



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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**COMBINED SCIENCE**

**0653/22**

Paper 2 (Core)

**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                  |  |
| <b>Total</b>       |  |

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



1 Fig. 1.1 shows a red blood cell and a root hair cell.

For  
Examiner's  
Use

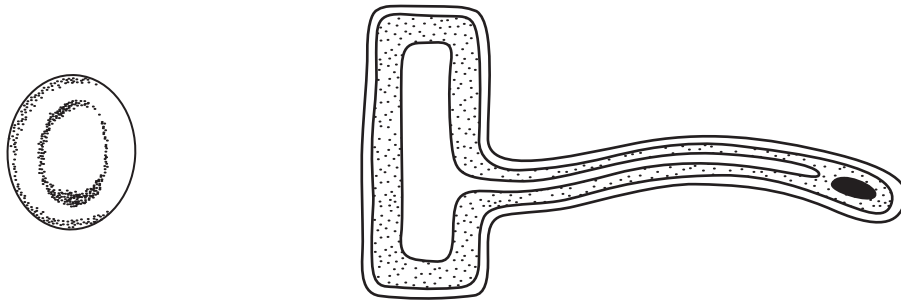


Fig 1.1

(a) Tick (✓) the boxes to show which structures are present in

- a red blood cell,
- a root hair cell.

| structure     | red blood cell           | root hair cell           |
|---------------|--------------------------|--------------------------|
| cell membrane | <input type="checkbox"/> | <input type="checkbox"/> |
| nucleus       | <input type="checkbox"/> | <input type="checkbox"/> |
| chloroplast   | <input type="checkbox"/> | <input type="checkbox"/> |

[2]

(b) (i) Name the red protein found in the cytoplasm of the red blood cell.

..... [1]

(ii) State the function of a red blood cell.

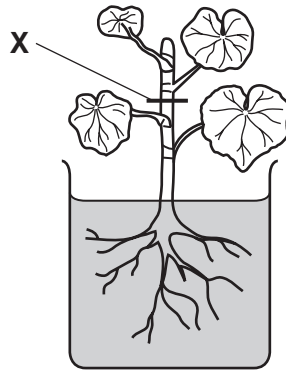
..... [1]

(c) Name the colourless carbohydrate in the cell wall of the root hair cell.

..... [1]

(d) Fig. 1.2 shows a plant with its roots in a beaker of water containing a blue dye.

For  
Examiner's  
Use



**Fig. 1.2**

After 10 minutes, the veins in the leaves of the plant became blue.

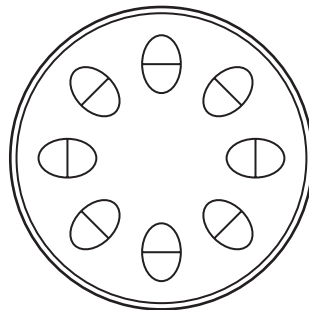
(i) Explain why the veins in the leaves became blue.

.....

.....

..... [2]

(ii) A student cut the stem of the plant at X. Fig. 1.3 shows the appearance of the cut stem seen through a microscope.



**Fig. 1.3**

On Fig. 1.3, use a pencil to shade the part that would look blue.

[1]

- 2 (a) The proton (atomic) number of the element fluorine is 9. Fluorine is found in Period 2 and Group 7 of the Periodic Table.

- (i) Predict the number of electrons in one atom of fluorine.

Explain your answer.

total number of electrons .....

explanation .....

..... [2]

- (ii) Predict and explain, in terms of its position in the Periodic Table, whether this element would be an electrical conductor or an insulator.

.....

..... [1]

- (b) The halogens are reactive elements found in Group 7 of the Periodic Table.

Halogens combine vigorously with the alkali metals from Group 1 to form colourless ionic compounds. The halogens and alkali metals from Periods 2 to 4 are shown in Fig. 2.1.

|    |    |
|----|----|
| Li | F  |
| Na | Cl |
| K  | Br |

Fig. 2.1

- (i) The alkali metals react with water to produce an alkaline solution and a gaseous element.

State and explain briefly which **one** of the alkali metals shown in Fig. 2.1 reacts most vigorously with water.

alkali metal .....

explanation .....

..... [2]

- (ii) Name the gas which is given off during the reaction in (i) and describe a test for this gas.

name .....

test .....

..... [3]

- (iii) Describe how potassium and bromine atoms become strongly bonded together when they react to form potassium bromide.

You may draw a diagram if it helps your answer.

.....

.....

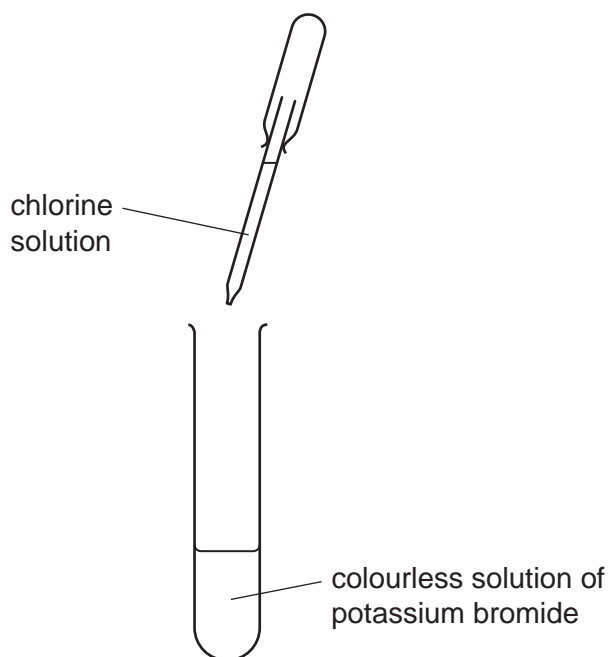
.....

.....

..... [3]

- (c) A student adds a solution containing chlorine to a colourless solution of potassium bromide as shown in Fig. 2.2.

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Use



**Fig. 2.2**

Describe and explain briefly what is observed when chlorine and potassium bromide react.

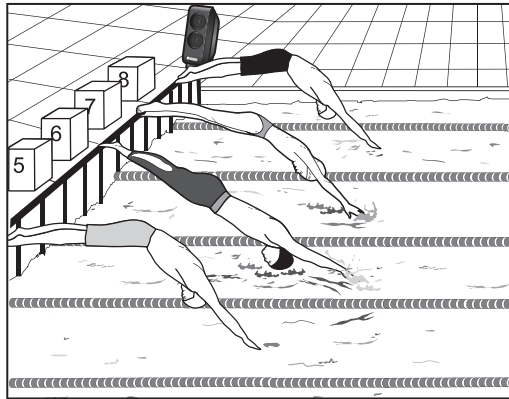
observation .....

.....

explanation .....

..... [2]

- 3 Fig. 3.1 shows four swimmers at the start of a race.



**Fig. 3.1**

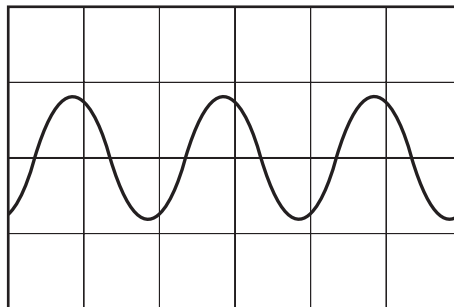
- (a) State the form of energy which the swimmers lose as they fall from their starting positions into the water.

..... [1]

- (b) The swimmers start their race when they hear a loud, high-pitched sound from a loudspeaker.

- (i) Fig. 3.2 shows the trace of a sound wave as it appears on an oscilloscope screen.

On Fig. 3.2 draw another trace of a sound wave from a sound that is louder than the one shown, but has the same pitch.



**Fig. 3.2**

[2]

(ii) Fig. 3.3 shows the trace of a sound wave as it appears on an oscilloscope screen.

On Fig. 3.3 draw another trace of a sound wave from a sound that has a higher pitch than the one shown, but has the same loudness.

For  
Examiner's  
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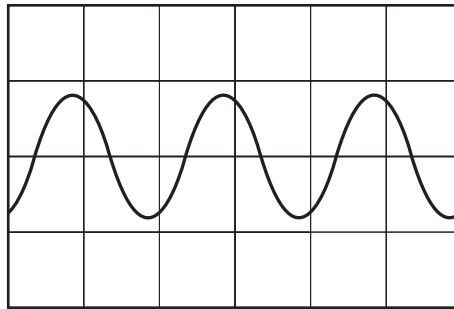


Fig. 3.3

[2]

(iii) The swimmers can hear the sound from the loudspeaker only if the frequency of the sound lies within a range of frequencies which the human ear can detect.

State this range of frequencies.

..... Hz to ..... Hz [1]

(c) Sound travels at 330 m/s in air. One swimmer is 0.4 m from the loudspeaker when he hears the sound.

Calculate the time taken for the sound to travel from the loudspeaker to the swimmer.

State the formula that you use and show your working.

formula used

working

..... s [2]



(d) When the swimmers have finished their race, they leave the pool. The water on their bodies evaporates.

*For  
Examiner's  
Use*

Explain in terms of particles how this evaporation takes place.

.....

.....

.....

..... [3]

4 (a) Fig. 4.1 shows part of a food web in a forest ecosystem.

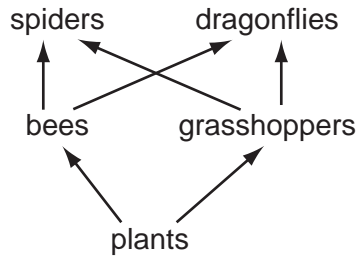


Fig. 4.1

(i) Plants are the producers in this food web.

Define the term *producer*.

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

(ii) Name **one** organism in the food web that is a carnivore.

..... [1]

(iii) What do the arrows in the food web represent?

..... [1]

(b) The food web shows that bees depend on plants. Some flowering plants also depend on bees and other insects to help them to reproduce.

(i) Complete the sentences, using words from the list.

- |                |                |                |                |
|----------------|----------------|----------------|----------------|
| <b>anthers</b> | <b>asexual</b> | <b>diploid</b> | <b>haploid</b> |
| <b>ovary</b>   | <b>petals</b>  | <b>sexual</b>  | <b>stigma</b>  |

Flowers are organs in which ..... reproduction takes place.

Pollen grains are made in the .....

During pollination, insects carry pollen grains from one flower to another. The

pollen grains are transferred to the ..... [3]

(ii) After they have been pollinated, flowers produce seeds.

List **two** environmental conditions that all seeds need for germination.

1 .....

2 .....

[2]

*For  
Examiner's  
Use*

- 5 Acid indigestion is caused by unusually high levels of stomach acid. This condition may be treated by taking an antacid tablet.

One type of antacid tablet contains a mixture of sodium hydrogencarbonate, calcium carbonate and magnesium carbonate.

A student investigated the reaction between these antacid tablets and dilute hydrochloric acid.

Fig. 5.1 shows one of the experiments the student carried out.

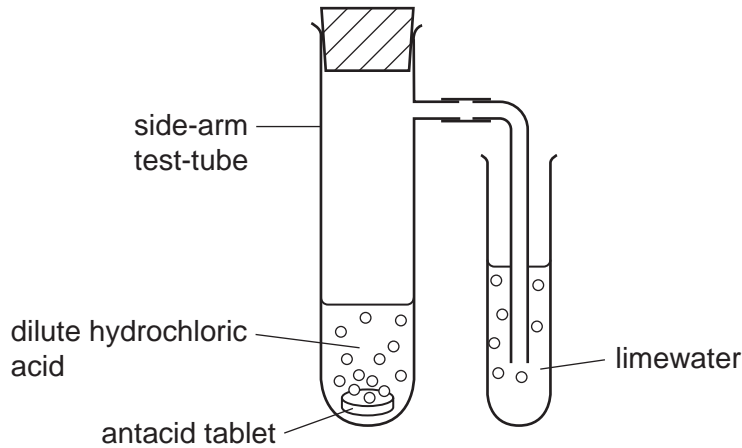


Fig. 5.1

A gas was given off when the antacid tablet reacted with the dilute hydrochloric acid. This gas reacted with the limewater.

- (a) Describe and explain the change in appearance of the limewater during the experiment.

.....

.....

..... [2]

- (b) The student used excess acid in the reaction shown in Fig. 5.1, which caused the antacid tablet to react and dissolve completely.

State the names of **two** salts that remain in the solution when the reaction is finished.

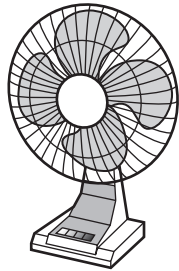
1 .....

2 ..... [2]

6 (a) The appliances shown convert electrical energy into other forms of energy.

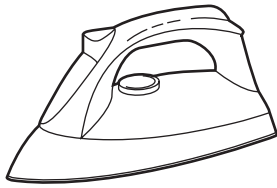
Complete the sentences next to each diagram to show the useful form of energy released.

(i)



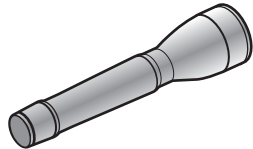
A fan converts electrical energy into  
..... energy. [1]

(ii)



An iron converts electrical energy into  
..... energy. [1]

(iii)



A torch (flashlight) converts electrical  
energy into  
..... energy. [1]

(b) There are several precautions that are necessary to avoid getting an electric shock or starting a fire when using electrical appliances.

(i) State **one** precaution that must be taken when using an electrical appliance.

.....  
..... [1]

(ii) For the precaution described in (i), explain why it is important.

.....  
.....  
..... [1]

- (c) Some torches (flashlights) use a filament lamp. Fig. 6.1 shows a circuit for measuring the current through a filament lamp as the potential difference is changed.

For  
Examiner's  
Use

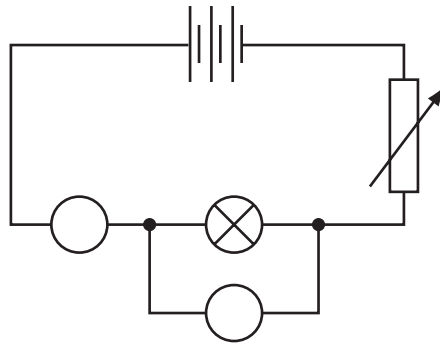


Fig. 6.1

Write the letters **A** and **V** in the two circles on the diagram. They should show the correct positions of the ammeter **A** and voltmeter **V**. [1]

- (d) Fig. 6.2 shows a graph of the results.

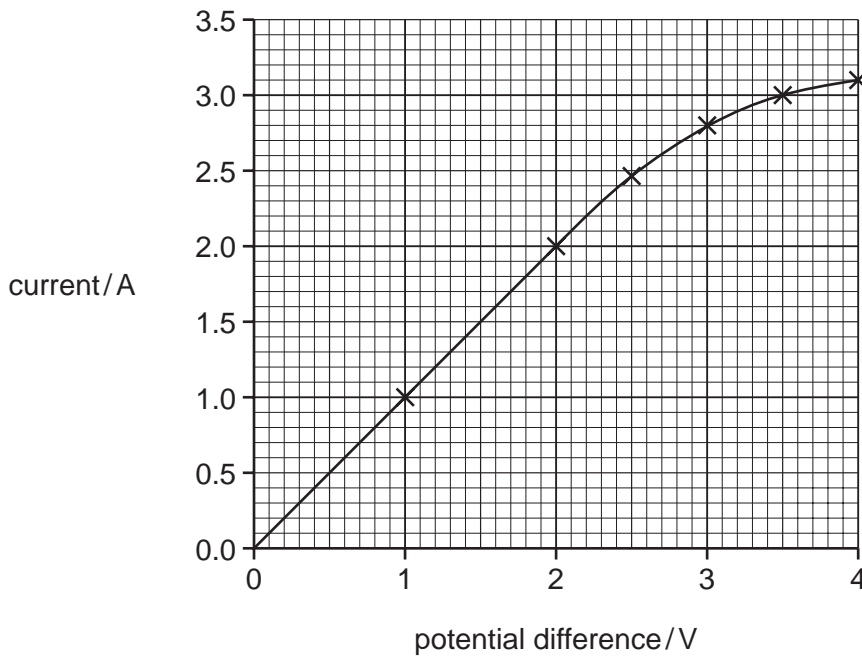


Fig. 6.2

- (i) Use the graph to find the current when the potential difference is 1.5V.

Show your working on the graph.

..... A [1]

(ii) Describe how the current through the filament lamp changes as the voltage increases above 2.0V.

.....  
..... [1]

(e) A single ray of light from a torch is shone onto a mirror as shown in Fig. 6.3.

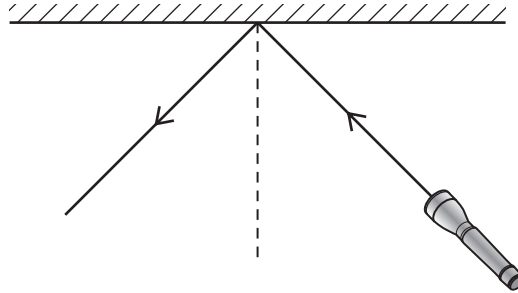


Fig. 6.3

(i) On Fig. 6.3, label the angle of incidence and angle of reflection. [1]

(ii) The angle of incidence = 45°.

Write down the value of the angle of reflection. .... [1]

7 (a) Fig. 7.1 shows the human alimentary canal.

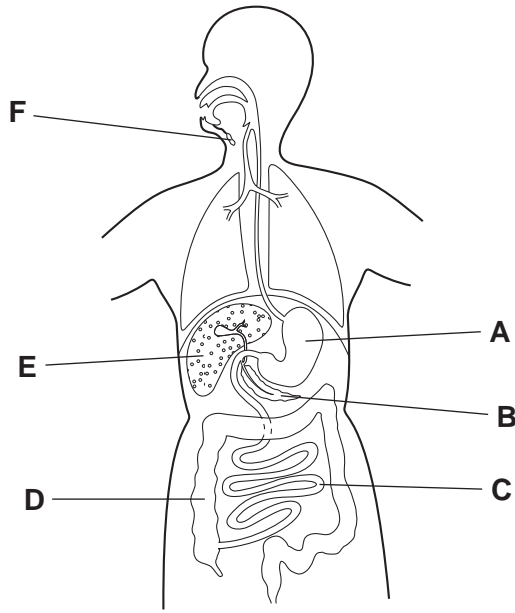


Fig. 7.1

(i) Name

part A, .....

part D. ....

[2]

(ii) State the **letter** that indicates

the liver, .....

the area where digested food is absorbed. ....

[2]

(b) Describe how the molar teeth help in the digestion of food.

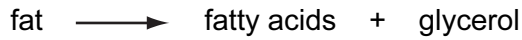
.....

.....

..... [2]



(c) Lipase is an enzyme that catalyses the breakdown of fats to fatty acids and glycerol.



For  
Examiner's  
Use

A student carried out an experiment to investigate the effect of temperature on the rate of the breakdown of fats by lipase. Fig. 7.2 shows how she set up two test-tubes.

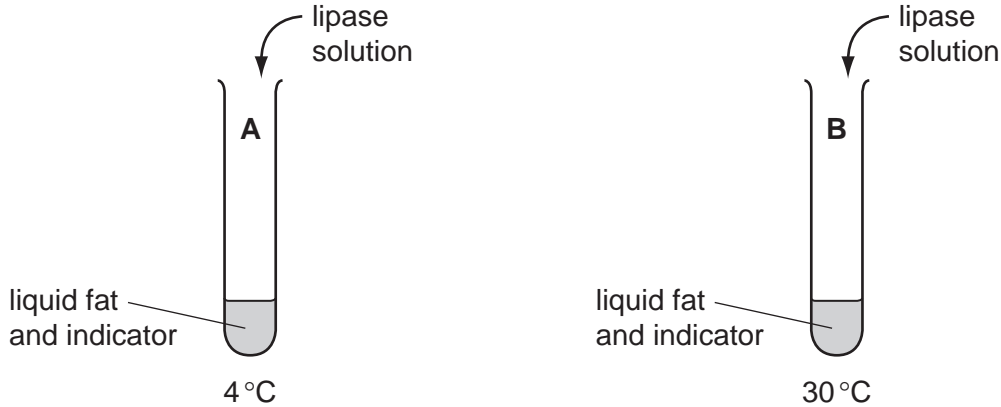


Fig. 7.2

The indicator that the student used changes colour from blue to yellow when the pH falls below 5.

Table 7.1 shows her results.

Table 7.1

| time / minutes | tube A (4°C) | tube B (30°C) |
|----------------|--------------|---------------|
| 0              | blue         | blue          |
| 5              | blue         | yellow        |
| 10             | blue         | yellow        |
| 15             | yellow       | yellow        |

(i) Explain why the indicator eventually changed to yellow in both tubes.

..... [1]

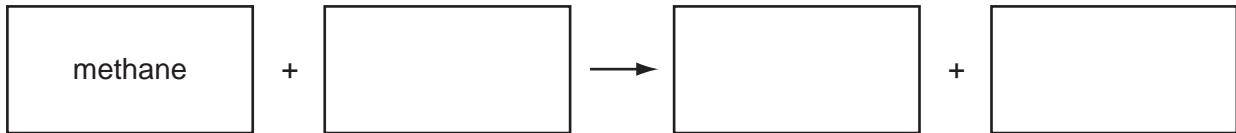
(ii) Explain the reason for the difference between the results for tube A and tube B.

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

8 Large amounts of chemical energy are stored in the world's reserves of fossil fuels such as natural gas and petroleum (crude oil).

(a) Methane is found in natural gas.

(i) Complete the **word** chemical equation for the complete combustion of methane.



[3]

(ii) State the term used to describe chemical reactions that release heat.

..... [1]

(b) Petroleum is a mixture of a very large number of compounds.

Fig. 8.1 shows a diagram of the industrial process used to separate petroleum into mixtures that are more useful.

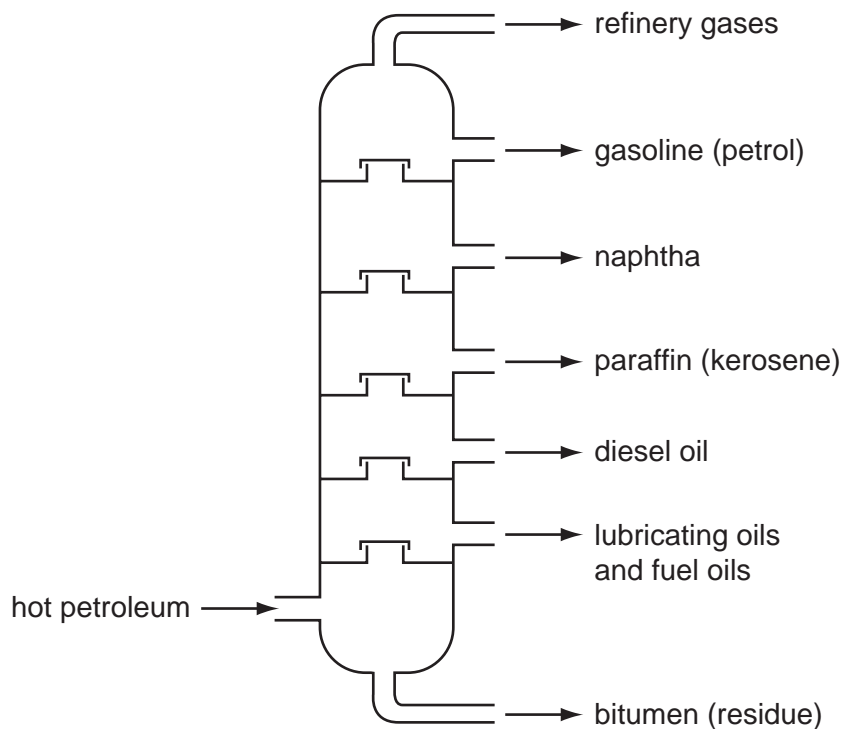
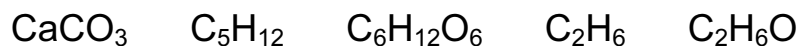


Fig. 8.1

(i) State the full name of the process shown in Fig. 8.1.

..... [1]

- (ii) The list below shows the chemical formulae of five compounds.



State and explain which of these formulae represent compounds that are found in petroleum.

formulae .....

explanation ..... [2]

- (iii) State **one** use of refinery gas.

..... [1]

- (iv) Refinery gas contains the compound ethane.

Complete the diagram of the structure of one molecule of ethane which has been started below.



[2]

For  
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9 Fig. 9.1 shows a toy car of mass 0.5 kg travelling over a plastic surface.

For  
Examiner's  
Use

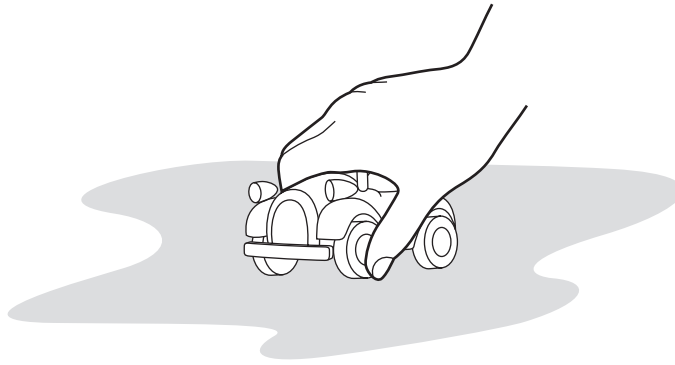


Fig. 9.1

(a) While the car is moving the wheels are rubbing against the plastic surface. The car becomes electrostatically charged with a positive charge.

Explain how this happens.

.....

.....

..... [3]

- (b) A speed – time graph for the car is shown in Fig. 9.2. It shows the motion of the car over a 25 second period.

For  
Examiner's  
Use

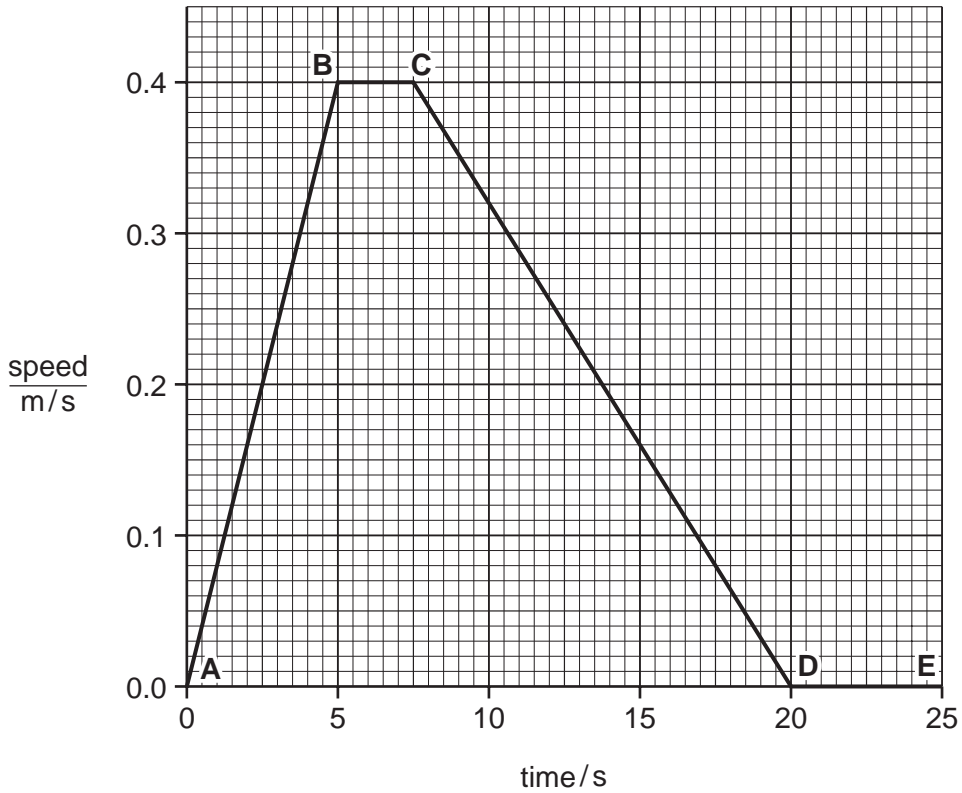


Fig. 9.2

- (i) Use the graph to find one time when the car is not moving. Write down this time.

..... [1]

- (ii) Determine **one** part of the graph when the car was travelling at constant speed and write down the value of this speed.

part of graph .....

speed ..... [2]





**DATA SHEET**  
**The Periodic Table of the Elements**

|     |     | Group                          |                              |                                     |                                    |                                    |                                     |                                     |                                     |                                  |                                   |                                    |                                      |                                     |  |                                    |                                     |  |                                       |                                    |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
|-----|-----|--------------------------------|------------------------------|-------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|----------------------------------|-----------------------------------|------------------------------------|--------------------------------------|-------------------------------------|--|------------------------------------|-------------------------------------|--|---------------------------------------|------------------------------------|--|-------------------------------------|---------------------------------------|-----------------------------------|----------------------------------|-----------------------------------|-------------------------------------|------------------------------------|
|     |     | I                              | II                           | III                                 | IV                                 | V                                  | VI                                  | VII                                 | VIII                                | IX                               | X                                 |                                    |                                      |                                     |  |                                    |                                     |  |                                       |                                    |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
|     |     | 1<br><b>H</b><br>Hydrogen<br>1 |                              |                                     |                                    |                                    |                                     |                                     |                                     |                                  |                                   |                                    |                                      |                                     |  |                                    |                                     |  |                                       |                                    |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
| 7   | 9   | <b>Li</b><br>Lithium<br>3      | <b>Be</b><br>Beryllium<br>4  |                                     |                                    |                                    |                                     |                                     |                                     |                                  |                                   |                                    |                                      |                                     |  |                                    |                                     |  |                                       |                                    |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
| 23  | 24  | <b>Na</b><br>Sodium<br>11      | <b>Mg</b><br>Magnesium<br>12 |                                     |                                    |                                    |                                     |                                     |                                     |                                  |                                   |                                    |                                      |                                     |  |                                    |                                     |  |                                       |                                    |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
| 39  | 40  | <b>K</b><br>Potassium<br>19    | <b>Ca</b><br>Calcium<br>20   | 45<br><b>Sc</b><br>Scandium<br>21   | 48<br><b>Ti</b><br>Titanium<br>22  | 51<br><b>V</b><br>Vanadium<br>23   | 52<br><b>Cr</b><br>Chromium<br>24   | 55<br><b>Mn</b><br>Manganese<br>25  | 56<br><b>Fe</b><br>Iron<br>26       | 59<br><b>Co</b><br>Cobalt<br>27  | 59<br><b>Ni</b><br>Nickel<br>28   | 64<br><b>Cu</b><br>Copper<br>29    | 65<br><b>Zn</b><br>Zinc<br>30        | 70<br><b>Ga</b><br>Gallium<br>31    | 73<br><b>Ge</b><br>Germanium<br>32     | 75<br><b>As</b><br>Arsenic<br>33   | 79<br><b>Se</b><br>Selenium<br>34   | 80<br><b>Br</b><br>Bromine<br>35       | 84<br><b>Kr</b><br>Krypton<br>36      |                                    |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
| 85  | 88  | <b>Rb</b><br>Rubidium<br>37    | <b>Sr</b><br>Strontium<br>38 | 89<br><b>Y</b><br>Yttrium<br>39     | 91<br><b>Zr</b><br>Zirconium<br>40 | 93<br><b>Nb</b><br>Niobium<br>41   | 96<br><b>Mo</b><br>Molybdenum<br>42 | 101<br><b>Ru</b><br>Ruthenium<br>44 | 106<br><b>Pd</b><br>Palladium<br>46 | 108<br><b>Ag</b><br>Silver<br>47 | 112<br><b>Cd</b><br>Cadmium<br>48 | 115<br><b>In</b><br>Indium<br>49   | 119<br><b>Sn</b><br>Tin<br>50        | 122<br><b>Sb</b><br>Antimony<br>51  | 128<br><b>Te</b><br>Tellurium<br>52    | 127<br><b>I</b><br>Iodine<br>53    | 131<br><b>Xe</b><br>Xenon<br>54     |  |                                       |                                    |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
| 133 | 137 | <b>Cs</b><br>Caesium<br>55     | <b>Ba</b><br>Barium<br>56    | 139<br><b>La</b><br>Lanthanum<br>57 | 178<br><b>Hf</b><br>Hafnium<br>72  | 181<br><b>Ta</b><br>Tantalum<br>73 | 184<br><b>W</b><br>Tungsten<br>74   | 190<br><b>Os</b><br>Osmium<br>76    | 195<br><b>Pt</b><br>Platinum<br>78  | 197<br><b>Au</b><br>Gold<br>79   | 201<br><b>Hg</b><br>Mercury<br>80 | 204<br><b>Tl</b><br>Thallium<br>81 | 207<br><b>Pb</b><br>Lead<br>82       | 209<br><b>Bi</b><br>Bismuth<br>83   | 210<br><b>Po</b><br>Polonium<br>84     | 210<br><b>At</b><br>Astatine<br>85 | 210<br><b>Rn</b><br>Radon<br>86     |  |                                       |                                    |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
|     | 226 | <b>Fr</b><br>Francium<br>87    | <b>Ra</b><br>Radium<br>88    | 227<br><b>Ac</b><br>Actinium<br>89  |                                    |                                    |                                     |                                     |                                     |                                  |                                   |                                    | 157<br><b>Gd</b><br>Gadolinium<br>64 | 159<br><b>Tb</b><br>Terbium<br>65   | 162<br><b>Dy</b><br>Dysprosium<br>66   | 165<br><b>Ho</b><br>Holmium<br>67  | 167<br><b>Er</b><br>Erbium<br>68    | 169<br><b>Tm</b><br>Thulium<br>69      | 173<br><b>Yb</b><br>Ytterbium<br>70   | 175<br><b>Lu</b><br>Lutetium<br>71 |  |                                     |                                       |                                   |                                  |                                   |                                     |                                    |
|     |     |                                |                              |                                     |                                    |                                    |                                     |                                     |                                     |                                  |                                   | 152<br><b>Eu</b><br>Europium<br>63 | 150<br><b>Sm</b><br>Samarium<br>62   | 144<br><b>Nd</b><br>Neodymium<br>60 | 141<br><b>Pr</b><br>Praseodymium<br>59 | 140<br><b>Ce</b><br>Cerium<br>58   | 137<br><b>La</b><br>Lanthanum<br>57 | 137<br><b>Pr</b><br>Praseodymium<br>59 | 137<br><b>Sm</b><br>Samarium<br>62    | 137<br><b>Eu</b><br>Europium<br>63 | 137<br><b>Gd</b><br>Gadolinium<br>64   | 137<br><b>Tb</b><br>Terbium<br>65   | 137<br><b>Dy</b><br>Dysprosium<br>66  | 137<br><b>Ho</b><br>Holmium<br>67 | 137<br><b>Er</b><br>Erbium<br>68 | 137<br><b>Tm</b><br>Thulium<br>69 | 137<br><b>Yb</b><br>Ytterbium<br>70 | 137<br><b>Lu</b><br>Lutetium<br>71 |
|     |     |                                |                              |                                     |                                    |                                    |                                     |                                     |                                     |                                  |                                   | 238<br><b>U</b><br>Uranium<br>92   | 238<br><b>Np</b><br>Neptunium<br>93  | 238<br><b>Pu</b><br>Plutonium<br>94 | 238<br><b>Am</b><br>Americium<br>95    | 238<br><b>Cm</b><br>Curium<br>96   | 238<br><b>Bk</b><br>Berkelium<br>97 | 238<br><b>Cf</b><br>Californium<br>98  | 238<br><b>Es</b><br>Einsteinium<br>99 | 238<br><b>Fm</b><br>Fermium<br>100 | 238<br><b>Md</b><br>Mendelevium<br>101 | 238<br><b>No</b><br>Nobelium<br>102 | 238<br><b>Lr</b><br>Lawrencium<br>103 |                                   |                                  |                                   |                                     |                                    |

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

|     |   |   |   |
|-----|---|---|---|
|     | a | X | a = relative atomic mass<br>X = atomic symbol<br>b = proton (atomic) number |
| Key | b | X |   |

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

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