Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

4970856379

COMBINED SCIENCE **0653/42**

Paper 4 (Extended) **October/November 2019**

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 an HB 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 20.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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

Cambridge Assessment International Education

1 **(a)** A student investigates the volumes of air breathed in and out of their lungs before and during exercise.

Fig. 1.1 shows graphs of the results.

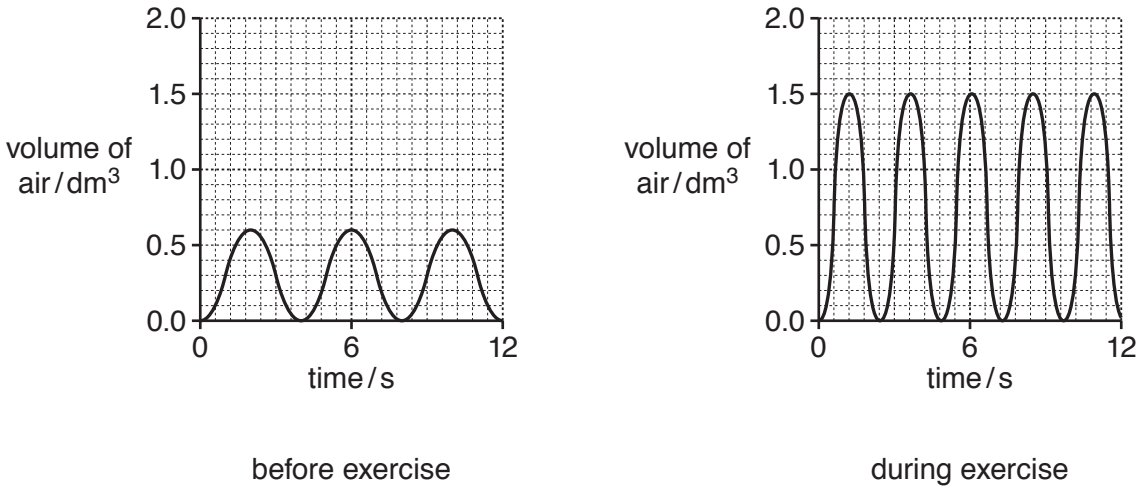

Fig. 1.1

(i) Use data from Fig. 1.1 to calculate the **extra** volume breathed in with each breath during exercise.

extra volume = ... dm^3 [1]

(ii) Use data from Fig. 1.1 to calculate the **increase** in breathing rate during exercise.

Write your answer in breaths per minute.

increase = ... breaths per minute [2]

(b) The pattern of breathing changes during exercise due to the change in the carbon dioxide concentration in the blood.

Explain the change in carbon dioxide concentration in the blood.

change in concentration .....

explanation .....

.....

[2]

(c) Smoking tobacco has harmful effects on the gas exchange system.

Describe the effect of carbon monoxide in tobacco smoke.

.....

.....

..... [2]

(d) Suggest **one** disease caused by the tar in tobacco smoke.

..... [1]

[Total: 8]

2 **(a)** Fig. 2.1 shows a fractional distillation column used in the separation of petroleum.

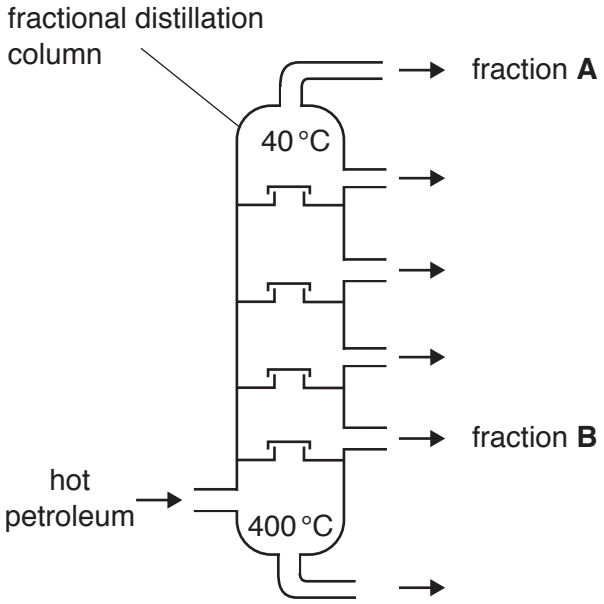

Fig. 2.1

(i) Describe **one similarity** of the molecules in fraction **A** and fraction **B**.

.....

..... [1]

(ii) Describe **one difference** between the molecules in fraction **A** and fraction **B**.

.....

..... [1]

(b) Methane and propane are both members of the homologous series of alkanes.

(i) State what is meant by a *homologous series*.

.....

.....

..... [2]

(ii) Complete Fig. 2.2 to show the structure of a molecule of propane, C_3H_8.

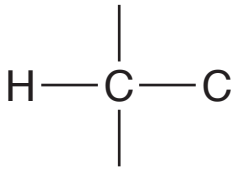

Fig. 2.2

[2]

(c) During the complete combustion of propane, carbon dioxide and water are formed.

(i) Construct the balanced symbol equation for the complete combustion of propane.

..... [2]

(ii) State **one** effect of an increase in the concentration of carbon dioxide in the atmosphere.

.....

..... [1]

(iii) Draw a dot-and-cross diagram of a molecule of carbon dioxide.

Show all of the outer shell electrons.

[2]

[Total: 11]

3 **(a)** Fig. 3.1 shows how a spring is stretched when a force is applied to one end.

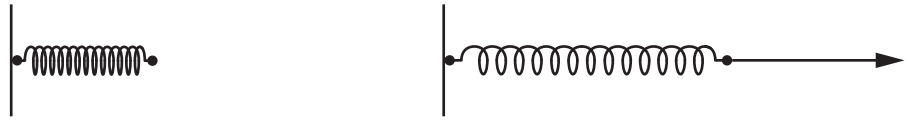

Fig. 3.1

(i) State Hooke's Law.

.....

..... [1]

(ii) The unstretched spring is a length of 0.10 m. When a force of 2.0 N is applied, the spring stretches to a length of 0.14 m.

Calculate the total force required to stretch the spring to a length of 0.16 m.

Show your working.

total force = ... N [2]

(iii) The spring is released and it returns to its original length. An average force of 0.75 N is then used to extend the spring by 0.015 m.

Calculate the work done in extending the spring.

Show your working.

work done = ... J [2]

(b) A ball of mass 125 g is projected vertically upwards by a spring.

The initial kinetic energy of the ball is 2.0 J.

(i) Calculate the maximum increase in the vertical height of the ball.

gravitational field strength $g = 10\,\text{N/kg}$

Show your working.

increase in height = ... m [3]

(ii) Suggest **one** reason why the ball will **not** reach the maximum height calculated in **(b)(i)**.

.....

..... [1]

[Total: 9]

4 **(a)** Fig. 4.1 shows a root hair cell and soil particles.

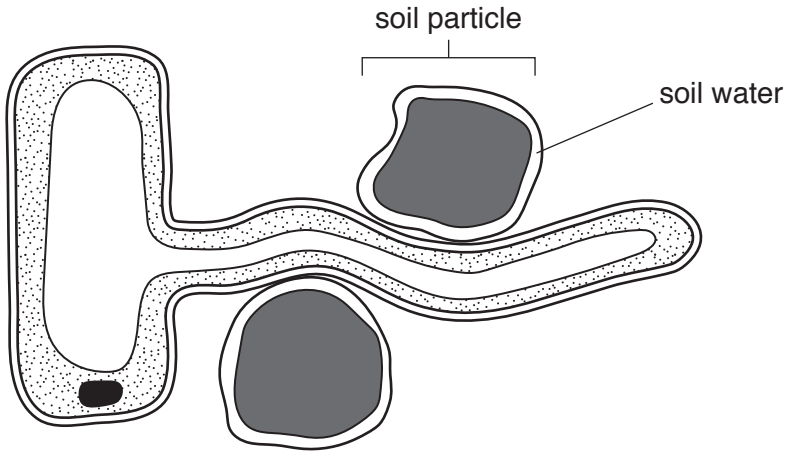

Fig. 4.1

(i) On the root hair cell in Fig. 4.1 use label lines to identify:

1. the nucleus

2. the cell membrane.

[2]

(ii) Explain how the structure of the root hair cell is adapted for water uptake.

.....

.....

..... [2]

(b) Plants need a supply of mineral ions. These are dissolved in water in the soil.

(i) Describe the importance of nitrate ions in a plant.

.....

..... [1]

(ii) Describe the pathway taken by nitrate ions from the root hair cells to the mesophyll cells in the leaf.

.....

.....

..... [2]

(c) Humans need vitamin D.

(i) Describe **one** effect of vitamin D deficiency in humans.

..... [1]

(ii) Name a food which is a rich source of vitamin D.

..... [1]

[Total: 9]

5 **(a)** Aluminium ore is mainly aluminium oxide. Aluminium is extracted from its ore by electrolysis.

(i) Name the ore from which aluminium is extracted.

..... [1]

(ii) The chemical formula of aluminium oxide is Al_2O_3.

The formula of an oxide ion is O^{2-}.

Deduce the formula of an aluminium ion.

..... [1]

(iii) Fig. 5.1 shows the industrial apparatus used for the extraction of aluminium by electrolysis.

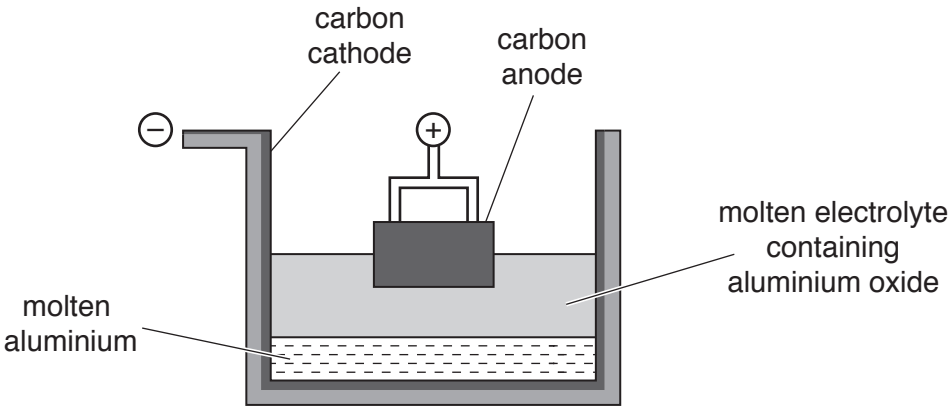

Fig. 5.1

Describe how aluminium atoms form from aluminium ions.

Use ideas about the movement of ions and electrons in your answer.

.....

.....

..... [2]

(iv) Copper is extracted from copper oxide by heating with carbon.

Explain why aluminium **cannot** be extracted from aluminium oxide by heating with carbon.

.....

..... [1]

(b) Explain why aluminium alloys, rather than pure aluminium, are used in aircraft construction.

.....

..... [1]

[Total: 6]

6 Fig. 6.1 shows an electric hair dryer.

Fig. 6.1

(a) Fig. 6.2 shows a label on the hair dryer.

240 V	750 W
Use only a 5 A replacement fuse.	

Fig. 6.2

Use data from Fig. 6.2 to explain why a 5 A fuse is the correct fuse rating to be used in the hair dryer when replacing the fuse.

Show your working.

explanation .....

.....

[3]

(b) The hair dryer contains:

- an electrical heater to heat the air used to dry the hair
- a fan driven by an electric motor to blow the air over the wet hair
- a two-way switch that enables the motor to drive the fan at slow speed or high speed.

Fig. 6.3 shows the circuit diagram for the hair dryer with the two-way switch in two different positions.

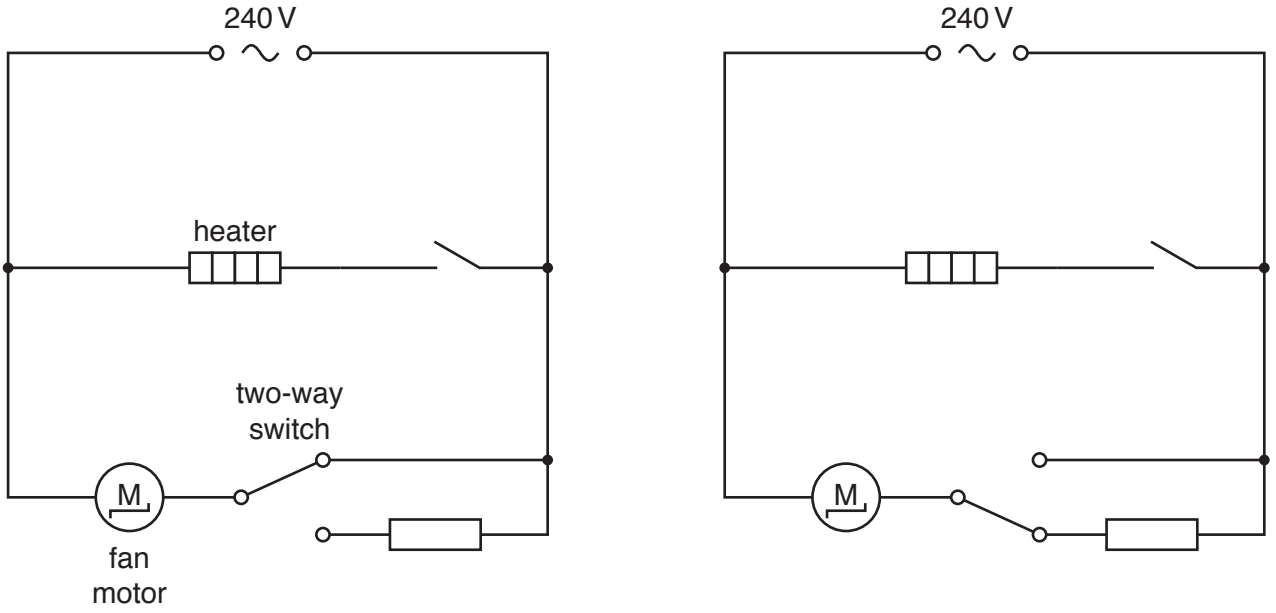

Fig. 6.3

The two-way switch changes the speed of the motor between fast and slow.

Suggest why use of the two-way switch in this circuit changes the speed of the motor.

Use the term *potential difference* in your answer.

.....

.....

.....

..... [3]

(c) When the hair dryer blows air over wet hair, the water evaporates.

Explain in terms of water molecules why wet hair dries faster when air is blown across it, and even faster if the air is heated.

.....

.....

..... [2]

[Total: 8]

7 **(a)** A person is investigating the effect of the enzyme lipase on milk.

The person adds lipase to some milk in a test-tube.

After 10 minutes the contents of the test-tube are tested with Universal Indicator.

The results show that the contents of the test-tube have become more acidic.

(i) Explain why the contents of the test-tube have become more acidic.

.....

.....

..... [2]

(ii) Chemical digestion takes place in the test-tube.

Explain what is meant by *chemical digestion*.

.....

.....

..... [2]

(iii) Name **one** area in the body where lipase is secreted.

..... [1]

(b) The investigation in **(a)** is repeated with boiled lipase.

There is no change in the acidity of the contents of the test-tube.

Explain in detail the effect of boiling the lipase on the action of the enzyme.

.....

.....

.....

..... [3]

(c) Food is chewed in the mouth before swallowing.

Explain why the chewing of food is an example of mechanical digestion.

.....

.....

..... [2]

[Total: 10]

[Turn over

8 Chlorine and astatine are two Group VII elements.

(a) Fig. 8.1 shows Group VII of the Periodic Table.

VII
9 **F** Fluorine 19
17 **Cl** Chlorine 35.5
35 **Br** Bromine 80
53 **I** Iodine 127
85 **At** Astatine –

Fig. 8.1

(i) Use Fig. 8.1 to determine the number of electrons in an astatine atom.

..... [1]

(ii) State the number of electrons in the outer shell of an astatine atom.

Explain your answer.

number of electrons .....

explanation .....

.....

[2]

(iii) Deduce the formula of potassium astatide.

..... [1]

(b) Chlorine combines with sodium in an exothermic reaction to produce sodium chloride.

(i) Describe what is meant by an *exothermic reaction*. Use ideas about energy, bond breaking and bond forming in your answer.

.....

.....

.....

..... [2]

(ii) Solid sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

Fig. 8.2 represents part of an ionic lattice of sodium chloride.

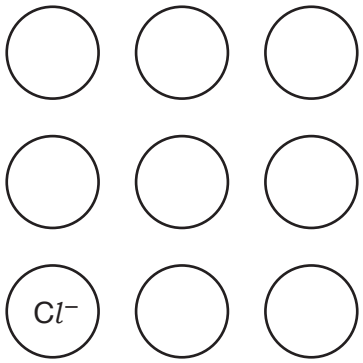

Fig. 8.2

[1]

Complete Fig. 8.2 to show the arrangement of sodium ions and chloride ions.

(iii) The boiling point of chlorine is –34 °C.

The boiling point of sodium chloride is 1465 °C.

Explain the difference in these boiling points.

.....

.....

.....

.....

..... [2]

[Total: 9]

9 Fig. 9.1 shows a lightning bolt, which is a form of electrostatic discharge.

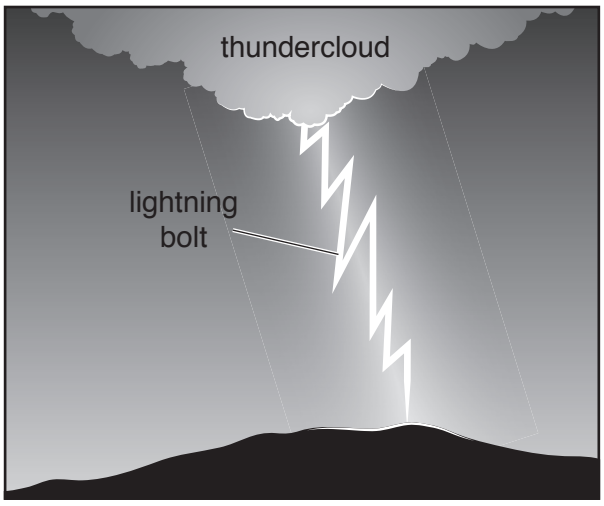

Fig. 9.1

(a) Fig. 9.2 shows the range of wavelengths of different parts of the electromagnetic spectrum.

$< 0.001 \times 10^{-9}$ m	$0.001–1 \times 10^{-9}$ m	$1–450 \times 10^{-9}$ m	$400–750 \times 10^{-9}$ m	750×10^{-9} m –0.001 m	0.001–1.0 m	> 1.0 m
gamma rays	X-rays				microwaves	

Fig. 9.2

A lightning bolt emits a range of wavelengths between 390 nm and 590 nm.
(1 nm = 1×10^{-9} m).

Identify the **two** parts of the electromagnetic spectrum emitted by lightning.

On Fig. 9.2 fill in the missing names of these parts in the correct places. [2]

(b) A person hears the thunder from a distant lightning bolt 10.0 s after the lightning is seen.

Sound travels in air at 330 m / s.

Calculate the distance of the person from the lightning bolt.

distance = ... m [2]

(c) Lightning bolts occur when clouds become highly charged and a very high voltage exists between the thundercloud and the ground.

The current in a lightning bolt is 30 000 A, and flows for 0.000050 s

Calculate the electric charge that passes to Earth from this lightning bolt.

Show your working, and give the unit of your answer.

charge = ... unit ..... [3]

(d) **(i)** The thundercloud consists mainly of water droplets. The droplets at the bottom are negatively charged and at the top are positively charged.

Name the type of particle exchanged between the droplets to produce the charges on them.

..... [1]

(ii) Just before a thunderstorm, some people find that their hair is standing on end.

Suggest a reason for this.

Explain your answer.

reason .....

explanation .....

.....
[2]

[Total: 10]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).