



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

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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.

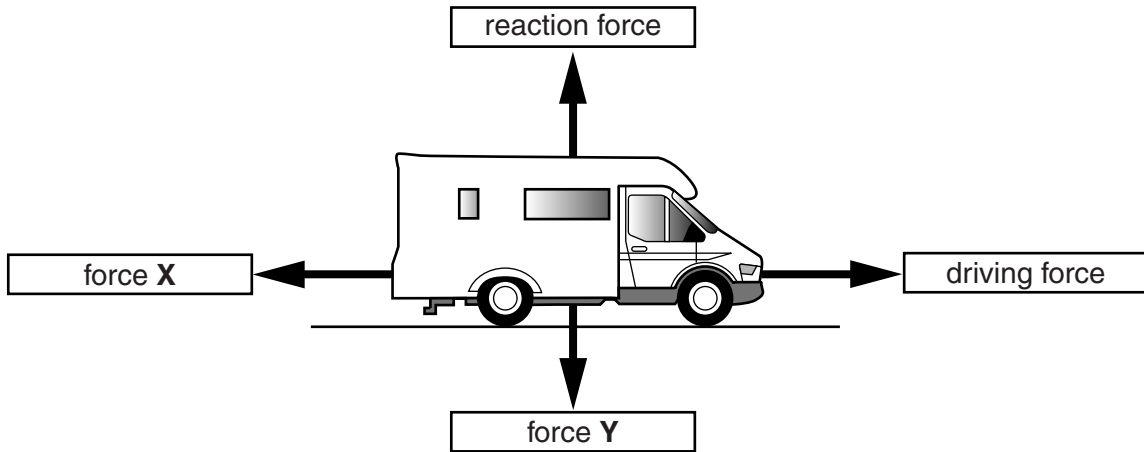


Fig. 1.1

- (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.

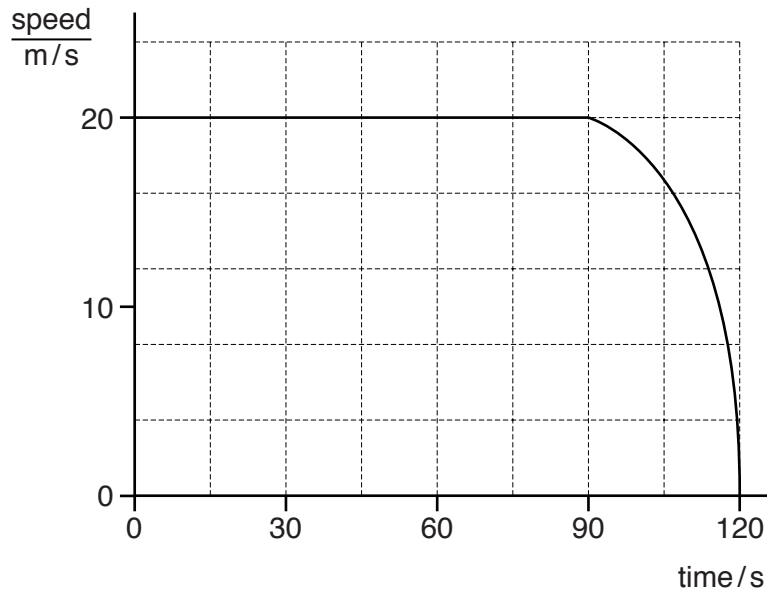


Fig. 1.2

(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.

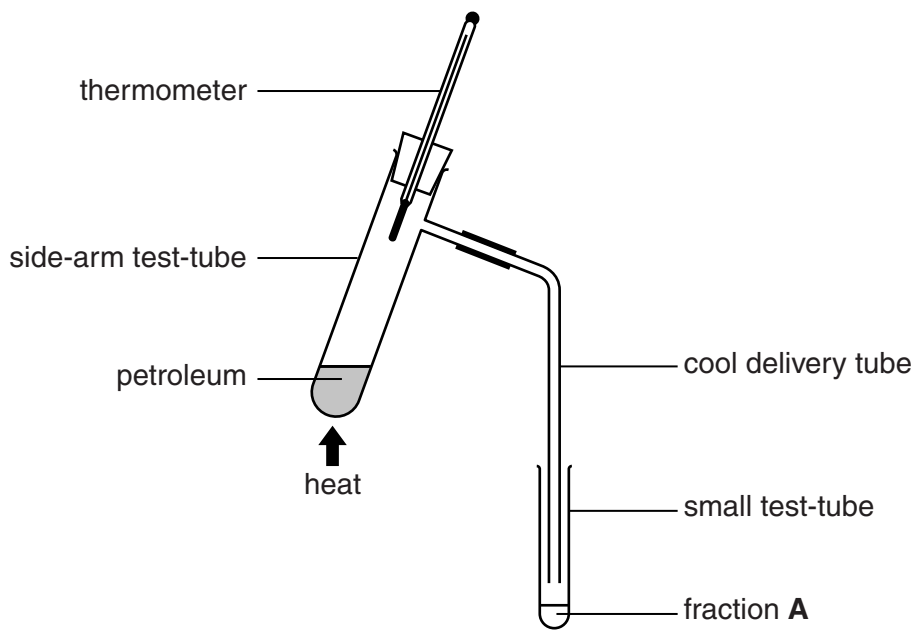


Fig. 2.1

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.

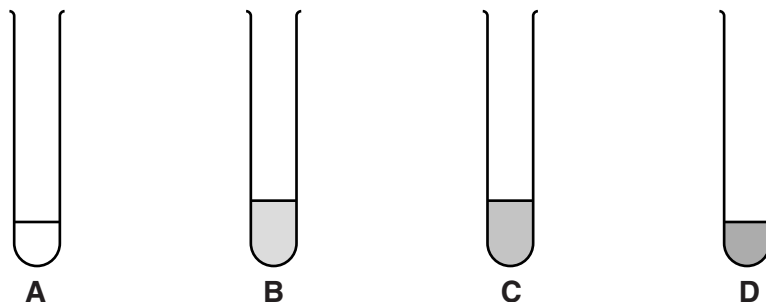


Fig. 2.2

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

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

Table 2.1

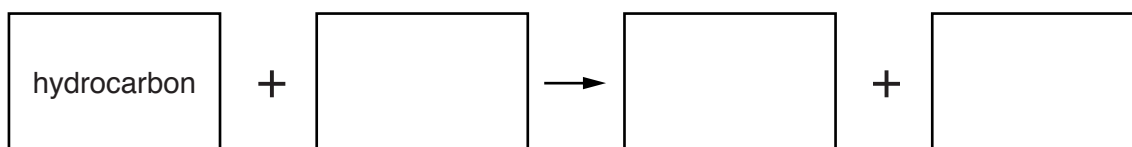
fraction	temperature range/°C
A	room temperature to 100
B	100 to 150
C	150 to 200
D	200 to 250

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.

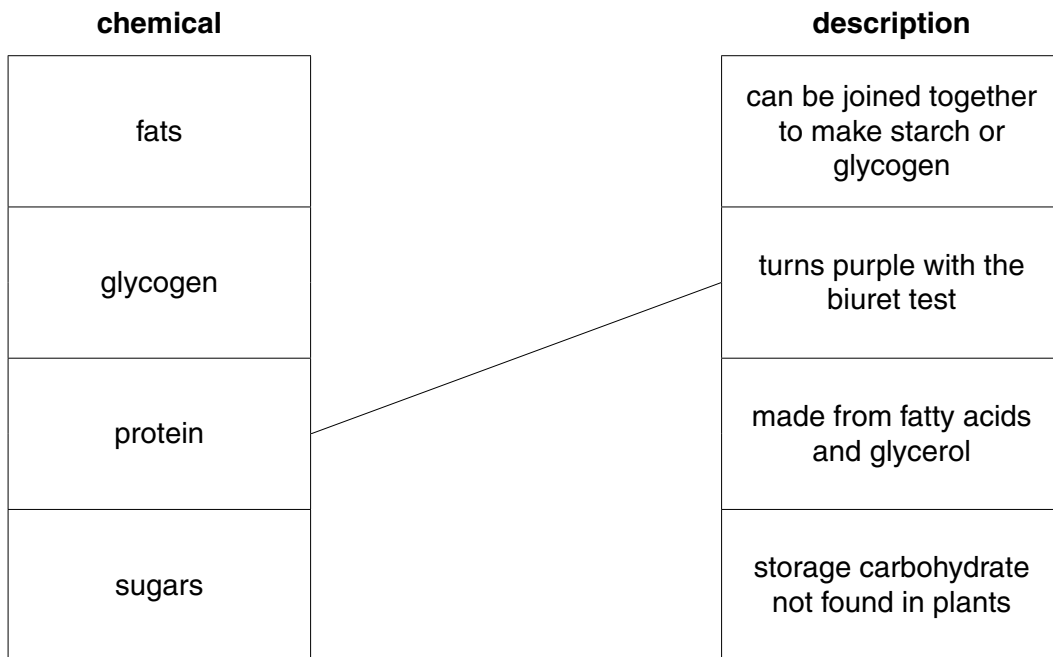


[2]

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.



[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.

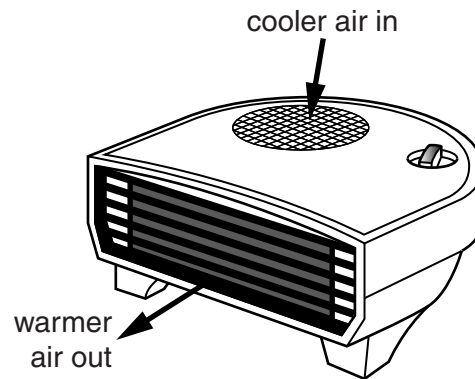


Fig. 4.1

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

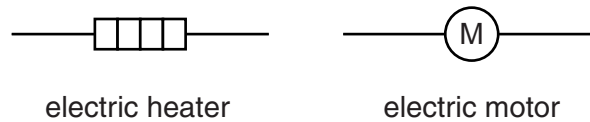


Fig. 4.2

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

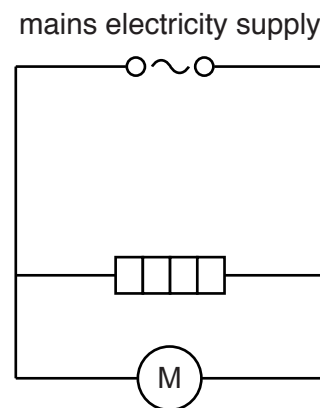


Fig. 4.3

(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.

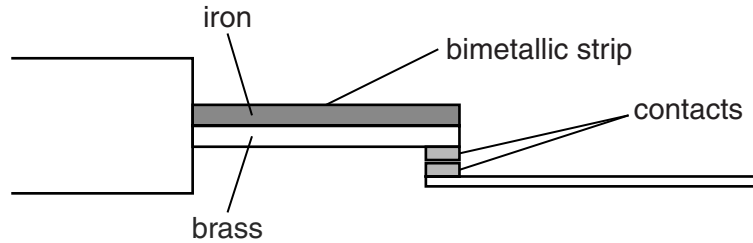


Fig. 4.4

- (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.

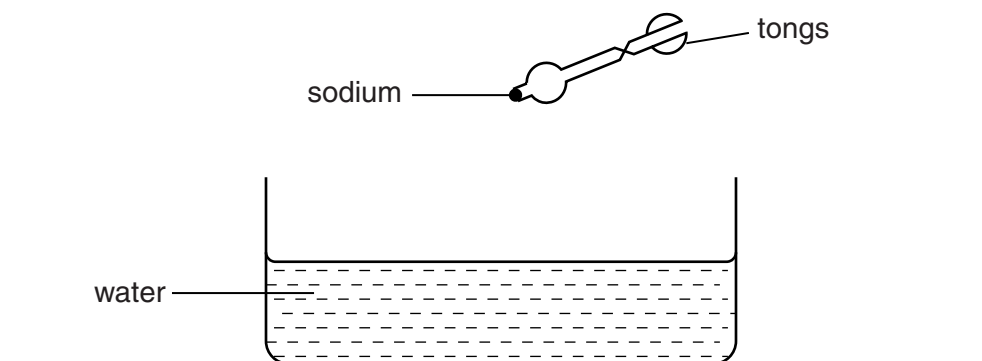


Fig. 5.1

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

similarity 1

similarity 2

difference[3]

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

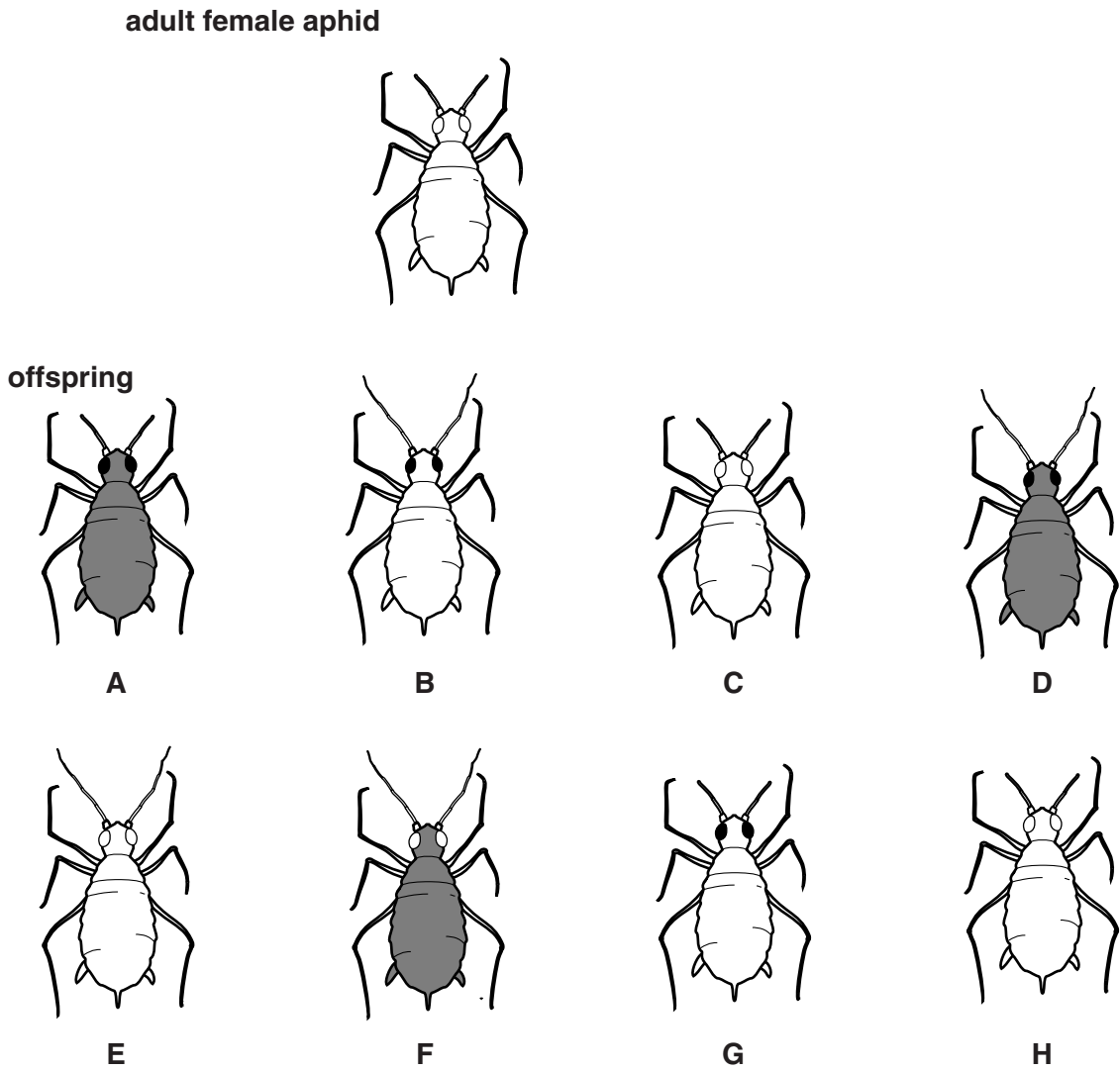


Fig. 6.1

- (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.

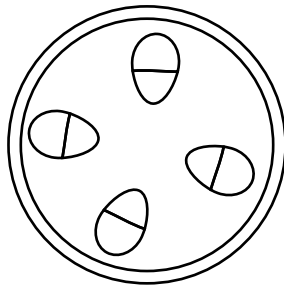


Fig. 6.2

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.

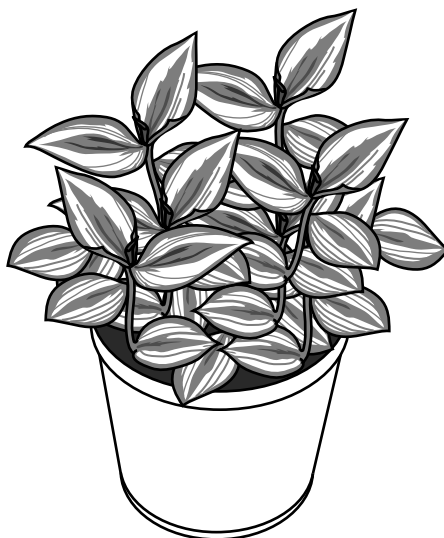


Fig. 6.3

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.

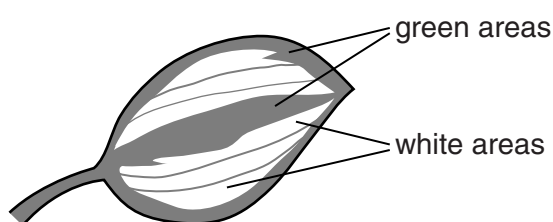


Fig. 6.4

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.

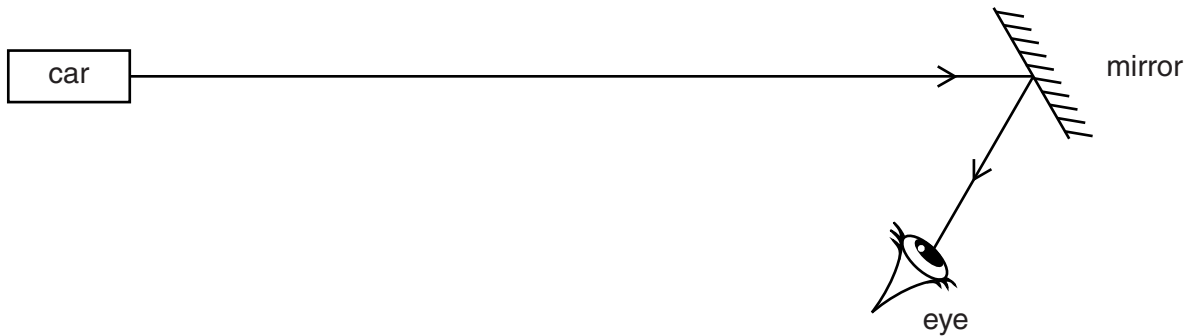


Fig. 7.2

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.

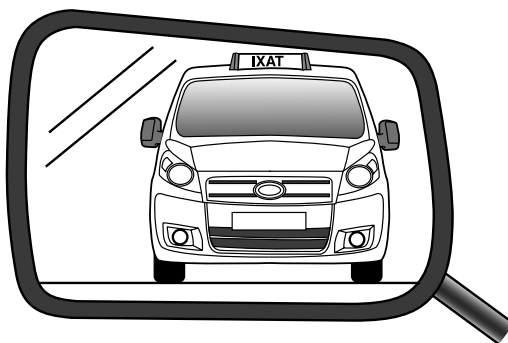


Fig. 7.3

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.

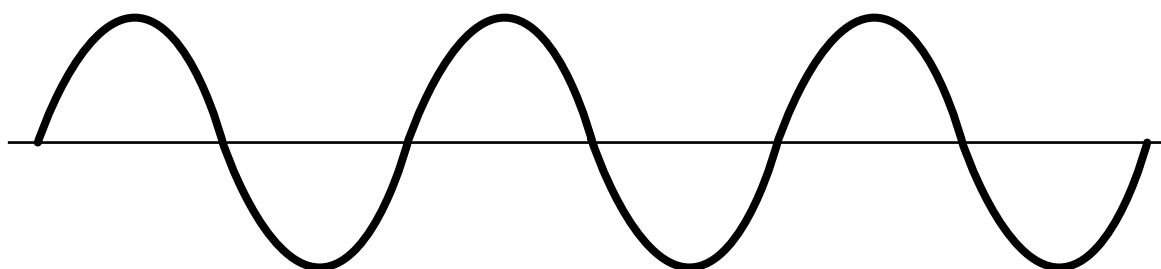


Fig. 7.4

[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.

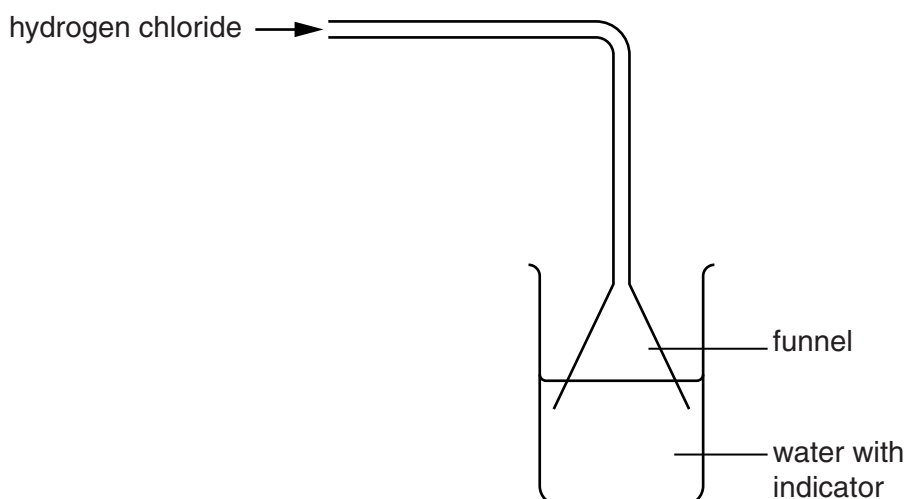


Fig. 8.1

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.

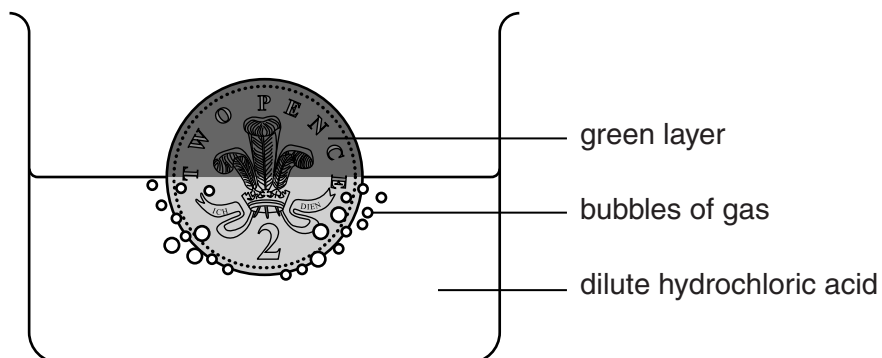
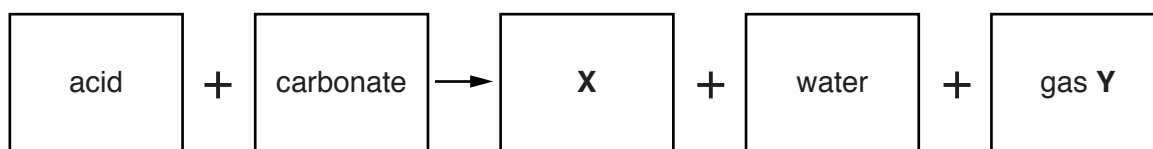


Fig. 8.2

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.

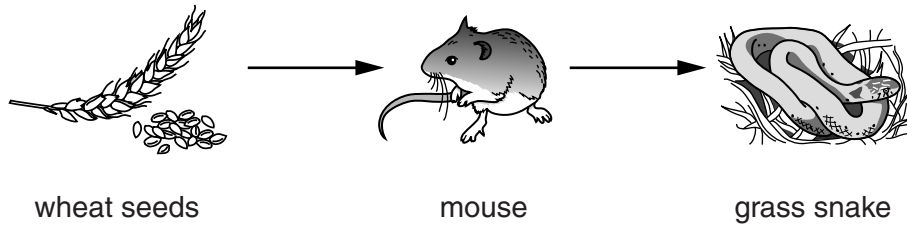


Fig. 9.1

(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.

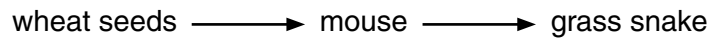


Fig. 9.2

[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							2 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4			5 B Boron 5	6 C Carbon 6	7 N Nitrogen 7	8 O Oxygen 8	9 F Fluorine 9	10 Ne Neon 10
11 Na Sodium 11	12 Mg Magnesium 12	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18		
19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28
37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46
55 Cs Cesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78
87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89							
			29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35
			47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53
			79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85
			64 Cu Copper 64	65 Zn Zinc 65	66 Ga Gallium 66	67 Ge Germanium 67	68 As Arsenic 68	69 Se Selenium 69	70 Br Bromine 70
			80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86
			101 Ag Silver 101	102 Cd Cadmium 102	103 In Indium 103	104 Sn Tin 104	105 Sb Antimony 105	106 Te Tellurium 106	107 I Iodine 107
			127 Au Gold 127	128 Hg Mercury 128	129 Tl Thallium 129	130 Pb Lead 130	131 Bi Bismuth 131	132 Po Polonium 132	133 At Astatine 133
			157 Gd Gadolinium 157	158 Tb Terbium 158	159 Dy Dysprosium 159	160 Ho Holmium 160	161 Er Erbium 161	162 Tm Thulium 162	163 Yb Ytterbium 163
			187 Ir Iridium 187	188 Pt Platinum 188	189 Au Gold 189	190 Hg Mercury 190	191 Tl Thallium 191	192 Pb Lead 192	193 Bi Bismuth 193
			209 Tl Thallium 209	210 Pb Lead 210	211 Bi Bismuth 211	212 Po Polonium 212	213 At Astatine 213	214 Rn Radon 214	215 Fr Francium 215
			227 Fr Francium 227	228 Ra Radium 228	229 Ac Actinium 229				
			231 Pa Protactinium 231	232 Th Thorium 232	233 Pa Protactinium 233	234 U Uranium 234	235 Np Neptunium 235	236 Pu Plutonium 236	237 Am Americium 237
			251 Es Einsteinium 251	252 Fm Fermium 252	253 Md Mendelevium 253	254 No Nobelium 254	255 Lr Lawrencium 255	256 Rf Rutherfordium 256	257 Db Dubnium 257
			289 Og Oganesson 289	290 Ts Tennessine 290	291 Lr Lawrencium 291	292 Rf Rutherfordium 292	293 Db Dubnium 293	294 Sg Seaborgium 294	295 Bh Bohrium 295
			315 Uu Ununpentium 315	316 Uub Ununhexium 316	317 Uuc Ununseptium 317	318 Uuq Ununquadium 318	319 Uur Ununpentium 319	320 Uus Ununseptium 320	321 Uuq Ununquadium 321
			331 Uuh Ununheptium 331	332 Uuq Ununquadium 332	333 Uur Ununpentium 333	334 Uus Ununseptium 334	335 Uut Ununtrium 335	336 Uuq Ununquadium 336	337 Uur Ununpentium 337
			353 Uuq Ununquadium 353	354 Uur Ununpentium 354	355 Uus Ununseptium 355	356 Uut Ununtrium 356	357 Uuq Ununquadium 357	358 Uur Ununpentium 358	359 Uus Ununseptium 359
			379 Uuq Ununquadium 379	380 Uur Ununpentium 380	381 Uus Ununseptium 381	382 Uut Ununtrium 382	383 Uuq Ununquadium 383	384 Uur Ununpentium 384	385 Uus Ununseptium 385
			409 Uuq Ununquadium 409	410 Uur Ununpentium 410	411 Uus Ununseptium 411	412 Uut Ununtrium 412	413 Uuq Ununquadium 413	414 Uur Ununpentium 414	415 Uus Ununseptium 415
			435 Uuq Ununquadium 435	436 Uur Ununpentium 436	437 Uus Ununseptium 437	438 Uut Ununtrium 438	439 Uuq Ununquadium 439	440 Uur Ununpentium 440	441 Uus Ununseptium 441
			459 Uuq Ununquadium 459	460 Uur Ununpentium 460	461 Uus Ununseptium 461	462 Uut Ununtrium 462	463 Uuq Ununquadium 463	464 Uur Ununpentium 464	465 Uus Ununseptium 465
			489 Uuq Ununquadium 489	490 Uur Ununpentium 490	491 Uus Ununseptium 491	492 Uut Ununtrium 492	493 Uuq Ununquadium 493	494 Uur Ununpentium 494	495 Uus Ununseptium 495
			519 Uuq Ununquadium 519	520 Uur Ununpentium 520	521 Uus Ununseptium 521	522 Uut Ununtrium 522	523 Uuq Ununquadium 523	524 Uur Ununpentium 524	525 Uus Ununseptium 525
			549 Uuq Ununquadium 549	550 Uur Ununpentium 550	551 Uus Ununseptium 551	552 Uut Ununtrium 552	553 Uuq Ununquadium 553	554 Uur Ununpentium 554	555 Uus Ununseptium 555
			579 Uuq Ununquadium 579	580 Uur Ununpentium 580	581 Uus Ununseptium 581	582 Uut Ununtrium 582	583 Uuq Ununquadium 583	584 Uur Ununpentium 584	585 Uus Ununseptium 585
			609 Uuq Ununquadium 609	610 Uur Ununpentium 610	611 Uus Ununseptium 611	612 Uut Ununtrium 612	613 Uuq Ununquadium 613	614 Uur Ununpentium 614	615 Uus Ununseptium 615
			639 Uuq Ununquadium 639	640 Uur Ununpentium 640	641 Uus Ununseptium 641	642 Uut Ununtrium 642	643 Uuq Ununquadium 643	644 Uur Ununpentium 644	645 Uus Ununseptium 645
			659 Uuq Ununquadium 659	660 Uur Ununpentium 660	661 Uus Ununseptium 661	662 Uut Ununtrium 662	663 Uuq Ununquadium 663	664 Uur Ununpentium 664	665 Uus Ununseptium 665
			689 Uuq Ununquadium 689	690 Uur Ununpentium 690	691 Uus Ununseptium 691	692 Uut Ununtrium 692	693 Uuq Ununquadium 693	694 Uur Ununpentium 694	695 Uus Ununseptium 695
			719 Uuq Ununquadium 719	720 Uur Ununpentium 720	721 Uus Ununseptium 721	722 Uut Ununtrium 722	723 Uuq Ununquadium 723	724 Uur Ununpentium 724	725 Uus Ununseptium 725
			739 Uuq Ununquadium 739	740 Uur Ununpentium 740	741 Uus Ununseptium 741	742 Uut Ununtrium 742	743 Uuq Ununquadium 743	744 Uur Ununpentium 744	745 Uus Ununseptium 745
			759 Uuq Ununquadium 759	760 Uur Ununpentium 760	761 Uus Ununseptium 761	762 Uut Ununtrium 762	763 Uuq Ununquadium 763	764 Uur Ununpentium 764	765 Uus Ununseptium 765
			779 Uuq Ununquadium 779	780 Uur Ununpentium 780	781 Uus Ununseptium 781	782 Uut Ununtrium 782	783 Uuq Ununquadium 783	784 Uur Ununpentium 784	785 Uus Ununseptium 785
			799 Uuq Ununquadium 799	800 Uur Ununpentium 800	801 Uus Ununseptium 801	802 Uut Ununtrium 802	803 Uuq Ununquadium 803	804 Uur Ununpentium 804	805 Uus Ununseptium 805
			819 Uuq Ununquadium 819	820 Uur Ununpentium 820	821 Uus Ununseptium 821	822 Uut Ununtrium 822	823 Uuq Ununquadium 823	824 Uur Ununpentium 824	825 Uus Ununseptium 825
			839 Uuq Ununquadium 839	840 Uur Ununpentium 840	841 Uus Ununseptium 841	842 Uut Ununtrium 842	843 Uuq Ununquadium 843	844 Uur Ununpentium 844	845 Uus Ununseptium 845
			859 Uuq Ununquadium 859	860 Uur Ununpentium 860	861 Uus Ununseptium 861	862 Uut Ununtrium 862	863 Uuq Ununquadium 863	864 Uur Ununpentium 864	865 Uus Ununseptium 865
			879 Uuq Ununquadium 879	880 Uur Ununpentium 880	881 Uus Ununseptium 881	882 Uut Ununtrium 882	883 Uuq Ununquadium 883	884 Uur Ununpentium 884	885 Uus Ununseptium 885
			899 Uuq Ununquadium 899	900 Uur Ununpentium 900	901 Uus Ununseptium 901	902 Uut Ununtrium 902	903 Uuq Ununquadium 903	904 Uur Ununpentium 904	905 Uus Ununseptium 905
			919 Uuq Ununquadium 919	920 Uur Ununpentium 920	921 Uus Ununseptium 921	922 Uut Ununtrium 922	923 Uuq Ununquadium 923	924 Uur Ununpentium 924	925 Uus Ununseptium 925
			939 Uuq Ununquadium 939	940 Uur Ununpentium 940	941 Uus				