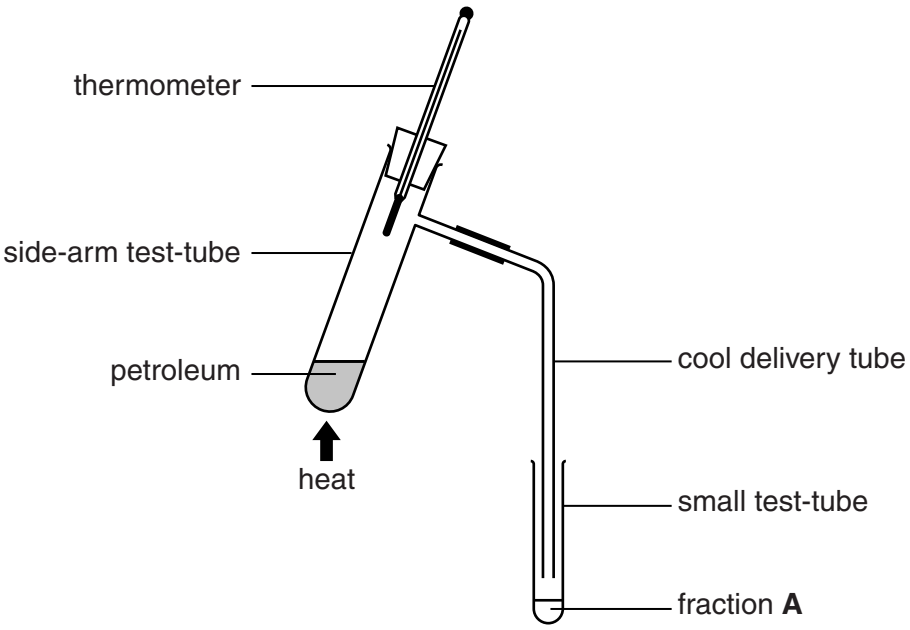


Fig. 2.1

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.

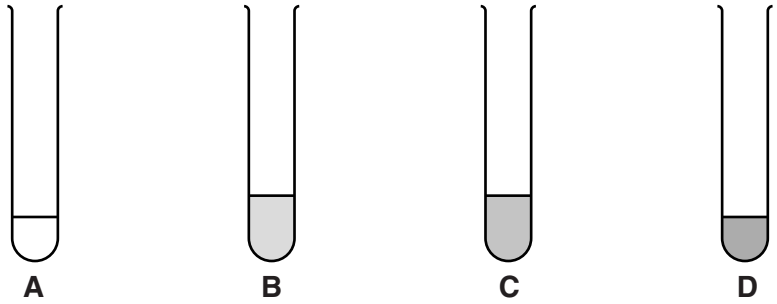


Fig. 2.2

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

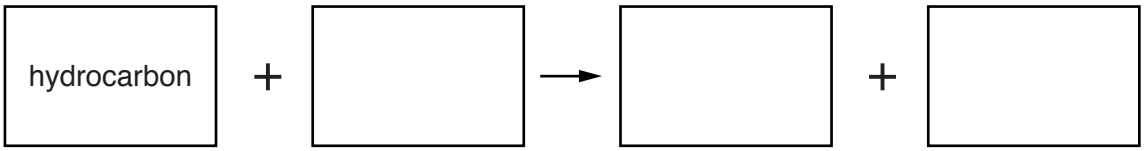
Use the information in Table 2.1 to state **one** trend in the physical properties of the fractions **A** to **D** apart from colour.

.....

.....[1]

(c) Petroleum fractions contain hydrocarbons.

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

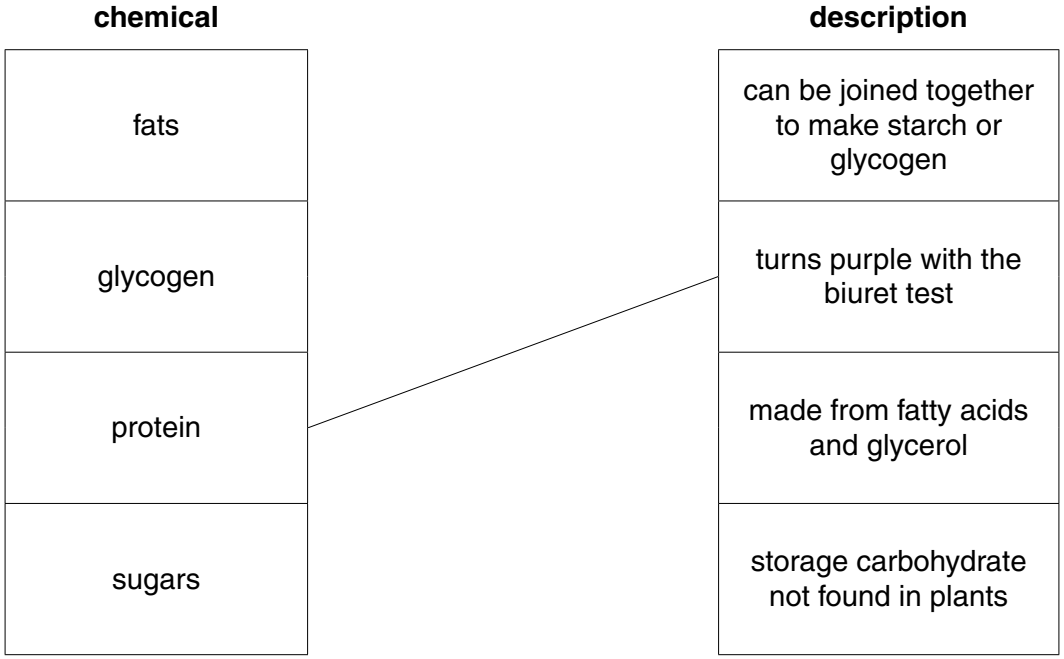


[2]

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.



[2]

(b) Table 3.1 gives some information about the nutrients contained in 100 cm^3 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.

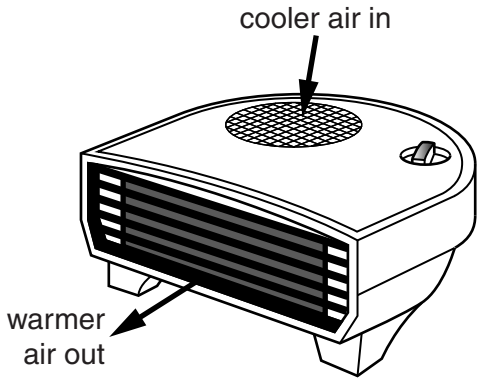


Fig. 4.1

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

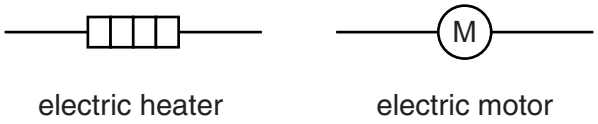


Fig. 4.2

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

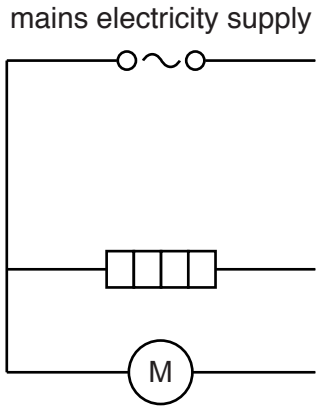


Fig. 4.3

(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.

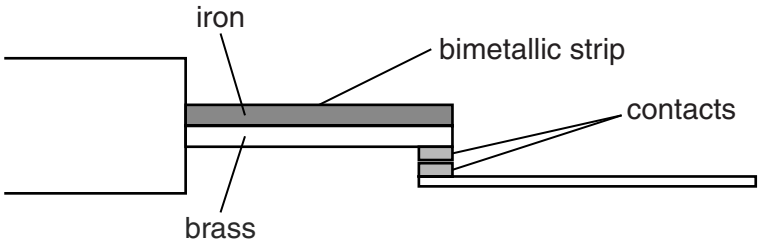


Fig. 4.4

(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
	hydrogen
least reactive	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.

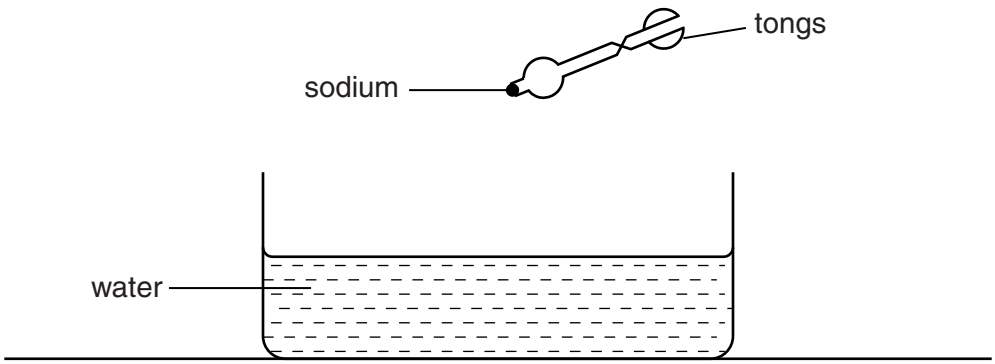


Fig. 5.1

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.

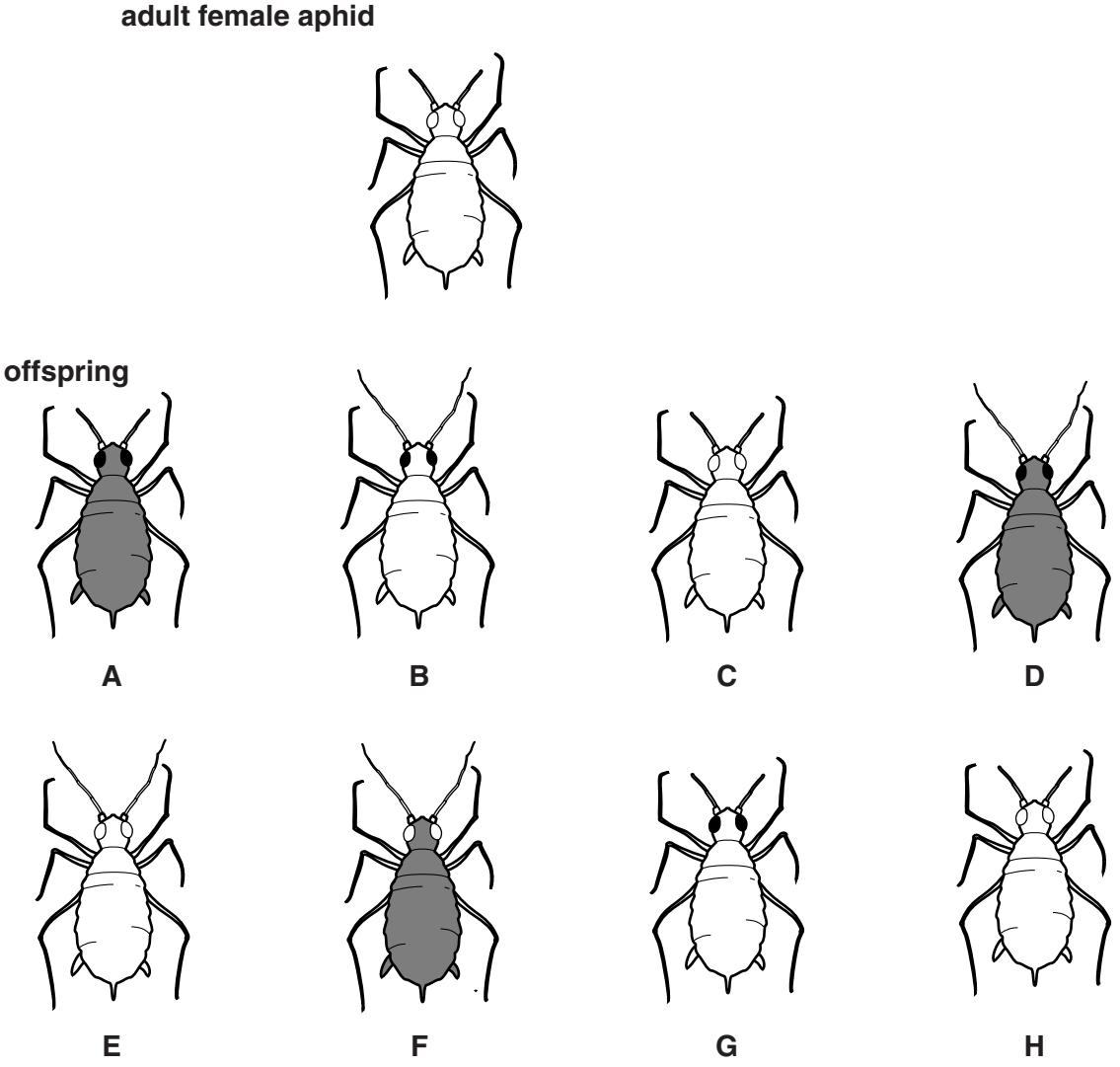


Fig. 6.1

(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.

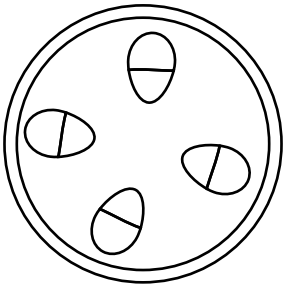


Fig. 6.2

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

[Turn over

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

(i) Complete the word equation for photosynthesis.

carbon dioxide + ... ⟶ sugar + ... [1]

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

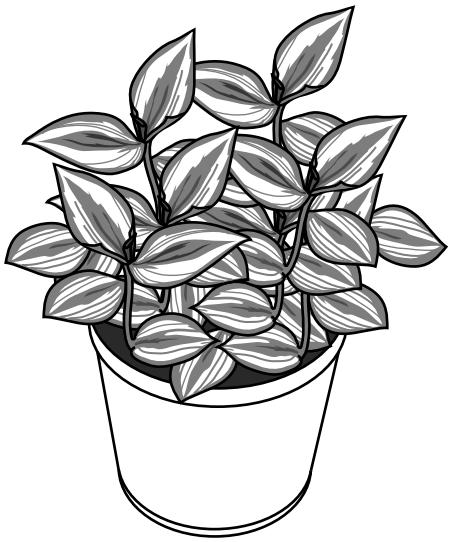


Fig. 6.3

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.

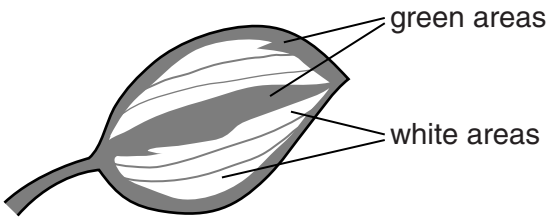


Fig. 6.4

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.

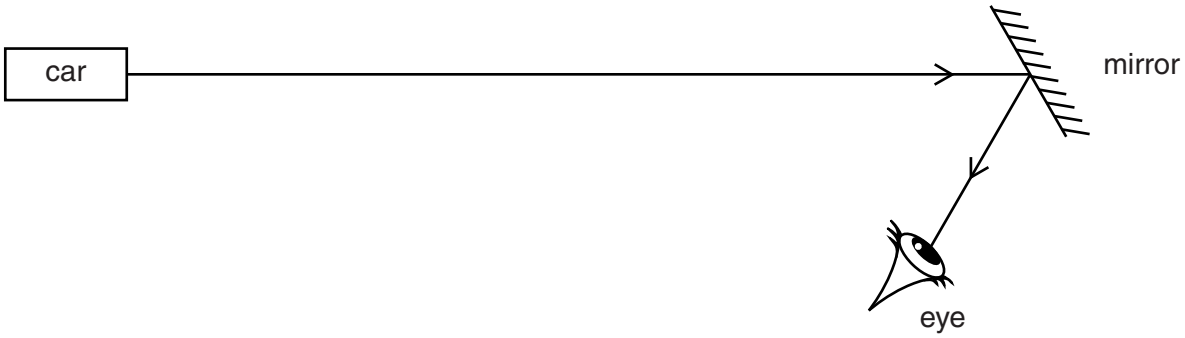


Fig. 7.2

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.

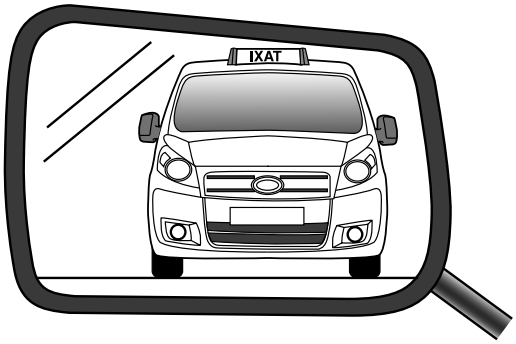


Fig. 7.3

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

.....

.....[1]

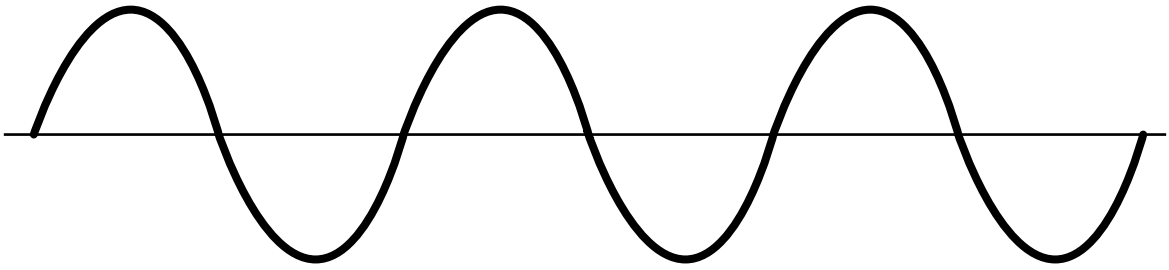
(b) The motorcyclist follows directions to his destination using his satellite navigation system (Satnav). The Satnav uses signals from satellites orbiting the Earth to show the position of the motorcycle on a map displayed on the Satnav screen in front of him.

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.



[1]

Fig. 7.4

(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.

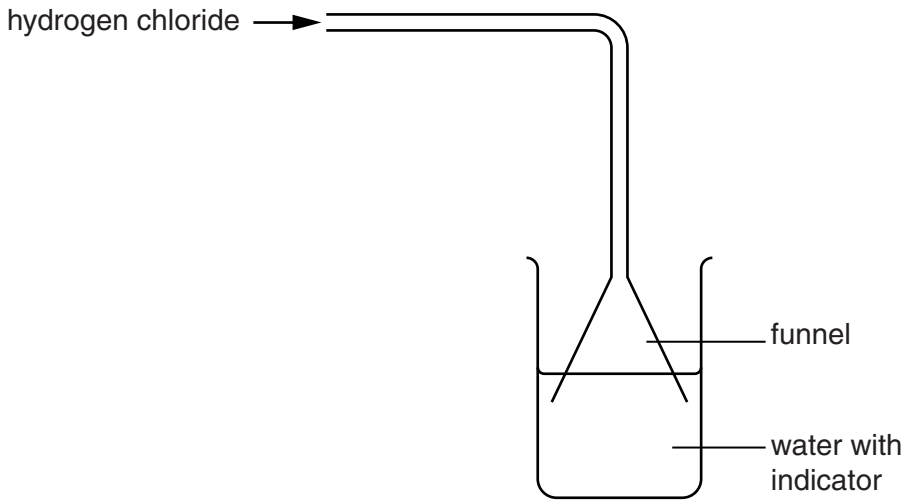


Fig. 8.1

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.

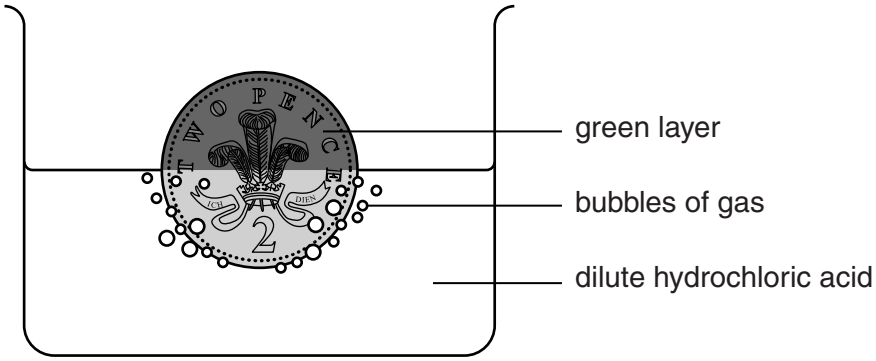
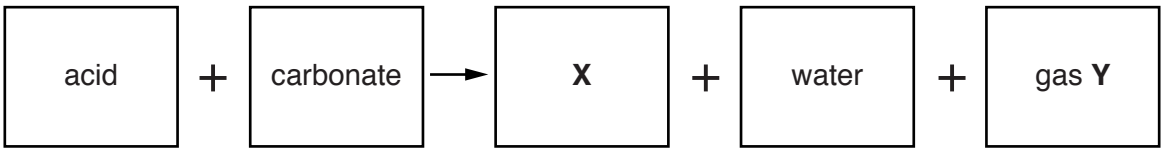


Fig. 8.2

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.

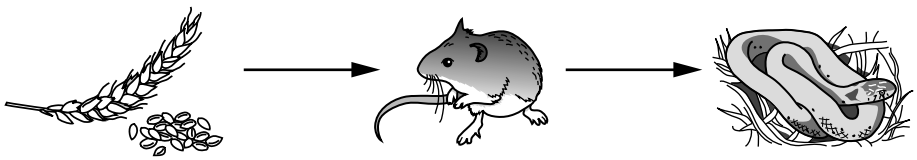
name of gas .....

test .....

.....

result .....[3]

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



wheat seeds mouse grass snake

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.

wheat seeds ⟶ mouse ⟶ grass snake

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											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.).