



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

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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.

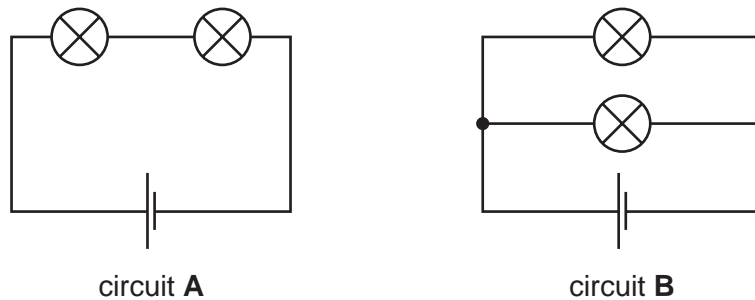


Fig. 1.1

- (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 circuit **A**.

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

(iii) The resistance of each lamp is $1.2\ \Omega$.

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]

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

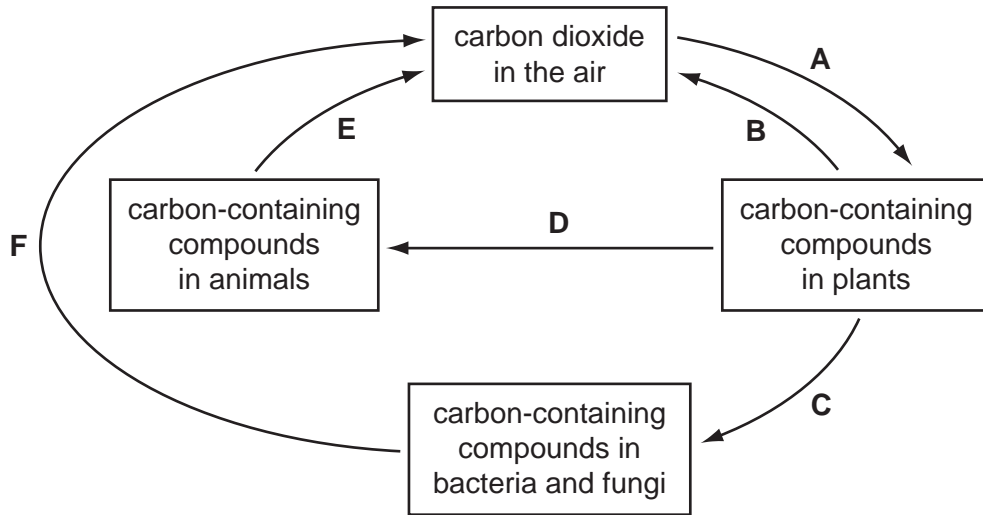


Fig. 2.1

(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.

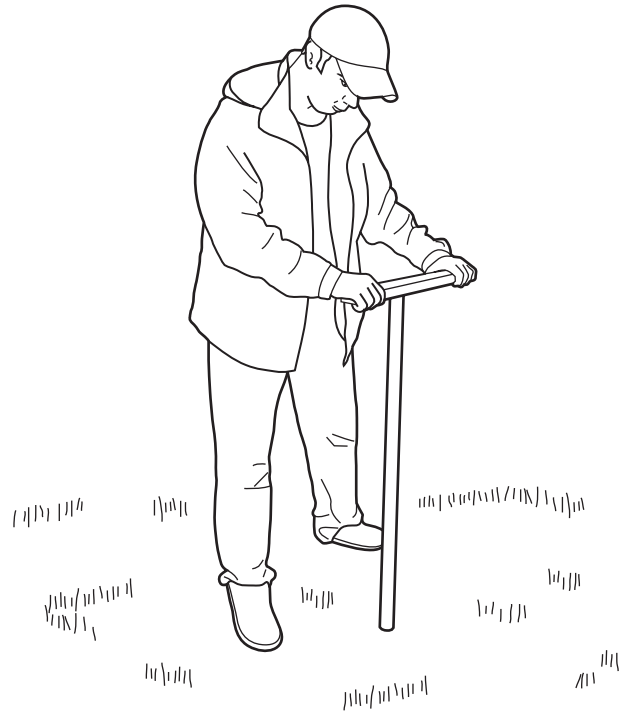
.....

 [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.

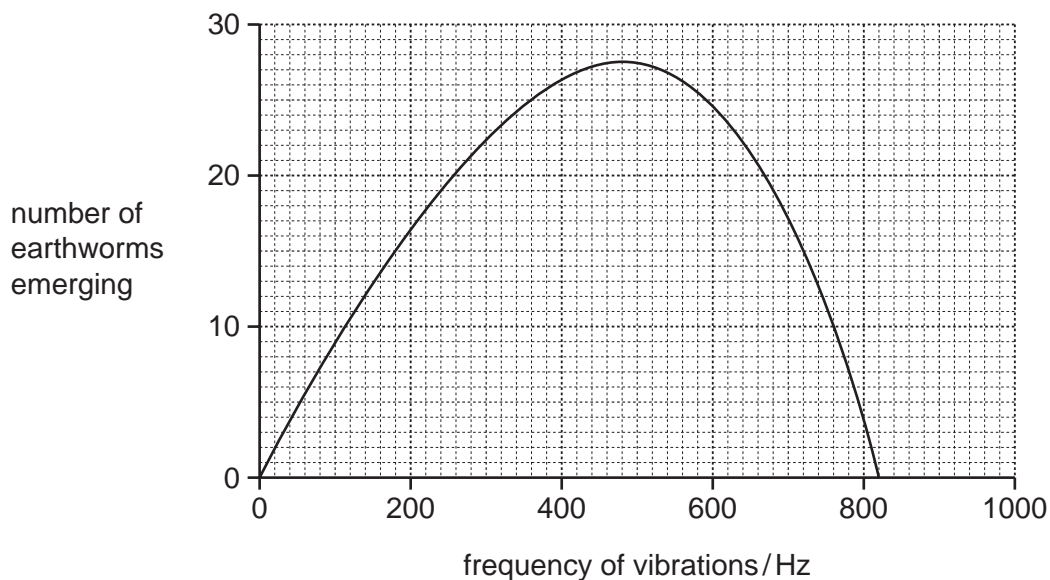


Fig. 2.2

- (i) Describe the effect of different frequencies of vibrations on the numbers of 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]

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

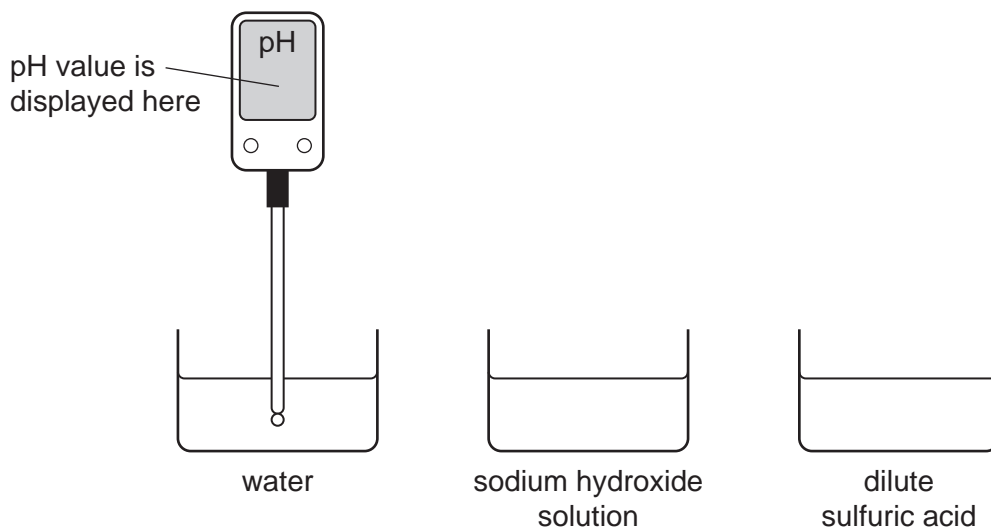


Fig. 3.1

- (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]

For
Examiner's
Use

(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]

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

For
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Use

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.

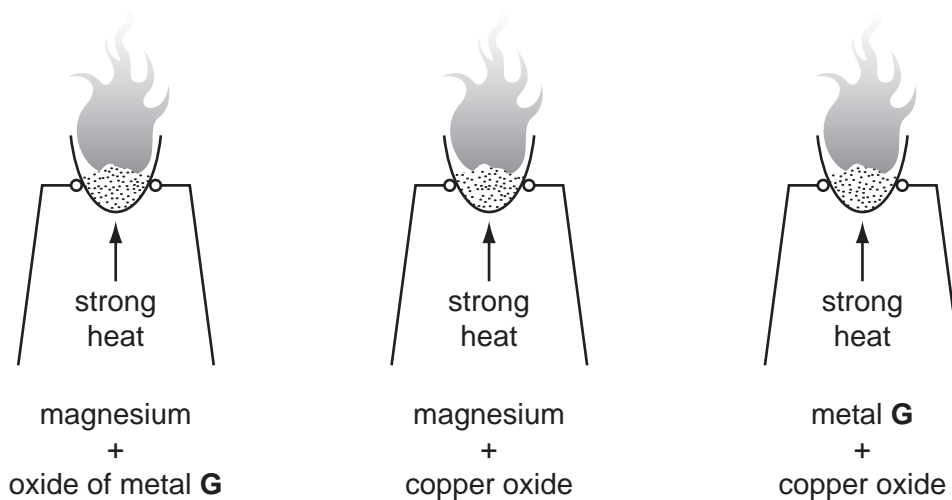


Fig. 3.2

- (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

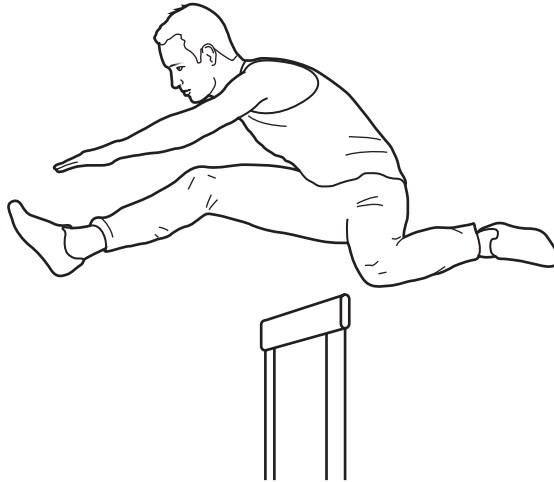
explanation

.....

..... [2]

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

For
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Use



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 germinating seeds.

For
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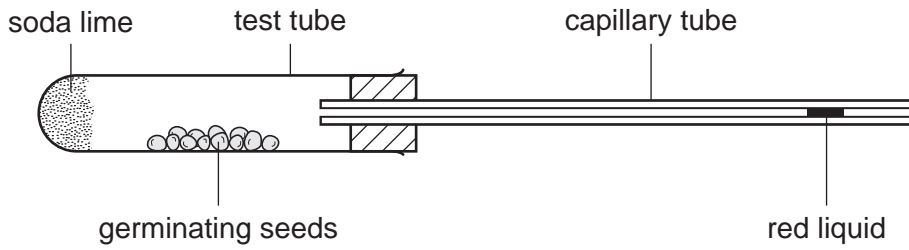


Fig. 5.1

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 rate of 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. Firework mixture is made from several solid substances which have been powdered and mixed together.

For
Examiner's
Use

Fig. 6.1 shows a typical firework.

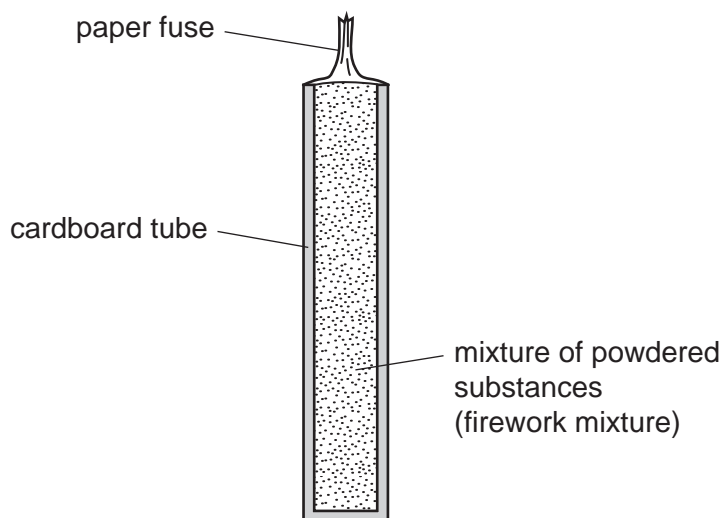


Fig. 6.1

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 ionic compound, aluminium oxide.

For
Examiner's
Use

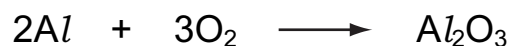
(i) The electron configuration of an aluminium **atom** is **2,8,3** and of an oxygen **atom** is **2,6**.

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.

.....

 [4]

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



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 compound 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.

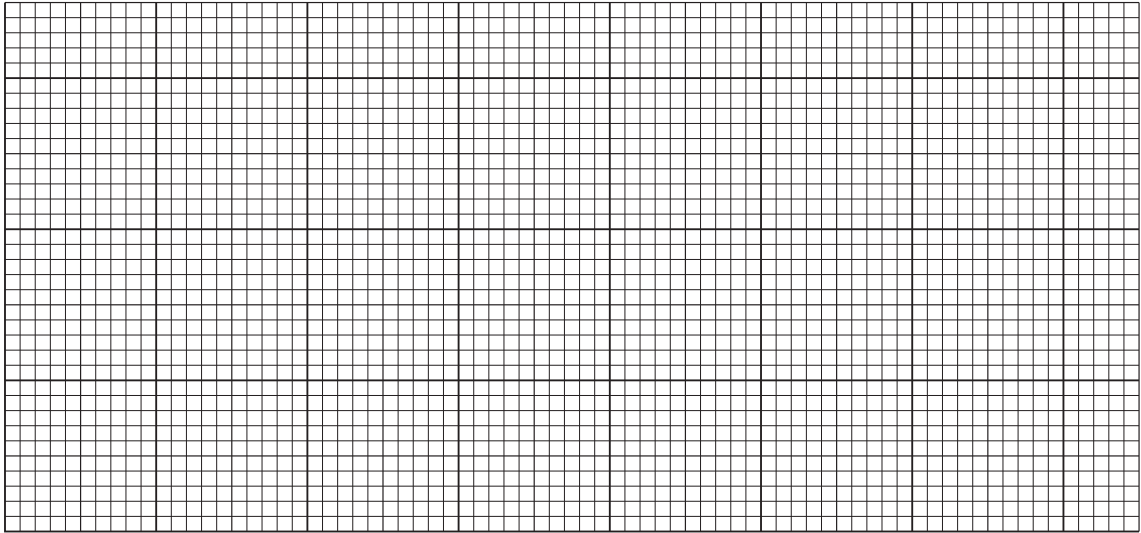
.....

.....

..... [2]

*For
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Use*

- 7 (a) On the grid below, draw a wave with an amplitude of 2 cm and a wavelength of 4 cm.
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 liquid, a gas and a vacuum.

For
Examiner's
Use

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

| | <u>speed of sound</u> 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.

For
Examiner's
Use

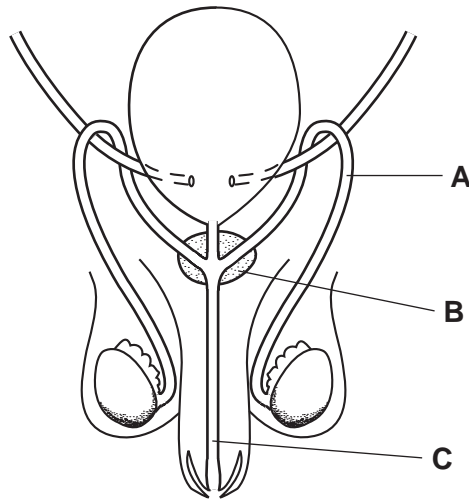


Fig. 8.1

(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 been 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.

For
Examiner's
Use

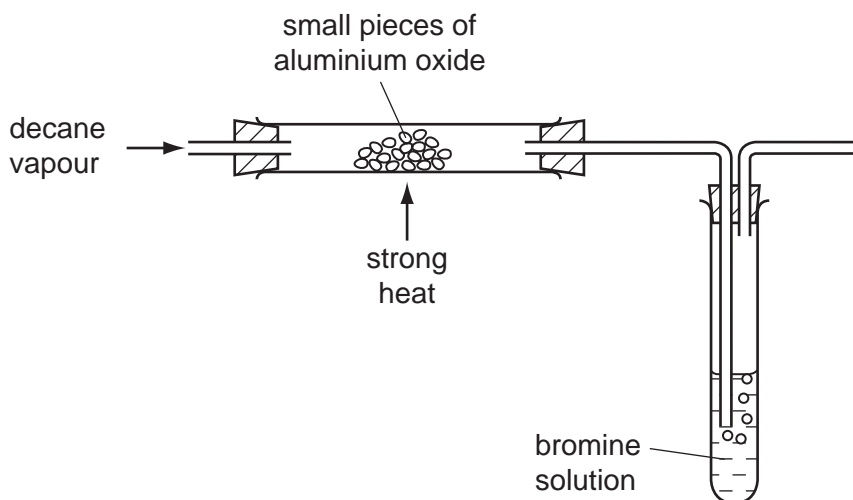


Fig. 9.1

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.

.....

.....

.....

.....

..... [3]

- (ii) Suggest why the catalyst was heated.

.....

..... [1]

DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | | | | | | |
|-----------------------------------|------------------------------------|---|--|-------------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|-------------------------------------|---------------------------------------|---------------------------------------|------------------------------------|--|-------------------------------------|---------------------------------------|----------------------------------|----------------------------------|--|
| | | I | II | III | IV | V | VI | VII | 0 | | | | | | | | | |
| | | 1 H Hydrogen 1 | | | | | | | | | | | | | | | | |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | | | | | | | | | | | | | | | | | |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | | | | | | | | | | | | | | | | | |
| 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 Caesium 55 | 137 Ba Barium 56 | 139 La Lanthanum 57 | 178 Hf Hafnium 72 | 181 Ta Tantalum 73 | 184 W Tungsten 74 | 190 Os Osmium 76 | 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 | 210 At Astatine 85 | 210 Rn Radon 86 | | | |
| 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 | 146 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 | 232 Pa Protactinium 91 | 238 U Uranium 92 | 238 Np Neptunium 93 | 244 Pu Plutonium 94 | 247 Am Americium 95 | 251 Cm Curium 96 | 257 Bk Berkelium 97 | 261 Cf Californium 98 | 265 Es Einsteinium 99 | 269 Fm Fermium 100 | 271 Md Mendelevium 101 | 285 No Nobelium 102 | 289 Lr Lawrencium 103 | | | |

Key

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

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

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