



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**COMBINED SCIENCE**

**0653/31**

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.



C33.1

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

Table 1.1

atom	protons	neutrons	electrons
<b>A</b>	2	2	2
<b>B</b>	3	4	3
<b>C</b>	1	0	1
<b>D</b>	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. 0653/31/M/J/13

.....

.....

..... [2]

For  
Examiner's  
Use

Atoms  
Elem  
T  
Compd

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

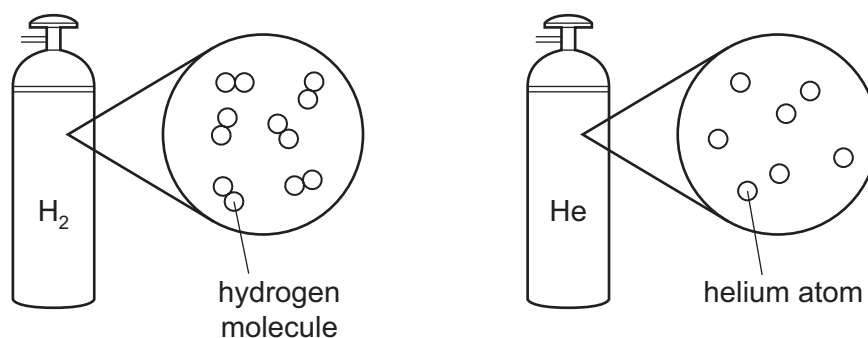


Fig. 1.1

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

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 molecules.

0653/31/M/J/13

.....

..... [1]

For  
Examiner's  
Use

Atoms  
/ Elem  
/ Compd

C10.2

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

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

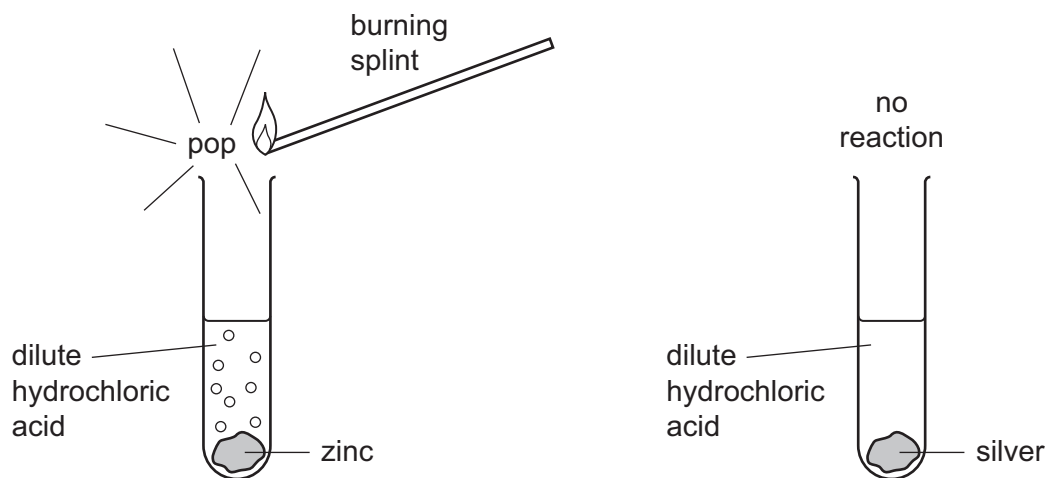


Fig. 1.2

0653/31/M/J/13

.....

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.....

.....

..... [3]

For  
Examiner's  
Use

Metals

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

0653/31/M/J/13

For  
Examiner's  
Use

This is shown in Fig. 2.1.

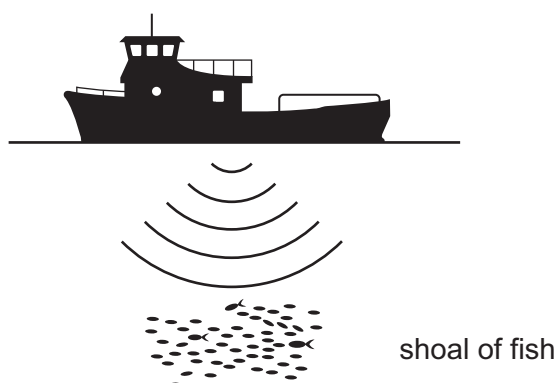


Fig. 2.1

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.

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]

Sound

2 (b) (i) Water waves are a renewable energy resource.

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For  
Examiner's  
Use

Energy

Outline **two** advantages of using renewable energy resources.

1 .....

2 .....

[2]

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

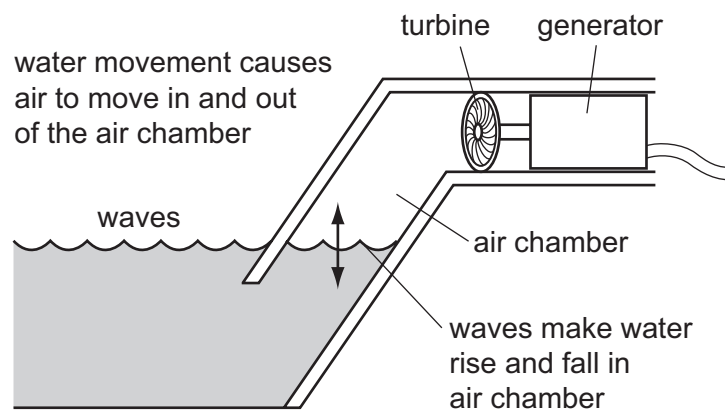


Fig. 2.2

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.

0653/31/M/J/13

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.....

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.....

.....

[2]

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

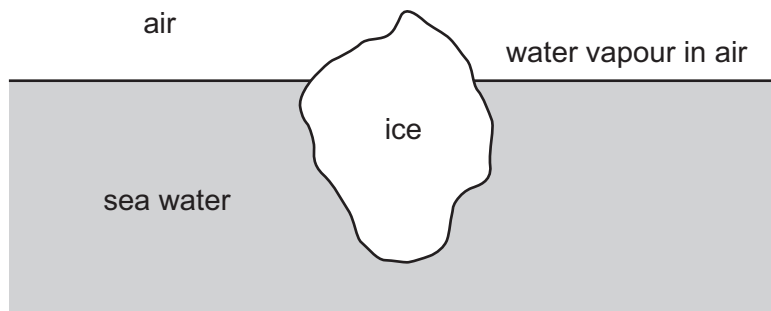


Fig. 2.3

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

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

0653/31/M/J/13

..... [1]

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

..... [1]

0653/31/M/J/13

Thermal Physics

For  
Examiner's  
Use

# Human influence on ecosystem

8

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.

For  
Examiner's  
Use

3 (a) Describe how acid rain is caused.

0653/31/M/J/13

.....

.....

.....

..... [2]

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

0653/31/M/J/13

.....

.....

.....

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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.

0653/31/M/J/13

.....

.....

.....

..... [2]



**Please turn over for Question 4.**

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

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

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

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For  
Examiner's  
UseOrg.  
Chem  
frac  
dist

[2]

- 4 (b) When petroleum is refined, it is separated into simpler mixtures.

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

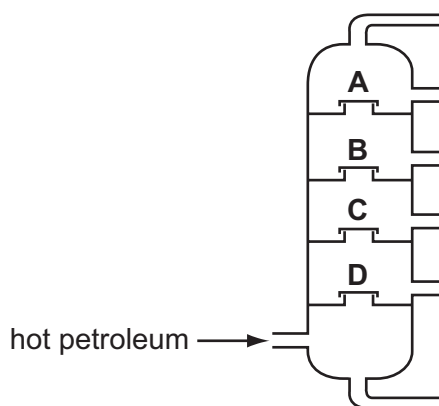


Fig. 4.1

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**.

.....

.....

.....

.....

..... [3]

- 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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- 4 c (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.

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

0653/31/M/J/13

For  
Examiner's  
Use

P.T.

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

- 5 (a) Table 5.1 shows the mass of some of the substances in 100g 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? **0653/31/M/J/13**

..... [1]

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

..... [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. **0653/31/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. **0653/31/M/J/13**

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

For  
Examiner's  
Use

Animal  
Nutr

5 (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.

0653/31/M/J/13

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

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

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

0653/31/M/J/13

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

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

0653/31/M/J/13

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

For  
Examiner's  
Use

Enzy.

- 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.

For  
Examiner's  
Use

Fig. 6.1 shows the two workers.

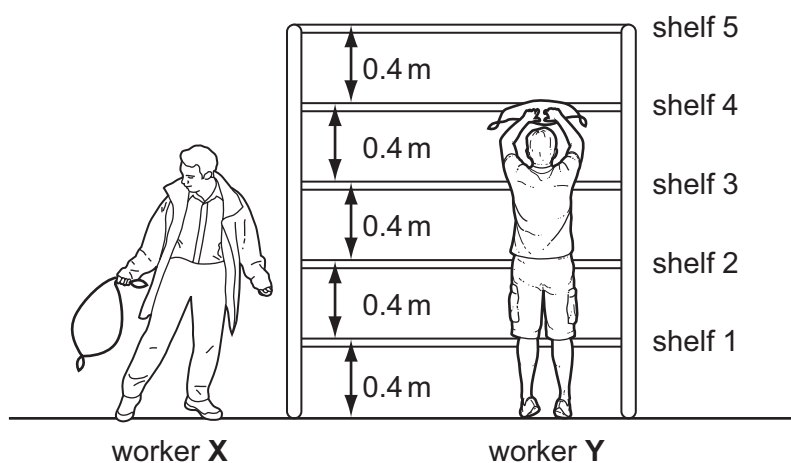


Fig. 6.1

- 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.

0653/31/M/J/13

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

Work  
Energy  
Power

..... [2]

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

0653/31/M/J/13

Which worker exerted the higher power during their lift?

Explain your answer.

..... [1]

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

0653/31/M/J/13

For  
Examiner's  
Use

Calculate the average density of the bag of flour.

State your answer in  $\text{g/cm}^3$ .

State the formula that you use and show your working.

formula

working

gm  
✓

.....  $\text{g/cm}^3$  [2]

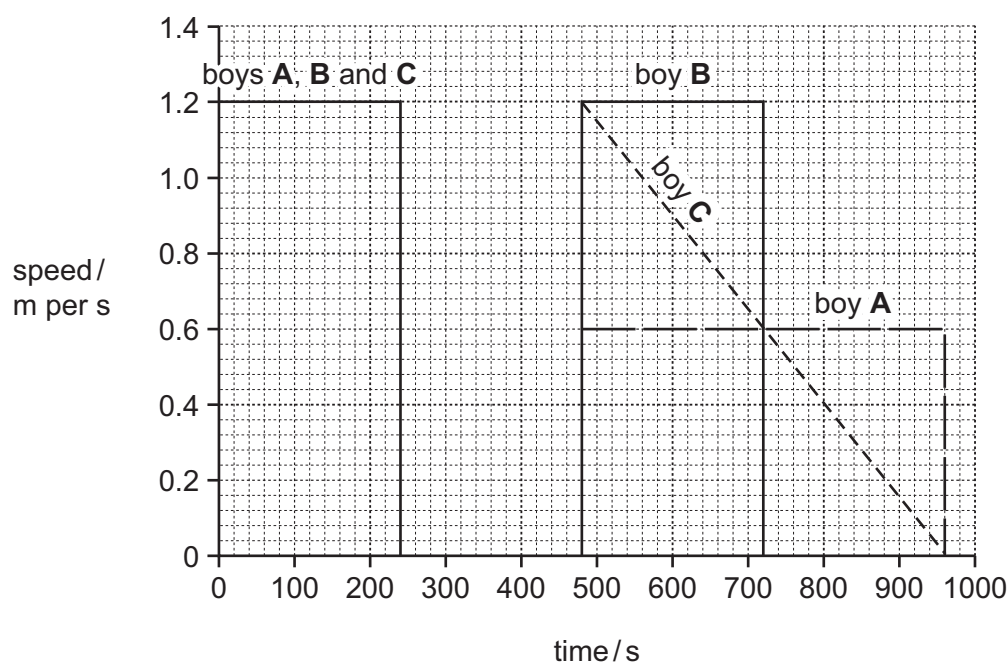
- 6(b)** Three boys, **A**, **B** and **C**, walk together from their school to a store. They stay at the store for a few minutes and then return to school.

For  
Examiner's  
Use

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.



S-T  
Graph

**Fig. 6.2**

- 6 b (i)** Calculate the distance of the store from the school.

0653/31/M/J/13

Show your working.

..... [2]

- 6 b (ii)** For how many seconds do the boys stay in the store?

0653/31/M/J/13

..... s [1]

- 6 b (iii)** Which boy slowed down on his way back to school?

0653/31/M/J/13

State a reason for your answer.

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

..... [1]



- 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.

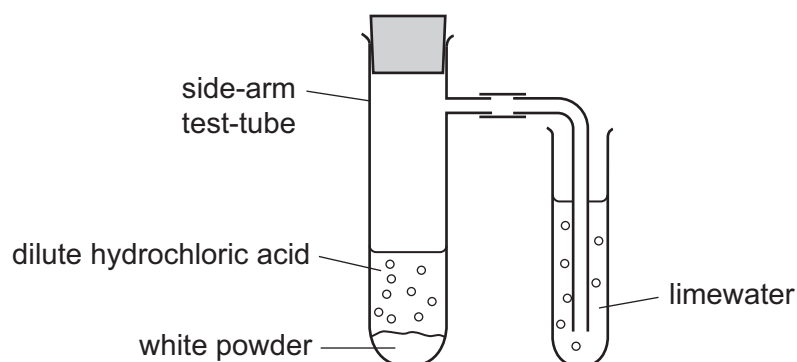


Fig. 7.1

0653/31/M/J/13

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

Explain your answer.

name of gas .....

explanation .....

.....

..... [2]

For  
Examiner's  
Use

Test  
for  
gas

- 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.

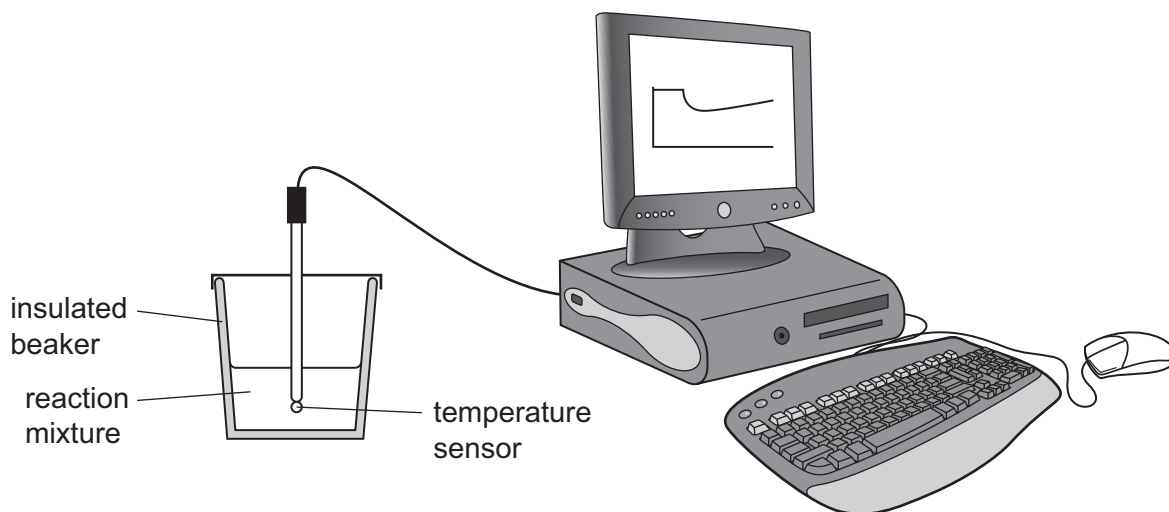


Fig. 7.2

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

This graph is shown in Fig. 7.3.

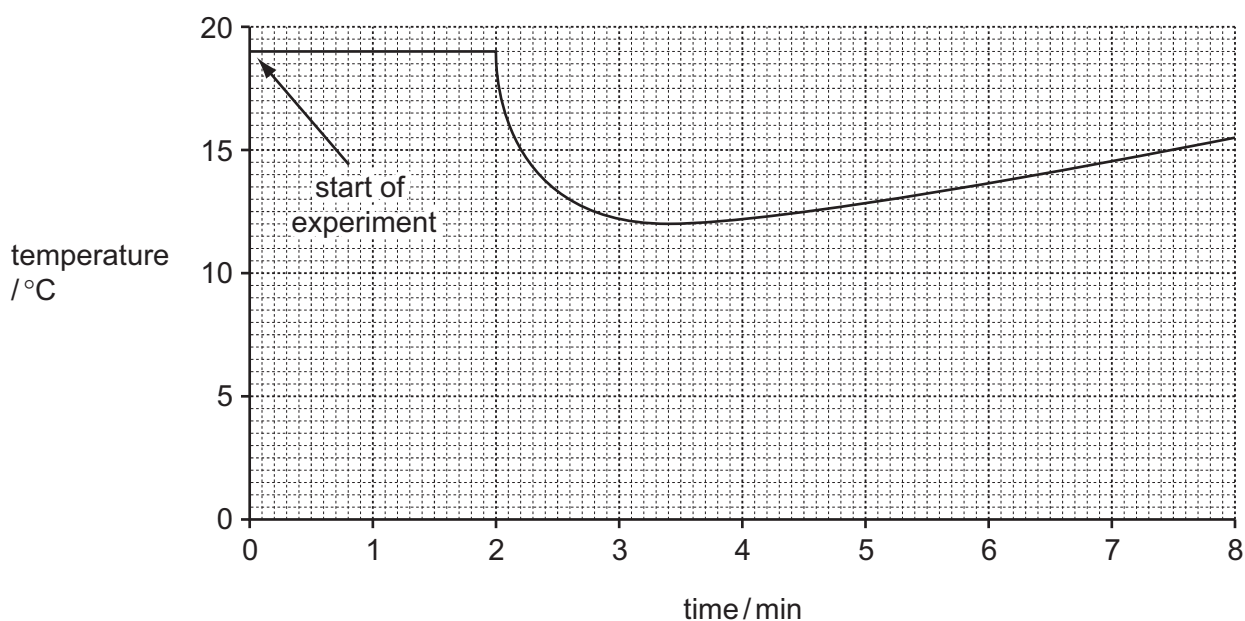


Fig. 7.3

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

0653/31/M/J/13

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

0653/31/M/J/13

..... [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.

0653/31/M/J/13

.....

.....

..... [2]

- 7 (c) Sodium hydrogencarbonate,  $\text{NaHCO}_3$ , 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. 0653/31/M/J/13

Explain your answer.

.....

.....

..... [3]

For  
Examiner's  
Use

Exo  
+

Endo

Stoic

8 Fig. 8.1 shows the human gas exchange system.

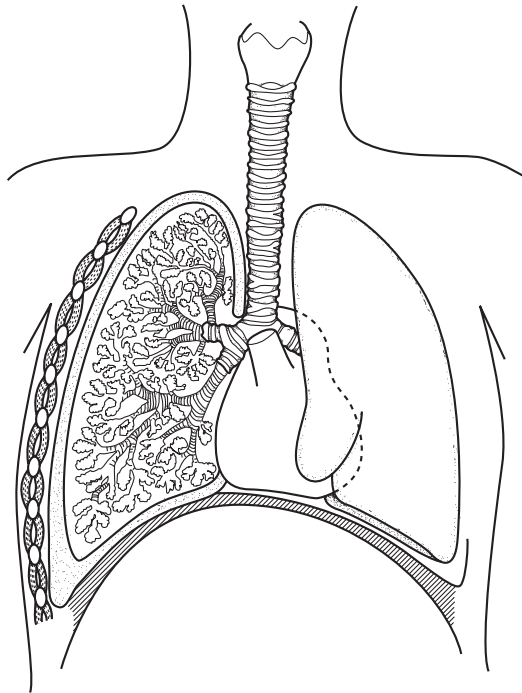


Fig. 8.1

For  
Examiner's  
Use

Gas  
Exch  
+  
Resp

8 (a) Use label lines to label each of these structures on Fig. 8.1.

0653/31/M/J/13

trachea

bronchus

[2]

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

0653/31/M/J/13

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

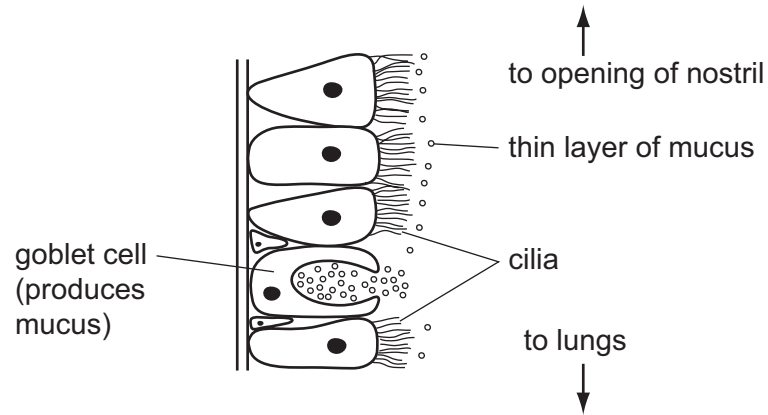
1 .....

2 ..... [2]

- 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.

0653/31/M/J/13

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.

.....

.....

.....

..... [2]

For  
Examiner's  
Use

Gas  
Exch.  
+  
Resp.

- 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? **0653/31/M/J/13**

..... [1]

- 8 d (ii) Suggest how exposure to cigarette smoke could affect the health of these three people. **0653/31/M/J/13**

.....

.....

.....

.....

.....

..... [3]

For  
Examiner's  
Use

Gas  
Exch  
1  
resp

**Please turn over for Question 9.**

- 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.

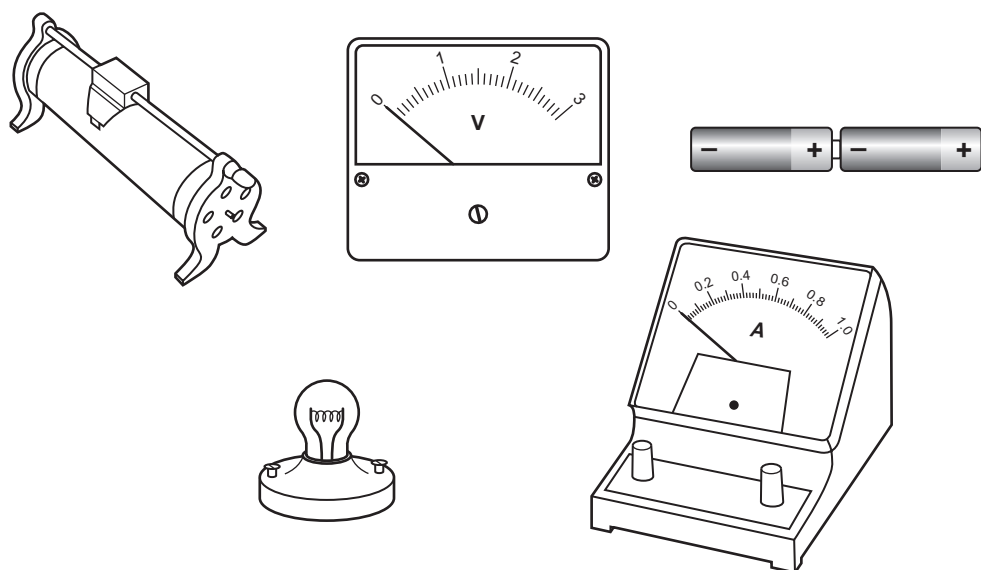


Fig. 9.1

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

0653/31/M/J/13

[3]

For  
Examiner's  
Use

Basic  
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.

State the formula that you use and show your working.

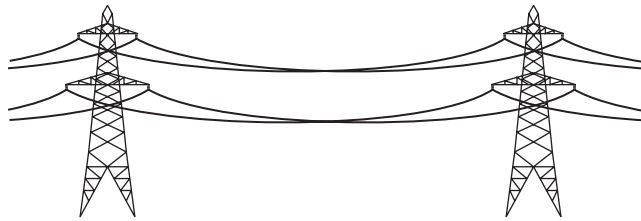
0653/31/M/J/13

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.



0653/31/M/J/13

**Fig. 9.2**

Suggest why the cables are hung loosely.

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

For  
Examiner's  
Use

Basic

Eke

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

Group																	
I	II											III	IV	V	VI	VII	0
		<div>1 H Hydrogen</div>															
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	101 Ru Ruthenium 44	101 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	127 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
Fr Francium 87	88 Ra Radium	227 Ac Actinium															
58-71 Lanthanoid series																	
90-103 Actinoid series																	
<div><div><div>a</div><div>X</div><div>b</div></div><div>a = relative atomic mass X = atomic symbol b = proton (atomic) number</div></div>																	
				140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	175 Lr Lawrencium 103
		232 Th Thorium 90	238 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103		

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

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

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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