UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6816777949

COMBINED SCIENCE **0653/31**

Paper 3 (Extended) **October/November 2012**

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 soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **22** printed pages and **2** blank pages.

1 **(a)** Complete Table 1.1 by choosing one of the words from the list to match each statement.

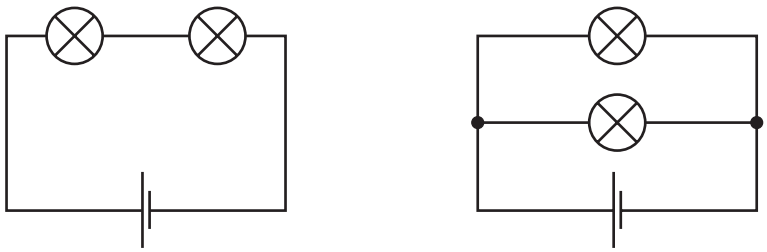
ammeter	**ampere**	**circuit**	**electron**
ohm	**volt**	**voltmeter**	**watt**

Table 1.1

statement	word
a complete loop of conductors	
a particle with a negative electrical charge	
an instrument that measures potential difference	
the unit of power	

[2]

(b) Fig. 1.1 shows two circuits, **A** and **B**. All the lamps and both cells are the same.



circuit **A** circuit **B**

Fig. 1.1

(i) One lamp is unscrewed from circuit **A**.

State what happens to the other lamp.

Explain your answer.

.....

.....

..... [1]

(ii) Explain why lights in a house are connected as in circuit **B** and **not** as in circ

.....

.....

..... [2]

(iii) The resistance of each lamp is 1.2 Ω.

Calculate the combined resistance of the two lamps in circuit **B**.

State the formula that you use and show your working.

formula used

working

..... [3]

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2 **(a)** Fig. 2.1 shows part of the carbon cycle.

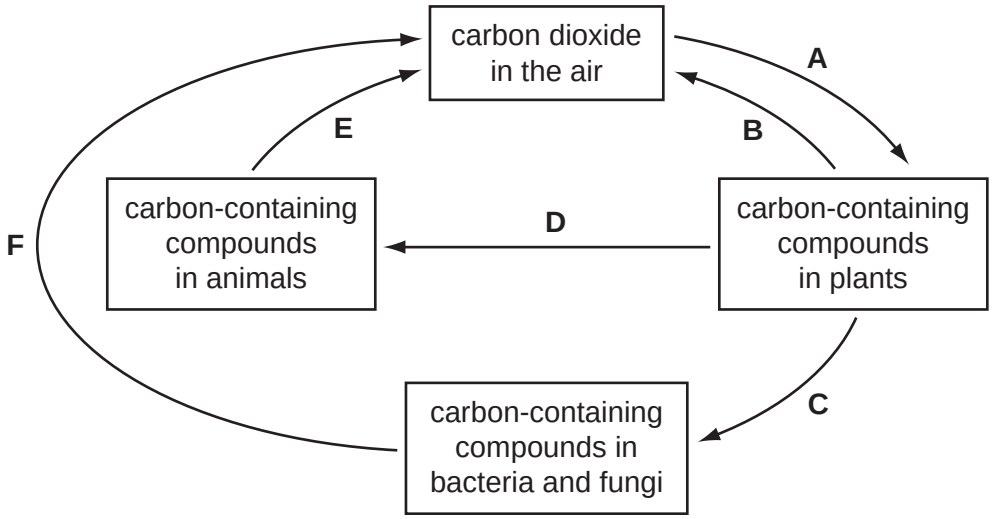


Fig. 2.1

(i) State the letter or letters, **A**, **B**, **C**, **D**, **E** or **F**, that represent

photosynthesis, ...

respiration. ..... [2]

(ii) Name **one** carbon-containing compound in plants.

..... [1]

(b) Earthworms play an important part in the carbon cycle. They are decomposers.

Describe the role of decomposers in the carbon cycle.

.....

.....

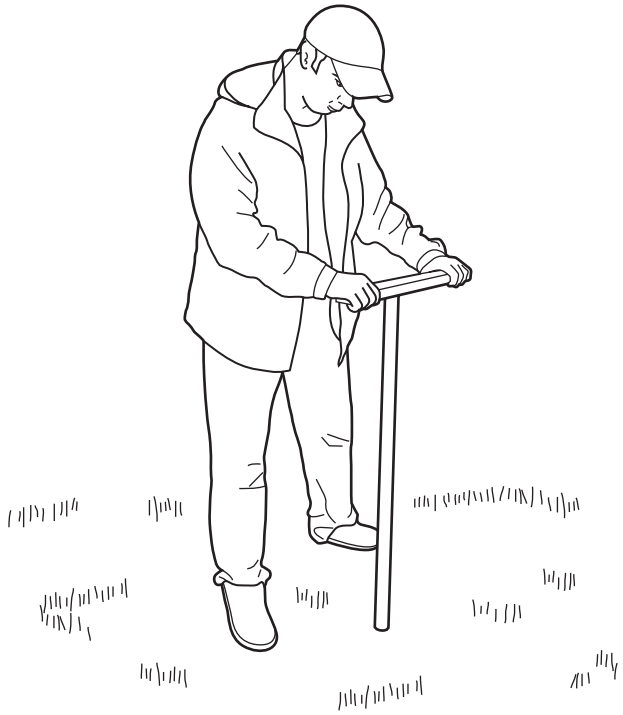
.....

..... [2]

(c) In Florida, USA, some people collect earthworms by vibrating the soil.

A wooden post is pushed into the ground, and then a heavy object is pulled across the top of the post to make it vibrate. The vibrations travel through the soil.

Earthworms respond to the vibrations by crawling out of their burrows onto the soil surface, where they can be caught.



A student investigated the effect of different frequencies of vibrations on the numbers of earthworms that emerged from the soil. Fig. 2.2 shows his results.

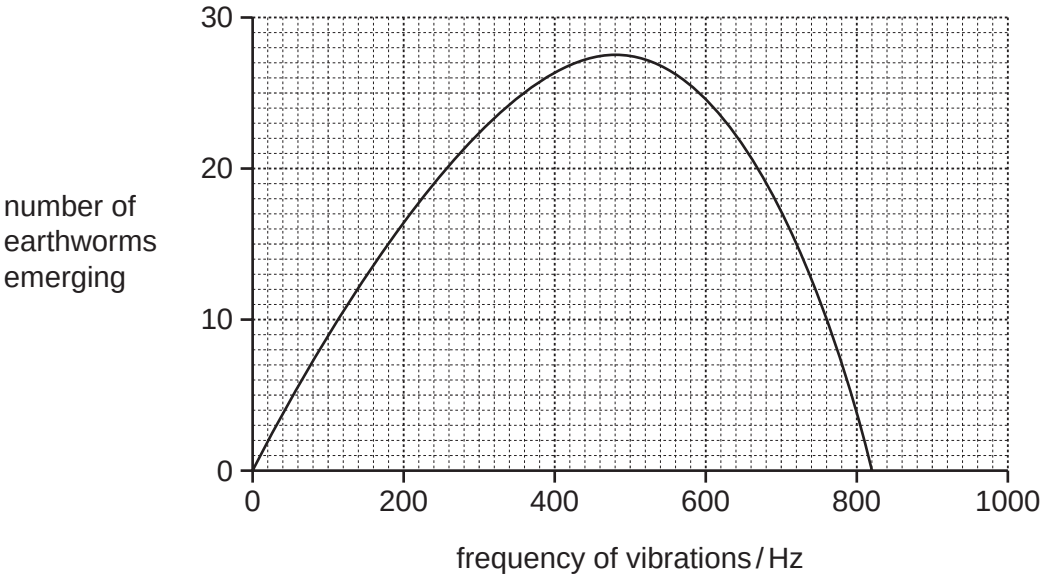


Fig. 2.2

(i) Describe the effect of different frequencies of vibrations on the numb
earthworms emerging.

.....

.....

.....

..... [2]

(ii) Moles are predators that live underground and eat earthworms. When moles burrow through the ground, they produce vibrations of around 500 Hz.

Suggest how the response of earthworms helps them to survive.

.....

.....

.....

..... [2]

3 **(a)** Fig. 3.1 shows how a digital pH meter is used to measure the pH of some liquids.

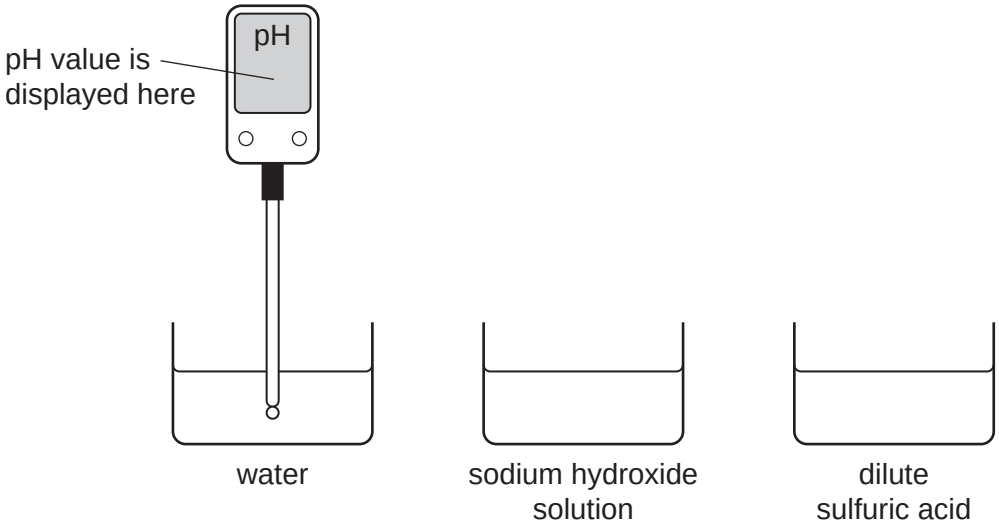


Fig. 3.1

(i) Complete Table 3.1 by suggesting suitable pH values for the different liquids.

Table 3.1

liquid	pH
water	
sodium hydroxide solution	
dilute sulfuric acid	

[2]

(ii) Suggest **one** advantage of using a digital pH meter rather than a piece of litmus paper to assess the acidity of an aqueous solution.

.....

..... [1]

(iii) Dilute acids are aqueous solutions that contain dissolved ions.

Table 3.2 shows the names of the ions in two common acids.

Table 3.2

name of dilute acid	names of dissolved ions
hydrochloric acid	hydrogen ions and chloride ions
sulfuric acid	hydrogen ions and sulfate ions

A student is given an unlabelled beaker which is known to contain either dilute hydrochloric acid or dilute sulfuric acid.

Describe a chemical test that a student could use to find out whether or not the beaker contains hydrochloric acid.

.....

.....

..... [2]

(b) Fig. 3.2 shows three experiments that a teacher set up to compare the reactiv magnesium, copper and an unknown metal **G**.

In each experiment she heated a mixture of one metal and the oxide of a different metal. In each case there was an exothermic chemical reaction.

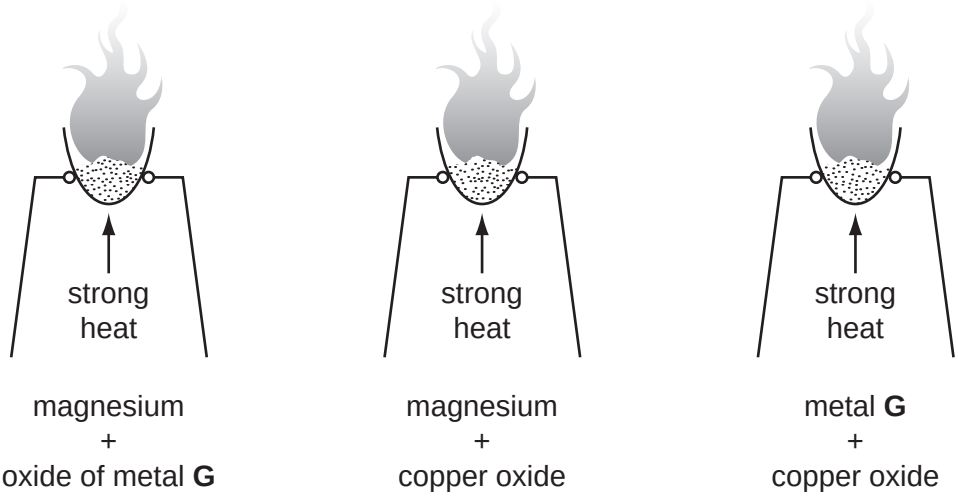


Fig. 3.2

(i) Write a **word** chemical equation for the reaction between magnesium and copper oxide.

.....[1]

(ii) Use the information in Fig. 3.2 to predict whether or not copper would react with the oxide of metal **G**.

Explain your answer.

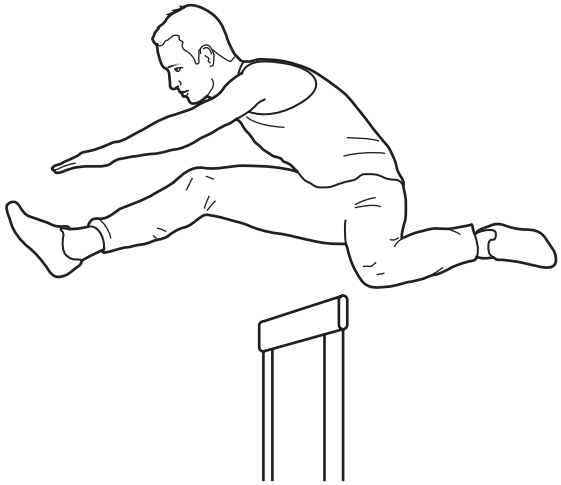
prediction .....

explanation .....

.....

.....[2]

4 **(a)** An athlete of mass 60 kg jumps 1.3 metres vertically.



Calculate the work done by the athlete to achieve this height.

State the formula that you use and show your working. The gravitational field strength of the Earth is 10 N / kg.

formula used

working

..... [3]

(b) Using your answer to **(a)**, state the gain in potential energy of the athlete when he jumps 1.3 metres.

..... [1]

(c) The work done in jumping vertically was completed in 0.5 s.

Calculate the power developed.

State the formula that you use and show your working.

formula used

working

..... [2]

5 Fig. 5.1 shows apparatus that can be used to measure the rate of respiration of germ
seeds.

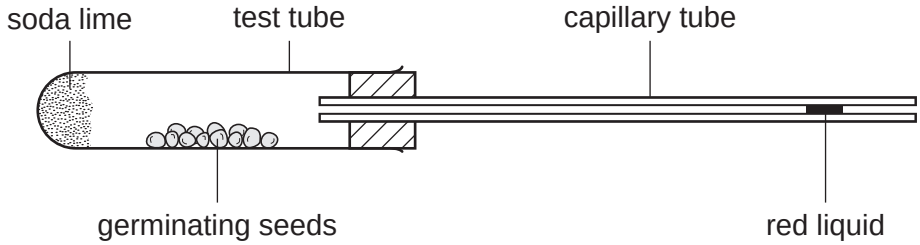


Fig. 5.1

The soda lime absorbs carbon dioxide from the air inside the apparatus.

(a) As the seeds respire, they use oxygen. This reduces the volume of gas inside the apparatus. The faster they respire, the faster the red liquid moves towards the left.

(i) Write the balanced equation for aerobic respiration.

..... [2]

(ii) Use the equation to explain why the liquid would **not** move if there was **no** soda lime in the apparatus.

.....

.....

.....

..... [2]

(b) An experiment was carried out to investigate the effect of temperature on the respiration of the germinating seeds.

Four sets of the apparatus shown in Fig. 5.1 were set up and labelled **A**, **B**, **C** and **D**. Each set of apparatus contained either germinating or dead seeds.

The distance moved by the red liquid in five minutes was measured for each set.

The results are shown in Table 5.1.

Table 5.1

set	contents	temperature / °C	distance moved by red liquid in 5 minutes / mm
A	germinating seeds	0	3
B	germinating seeds	10	6
C	germinating seeds	20	12
D	dead seeds	20	0

(i) Explain why it was important to include set **D** in the experiment.

.....

.....

..... [1]

(ii) With reference to Table 5.1, describe the effect of temperature on the rate of respiration of germinating seeds.

.....

.....

..... [2]

(iii) Predict and explain the results you would expect if the apparatus was set up with germinating seeds at a temperature of 60 °C.

predicted results .....

explanation .....

.....

..... [2]

6 Some types of firework are made by filling a cardboard tube with firework mixture. Fi
mixture is made from several solid substances which have been powdered and m
together.

Fig. 6.1 shows a typical firework.

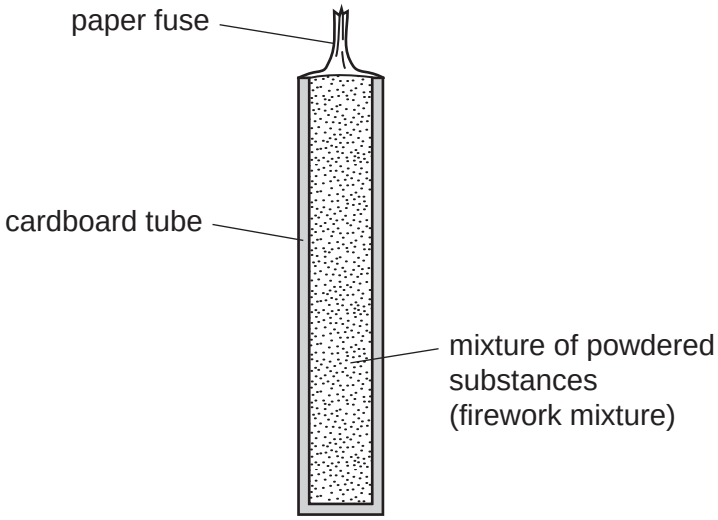


Fig. 6.1

When the paper fuse is lit, exothermic chemical reactions occur inside the firework.

(a) Explain, in terms of rate of reaction, why firework mixture is a powder.

.....

.....

..... [2]

(b) Some firework mixtures contain aluminium which is oxidised to produce the compound, aluminium oxide.

(i) The electron configuration of an aluminium **atom** is **2**,**8**,**3** and of an oxygen **atom** is **2**,**6**.

Explain how aluminium and oxygen atoms become strongly bonded when they react to form aluminium oxide. You may draw some diagrams to help your explanation.

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..... [4]

(ii) A student suggested the symbolic equation below for the formation of aluminium oxide.

$$2Al + 3O_2 \longrightarrow Al_2O_3$$

State and explain whether or not this equation is balanced.

.....

.....

..... [2]

(c) The firework mixture contained in the firework in Fig. 6.1 contains the co
potassium perchlorate, $KClO_4$.

When potassium perchlorate is heated, a colourless gas is given off which re-lights a glowing splint.

Suggest why the firework mixture needs to contain potassium perchlorate.

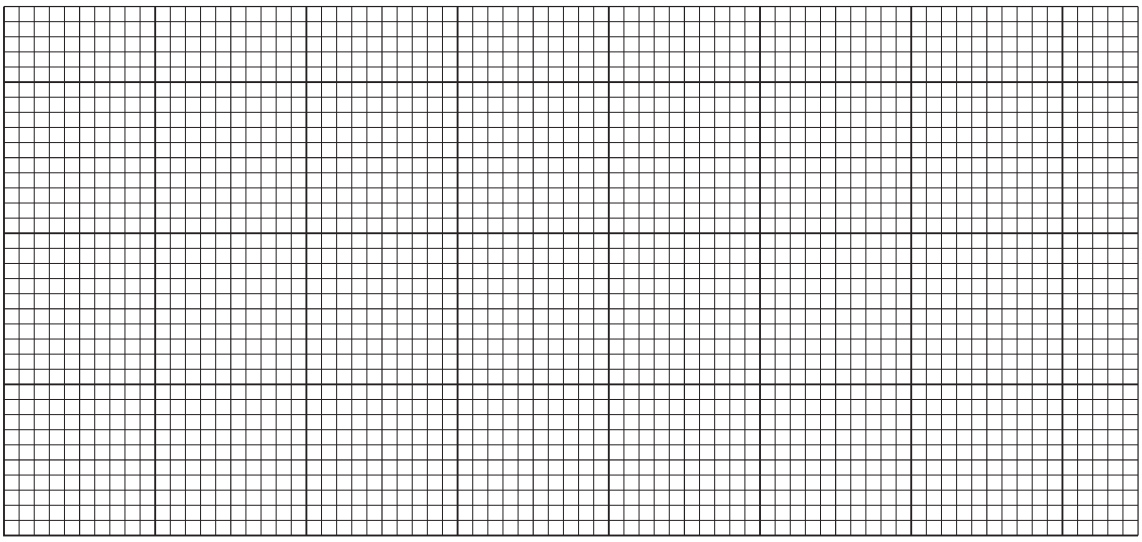
.....

.....

..... [2]

7 **(a)** On the grid below, draw a wave with an amplitude of 2 cm and a wavelength of 4

On your diagram, clearly label the amplitude and the wavelength.



[3]

(b) **(i)** Two sound waves, **A** and **B**, have the same frequency. **A** has a greater amplitude than **B**.

What difference would you hear?

.....

[1]

(ii) Two sound waves, **X** and **Y**, have the same amplitude. **X** has a greater frequency than **Y**.

What difference would you hear?

.....

[1]

(iii) The speed of sound was calculated for sound passing through a solid, a li
gas and a vacuum.

The values recorded were

0 m / s 330 m / s

1500 m / s 5000 m / s.

Write the values in the correct boxes in Table 7.1.

Table 7.1

	speed of sound / m / s
vacuum	
solid	
liquid	
gas	

[2]

(iv) Sound travels through the air by a series of compressions and rarefactions.

Explain what is meant by *compressions* and *rarefactions*. You may use a diagram to help your explanation.

.....

.....

..... [2]

(c) Energy travels to the Earth from the Sun.

State whether this transfer of energy is by conduction, convection or radiation.

Explain your answer.

.....

.....

..... [2]

(d) Light is able to travel down optical fibres by total internal reflection.

Complete the diagram to show how the ray of light passes down the optical fibre.

[2]

8 Fig. 8.1 shows the male reproductive system.

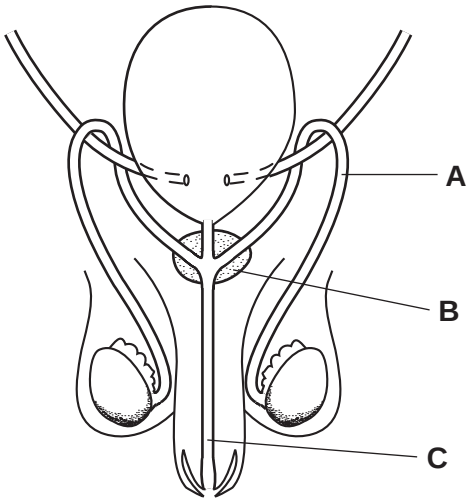


Fig. 8.1

(a) (i) State the functions of parts **A**, **B** and **C**.

A .....

B .....

C ..... [3]

(ii) On Fig. 8.1, use a label line and the letter **S** to indicate where male gametes are made. [1]

(b) Describe **two** ways in which human male gametes differ from human female gametes.

1 .....

2 ..... [2]

(c) HIV is the virus that causes AIDS. HIV can be passed from one person to another during sexual intercourse.

Outline how HIV affects the immune system of a person with HIV/AIDS.

.....

.....

.....

..... [2]

9 **(a)** **(i)** Methane and ethane are hydrocarbons found in fossil fuels.

Complete the structures of molecules of methane and ethane that have bee started below.

methane	ethane
H—C	H—C

[2]

(ii) Methane and ethane are found in refinery gas, which is an important product obtained from petroleum (crude oil).

State **one** use for refinery gas.

..... [1]

(b) Draw **three** straight lines to connect each process or reaction in the left hand column with its meaning in the right hand column.

term	meaning
catalytic cracking	exothermic oxidation of hydrocarbons
fractional distillation	reaction that produces alkenes
combustion	process that simplifies a complex mixture

[2]

(c) Decane is a colourless liquid compound which has the chemical formula, $C_{10}H_{22}$.

Fig. 9.1 shows apparatus that a teacher used to show what happens when decane vapour is passed over a hot catalyst.

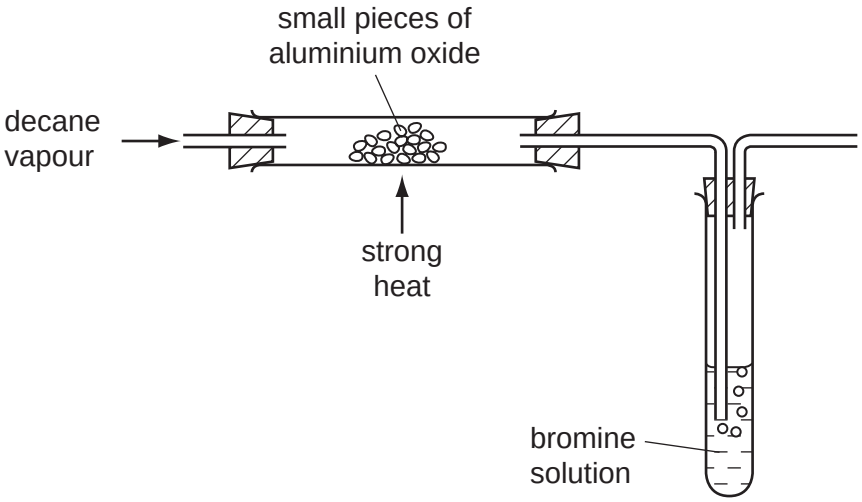


Fig. 9.1

When the teacher started to pass the decane vapour through the apparatus, the solution of bromine rapidly changed colour from orange to colourless.

(i) Suggest and explain why the bromine solution changed from orange to colourless.

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.....

.....

..... [3]

(ii) Suggest why the catalyst was heated.

.....

..... [1]

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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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

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

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

Key

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

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