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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6016235304

COMBINED SCIENCE **0653/21**

Paper 2 (Core) **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 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.

This document consists of **23** printed pages and **1** blank page.

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[Turn over

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For Examiner's

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
A	1	0	1
B	8	8	8
C	1	1	1
D	15	16	15

(i) Name the central part of an atom that contains protons and neutrons.

..... [1]

(ii) Explain which one of the atoms, **A**, **B**, **C** or **D**, has a nucleon number (mass number) of 16.

atom .....

explanation .....

..... [2]

(iii) Use the information in Table 1.1 to explain why atoms do **not** have an overall electrical charge.

.....

.....

..... [2]

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

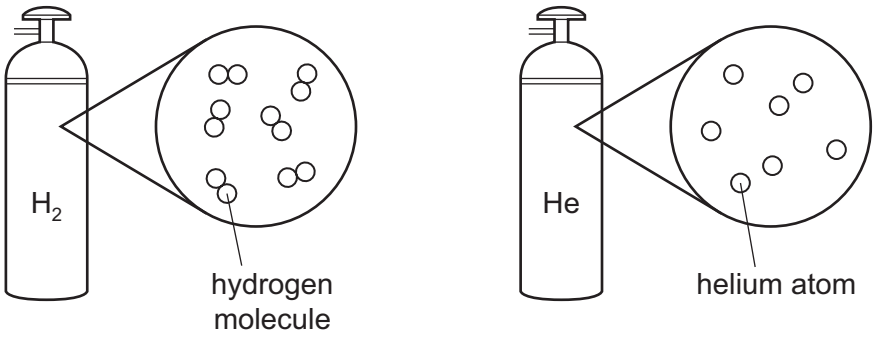

Fig. 1.1

(i) Hydrogen is usually described as a non-metal.

Name the type of chemical bond joining the atoms in a hydrogen molecule.

..... [1]

(ii) Suggest why helium exists as uncombined atoms.

.....

..... [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.

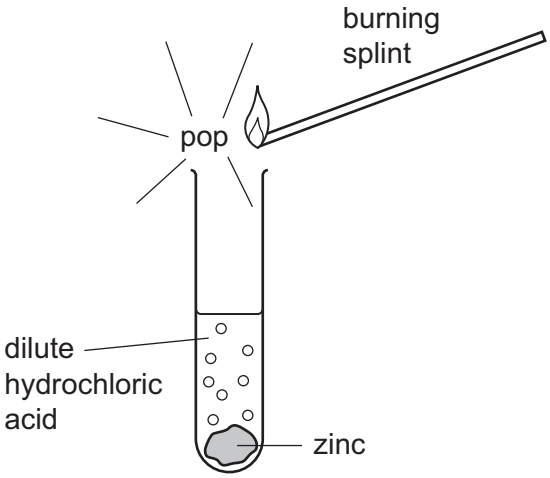

Fig. 1.2

.....

.....

.....

..... [2]

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2 **(a)** A fishing boat is floating on the sea.

A fisherman drops a heavy anchor from the boat. The anchor accelerates as it falls through the water.

(i) Name the downward force which makes the anchor accelerate.

..... [1]

(ii) Complete the sentence below to describe the main energy change that happens to the anchor during its fall.

..... energy is changed into .....

energy. [2]

(b) Fig. 2.1 shows a diagram of a water wave.

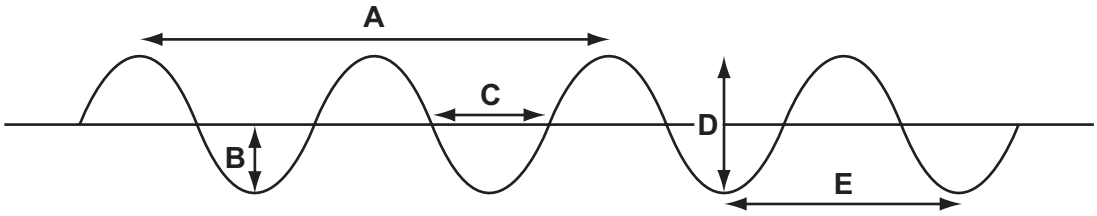

Fig. 2.1

Which measurement **A**, **B**, **C**, **D** or **E** is

(i) the wavelength of the wave? ..... [1]

(ii) the amplitude of the wave? ..... [1]

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(c) Water waves are a renewable energy resource.

Fig. 2.2 shows how water waves can be used to produce electricity.

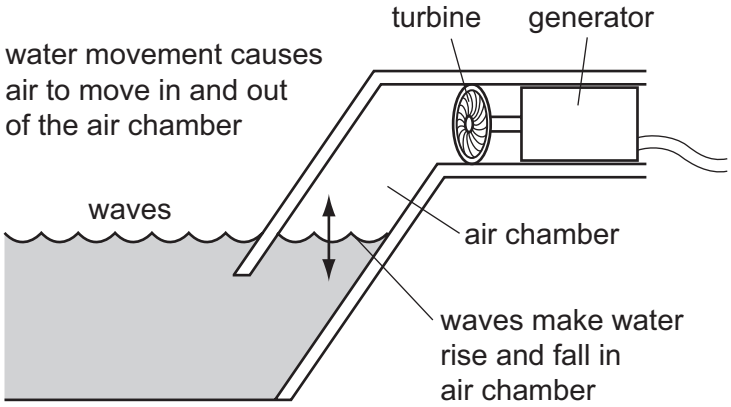

Fig. 2.2

Complete the sentences below to describe how the kinetic energy of the waves is changed into electrical energy.

The kinetic energy of the waves is transferred into the gravitational potential energy of the water.

This causes the air to move and make the ..... spin.

Electrical energy is produced in the ..... . [2]

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3 Fig. 3.1 shows some organisms that live in and around a pond.

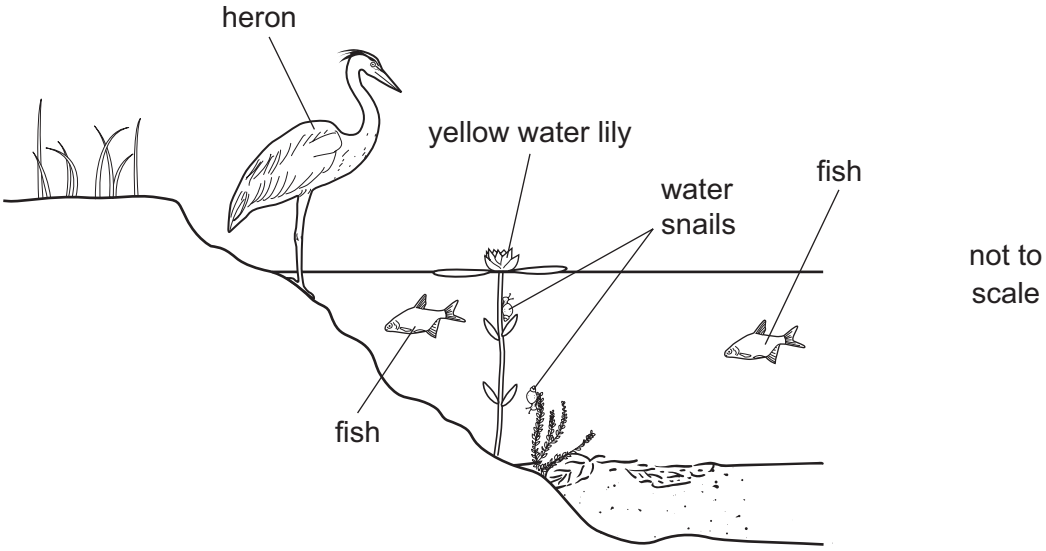

Fig. 3.1

(a) Herons eat fish. Water snails eat water plants, such as yellow water lilies.

Tick **all** the boxes that correctly describe each organism.

	producer	consumer	carnivore	herbivore
heron				
water snail				
yellow water lily				

[3]

(b) The addition of a harmful substance to the environment is called pollution. Two examples of pollution caused by human activities are

- untreated sewage entering a pond,
- the release of methane into the atmosphere.

(i) Explain why untreated sewage entering a pond may cause fish to die.

.....

.....

.....

..... [2]

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(ii) Methane is produced by bacteria and other decomposers breaking down o waste material in rubbish dumps.

Describe how air pollution by methane can harm the environment.

.....

.....

.....

..... [2]

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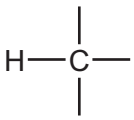
4 Petroleum (crude oil) and rock salt occur naturally in the Earth's crust.

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

(i) Complete the diagram of the alkane molecule that contains two carbon atoms.



[2]

(ii) Fig. 4.1 shows a simple pie chart of the composition of natural gas.

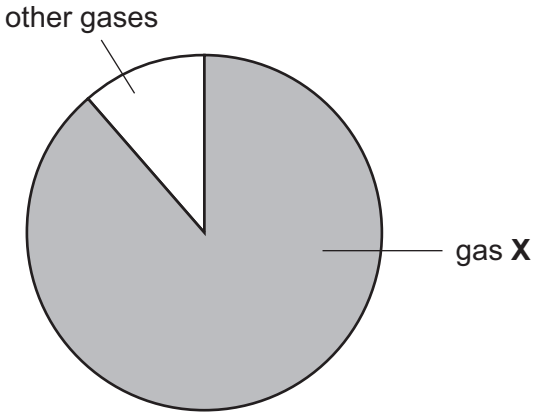


Fig. 4.1

Name gas **X**. ..... [1]

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(b) When petroleum is refined, it is separated into fractions.

Fig. 4.2 shows a simplified diagram of apparatus that is used to refine petroleum.

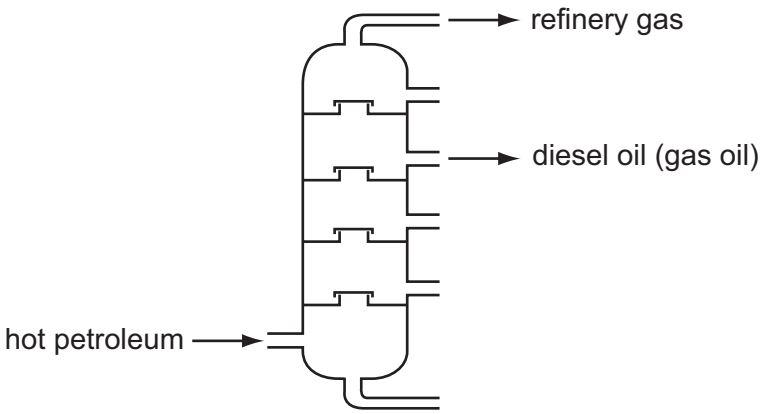

Fig. 4.2

(i) State the full name of the process shown in Fig. 4.2.

..... [1]

(ii) Refinery gas and diesel oil are used as fuels.

Name the **two** compounds that are formed when alkanes in these fuels undergo complete combustion.

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

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

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

.....

..... [1]

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(ii) Fig. 4.3 shows diagrams of a sodium atom and a chlorine atom.

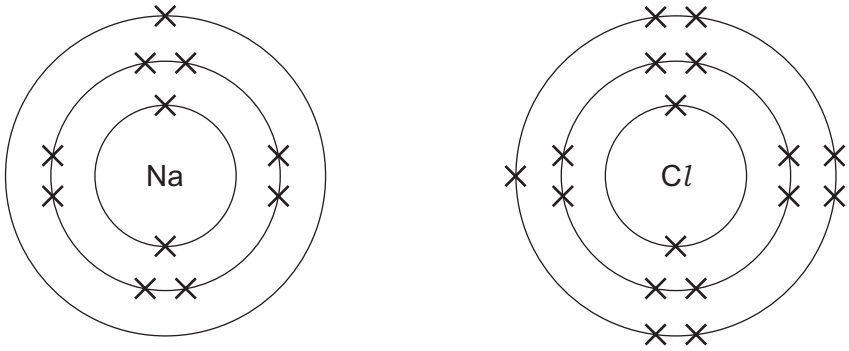

Fig. 4.3

When sodium reacts with chlorine, the atoms shown in Fig. 4.3 first change into electrically charged atoms known as ions.

Describe briefly what happens when sodium atoms and chlorine atoms are changed into ions.

.....

.....

..... [2]

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

Table 5.1 shows the mass of some of the substances in 100 g samples of milk from two mammals.

Table 5.1

substance	cow's milk	water-buffalo's milk
protein / g	3.2	4.5
fat / g	3.9	8.0
carbohydrate / g	4.8	4.9
calcium / mg	120	195

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

..... [1]

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

..... [1]

(c) Explain why both cow's milk and water-buffalo's milk produce a violet colour when tested with biuret solution.

..... [1]

(d) Predict the colour you would see if you added iodine solution to cow's milk.

Explain your answer.

colour .....

explanation ..... [2]

(e) List the components of milk, shown in Table 5.1, that provide energy.

..... [1]

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

.....

..... [2]

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6 **(a)** In a store, two workers are lifting 5 kg bags of flour onto the shelves. There a shelves, 0.5 m apart. The lowest shelf is 0.5 m from the floor.

Fig. 6.1 shows the two workers.

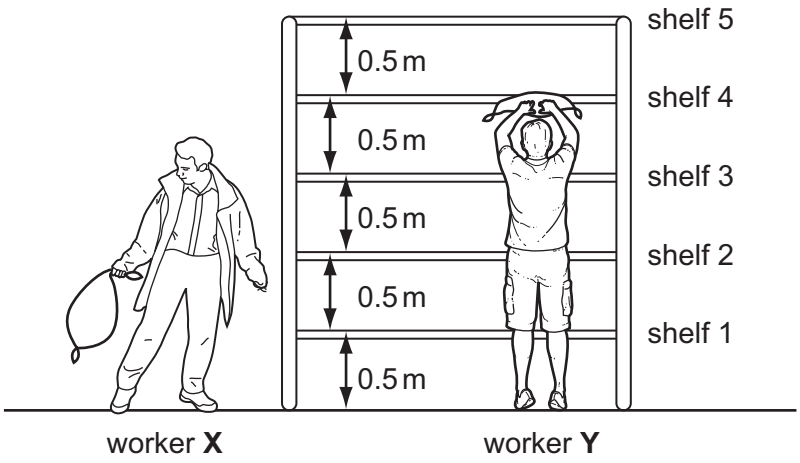

Fig. 6.1

(i) Worker **X** lifts a bag of flour onto shelf 2. Worker **Y** lifts a bag of flour onto shelf 4.

Which worker has done more work?

Explain your answer.

worker ..... because .....

..... [1]

(ii) State the unit in which work and energy are measured. ..... [1]

(iii) State the mass of each 5 kg bag of flour in grams. ..... g [1]

(iv) 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]

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(b) Three boys, **A**, **B** and **C**, walk together from their school to a store. They stay 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.

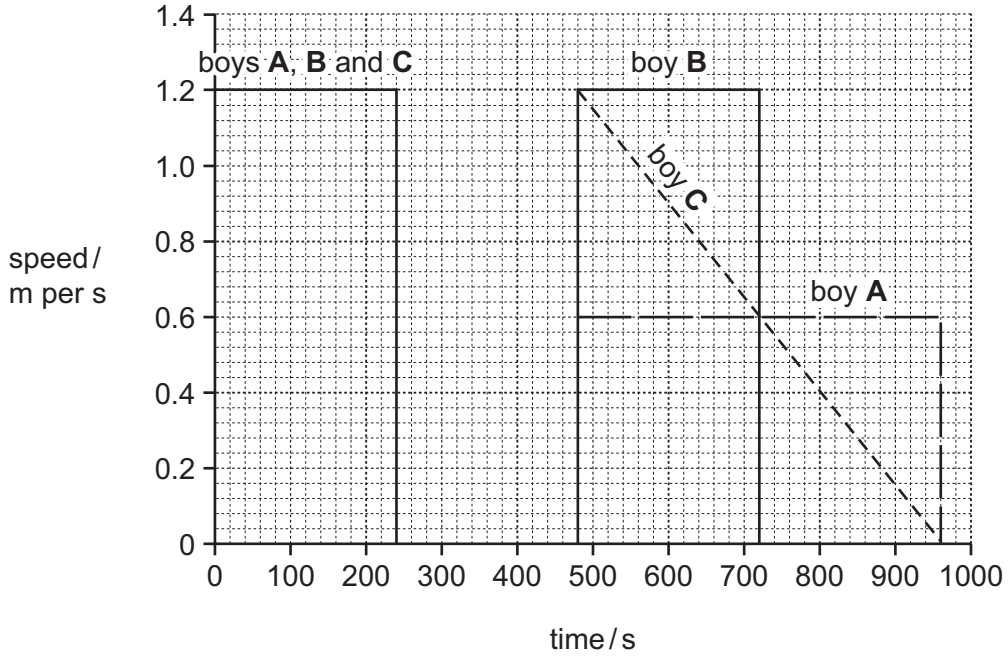

Fig. 6.2

(i) Calculate the distance of the store from the school.

Show your working.

..... m [2]

(ii) For how many seconds do the boys stay in the store?

..... s [1]

(iii) Which boy slowed down on his way back to school?

State a reason for your answer.

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

..... [2]

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7 **(a)** Sodium hydrogencarbonate, $NaHCO_3$, is a white solid compound.

State the number of different elements that are shown combined in the formula $NaHCO_3$.

..... [1]

(b) Fig. 7.1 shows apparatus a student used to investigate the reaction between sodium hydrogencarbonate and dilute hydrochloric acid.

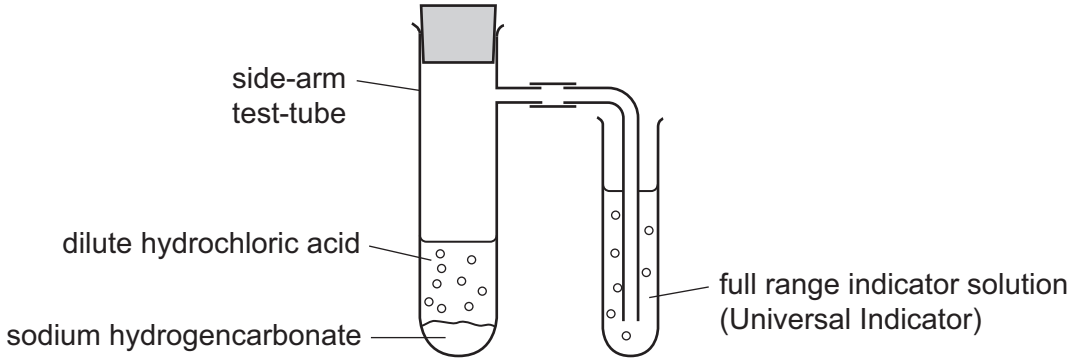

Fig. 7.1

The student observed that the indicator changed colour from green to orange.

Explain this observation.

.....

.....

..... [2]

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

Fig. 7.2 shows the apparatus she used.

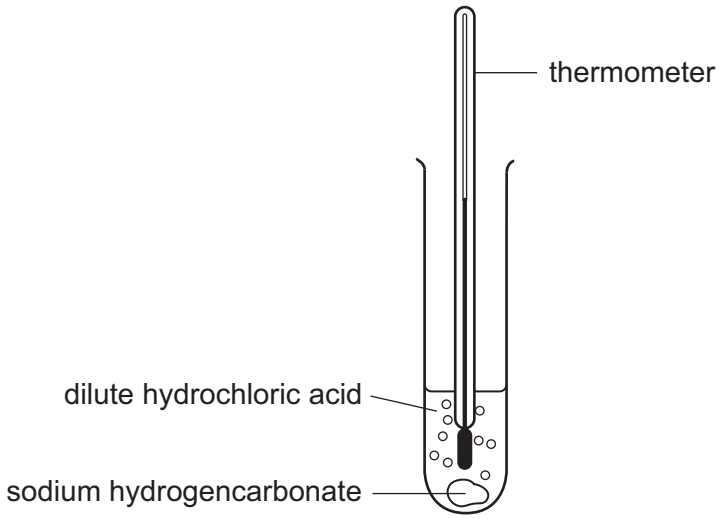

Fig. 7.2

Table 7.1 shows the temperature measurements the student made.

Table 7.1

temperature of the acid before the reaction / °C	19.0
temperature of the reaction mixture after reaction / °C	12.0

(i) Calculate the temperature change that occurred during the reaction.

..... °C [2]

(ii) State the term that is used to describe chemical reactions that cause this **type** of temperature change.

..... [1]

(d) A soluble calcium compound can be made by reacting lemon juice with finely powdered egg shells, which are made mainly of calcium carbonate.

Lemon juice contains a relatively low concentration of acid.

State the effect on the rate of reaction of

using a relatively low acid concentration,

.....

using egg shells in the form of a fine powder.

..... [2]

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8 Fig. 8.1 shows the human gas exchange system.

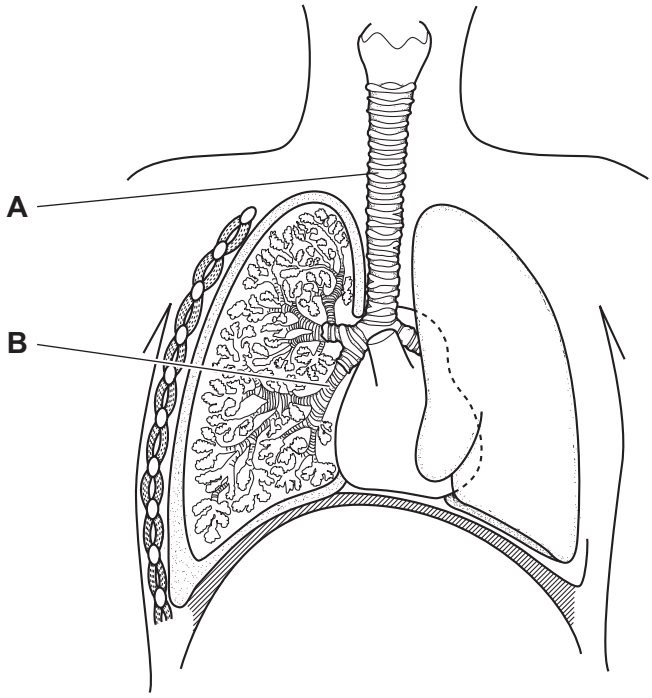

Fig. 8.1

(a) Name structures **A** and **B**.

A .....

B ..... [2]

(b) Table 8.1 shows the differences in the composition of inspired and expired air.

Table 8.1

gas	percentage in inspired air	percentage in expired air
nitrogen	78	
oxygen	21	17
carbon dioxide	0.04	4
noble gases	1	

(i) Complete Table 8.1. [1]

(ii) Name **one** noble gas that is present in air.

..... [1]

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(iii) Explain why the air that we breathe out (expired air) contains less oxygen and more carbon dioxide than the air we breathe in.

.....

.....

.....

..... [2]

(iv) Describe how you could show that expired air contains more carbon dioxide than inspired air. You can use a diagram if it helps your answer.

.....

.....

.....

..... [3]

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(c) An athlete exercised on a treadmill. The treadmill measured her power output, in
The faster she ran, the greater her power output.

(i) Explain why the athlete's power output was greater when she ran faster.

.....

.....

.....

..... [2]

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(ii) The athlete was connected to a machine that measured the rate and depth breathing.

Fig. 8.2 shows how her depth of breathing changed when she ran with different power outputs.

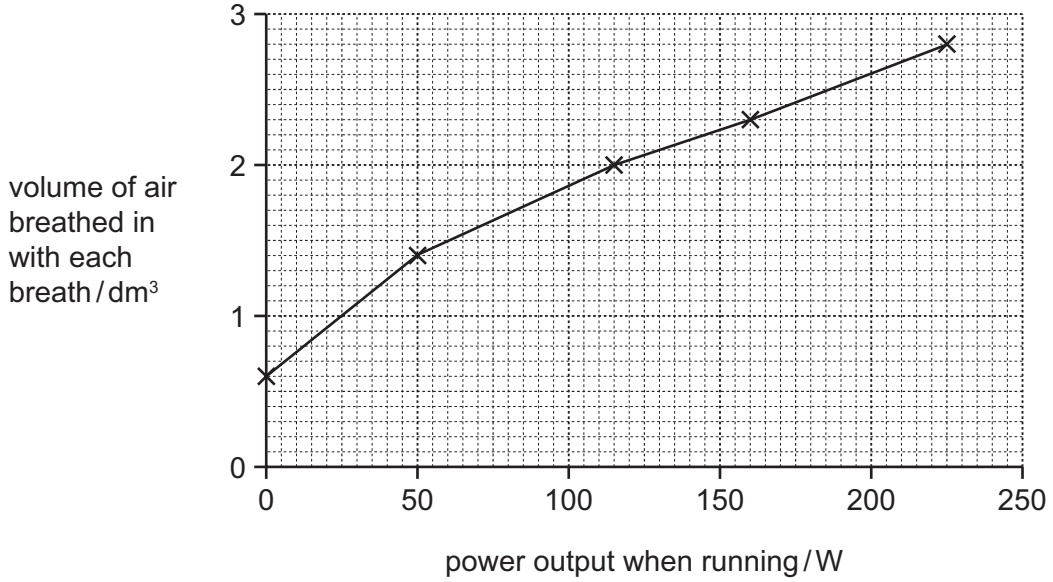

Fig. 8.2

Describe how the athlete's depth of breathing changed when she ran with a greater power output.

.....

.....

.....

..... [2]

(iii) State **one** other way in which her breathing would change when she ran with a greater power output.

..... [1]

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9 **(a)** Complete the following sentences choosing from the terms below.

Each term may be used once, more than once or not at all.

current **parallel** **potential difference**

resistance **series** **watt**

A flow of electric charge is called a ..... .

An ammeter is used to measure ..... . [2]

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(b) A student investigated how a change in potential difference across a lamp affec current flowing through the lamp.

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

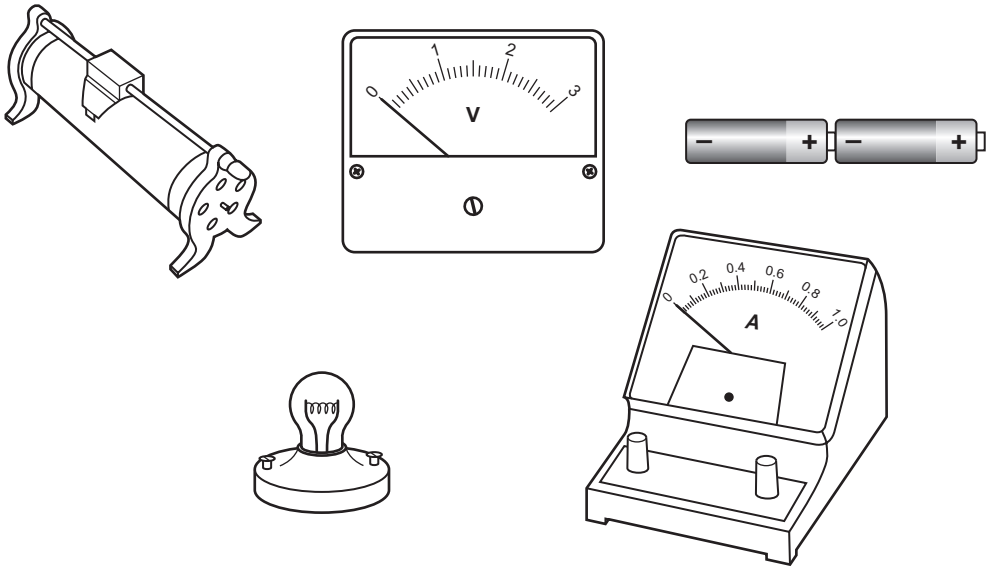

Fig. 9.1

Using the correct circuit symbols, draw a diagram to show the circuit she used.

[4]

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

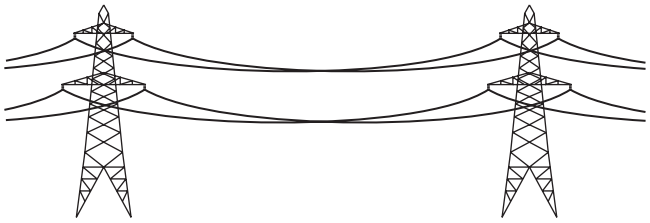

Fig. 9.2

Suggest why the cables are hung loosely.

.....

.....

..... [2]

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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** 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	
X	a = relative atomic mass
	X = atomic symbol
b	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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International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

6319202059

COMBINED SCIENCE **0653/22**

Paper 2 (Core) **May/June 2013**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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

This document consists of **20** printed pages.

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1 **(a)** Fig. 1.1 shows some of the elements in Group 1 of the Periodic Table.

Li
Na
K

Fig. 1.1

(i) Name the gas which is given off when the metals in Fig. 1.1 react with water.

..... [1]

(ii) Describe how the rate of reaction between water and the metals in Fig. 1.1 changes as you go down the group.

.....

..... [1]

(b) Fig. 1.2 shows some of the elements in Group 7 of the Periodic Table.

Cl
Br
I

Fig. 1.2

(i) Describe how the melting point of the elements in Fig. 1.2 changes as you go down the group.

.....

..... [1]

(ii) A solution of potassium bromide is colourless and a solution of chlorine is almost colourless.

Describe and explain briefly what would be seen when these solutions are mixed.

what would be seen .....

explanation .....

.....

..... [3]

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(c) Phosphorus is a non-metallic, solid element.

One form of phosphorus is white, has the chemical formula P_4 and has to be kept under water.

Fig. 1.3 shows a bottle containing phosphorus.

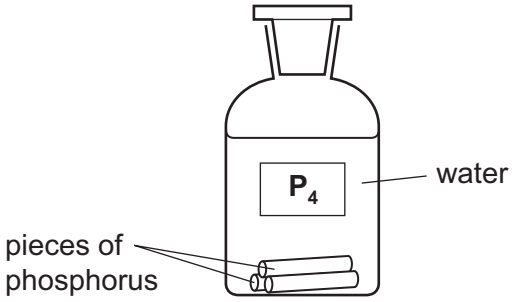

Fig. 1.3

(i) Suggest why white phosphorus has to be stored under water.

.....

.....

..... [2]

(ii) Explain the meaning of the chemical formula P_4.

.....

.....

..... [2]

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2 **(a)** Fig. 2.1 shows a child's toy. As the ball falls, the toy elephant moves across the table.

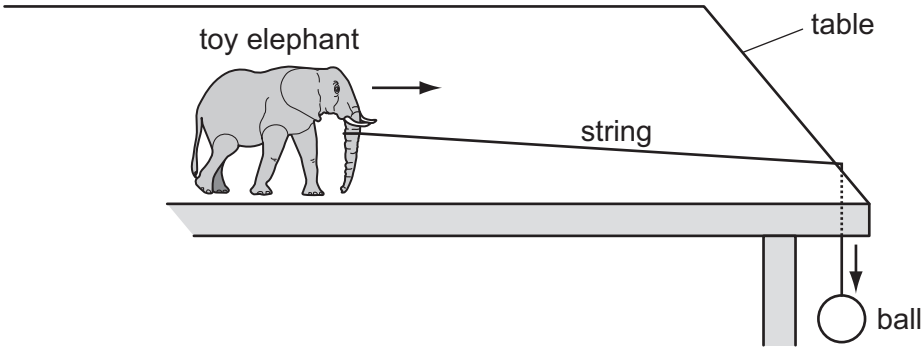

Fig. 2.1

(i) Name the main force that opposes the motion of the toy elephant.

..... [1]

(ii) State the unit used to measure forces.

..... [1]

(iii) Choose words from the list below to complete the sentences. You may use each word once, more than once or not at all.

chemical **electrical** **gravitational potential** **kinetic**

light **sound** **thermal**

The useful energy transfer for the toy is ..... energy

to ..... energy.

The energy wasted by the toy is ..... energy. [2]

(iv) The toy elephant travels 1.2 metres in 3 seconds.

Calculate the average speed of the elephant.

State the formula that you use and show your working.

formula

working

..... m / s [2]

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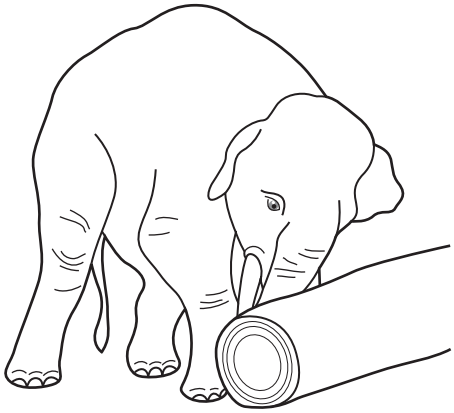
(b) An elephant of mass 5000 kg exerts a constant force to push a tree trunk along at a steady speed of 1.5 m / s.



State the **two** quantities that would need to be measured to calculate the work done by the elephant.

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

(c) An elephant can communicate with other elephants using infrasound. This is a very low frequency vibration which it is usually impossible for a human to hear.

(i) Suggest a possible frequency for this vibration and explain why you chose your answer.

frequency ..... Hz

explanation .....

..... [2]

(ii) State the meaning of the term *frequency*.

.....

..... [1]

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3 **(a)** Four sets of pea seeds were placed in Petri dishes containing either damp soil or damp filter paper. They were left in different conditions, shown in Table 3.1.

Table 3.1

set	conditions		
A	damp soil	cold	dark
B	damp filter paper	warm	light
C	damp filter paper	warm	dark
D	damp soil	cold	light

Predict which sets of seeds will germinate.

Explain your answer.

prediction .....

explanation .....

.....

..... [3]

(b) A pea seed was planted in a pot. When the seed had grown into a young plant, the pot was placed on its side in a room where light was coming from all sides.

Fig. 3.1 shows the young pea plant three days after the pot had been placed on its side.

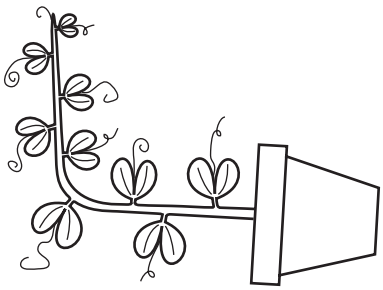

Fig. 3.1

(i) Which **two** terms describe the response of the plant shown in Fig. 3.1?

Circle the correct answers.

geotropism **photosynthesis** **phototropism**

sensitivity **transpiration** [2]

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(ii) Suggest how this response will help the plant to reproduce sexually when grown to maturity.

.....

.....

.....

..... [2]

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4 Fig. 4.1 shows a microwave oven.

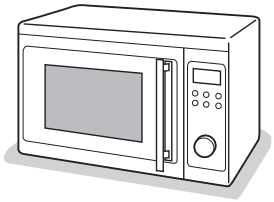


Fig. 4.1

(a) Microwaves cook food by transferring energy to the food.

(i) Choose words from the list to complete the sentences below. You may use each word once, more than once or not at all.

chemical	**conduction**	**convection**
potential	**radiation**	**thermal**

Microwaves are absorbed by the outer layers of food.

The microwave energy is transferred to water and fat molecules in these layers,

increasing the ..... energy of these layers.

..... energy is mostly transferred to the

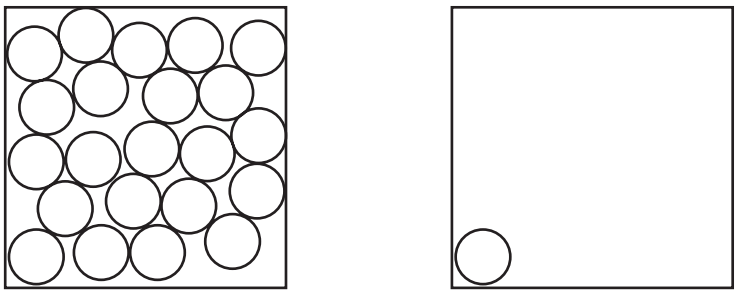
centre of solid food by ..... . [2]

(ii) State **one** use for microwaves other than cooking.

..... [1]

(b) Water can be heated in a microwave oven. The microwave oven is made of solids. The water is a liquid.

Complete Fig. 4.2 to show the arrangement of particles in a solid. The diagram for a liquid has been done for you.



liquid solid

[2]

Fig. 4.2

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5 **(a)** **(i)** Explain why hydrogen and carbon are described as elements, but hydroc such as methane and ethane are described as compounds.

.....

.....

.....

..... [2]

(ii) Name the fossil fuel found in the Earth that is the main source of methane.

..... [1]

(iii) Name **one** type of fossil fuel that is a solid. ..... [1]

(iv) Methane is used as a fuel because it reacts very quickly with oxygen, releasing heat.

Name the **two** compounds that are formed when methane undergoes complete combustion.

1 .....

2 ..... [2]

(b) Magnesium metal also reacts quickly with oxygen, releasing heat.

(i) Name the compound which is formed when magnesium reacts with oxygen.

..... [1]

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(ii) Fig. 5.1 shows diagrams of a magnesium atom and an oxygen atom.

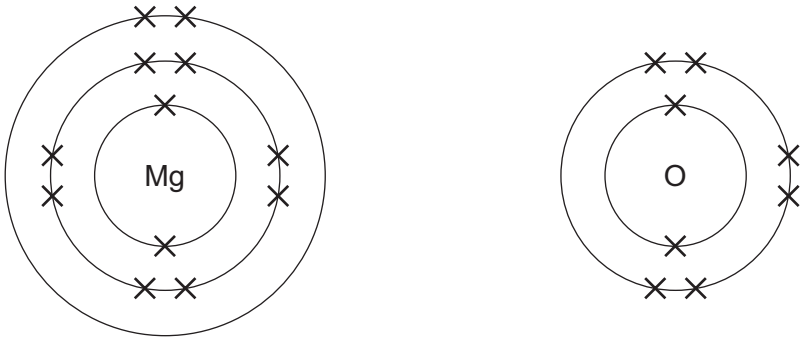

Fig. 5.1

When magnesium reacts with oxygen, the atoms shown in Fig. 5.1 first change into electrically charged atoms known as ions.

Describe what happens when these atoms change into ions.

magnesium .....

.....

oxygen .....

..... [2]

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6 Fig. 6.1 shows a food chain. The arrows show how energy flows from one organism to another, along the chain.

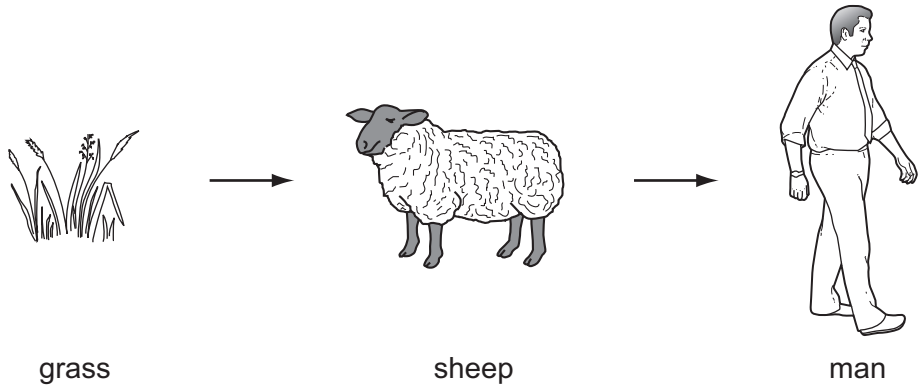

Fig. 6.1

(a) Energy enters the food chain as sunlight. Plant leaves use this energy to make food.

(i) Name the substance in the leaves of a plant that absorbs this energy.

..... [1]

(ii) Name the **two** raw materials that the plant uses to make food.

1 ..... 2 ..... [2]

(iii) Name the gas released from plant leaves during this process.

..... [1]

(b) A sheep is a herbivore.

Define the term *herbivore*.

.....

..... [2]

(c) Meat from the sheep contains protein.

Describe the importance of protein in the diet.

.....

.....

..... [2]

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(d) The cells in the man's body use respiration to release useful energy from nutrients he has absorbed.

(i) Tick the processes in the list below that use energy.

the diffusion of oxygen from the lungs into the blood	☐
the passage of nerve impulses along a nerve cell	☐
muscle contraction	☐
protein synthesis	☐ [1]

(ii) A person living in a very cold climate generally needs to eat more than a person living in a hot climate.

Explain why.

.....

.....

..... [2]

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7 **(a)** The diagrams below show the circuit symbols for three components of an electric torch (flashlight).

(i) On the line below each diagram, state the name of the component.

.... [3]

(ii) Using **only** these symbols, draw a circuit diagram for a torch.

[1]

(b) Torches are usually powered by electrical cells. They can also be powered by energy from the Sun (solar energy).

Solar energy is a renewable energy resource.

(i) Name **one** other renewable energy resource.

..... [1]

(ii) Name **one** non-renewable energy resource.

..... [1]

(iii) Energy is transferred from the Sun to the Earth by radiation.

Explain why energy cannot be transferred from the Sun to the Earth by conduction.

.....

..... [1]

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(c) A ray of light from the torch is reflected by a mirror. This is shown in Fig. 7.1.

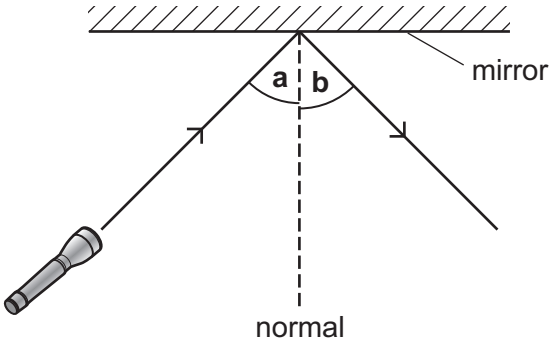

Fig. 7.1

Angle **a** has a value of 45°.

Name angle **b** and write down its value.

name .....

value ..... ° [2]

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8 **(a)** A student added a solution of the same dilute acid to each of the test-tubes shown in Fig. 8.1.

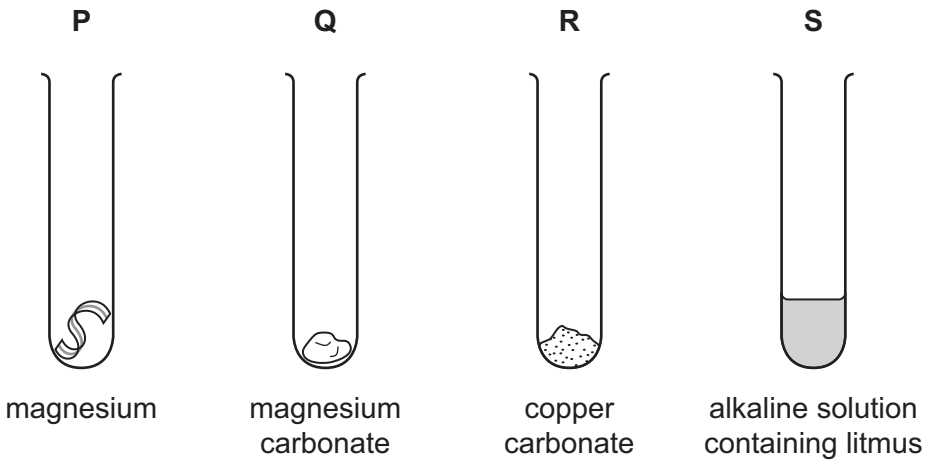

Fig. 8.1

Complete Table 8.1 by matching the test-tubes, **P**, **Q**, **R** and **S**, with the observations which are made when the dilute acid reacts with the contents.

One of the observations applies to more than one of the test-tubes. You may use each letter once, more than once or not at all.

Table 8.1

observations	test-tube(s)
Hydrogen gas is given off.	
A blue solution is formed.	
Carbon dioxide gas is given off.	

[3]

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(b) The student used the apparatus shown in Fig. 8.2 to investigate neutralisation reactions involving three acids, **A**, **B** and **C**.

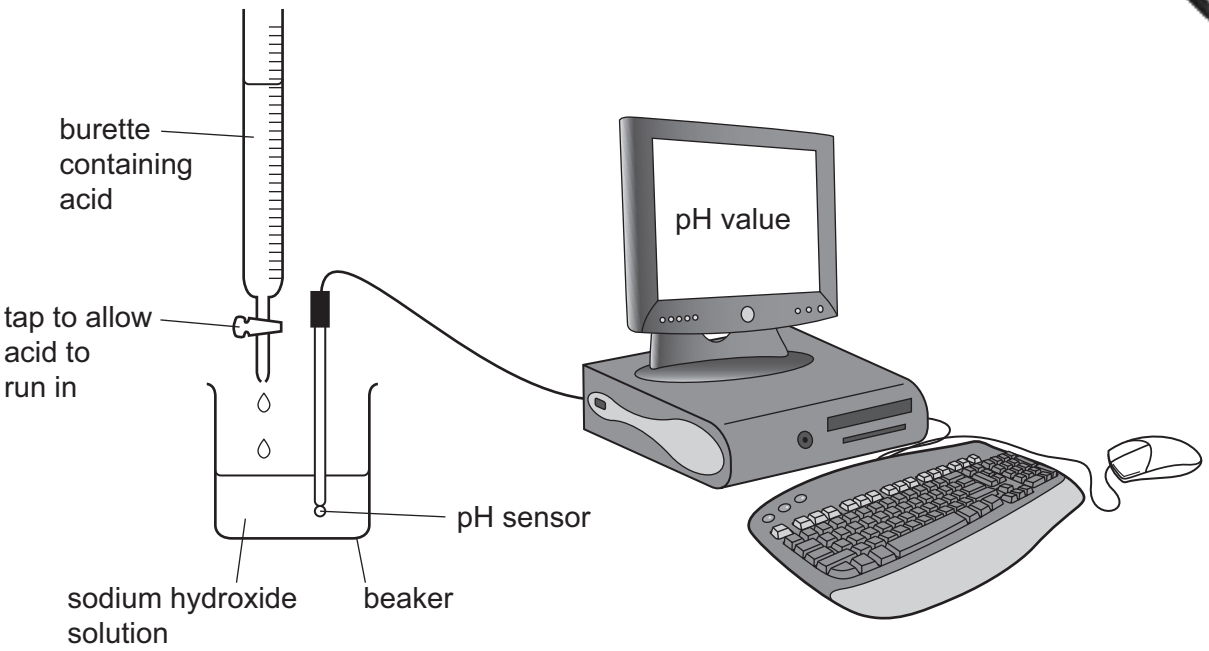

Fig. 8.2

25.0 cm^3 of the same solution of the alkali, sodium hydroxide, were placed into each of three beakers.

Acid was slowly added to each of the beakers in turn, and the pH values of the mixtures were displayed on the computer screen.

Some of the measurements from the three experiments are shown in Table 8.2.

Table 8.2

acid	source of acid	volume required to neutralise the alkali / cm^3
A	sample taken from an acidic lake	42.0
B	sample taken from a car battery	15.0
C	acid from a chemical laboratory	60.0

(i) Suggest a possible pH value of the alkali before any acid was added.

..... [1]

(ii) Describe briefly what the student would observe when the acid had neutralised the alkali.

.....

..... [1]

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(iii) State, with a reason, which acid, **A**, **B** or **C**, had the highest concentration.

acid .....

reason .....

..... [1]

(iv) The student noticed that, in all three experiments, the temperature of the mixture increased as the acid was added.

Suggest why the temperature increased.

.....

..... [1]

(v) Complete the general word equation for the reaction which occurs between an acid and an alkali.

acid	+	alkali	→		+	

[2]

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For Examiner's

9 Fig. 9.1 shows a section through a small blood vessel.

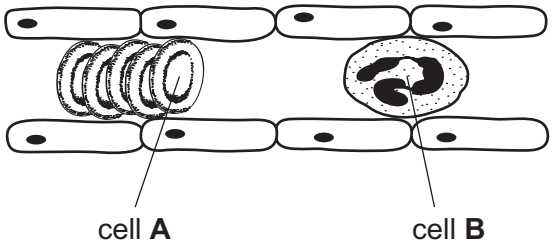

Fig. 9.1

(a) Cell **A** is a red blood cell.

(i) Outline **two** ways in which this cell differs from a liver cell.

1 .....

2 ..... [2]

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

.....

.....

.....

..... [2]

(b) Describe the function of cell **B**.

.....

.....

.....

..... [2]

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(c) Complete the sentences about the functions of blood plasma, using words from the list. You may use each word once, more than once, or not at all.

adrenaline	**enzymes**	**insoluble**	**small intestine**
soluble	**stomach**	**starch**	**vitamins**

Blood plasma transports ..... nutrients such as sugars.

These nutrients enter the blood in the ..... .

Blood plasma also transports hormones such as ..... . [3]

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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** 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 **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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International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

* 2 9 7 2 9 8 1 0 3 9 *

COMBINED SCIENCE **0653/23**

Paper 2 (Core) **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 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.

This document consists of **23** printed pages and **1** blank page.

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For Examiner's

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
A	1	0	1
B	8	8	8
C	1	1	1
D	15	16	15

(i) Name the central part of an atom that contains protons and neutrons.

..... [1]

(ii) Explain which one of the atoms, **A**, **B**, **C** or **D**, has a nucleon number (mass number) of 16.

atom .....

explanation .....

..... [2]

(iii) Use the information in Table 1.1 to explain why atoms do **not** have an overall electrical charge.

.....

.....

..... [2]

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

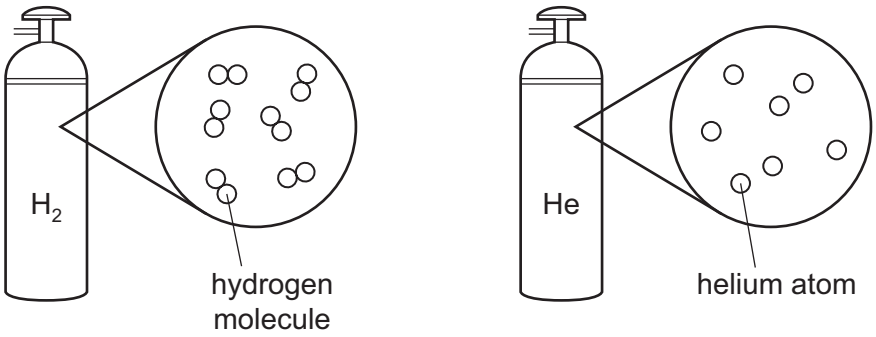

Fig. 1.1

(i) Hydrogen is usually described as a non-metal.

Name the type of chemical bond joining the atoms in a hydrogen molecule.

..... [1]

(ii) Suggest why helium exists as uncombined atoms.

.....

..... [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.

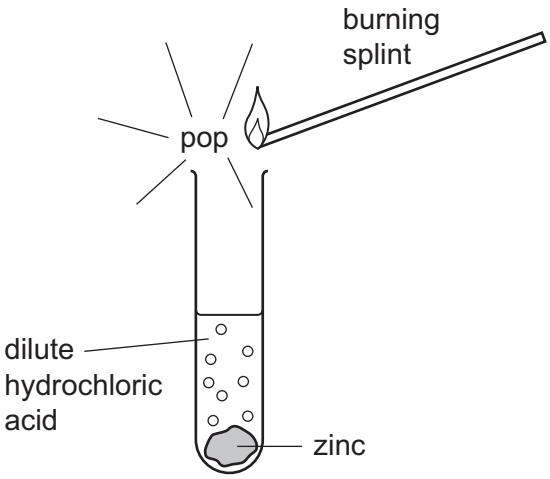

Fig. 1.2

.....

.....

.....

..... [2]

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2 **(a)** A fishing boat is floating on the sea.

A fisherman drops a heavy anchor from the boat. The anchor accelerates as it falls through the water.

(i) Name the downward force which makes the anchor accelerate.

..... [1]

(ii) Complete the sentence below to describe the main energy change that happens to the anchor during its fall.

..... energy is changed into .....

energy. [2]

(b) Fig. 2.1 shows a diagram of a water wave.

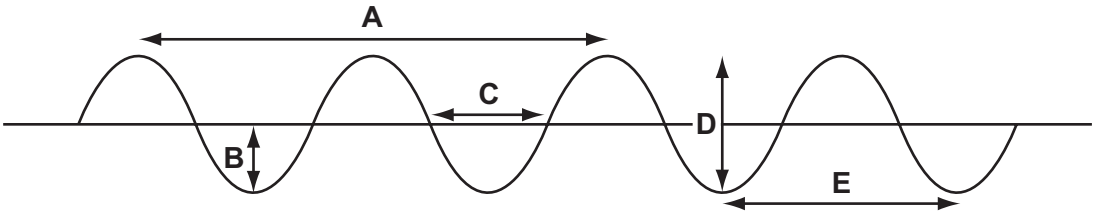

Fig. 2.1

Which measurement **A**, **B**, **C**, **D** or **E** is

(i) the wavelength of the wave? ..... [1]

(ii) the amplitude of the wave? ..... [1]

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(c) Water waves are a renewable energy resource.

Fig. 2.2 shows how water waves can be used to produce electricity.

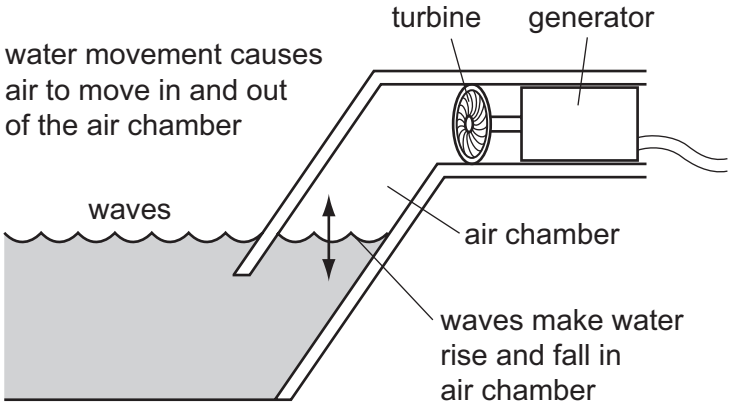

Fig. 2.2

Complete the sentences below to describe how the kinetic energy of the waves is changed into electrical energy.

The kinetic energy of the waves is transferred into the gravitational potential energy of the water.

This causes the air to move and make the ..... spin.

Electrical energy is produced in the ..... . [2]

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3 Fig. 3.1 shows some organisms that live in and around a pond.

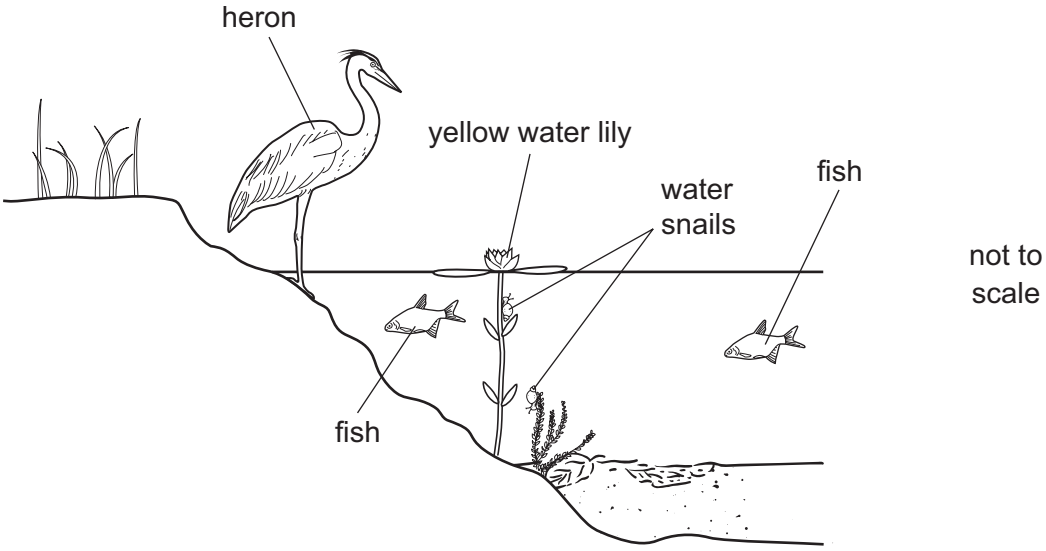

Fig. 3.1

(a) Herons eat fish. Water snails eat water plants, such as yellow water lilies.

Tick **all** the boxes that correctly describe each organism.

	producer	consumer	carnivore	herbivore
heron				
water snail				
yellow water lily				

[3]

(b) The addition of a harmful substance to the environment is called pollution. Two examples of pollution caused by human activities are

- untreated sewage entering a pond,
- the release of methane into the atmosphere.

(i) Explain why untreated sewage entering a pond may cause fish to die.

.....

.....

.....

..... [2]

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(ii) Methane is produced by bacteria and other decomposers breaking down o waste material in rubbish dumps.

Describe how air pollution by methane can harm the environment.

.....

.....

.....

..... [2]

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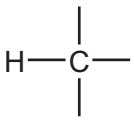
4 Petroleum (crude oil) and rock salt occur naturally in the Earth's crust.

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

(i) Complete the diagram of the alkane molecule that contains two carbon atoms.



[2]

(ii) Fig. 4.1 shows a simple pie chart of the composition of natural gas.

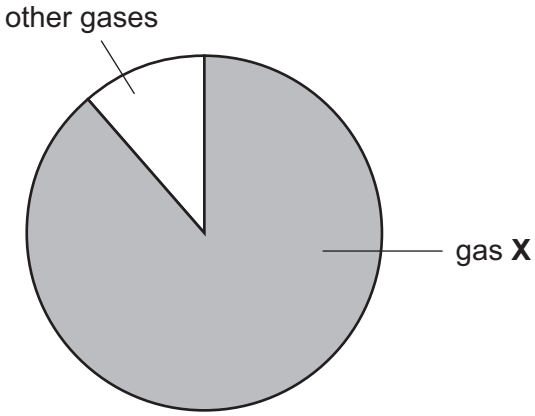


Fig. 4.1

Name gas **X**. ..... [1]

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(b) When petroleum is refined, it is separated into fractions.

Fig. 4.2 shows a simplified diagram of apparatus that is used to refine petroleum.

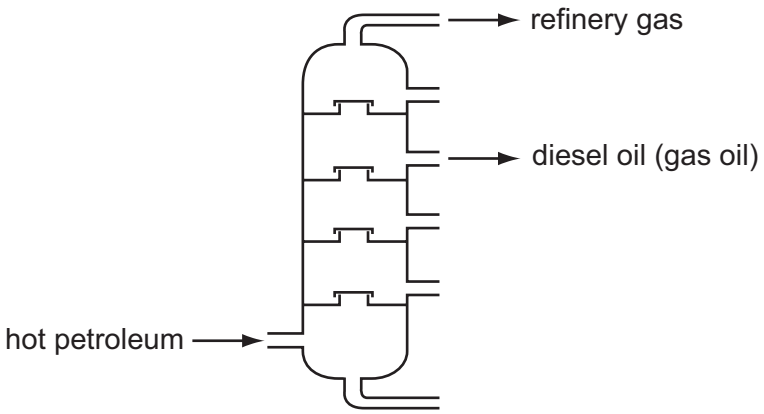

Fig. 4.2

(i) State the full name of the process shown in Fig. 4.2.

..... [1]

(ii) Refinery gas and diesel oil are used as fuels.

Name the **two** compounds that are formed when alkanes in these fuels undergo complete combustion.

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

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

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

.....

..... [1]

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(ii) Fig. 4.3 shows diagrams of a sodium atom and a chlorine atom.

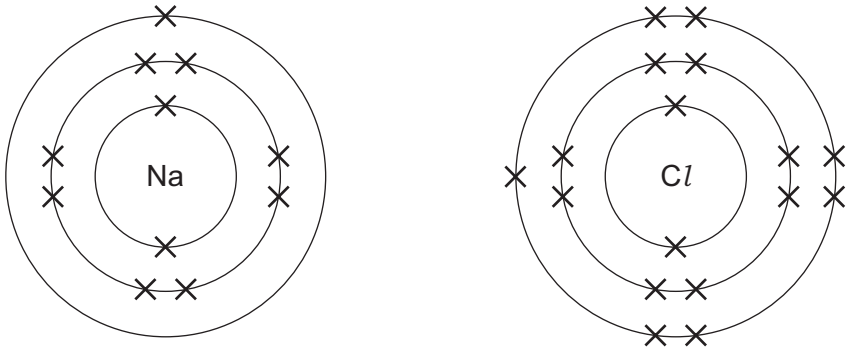

Fig. 4.3

When sodium reacts with chlorine, the atoms shown in Fig. 4.3 first change into electrically charged atoms known as ions.

Describe briefly what happens when sodium atoms and chlorine atoms are changed into ions.

.....

.....

..... [2]

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

Table 5.1 shows the mass of some of the substances in 100 g samples of milk from two mammals.

Table 5.1

substance	cow's milk	water-buffalo's milk
protein / g	3.2	4.5
fat / g	3.9	8.0
carbohydrate / g	4.8	4.9
calcium / mg	120	195

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

..... [1]

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

..... [1]

(c) Explain why both cow's milk and water-buffalo's milk produce a violet colour when tested with biuret solution.

..... [1]

(d) Predict the colour you would see if you added iodine solution to cow's milk.

Explain your answer.

colour .....

explanation ..... [2]

(e) List the components of milk, shown in Table 5.1, that provide energy.

..... [1]

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

.....

..... [2]

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6 **(a)** In a store, two workers are lifting 5 kg bags of flour onto the shelves. There a shelves, 0.5 m apart. The lowest shelf is 0.5 m from the floor.

Fig. 6.1 shows the two workers.

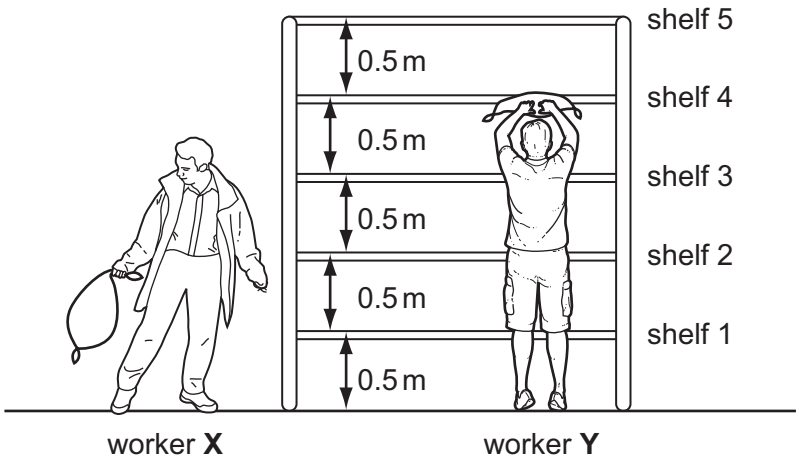

Fig. 6.1

(i) Worker **X** lifts a bag of flour onto shelf 2. Worker **Y** lifts a bag of flour onto shelf 4.

Which worker has done more work?

Explain your answer.

worker ..... because .....

..... [1]

(ii) State the unit in which work and energy are measured. ..... [1]

(iii) State the mass of each 5 kg bag of flour in grams. ..... g [1]

(iv) 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]

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(b) Three boys, **A**, **B** and **C**, walk together from their school to a store. They stay 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.

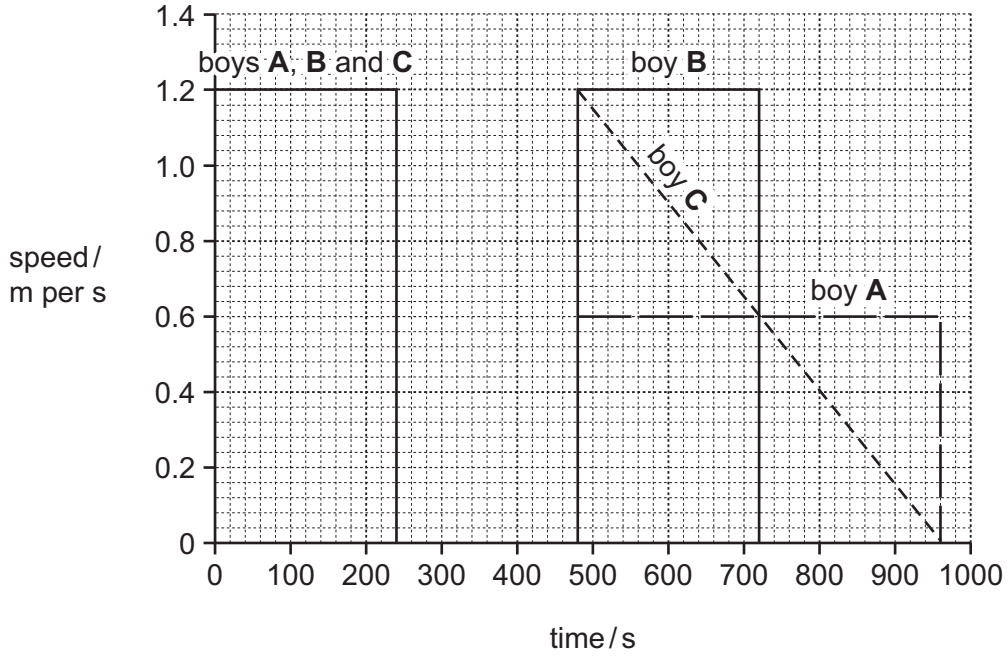

Fig. 6.2

(i) Calculate the distance of the store from the school.

Show your working.

..... m [2]

(ii) For how many seconds do the boys stay in the store?

..... s [1]

(iii) Which boy slowed down on his way back to school?

State a reason for your answer.

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

..... [2]

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7 **(a)** Sodium hydrogencarbonate, $NaHCO_3$, is a white solid compound.

State the number of different elements that are shown combined in the formula $NaHCO_3$.

..... [1]

(b) Fig. 7.1 shows apparatus a student used to investigate the reaction between sodium hydrogencarbonate and dilute hydrochloric acid.

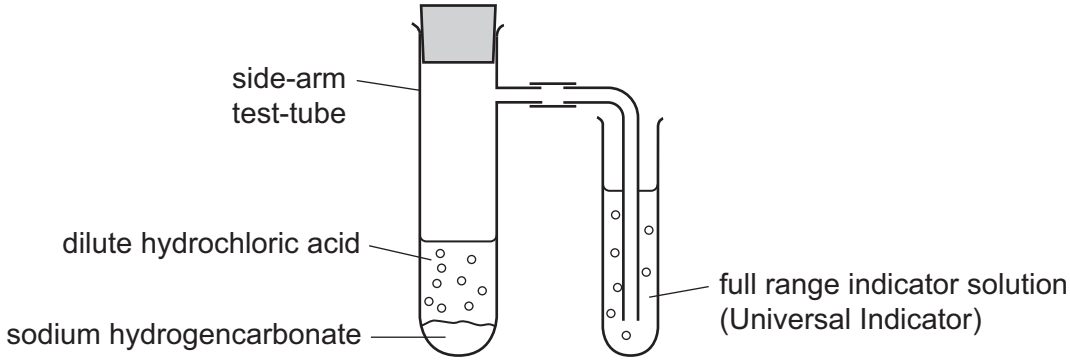

Fig. 7.1

The student observed that the indicator changed colour from green to orange.

Explain this observation.

.....

.....

..... [2]

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

Fig. 7.2 shows the apparatus she used.

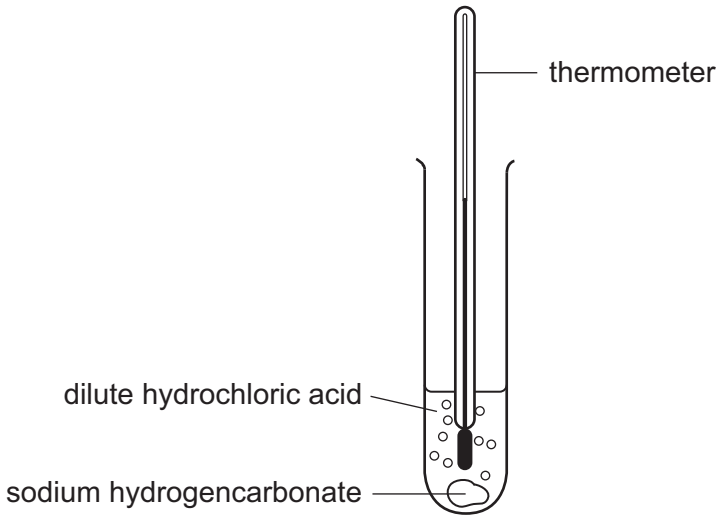

Fig. 7.2

Table 7.1 shows the temperature measurements the student made.

Table 7.1

temperature of the acid before the reaction / °C	19.0
temperature of the reaction mixture after reaction / °C	12.0

(i) Calculate the temperature change that occurred during the reaction.

..... °C [2]

(ii) State the term that is used to describe chemical reactions that cause this **type** of temperature change.

..... [1]

(d) A soluble calcium compound can be made by reacting lemon juice with finely powdered egg shells, which are made mainly of calcium carbonate.

Lemon juice contains a relatively low concentration of acid.

State the effect on the rate of reaction of

using a relatively low acid concentration,

.....

using egg shells in the form of a fine powder.

..... [2]

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8 Fig. 8.1 shows the human gas exchange system.

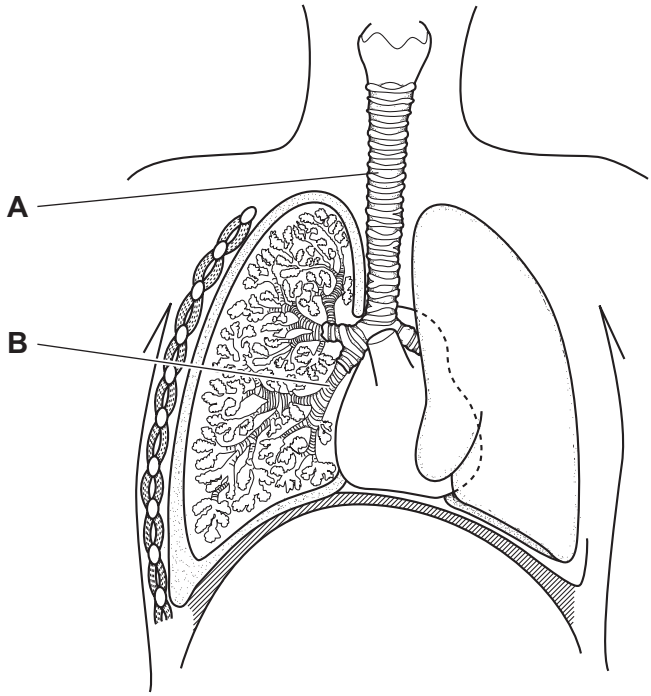

Fig. 8.1

(a) Name structures **A** and **B**.

A .....

B ..... [2]

(b) Table 8.1 shows the differences in the composition of inspired and expired air.

Table 8.1

gas	percentage in inspired air	percentage in expired air
nitrogen	78	
oxygen	21	17
carbon dioxide	0.04	4
noble gases	1	

(i) Complete Table 8.1. [1]

(ii) Name **one** noble gas that is present in air.

..... [1]

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(iii) Explain why the air that we breathe out (expired air) contains less oxygen and more carbon dioxide than the air we breathe in.

.....

.....

.....

..... [2]

(iv) Describe how you could show that expired air contains more carbon dioxide than inspired air. You can use a diagram if it helps your answer.

.....

.....

.....

..... [3]

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(c) An athlete exercised on a treadmill. The treadmill measured her power output, in
The faster she ran, the greater her power output.

(i) Explain why the athlete's power output was greater when she ran faster.

.....

.....

.....

..... [2]

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(ii) The athlete was connected to a machine that measured the rate and depth breathing.

Fig. 8.2 shows how her depth of breathing changed when she ran with different power outputs.

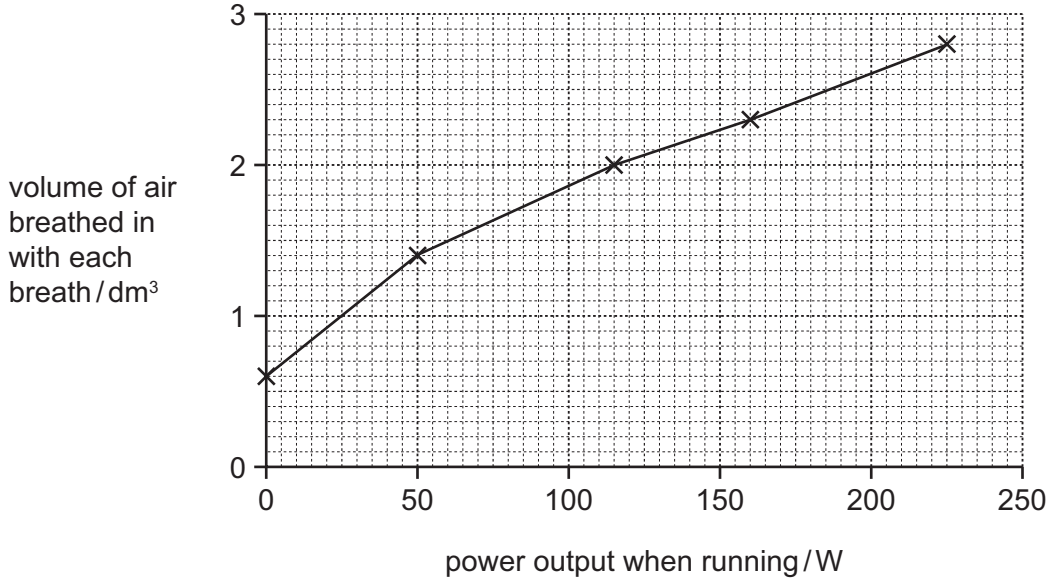

Fig. 8.2

Describe how the athlete's depth of breathing changed when she ran with a greater power output.

.....

.....

.....

..... [2]

(iii) State **one** other way in which her breathing would change when she ran with a greater power output.

..... [1]

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9 **(a)** Complete the following sentences choosing from the terms below.

Each term may be used once, more than once or not at all.

current **parallel** **potential difference**

resistance **series** **watt**

A flow of electric charge is called a ..... .

An ammeter is used to measure ..... . [2]

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(b) A student investigated how a change in potential difference across a lamp affect current flowing through the lamp.

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

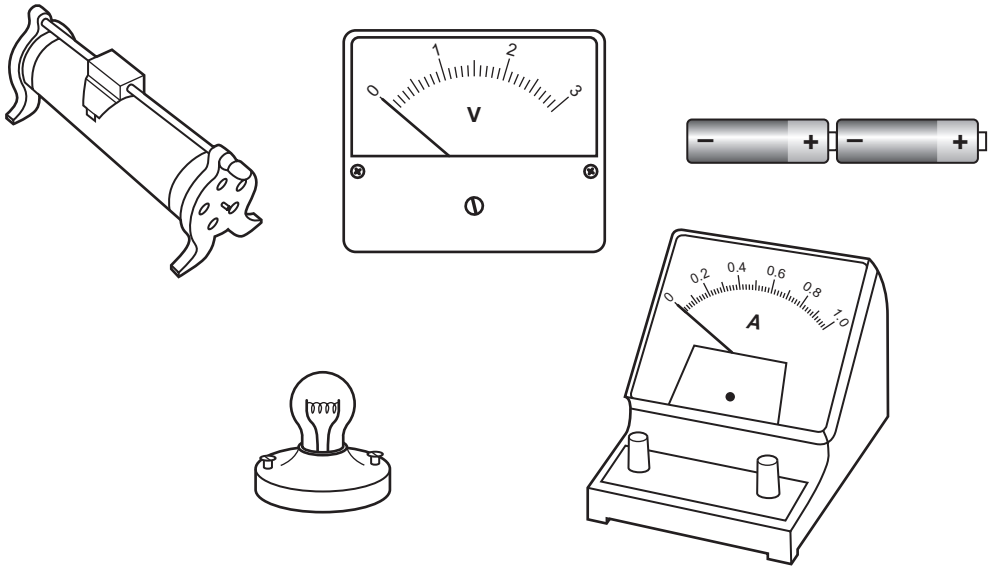

Fig. 9.1

Using the correct circuit symbols, draw a diagram to show the circuit she used.

[4]

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

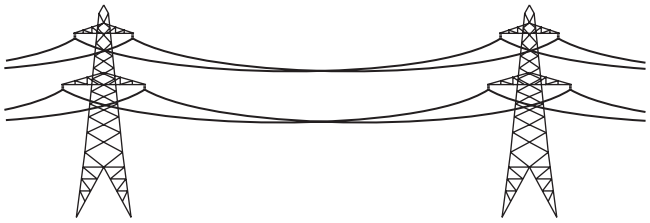

Fig. 9.2

Suggest why the cables are hung loosely.

.....

.....

..... [2]

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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** 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 **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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