



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

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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.



- 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.

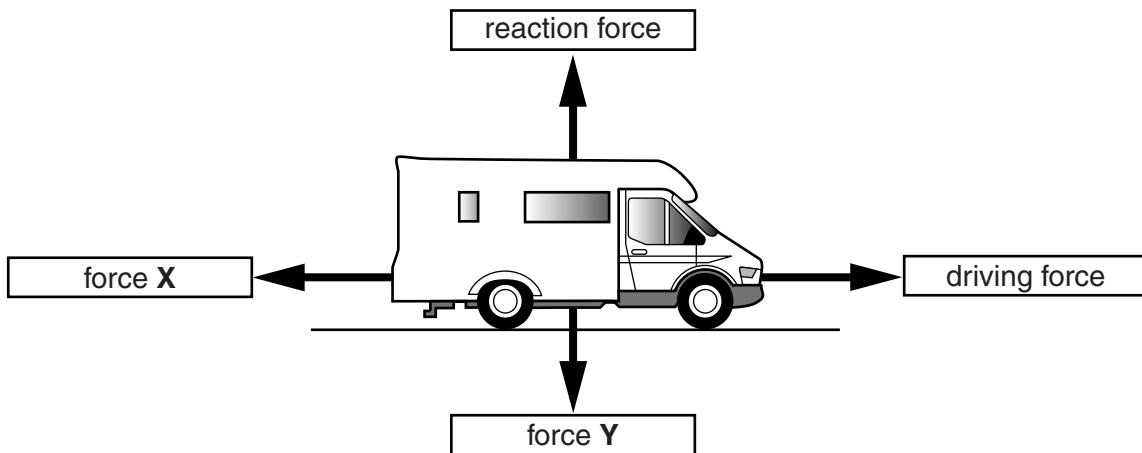


Fig. 1.1

- (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.

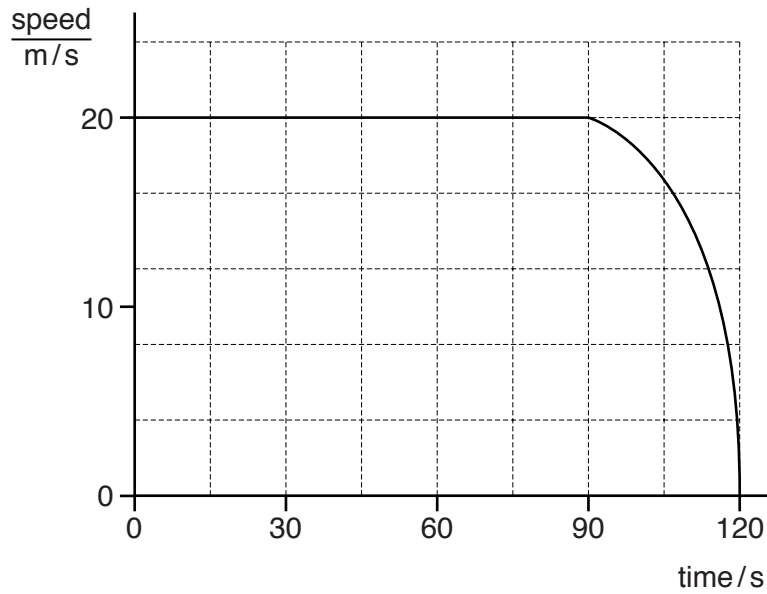


Fig. 1.2

(i) Describe the motion of the van between

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

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

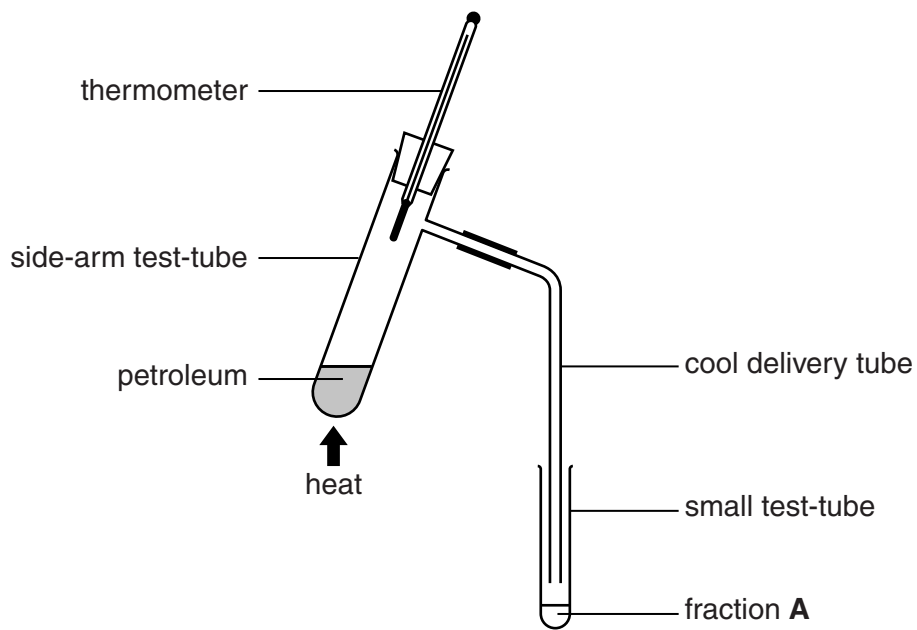


Fig. 2.1

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.

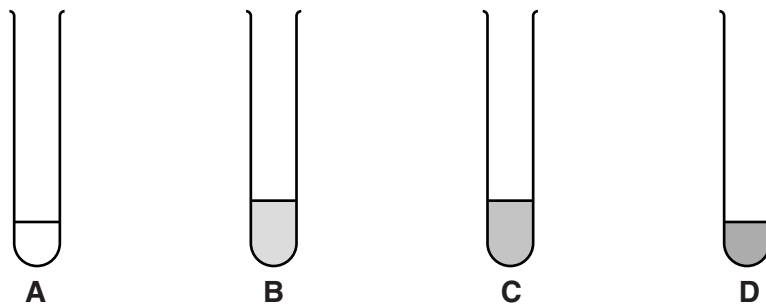


Fig. 2.2

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

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

Table 2.1

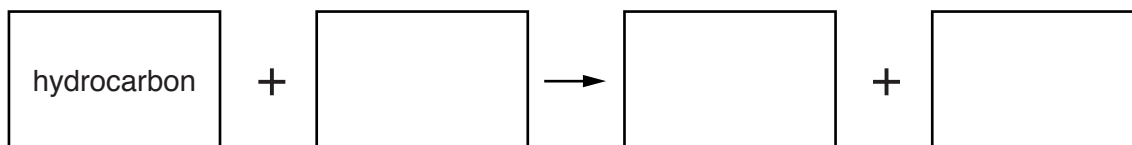
fraction	temperature range/°C
A	room temperature to 100
B	100 to 150
C	150 to 200
D	200 to 250

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 = cm³ [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.

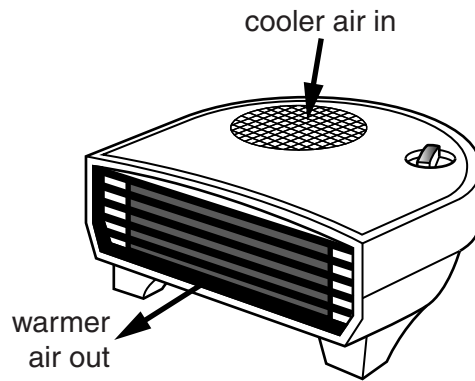


Fig. 4.1

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

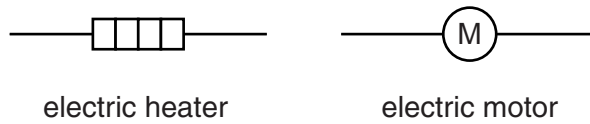


Fig. 4.2

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

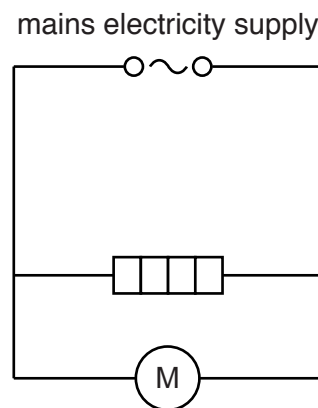


Fig. 4.3

(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.

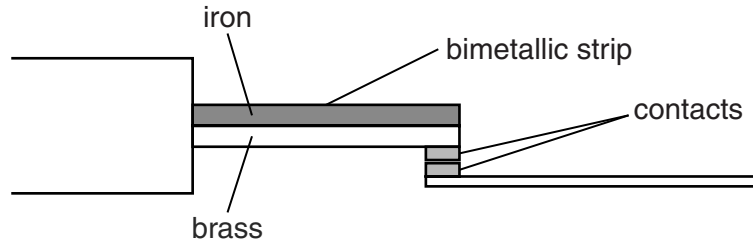


Fig. 4.4

- (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.

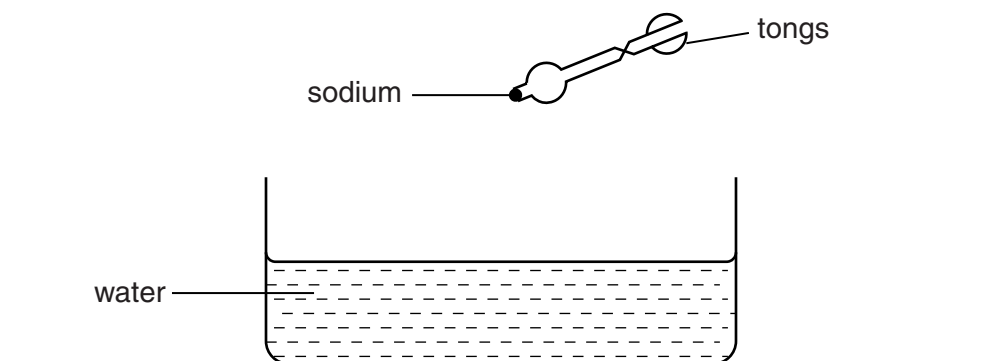


Fig. 5.1

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

similarity 1

similarity 2

difference

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

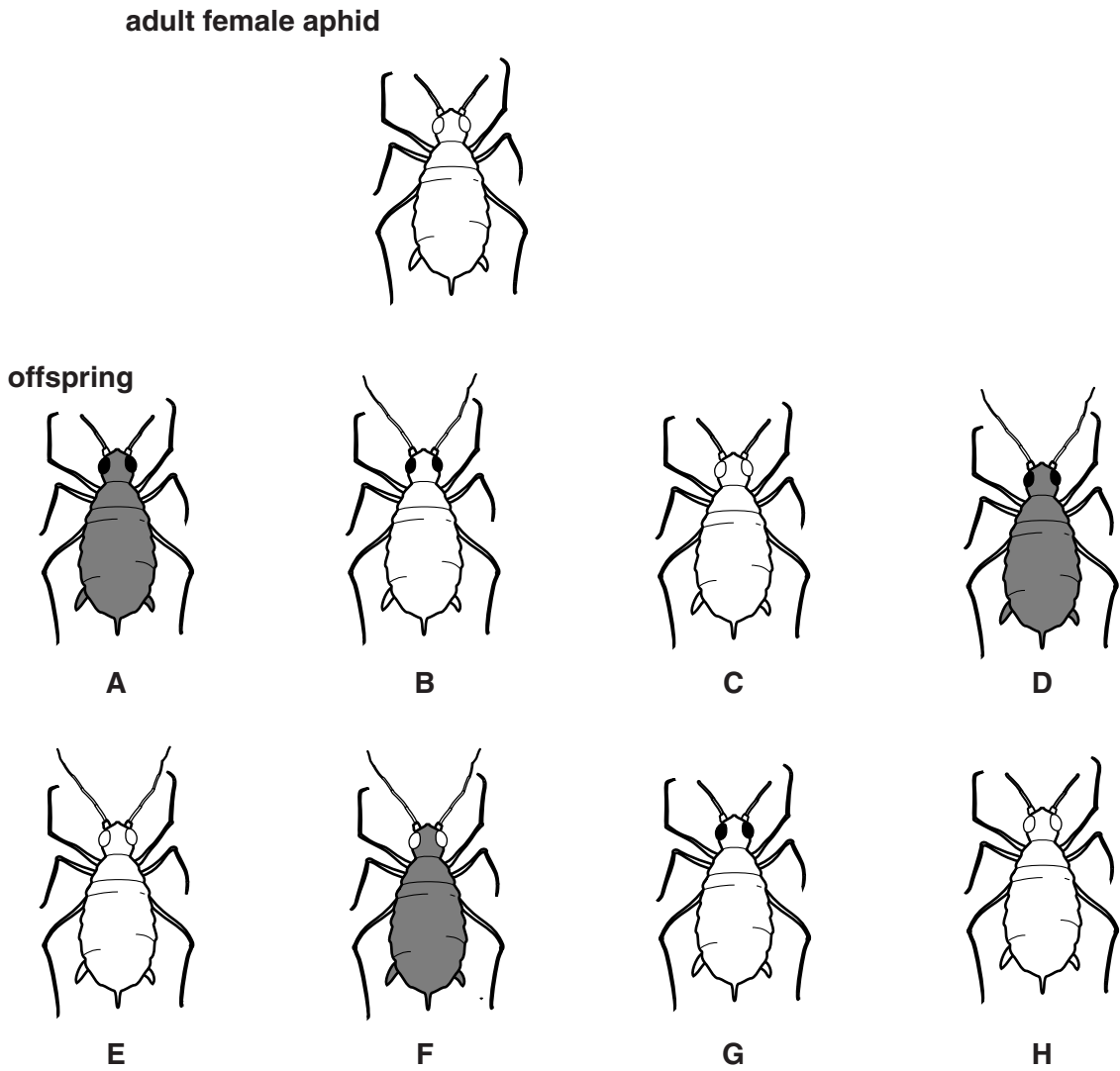


Fig. 6.1

- (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.

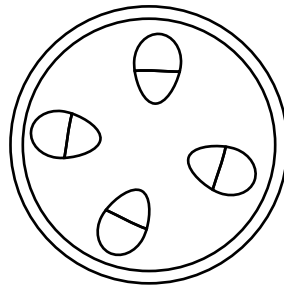


Fig. 6.2

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.

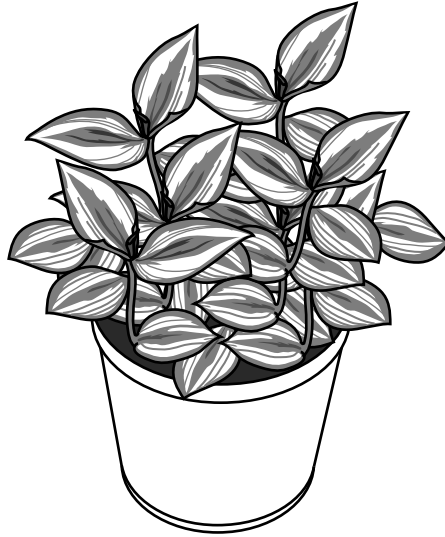


Fig. 6.3

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.

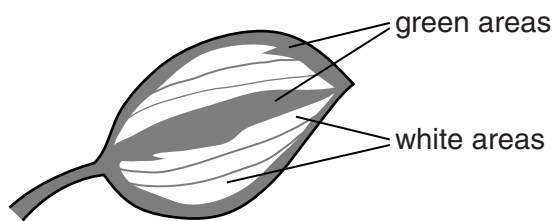


Fig. 6.4

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.

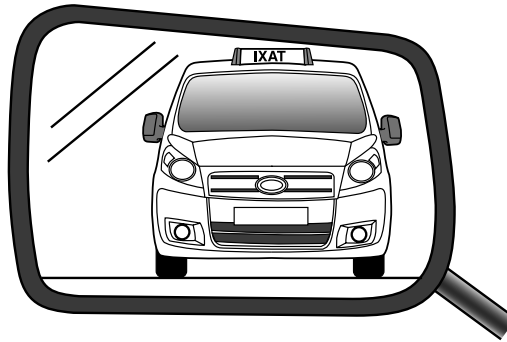


Fig. 7.3

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.

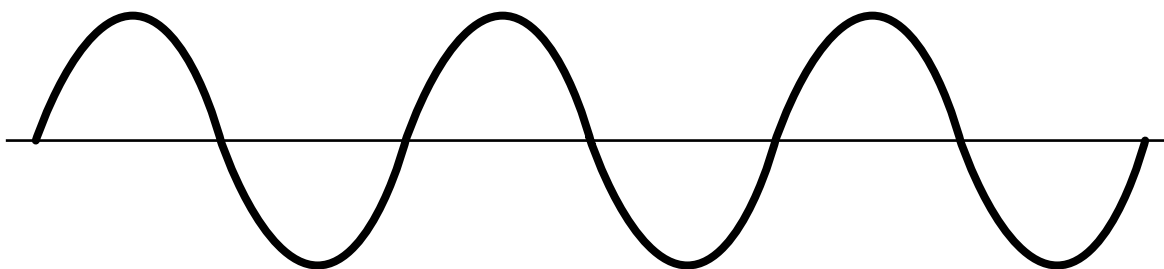


Fig. 7.4

[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.

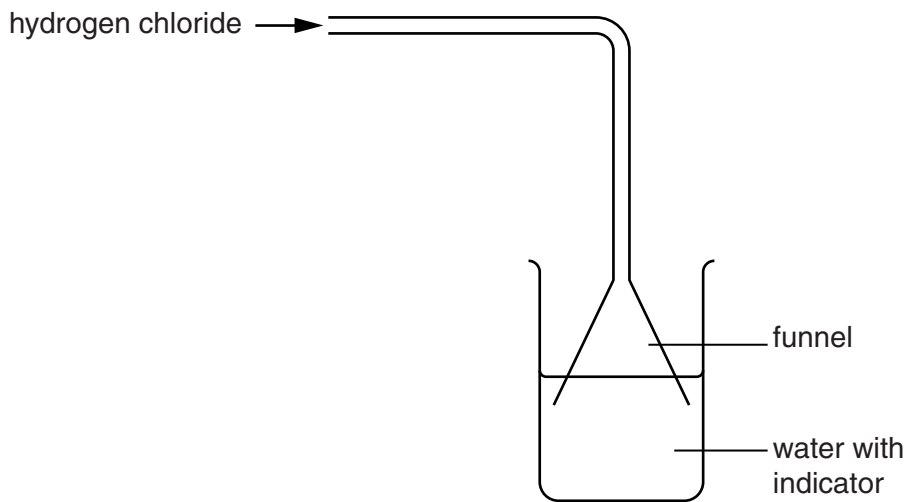


Fig. 8.1

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.

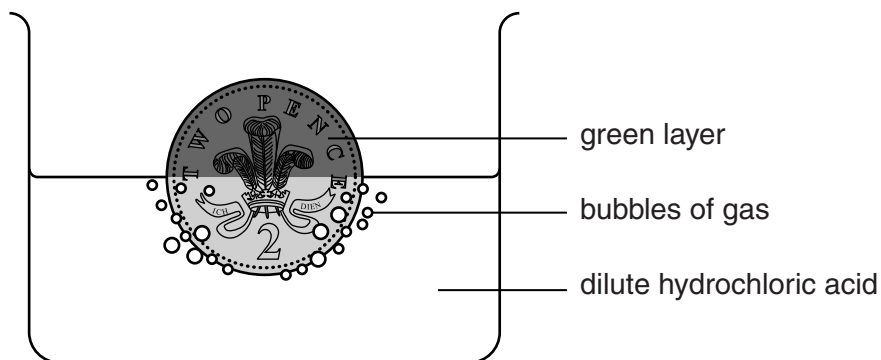
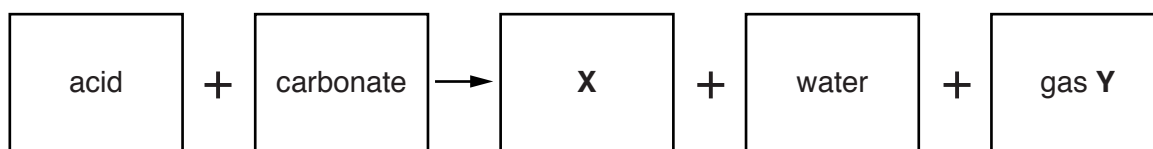


Fig. 8.2

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.

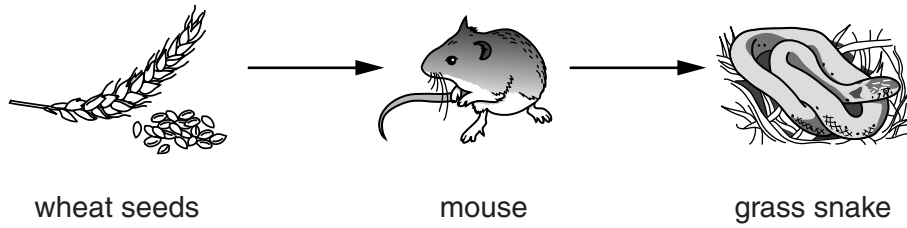


Fig. 9.1

(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.

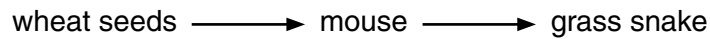


Fig. 9.2

[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	O																								
1 H Hydrogen																															
3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon	11 B Boron	12 C Carbon	13 Al Aluminium	14 N Nitrogen	15 P Phosphorus	16 O Oxygen	17 Cl Chlorine	18 Ar Argon																
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton														
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon														
55 Cs Caesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon														
87 Fr Francium	88 Ra Radium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson

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

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

Key

a	X
---	----------

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