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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/03**

Paper 3 (Extended) **May/June 2008**

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 20.

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.

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1	
2	
3	
4	
5	
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7	
8	
9	
Total	

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For Examiner's

1 **(a)** Give the term that matches each of these definitions.

a green pigment, found in some plant cells, which absorbs light energy

.....

an organelle, found in some plant cells, where photosynthesis occurs

.....

a fully permeable layer surrounding a plant cell

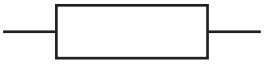
.....

a partially permeable layer surrounding all cells

..... [2]

(b) During photosynthesis, glucose is produced in the leaves of a plant. Some of the glucose is changed to a different sugar and transported to the roots, where it is converted into starch and stored.

(i) The diagram represents a glucose molecule. Complete the diagram to show part of a starch molecule.



[1]

(ii) If the outer parts of a plant stem are damaged, this can prevent sugars being transported to the roots.

Explain why this happens, and why it can kill the plant.

.....

.....

..... [2]

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(c) Fig. 1.1 shows one of the ways in which a plant called *Bryophyllum* reproduces. It grows new plantlets from its leaves.

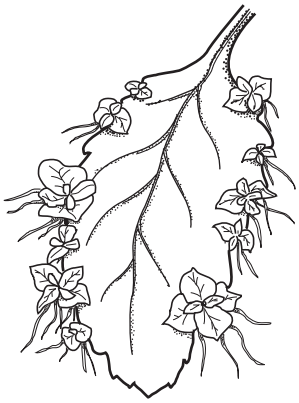

Fig. 1.1

(i) Name the type of reproduction that is taking place.

..... [1]

(ii) Explain why reproducing in this way, rather than by producing seeds, might be an advantage to the plant.

.....

.....

.....

..... [3]

(d) Describe **one** other function of plant leaves, apart from photosynthesis and reproduction.

.....

.....

..... [2]

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For Examiner's

2 **(a)** A student wrote down some properties of alpha, beta and gamma radiations.

Draw a line from each property to the correct radiation.

contains negatively charged particles	alpha
passes through several centimetres of lead	
has no mass	beta
is deflected towards a negatively charged plate	
is not affected by an electric field	gamma
is the most ionising in air	

[3]

(b) Cobalt-60 is a radioactive isotope of cobalt.

Explain what is meant by the word *isotope*.

.....

.....

..... [2]

(c) Gamma radiation can be used to sterilise surgical instruments. What property of gamma radiation makes it suitable for this purpose?

..... [1]

(d) A scientist investigated the activity of a radioactive isotope. She measured a count rate of 8000 per second.

20 minutes later the count rate was 2000 per second.

(i) Calculate the half-life of the isotope.

..... [1]

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(ii) Predict how long after the start of the experiment the scientist could expect to measure a count rate of 250 per second.

Show your working.

..... [2]

(e) In an experiment, a radiation detector was set up and used to measure background radiation. The background radiation in the laboratory was found to be 40 counts per minute.

(i) What is *background radiation*?

.....

..... [1]

(ii) A radioactive source was placed near the detector and a reading of 1200 counts per minute was recorded. What was the count rate of the radioactive source?

..... counts per minute [1]

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3 Kerosene is a mixture of hydrocarbons used as a fuel for aircraft and for lighting and cooking.

Kerosene is obtained from petroleum (crude oil) and is a liquid which boils in the range 150 °C – 200 °C.

(a) **(i)** Name **one** other type of liquid fuel which is obtained from petroleum.

..... [1]

(ii) State the important difference between the various compounds in petroleum which enables them to be separated by fractional distillation.

..... [1]

(b) A typical molecule in kerosene has the formula $C_{13}H_{28}$.

Complete the balanced equation below for the complete combustion of $C_{13}H_{28}$.

$$C_{13}H_{28} + \text{.....} \rightarrow 13CO_2 + 14H_2O$$

[2]

(c) Fig. 3.1 shows a dot-and-cross diagram of a molecule of carbon dioxide.

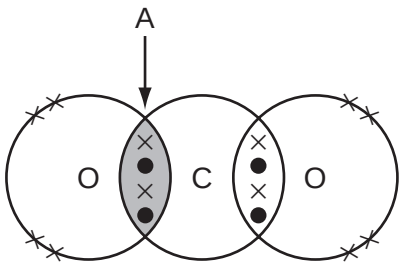

Fig. 3.1

Describe in detail what is shown by the shaded area, **A**.

.....

.....

..... [2]

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4 Fig. 4.1 shows the quantity of nitrogen oxides and sulphur dioxide that was emitted atmosphere by a large industrial company between 2001 and 2005.

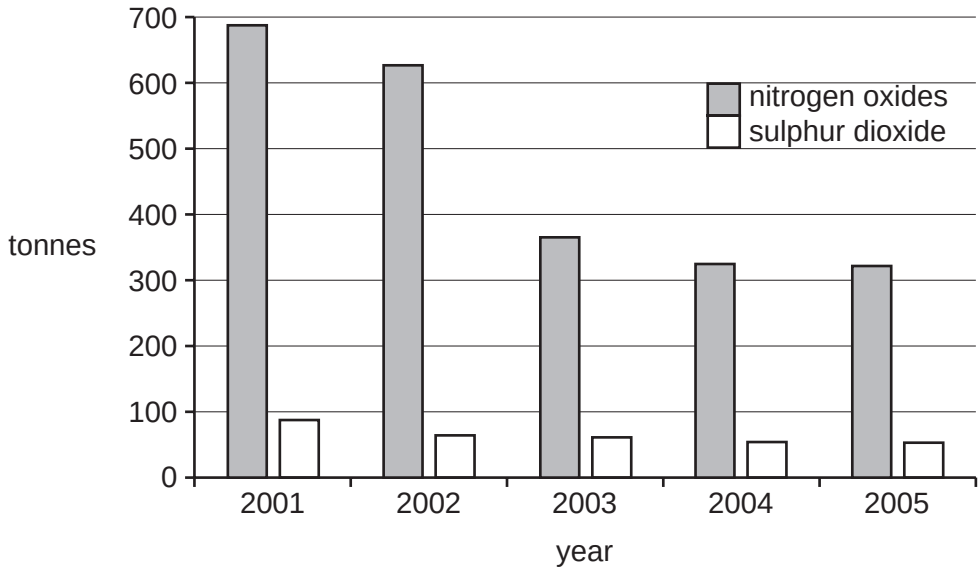

Fig. 4.1

(a) Describe the change in emissions of nitrogen oxides between 2001 and 2005.

.....

.....

..... [2]

(b) Suggest **two** ways in which the changes in sulphur dioxide emissions may have been brought about.

.....

.....

..... [2]

(c) Explain why reducing the quantities of nitrogen oxides and sulphur dioxide that are emitted to the air would be beneficial to the environment.

.....

.....

.....

..... [3]

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5 A man is playing golf.

(a) As the golfer moves around the course in a golf cart, his movement is measured. The measurements are plotted on the graph in Fig. 5.1.

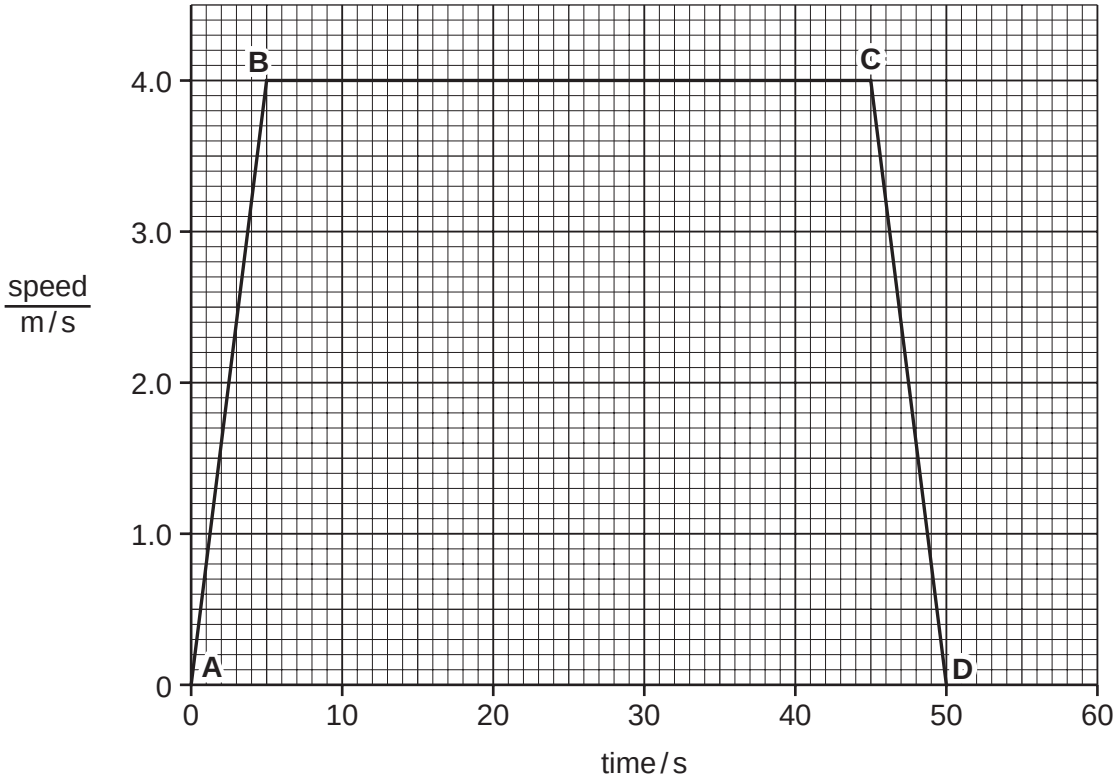

Fig. 5.1

Describe what is happening between

A – B

.....

B – C

..... [2]

(b) Calculate the total distance covered.

Show your working.

..... [3]

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6 Fig. 6.1 shows apparatus which can be used to reduce copper oxide to copper.

Copper oxide is a black powder and during the reaction metallic copper forms inside the reaction tube.

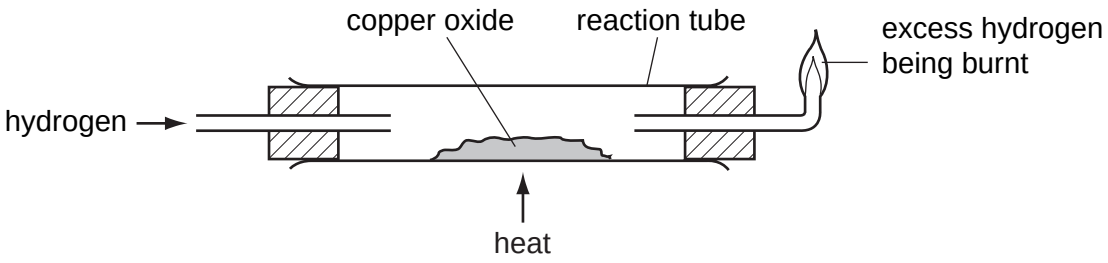

Fig. 6.1

(a) **(i)** Select from the list of substances below to complete the word equation for the reaction in Fig. 6.1.

air	**copper**	**copper oxide**
hydrogen	**oxygen**	**water**

[ ] + [ ] → [ ] + [ ]

[1]

(ii) Describe **one** piece of evidence which would show that copper had been formed in this reaction.

.....

..... [1]

(b) Copper oxide is an ionic compound.

(i) Explain why an oxide ion has an electrical charge of –2 but an oxygen atom is electrically neutral.

.....

.....

.....

..... [2]

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(ii) The formula of copper oxide is CuO.

State the number of electrons which each copper ion gains to become a copper atom during the reaction in Fig. 6.1.

Explain your answer.

.....

.....

..... [2]

(c) Fig. 6.2 shows another method of producing copper from copper oxide.

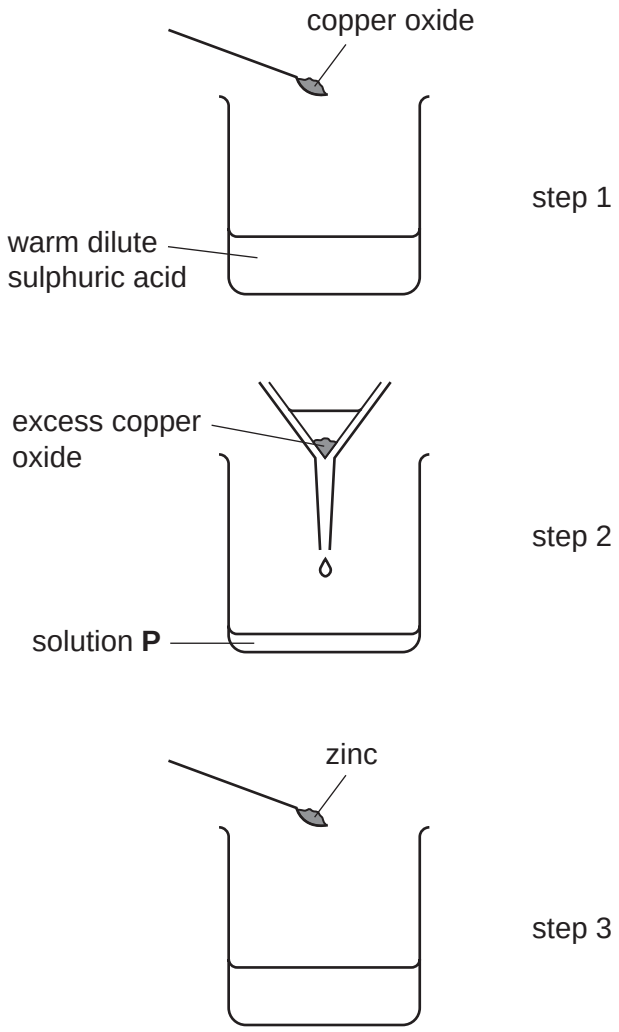

Fig. 6.2

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(i) Write the name of the salt dissolved in solution **P** in Fig. 6.2.

..... [1]

(ii) Explain why zinc is able to react with the salt in solution **P**.

.....

..... [1]

(iii) Explain, in terms of the transfer of electrons, which substance is oxidised when zinc reacts in solution **P**.

.....

..... [2]

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7 Fig. 7.1 shows the structure of the human thorax.

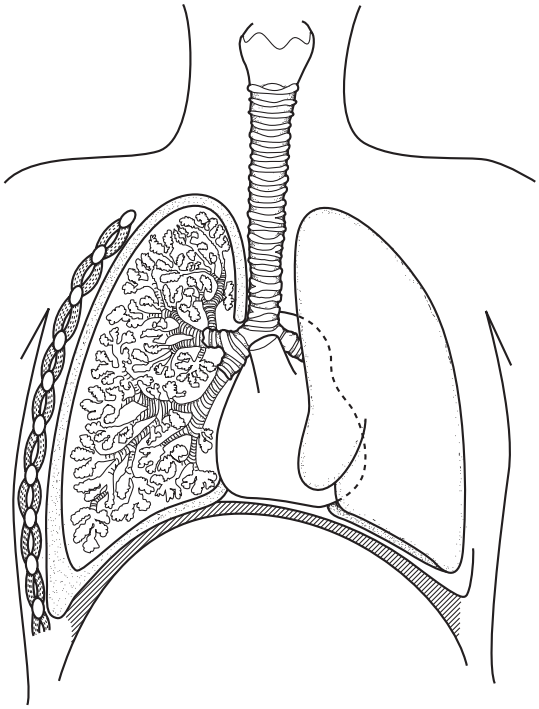

Fig. 7.1

(a) Using label lines, label each of the following structures.

- bronchus
- pleural membrane
- trachea
- rib [2]

(b) Gas exchange takes place in the alveoli. When a person smokes for a number of years, the walls of the alveoli start to break down. This is called emphysema.

Explain why emphysema makes it more difficult for oxygen to get into the blood.

.....

.....

..... [2]

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(c) Oxygen is transported around the body in red blood cells. Fig. 7.2 is a diagram of a group of red blood cells.

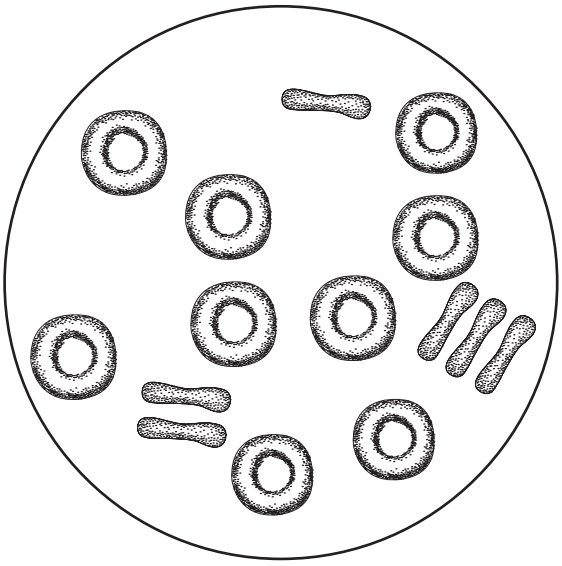

Fig. 7.2

Choose **three** features of red blood cells and for each of them explain how this adapts them for their function.

.....

.....

.....

..... [3]

(d) Explain why body cells need a constant supply of oxygen.

.....

.....

..... [2]

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8 **(a)** A car travels 2 kilometres, at a steady speed, in 100 seconds. The total force the car forward is 1000 N.

(i) Calculate the work done by the total driving force over this distance.

State the formula that you use and show your working.

formula

working

..... [2]

(ii) Calculate the useful power output of the engine during this time.

State the formula that you use and show your working.

formula

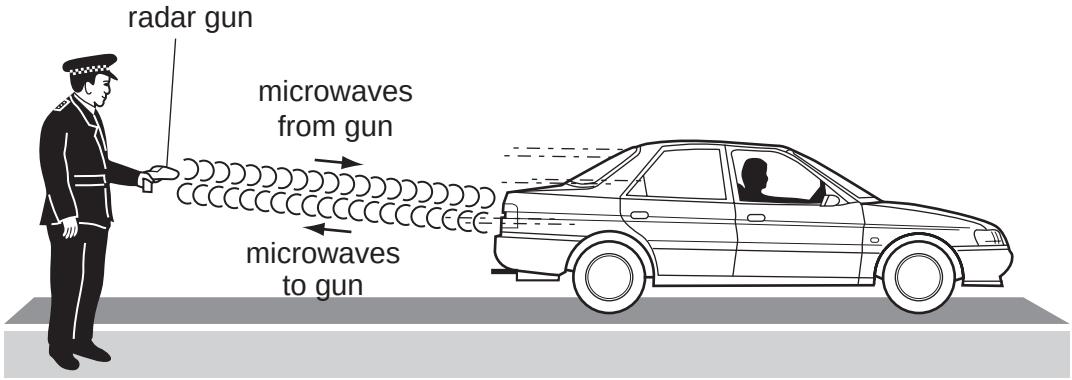
working

..... [2]

(b) A policeman is using a radar gun to measure the speed of a car.

The radar gun emits microwaves which hit the moving car and bounce back to a receiver in the radar gun.

A computer in the radar gun calculates the speed of the car.



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(i) What type of waves are microwaves?

..... [1]

(ii) The waves bounce off the car back towards the radar gun. Name this process.

..... [1]

(c) The headlamps on the car are connected in parallel as shown in Fig. 8.1.

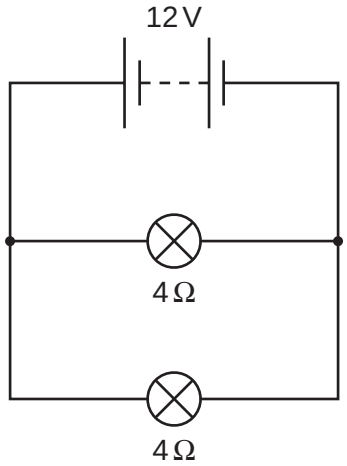

Fig. 8.1

Each headlamp has a resistance of 4 ohms.

Calculate the combined resistance of the two headlamps.

State the formula that you use and show your working.

formula

working

..... [3]

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(d) Fig. 8.2 shows a spring. The spring is 10 cm long. A 50 g mass is hung on the and the length of the spring increases to 13 cm.

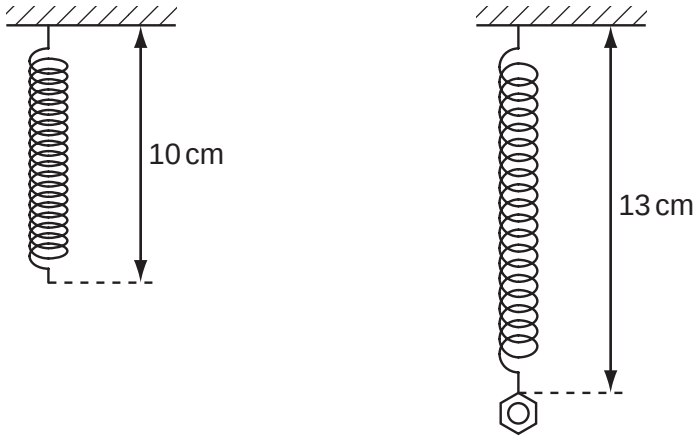

Fig. 8.2

The 50 g mass is replaced by an object of unknown mass. The new length of the spring is 22 cm.

Calculate the value of the unknown mass.

Show your working.

..... [2]

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9 The Periodic Table shows all of the chemical elements arranged into groups and per

Fig. 9.1 shows part of the Periodic Table. The letters in this table are **not** the norm chemical symbols of the elements.

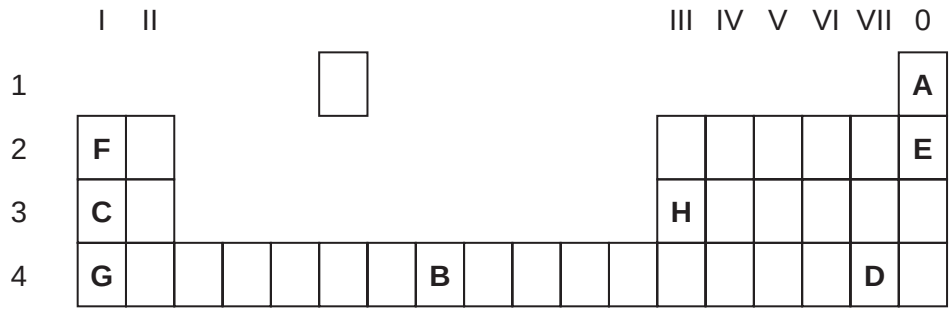

Fig. 9.1

(a) Complete the statements below using letters, chosen from **A** to **H**, which refer to elements in Fig. 9.1. Letters may be used once, more than once or not at all.

- The three elements shown as letters ....., ... and ..... have the same number of electrons in the outer shells of their atoms.
- The element shown as letter ..... is a very reactive non-metal. [2]

(b) A student used the apparatus shown in Fig. 9.2 to investigate the decomposition of the compound hydrogen peroxide, H_2O_2.

The balanced equation for the decomposition of hydrogen peroxide is shown below.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

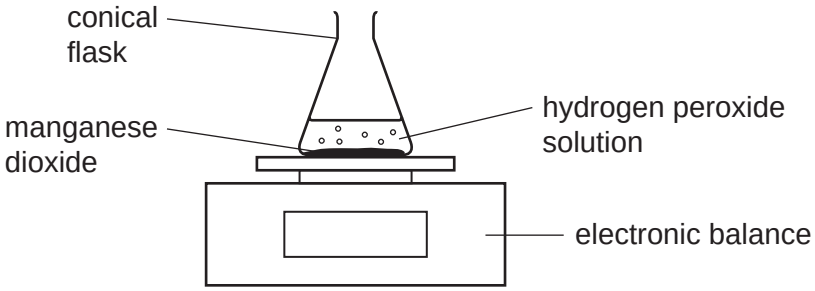

Fig. 9.2

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The student measured the decrease in mass of the conical flask and its contents occurred during the reaction.

Table 9.1 shows the measurements the student made in a series of trials using different masses of manganese dioxide.

The initial concentration and volume of the hydrogen peroxide solution in each trial were the same.

Table 9.1

trial	mass of manganese dioxide / g		time for reaction to finish / seconds	**decrease** in mass during trial / g
	start	end		
1	0	0	too long to measure	0
2	0.5	0.5	540	1.6
3	1.0	1.0	270	1.6
4	2.0	2.0	135	1.6

(i) Explain why the mass of the flask and contents decreased in trials **2** to **4**.

.....

..... [1]

(ii) What effect does the mass of manganese dioxide have on the rate of decomposition of hydrogen peroxide?

.....

..... [1]

(iii) Use the information in Table 9.1 to explain the role of manganese dioxide in this reaction.

.....

.....

.....

.....

..... [3]

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(iv) The rate of chemical reactions increases if the temperature increases.

Explain in terms of collisions between particles why this happens.

.....

.....

.....

..... [2]

(c) Calculate the relative molecular mass (M_r) of hydrogen peroxide.

Show your working.

..... [1]

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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** Sulphur 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 †															

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

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

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.).

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