**International General Certificate of Secondary Education**
**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**COMBINED SCIENCE**                                        **0653/3**

PAPER 3

**MAY/JUNE SESSION 2002**

1 hour 15 minutes

Candidates answer on the question paper.
No additional materials are required.

**TIME**     1 hour 15 minutes

**INSTRUCTIONS TO CANDIDATES**

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is printed on page 20.

| FOR EXAMINER'S USE | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| TOTAL | |

**This question paper consists of 18 printed pages and 2 blank pages.**

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**[Turn over**

**1** Fig. 1.1 shows how the current in a circuit varies with voltage.
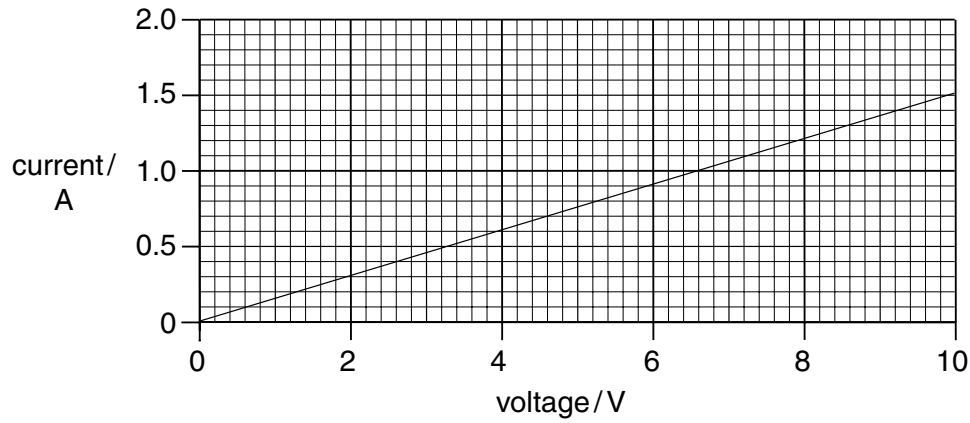


**Fig. 1.1**

**(a)** Is Ohm's law obeyed in this circuit? Explain your answer.

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

**(b)** What current would you expect at 12 V? Explain your answer.

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

**(c)** In the space below, draw a circuit diagram for the circuit you would use to obtain the results shown in Fig. 1.1.

[4]

**2** Haemoglobin is a protein that transports oxygen around the body.

**(a)** State precisely where haemoglobin is found in the human body.

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

**(b)** Some people have a disease called sickle cell anaemia. This happens because they are homozygous for a recessive allele, **a**, of the haemoglobin gene. This allele produces a form of haemoglobin, called sickle cell haemoglobin, that does not transport oxygen very well. The dominant allele, **A**, produces normal haemoglobin.

 **(i)** Give the genotype of a person with sickle cell anaemia.

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

 **(ii)** Draw a genetic diagram to show how two people with normal haemoglobin could have a child with sickle cell anaemia.

Your genetic diagram should show the phenotypes and genotypes of the parents, the genotypes of the gametes, and all the possible genotypes of their children.

[4]

**(c)** Explain why someone with sickle cell anaemia may feel very tired and ill if they try to do vigorous exercise.

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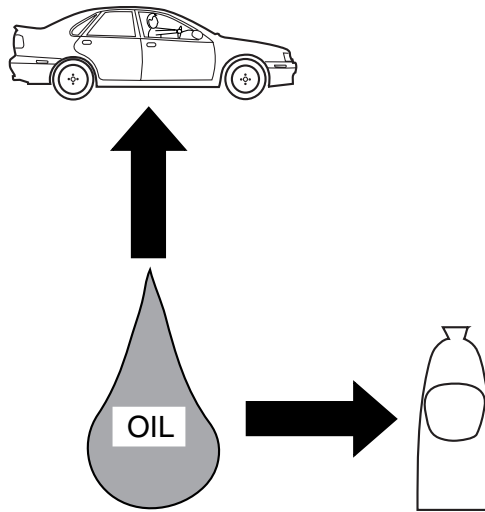......................................................................................................................... [3]

**(d)** People can also suffer from anaemia if they are lacking a particular mineral in their diet.

Name this mineral.

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

**[Turn over**

**3** Crude oil (petroleum) is a natural raw material which is processed into many useful products, including fuels and plastics.



**(a)** The list below shows some stages that are necessary in order to produce plastic bottles from crude oil.

**cracking**

**fractional distillation**

**moulding**

**oil arrives at the refinery**

**polymerisation**

Complete the table, Fig. 3.1, to place these processes into the correct sequence.

| 1 | oil arrives at the refinery |
|---|---|
| 2 | |
| 3 | |
| 4 | |
| 5 | moulding |

**Fig. 3.1** [2]

**(b)** The equations **A**, **B** and **C**, below show different types of chemical reaction which involve hydrocarbons.
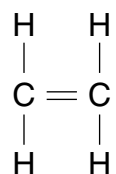
**A**   $C_3H_8 + 5O_2$ $\qquad$ $3CO_2 + 4H_2O$

**B**   $C_{15}H_{32}$ $\qquad$ $C_8H_{18} + C_3H_6 + 2C_2H_4$

**C**   $C_4H_8 + Br_2$ $\qquad$ $C_4H_8Br_2$

 **(i)** State which one of the equations, **A**, **B** or **C**, represents a typical cracking reaction.

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

 **(ii)** State which one of the equations, **A**, **B** or **C**, shows a chemical test for double bonds in hydrocarbon molecules.

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

**(c)** The displayed formula of one molecule of the gas ethene is shown below.

$$\begin{array}{ccc} H & & H \\ | & & | \\ C & = & C \\ | & & | \\ H & & H \end{array}$$

When ethene is heated and pressurised in the absence of air, a white solid is formed.

Name the solid, and describe what happens to ethene molecules during the reaction.

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**(d)** Calculate the relative molecular mass of butane, $C_4H_{10}$.

Show your working.

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

**[Turn over**

**4** Fig. 4.1 shows a flask containing water at 20 °C.



narrow glass tube

bung
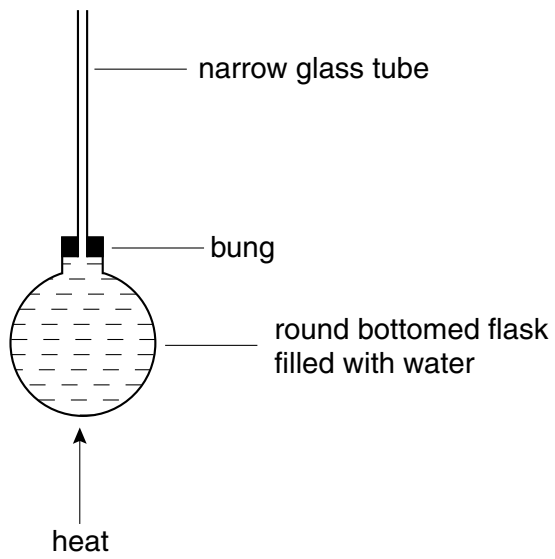
round bottomed flask
filled with water

heat

**Fig. 4.1**

Describe and explain, in terms of molecules, what happens to the flask and its contents
when they are heated steadily to 50 °C.

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**5** **(a)** A spacecraft is launched to travel to Mars. Calculate the average speed of the spacecraft if it travels $2.0 \times 10^8$ km (200 million km) in 2 500 hours.

Show your working and state any formula that you use.

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

**(b)** The spacecraft sends a radio message $2.0 \times 10^8$ km back to Earth from Mars.

  **(i)** Write down the speed at which radio waves travel in a vacuum.

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

  **(ii)** Calculate the time taken for the message to be received on Earth.

  Show your working and state any formula that you use.

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

**(c)** An astronaut's mass on Earth is 60 kg.

What will be her mass on Mars? Explain your answer.

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

**[Turn over**