UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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|---|---|---|---|---|---|---|---|---|---|
| CANDIDATE NAME | | | | | | | | | |
| CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | |

*4173626436*

**COMBINED SCIENCE** **0653/33**

Paper 3 (Extended) **May/June 2013**

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

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 28.

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.

This document consists of **26** printed pages and **2** blank pages.




UNIVERSITY of CAMBRIDGE International Examinations

*For Examiner's Use*

**1 (a)** Table 1.1 shows the numbers of protons, neutrons and electrons in four atoms, **A**, **B**, **C** and **D**.

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**Table 1.1**

| atom | protons | neutrons | electrons |
|---|---|---|---|
| **A** | 2 | 2 | 2 |
| **B** | 3 | 4 | 3 |
| **C** | 1 | 0 | 1 |
| **D** | 4 | 5 | 4 |

1(a) **(i)** Explain which one of the atoms, **A**, **B**, **C** or **D**, has a nucleon number (mass number) of four.

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atom .....

explanation .....

..... [1]

1(a) **(ii)** Explain why all atoms do **not** have an overall electrical charge. 0653/33/M/J/13

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..... [2]

1**(b)** Fig. 1.1 shows containers of hydrogen and helium.

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*For Examiner's Use*

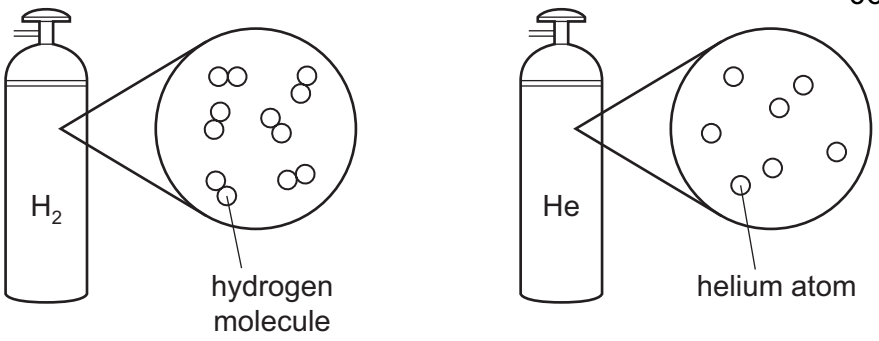


**Fig. 1.1**

1(b) **(i)** Describe, in terms of electrons, how a chemical bond forms between two hydrogen atoms.

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You may draw a diagram of a hydrogen molecule if it helps you to answer this question.

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..... [2]

1(b) **(ii)** Explain why helium exists as single atoms and **not** as molecule

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.....

..... [1]

1 **(c)** Hydrogen is often included in the reactivity series of me1tals.

*For Examiner's Use*

Use the idea of reactivity to explain the observations shown in Fig. 1.2.



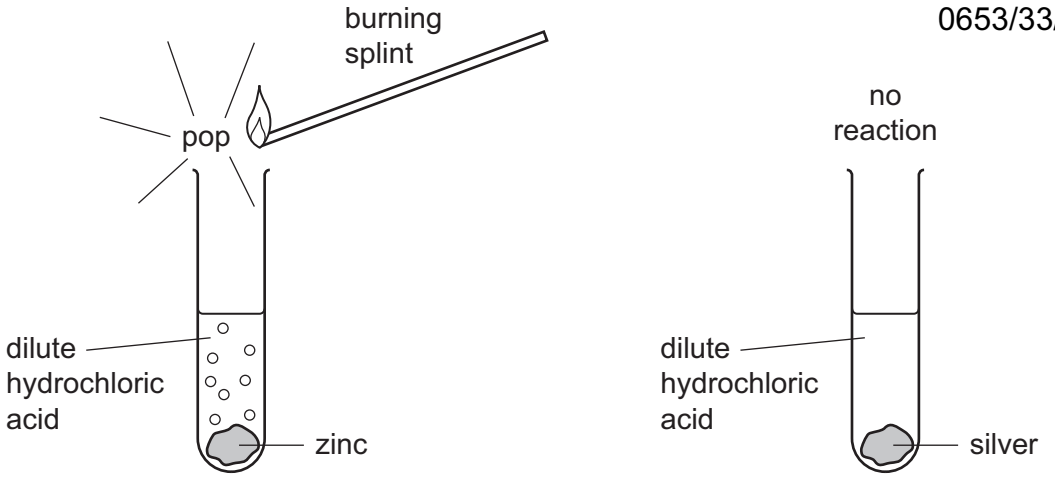


**Fig. 1.2**

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..... [3]

*For Examiner's Use*

**2** **(a)** A fishing boat uses echo sounding to detect a shoal of fish.

This is shown in Fig. 2.1.

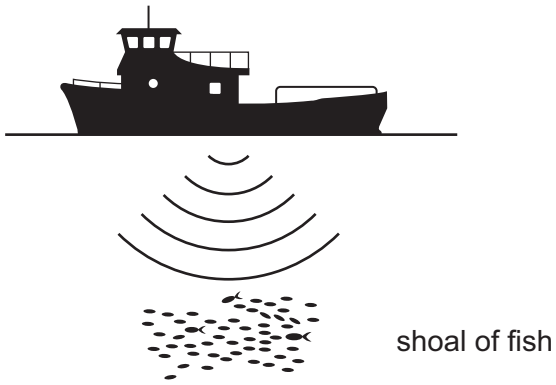


**Fig. 2.1**

Short pulses of sound are sent out from the boat. The echo from the shoal of fish is detected by a receiver on the boat 0.2 seconds later.

Sound waves travel through water at a speed of 1600 m / s.

2(a) **(i)** Calculate the distance of the shoal of fish below the boat.

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State the formula that you use and show your working.

formula

working

..... [2]

2(a) **(ii)** The sound waves have a wavelength of 0.25 m.

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Calculate the frequency of the waves.

State the formula that you use and show your working.

formula

working

..... [2]

For Examiner's Use

2 **(b) (i)** Water waves are a renewable energy resou2 rce.

Outline **two** advantages of using renewable energy resources. 0653/33/M/J/13

1 .....

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2 .....

..... [2]

2(b) **(ii)** Fig. 2.2 shows how water waves can be used to produce electricity.

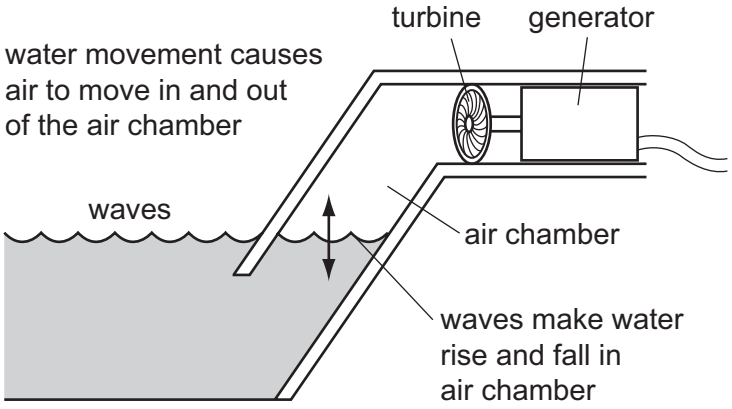


**Fig. 2.2**

Using the information in Fig. 2.2, describe **two** of the energy transfers that are involved in changing the kinetic energy of the waves into electrical energy.

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..... [2]

For Examiner's Use

2 **(c)** Fig. 2.3 shows an iceberg floating in2 the sea.

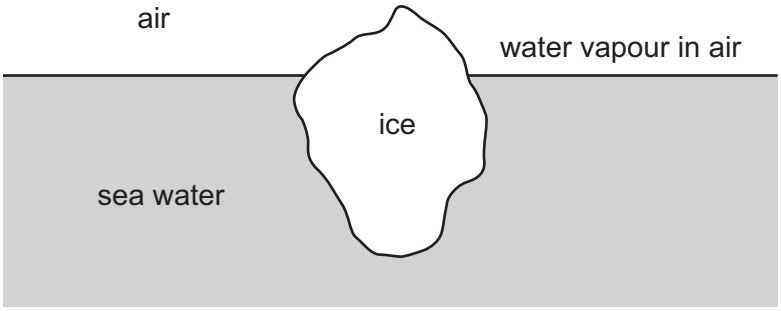


**Fig. 2.3**

2(c) **(i)** Which material named on Fig. 2.3 best fits the statement below?

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*"The particles are able to move, are randomly arranged and are closely packed."*

..... [1]

**(**2(c) (**ii)** Name the process by which water molecules in the sea become water molecules in the air.

..... [1]

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*For Examiner's Use*

**3** The addition of a harmful substance to the environment is called pollution. Three examples of pollution caused by human activities are

- acid rain,
- fertilisers entering rivers and lakes,
- the release of too much carbon dioxide into the atmosphere.

3 **(a)** Describe how acid rain is caused. 0653/33/M/J/13

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..... [2]

3 **(b)** Explain what happens in a lake after large quantities of fertilisers are washed into it.

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..... [3]

3 **(c)** Explain how cutting down forests can result in an increase in the carbon dioxide concentration in the atmosphere.

0653/33/M/J/13

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..... [2]

**Please turn over for Question 4.**

*For Examiner's Use*

**4** Petroleum (crude oil) and rock salt occur naturally in the Earth's crust.

**(a)** Petroleum is a mixture that contains thousands of different compounds. Many of these compounds are alkanes.

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Draw the structure of the alkane molecule that contains eight hydrogen atoms. Use short lines to represent covalent bonds.

[2]

4 **(b)** When petroleum is refined, it is separated into simpler mixtures. 0653/33/M/J/13

Fig. 4.1 shows a simplified diagram of apparatus that is used to refine petroleum.

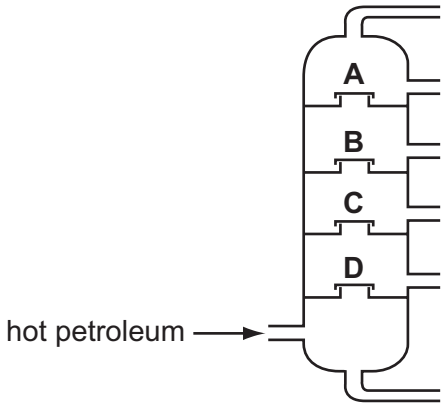


**Fig. 4.1**

Explain, in terms of intermolecular forces and the size of molecules, why the average boiling point of the fraction at **B** differs from the average boiling point of the fraction at **C**.

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..... [3]

*For Examiner's Use*

4 **(c)** Rock salt contains mainly sodium chloride which is a compound of the alkali metal, sodium, and the halogen, chlorine.

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**(i)** Explain why the uncombined elements sodium and chlorine are **not** found in the Earth's crust.

.....

..... [1]

4(c) **(ii)** Describe the changes in electron configuration when sodium atoms (2,8,1) react with chlorine atoms (2,8,7) to form sodium chloride.

0653/33/M/J/13

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..... [2]

*For Examiner's Use*

**5** Milk is a liquid produced by cows, goats and other mammals, on which they feed their young.

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**(a)** Table 5.1 shows the mass of some of the substances in 100 g samples of milk from three mammals.

**Table 5.1**

| substance | cow's milk | goat's milk | water-buffalo's milk |
|---|---|---|---|
| protein / g | 3.2 | 3.1 | 4.5 |
| fat / g | 3.9 | 3.5 | 8.0 |
| carbohydrate / g | 4.8 | 4.4 | 4.9 |
| calcium / mg | 120 | 100 | 195 |

5(a)**(i)** Which substance shown in Table 5.1 is present in the samples of milk in the smallest quantity?

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..... [1]

5(a) **(ii)** Suggest which substance, **not** shown in Table 5.1, is present in the samples of milk in the largest quantity.

0653/33/M/J/13

..... [1]

5(a) **(iii)** Explain **one** way in which drinking water-buffalo's milk might be better for a person's health than drinking goat's milk.

0653/33/M/J/13

.....

.....

..... [2]

5(a) **(iv)** State and explain which substance in Table 5.1 does **not** need to be digested in the human alimentary canal.

0653/33/M/J/13

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.....

..... [2]

*For Examiner's Use*

**(b)** Milk can be used for making yoghurt.

- Bacteria are added to the milk. The milk is kept at a temperature of 40 °C.
- The bacteria convert lactose in the milk to lactic acid.
- When the pH has reached about 4.5, the yoghurt is moved to a refrigerator at a temperature of 3 °C.

5(b)**(i)** Explain why the milk is kept at a temperature of 40 °C after the bacteria have been added to it.

0653/33/M/J/13

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..... [2]

5(b) 5(b) **(ii)** Suggest why the yoghurt is kept in a refrigerator at a temperature of 3 °C.

0653/33/M/J/13

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..... [1]

5(b)**(iii)** Milk has a pH of about 6.5. Explain why the pH of milk changes during the manufacture of yoghurt.

0653/33/M/J/13

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..... [1]

*For Examiner's Use*

**6 (a)** In a store, two workers are lifting 5 kg bags of flour onto the shelves. There are five shelves, 0.4 m apart. The lowest shelf is 0.4 m from the floor.

Fig. 6.1 shows the two workers.

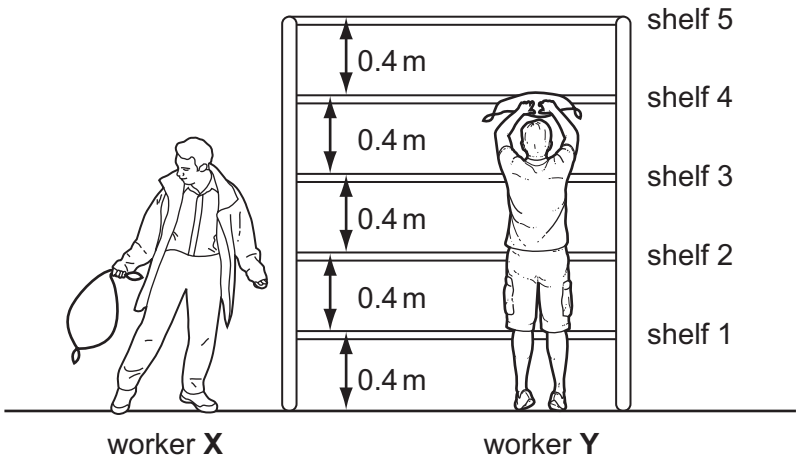


**Fig. 6.1**

6(a) **(i)** Worker **X** lifts three bags from the floor to shelf 2. Worker **Y** lifts one bag from the floor to shelf 5.

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Worker **X** says that he has done more work than worker **Y**.

Use calculations of the work done to explain whether or not he is correct.

State the formula that you use.

formula

.....

..... [2]

6(a) **(ii)** Each worker lifts one bag from the floor to shelf 2. Worker **X** does this more quickly than worker **Y**.

0653/33/M/J/13

Which worker exerted the higher power during their lift?

Explain your answer.

.....

..... [1]

*For Examiner's Use*

6(a) **(iii)** Each 5 kg bag of flour has a volume of 5500 $cm^3$.

Calculate the average density of the bag of flour.

State your answer in $g/cm^3$.

State the formula that you use and show your working.

formula

working

..... $g/cm^3$ [2]

For Examiner's Use

6 **(b)** Three boys, **A**, **B** and **C**, walk together from their school to a store. They stay at the store for a few minutes and then return to school.

When they leave the store,

- one boy walks back to school at a steady pace,
- one boy walks back to school at a slower steady pace,
- one boy slows down gradually as he walks back to school.

The graph in Fig. 6.2 shows how their speeds vary with time during the whole journey to the store and back again.

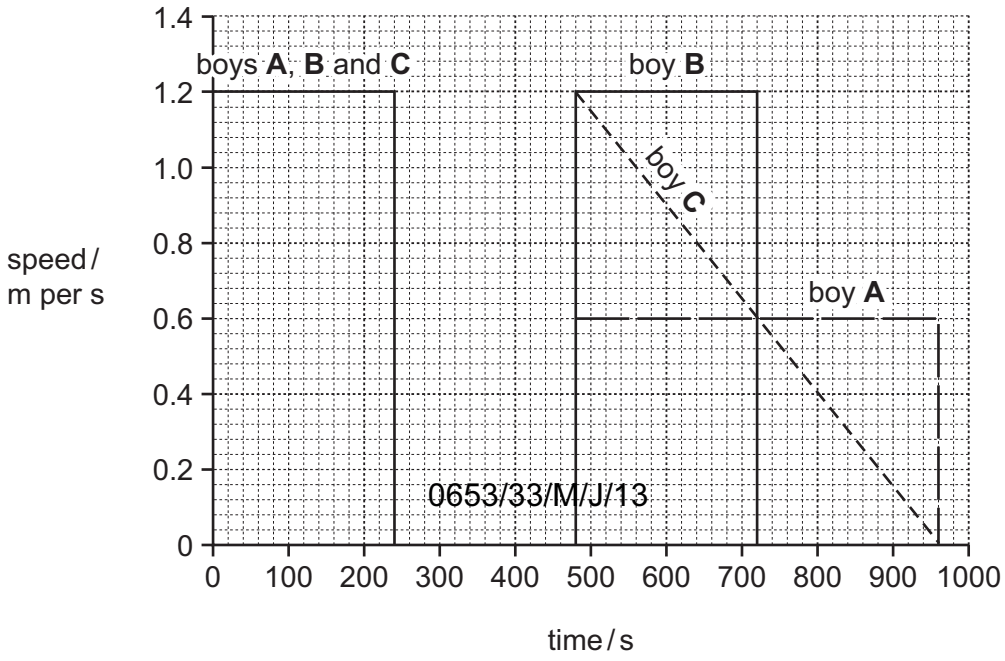


**Fig. 6.2**

6(b) **(i)** Calculate the distance of the store from the school. 0653/33/M/J/13

Show your working.

..... [2]

6(b) **(ii)** For how many seconds do the boys stay in the store? 0653/33/M/J/13

..... s [1]

6(b) **(iii)** Which boy slowed down on his way back to school? 0653/33/M/J/13

State a reason for your answer.

boy ..... because .....

..... [1]

*For Examiner's Use*

**7** **(a)** Fig. 7.1 shows apparatus a student used to investigate the reaction between a white powder and dilute hydrochloric acid.

The student predicted that a gas would be given off in her experiment and chose to test the gas using limewater.

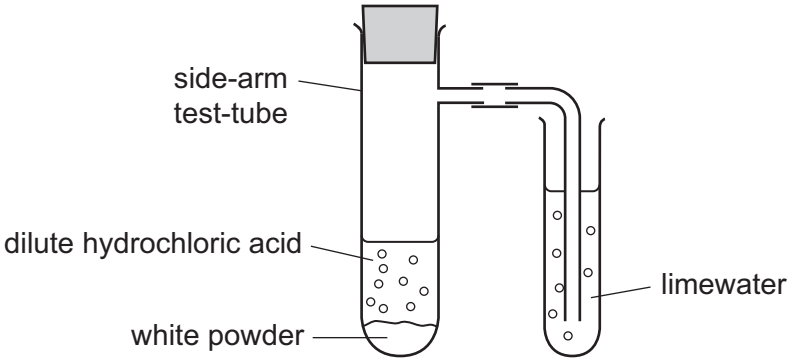


**Fig. 7.1**

State the gas that the student predicted would be given off.

Explain your answer.

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name of gas .....

explanation .....

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..... [2]

For Examiner's Use

7 **(b)** The student investigated the temperature change when sodium hydrogencarbonate was added to excess dilute hydrochloric acid.

Fig. 7.2 shows the apparatus she used.

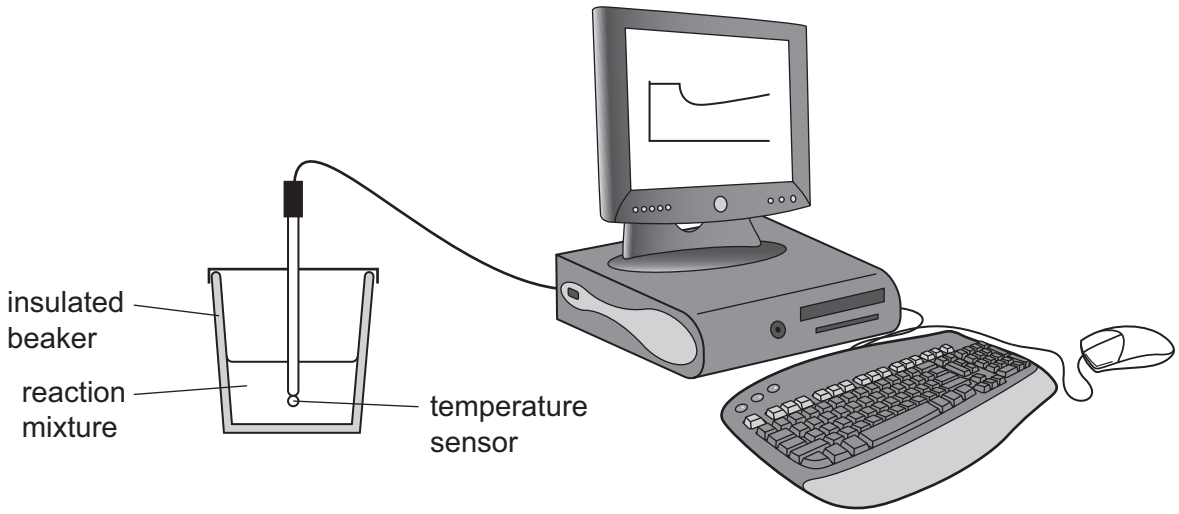


**Fig. 7.2**

Temperature measurements were displayed on the computer screen as a graph of temperature against time.

This graph is shown in Fig. 7.3.

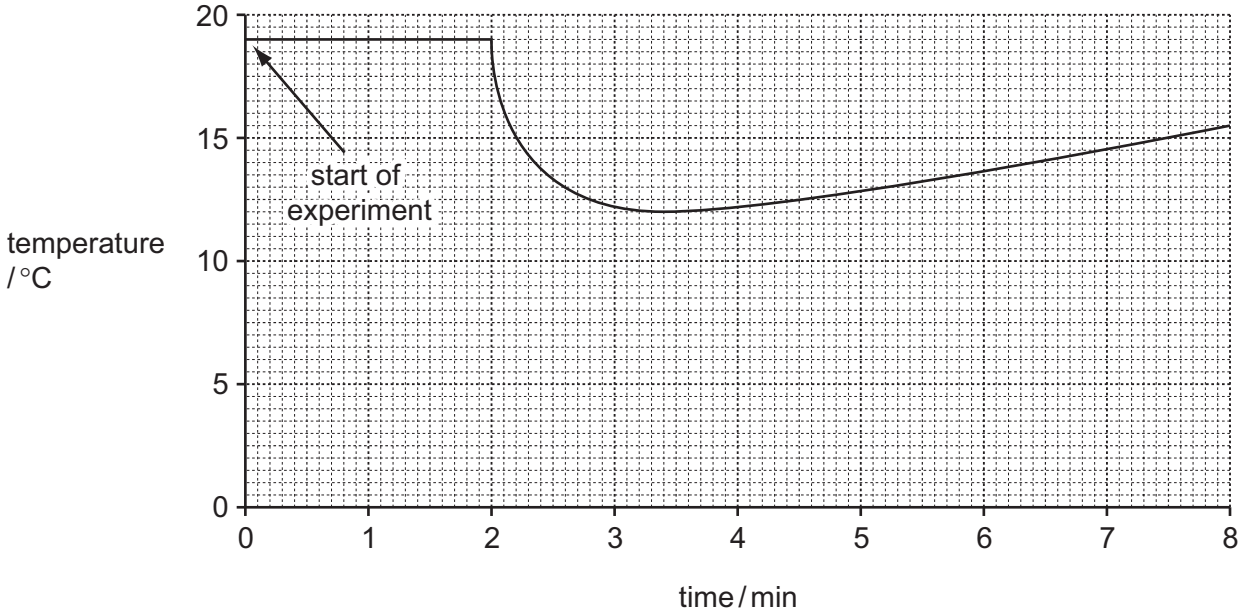


**Fig. 7.3**

**(i)** On the graph, mark with an **X** the point where sodium hydrogencarbonate was added to the dilute hydrochloric acid. [1]

*For Examiner's Use*

7(b) **(ii)** Calculate the temperature change shown in Fig. 7.3 that occurred during the reaction.

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.....

[2]

7(b) **(iii)** Use the results shown in Fig. 7.3 to explain, in terms of chemical energy and heat energy, the energy transformation that occurred during the reaction.

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.....

[2]

7 **(c)** Sodium hydrogencarbonate, $NaHCO_3$, is a solid compound made of sodium ions and hydrogencarbonate ions. Sodium is a metal in Group 1 of the Periodic Table.

Deduce the formula and electrical charge of a hydrogencarbonate ion.

0653/33/M/J/13

Explain your answer.

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[3]





**[Turn over**

**8** Fig. 8.1 shows the human gas exchange system.

*For Examiner's Use*

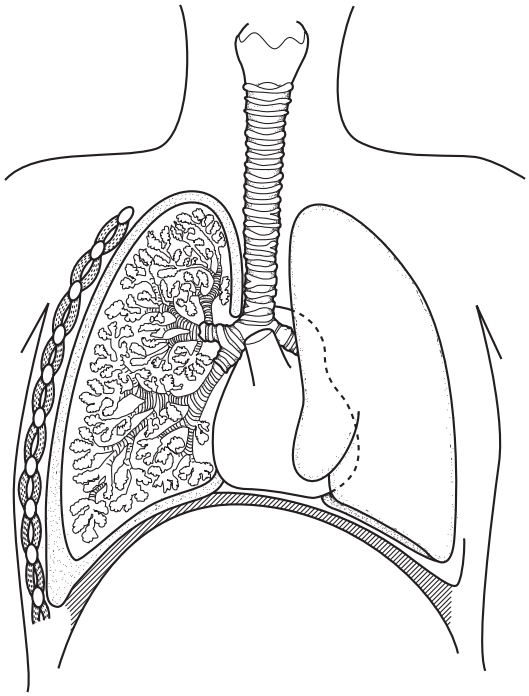

**Fig. 8.1**

8 **(a)** Use label lines to label each of these structures on Fig. 8.1. 0653/33/M/J/13

trachea

bronchus [2]

8 **(b)** Gas exchange takes place across the surface of the alveoli in the lungs.

List **two** features of alveoli that help gas exchange to take place quickly.

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1 .....

2 ..... [2]

For Examiner's Use

8 **(c)** The gas exchange system is protected from pathogens and harmful substances by a tissue, containing goblet cells and ciliated cells, that lines the nose, trachea and bronchi.

Fig. 8.2 shows part of this tissue inside the nose.

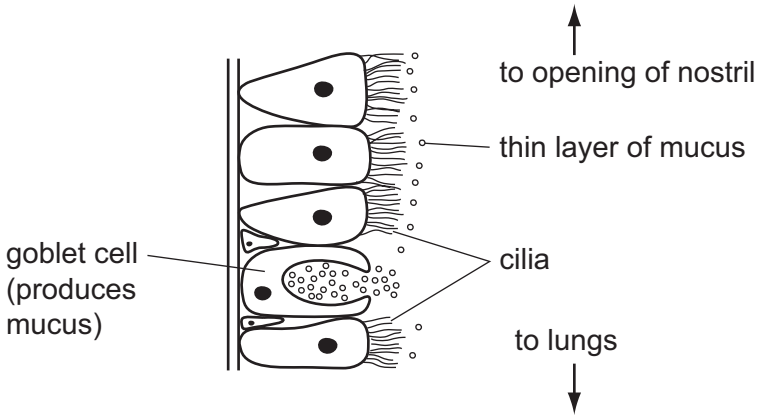


**Fig. 8.2**

Describe how the tissue shown in Fig. 8.2 helps to stop harmful substances getting into the lungs.

0653/33/M/J/13

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..... [2]

*For Examiner's Use*

8 **(d)** An experiment was carried out to find out how passive smoking affects the activity of the goblet cells and cilia.

Six people sat in a closed room. On day **1**, they breathed normal, clean air. On day **2**, they breathed air containing cigarette smoke.

After one hour, a substance was sprayed into each person's nose. After 40 minutes, the researchers measured the percentage of the substance that remained in each person's nose. This was done on both days.

The faster the cilia and goblet cells were working, the faster the substance was removed from the nose.

Table 8.1 shows the results.

**Table 8.1**

| person | percentage of substance remaining after 40 minutes | |
|---|---|---|
| | day **1** after breathing clean air | day **2** after breathing air containing cigarette smoke |
| 1 | 65 | 26 |
| 2 | 84 | 49 |
| 3 | 67 | 96 |
| 4 | 23 | 51 |
| 5 | 40 | 91 |
| 6 | 78 | 24 |

8(d) **(ii)** Which three persons' results showed that breathing air containing cigarette smoke slowed down the rate at which their cilia and goblet cells worked? 0653/33/M/J/13

..... [1]

8(d) **(ii)** Suggest how exposure to cigarette smoke could affect the health of these three people. 0653/33/M/J/13

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..... [3]

**Please turn over for Question 9.**

For Examiner's Use

**9** **(a)** A student investigated how a change in potential difference across a lamp affected the current flowing through the lamp.

She used wires to connect the components shown in Fig. 9.1 to make a circuit.

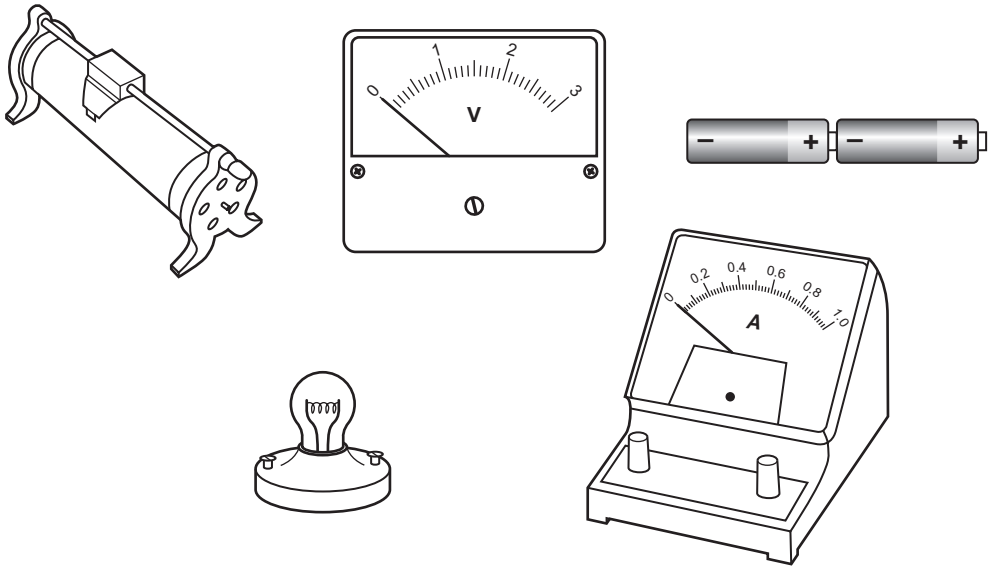


**Fig. 9.1**

9(a) **(i)** Using the correct circuit symbols, draw a diagram to show the circuit she used.

[3]

For Examiner's Use

9(a) **(ii)** The student measured the current passing through a wire when a potential difference was applied across it.

Calculate the resistance of the wire when a potential difference of 0.3 V is applied and the current measured is 0.5 A.

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State the formula that you use and show your working.

formula

working

..... [2]

9 **(b)** Electricity is often transmitted through overhead power cables hung from pylons. If these cables are put up on a hot summer day, they are hung loosely from the pylons as shown in Fig. 9.2.

0653/33/M/J/13

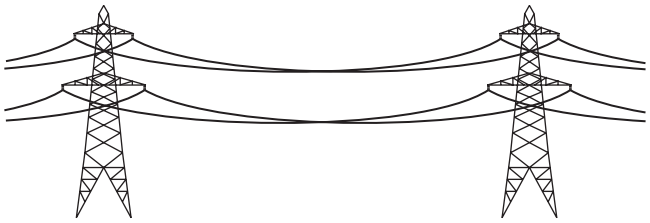

**Fig. 9.2**

Suggest why the cables are hung loosely.

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..... [2]

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

| Group | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | | | | | | | | | III | IV | V | VI | VII | 0 |
| | | | | | | | | | | | | | | | 4 He Helium 2 |
| | | | | | 1 H Hydrogen 1 | | | | | | | | | | |
| 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 † | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 = 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.).