Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

7600637314

PHYSICAL SCIENCE **0652/42**

Paper 4 (Extended) **October/November 2017**

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, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 20.
Electronic calculators may be used.

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 International Examinations

1 A ball falls through the atmosphere of a planet.

Fig. 1.1 shows a graph of the ball's speed against time.

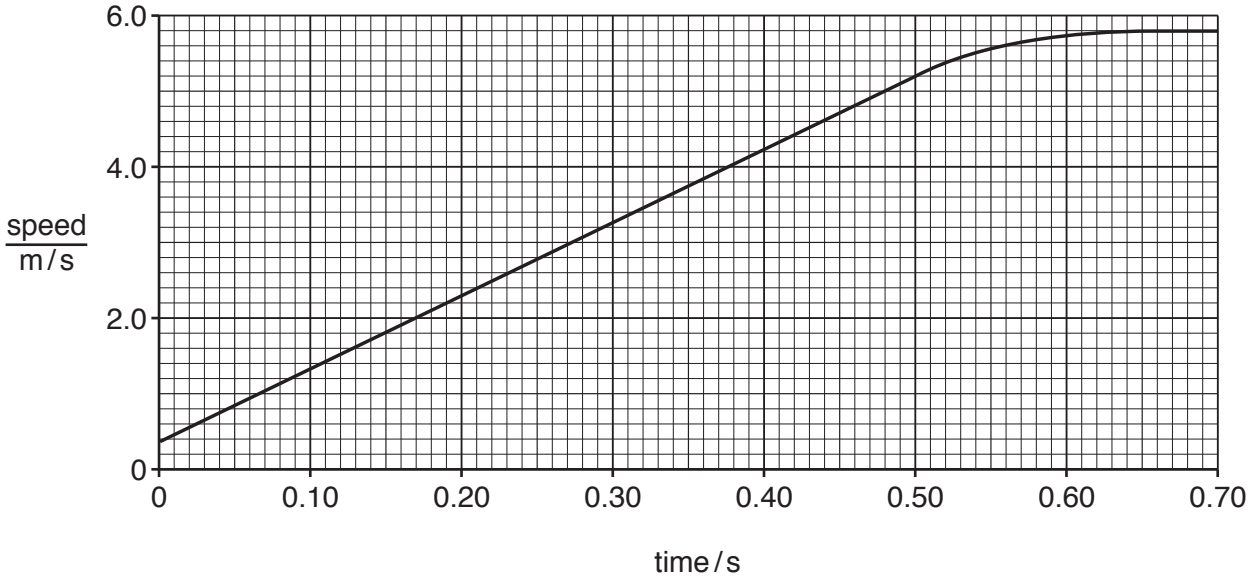

Fig. 1.1

(a) (i) Use the graph to determine the acceleration of the ball in the first 0.50 s of its fall.

Show your working.

acceleration = ... unit = ... [3]

(ii) The ball has a mass of 0.15 kg.

Use your answer from **(a)(i)** to calculate the downward force on the ball.

force = ... N [2]

(iii) In the first 0.40 s the ball falls through a distance of 4.2 m.

Use your answer from **(a)(ii)** to calculate the work done on the ball by the downward force.

work done = ... J [2]

(b) (i) Between 0.50 s and 0.70 s the acceleration decreases.

State the evidence from the graph that the acceleration decreases.

.....

.....[1]

(ii) Explain why the acceleration decreases.

.....

.....[1]

2 Chlorine is in Group VII of the Periodic Table.

Fig. 2.1 shows the number of electrons in the shells of an atom of chlorine.

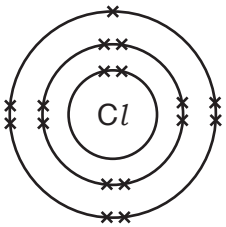

Fig. 2.1

(a) State how Fig. 2.1 shows that chlorine is in Group VII of the Periodic Table.

.....[1]

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

Chlorine gas reacts with hydrogen gas to form hydrogen chloride gas.

The equation shows this reaction.

$$Cl_2 + H_2 \rightarrow 2HCl$$

(i) Calculate the volume of chlorine, measured at room temperature and pressure, that produces 10 dm^3 of hydrogen chloride gas.

volume of chlorine = ... dm^3

[2]

(ii) This reaction will **not** take place in the dark.

State why sunlight enables the reaction to take place.

.....

.....[1]

(c) Silver bromide, AgBr can be used to make photographic film.

In photography, silver bromide is reduced to metallic silver. The other product is bromine.

(i) Write the balanced symbol equation for this reaction.

.....[2]

(ii) Explain how the reduction of silver bromide to metallic silver is used in photography.

.....

.....

.....

.....[2]

3 **(a)** Name the main process by which energy is produced in the Sun.

..... [1]

(b) **(i)** Describe the process by which energy is produced in the Sun.

.....

.....

.....

.....[3]

(ii) The mass of the Sun decreases at a rate of 4.0×10^7 kg/s.

The speed of electromagnetic waves is 3.0×10^8 m/s.

Calculate the energy released by the Sun in 1.0 s.

energy = ... J [3]

4 Nonadecane is an organic compound, with the formula $C_{19}H_{40}$. It contains only carbon and hydrogen atoms.

(a) Suggest the homologous series nonadecane belongs to.

.....[1]

(b) Nonadecane is found in the lubricating fraction of petroleum.

One use of this fraction is to make lubricants.

State one other use for the lubricating fraction.

.....[1]

(c) Some fractions in petroleum are in greater demand than others.

Cracking is a process that breaks long chain molecules in petroleum into smaller, more useful molecules.

(i) The equation shows the type of reaction that takes place during cracking.

Complete the equation.

$$C_{19}H_{40} \rightarrow C_8H_{18} + 3C_3H_6 + ...$$ [1]

(ii) State **two** conditions needed for **thermal** cracking to occur.

1 .....

2 .....

[2]

(iii) Cracking can also take place using a catalyst.

Describe the effect catalysts have on a reaction.

.....[1]

(d) C_3H_6 is an unsaturated hydrocarbon.

State a chemical test that distinguishes between unsaturated and saturated hydrocarbons.

Include the results of the test in your answer.

test .....

.....

result for unsaturated hydrocarbon .....

.....

result for saturated hydrocarbon .....

.....

[3]

Question 5 begins over the page

5 Fig. 5.1 shows a thermocouple thermometer.

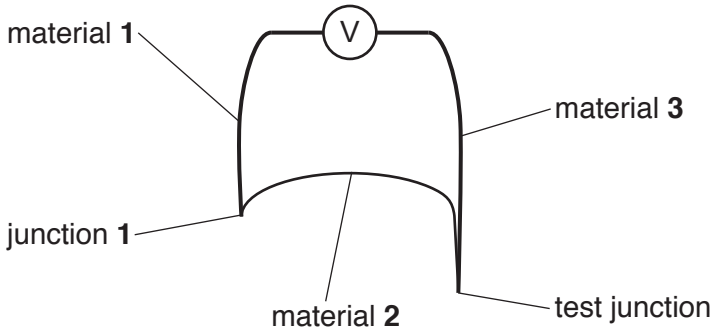

Fig. 5.1

(a) Suggest suitable materials for

material **1**, ...

material **2**, ...

material **3**. .....

[2]

(b) Fig. 5.2 shows the thermocouple thermometer used in an experiment.

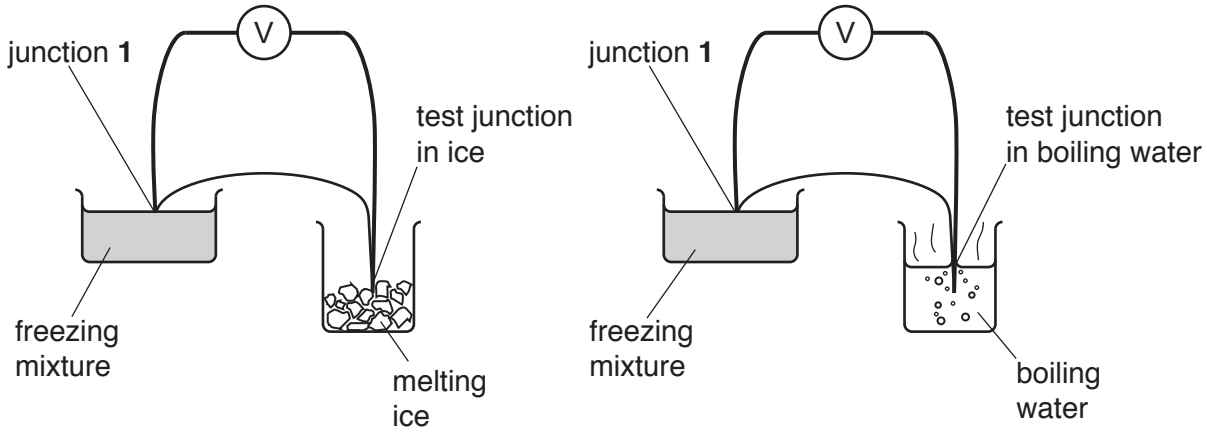

Fig. 5.2

Junction **1** is placed in a freezing mixture. The test junction is placed in melting ice and then in boiling water. The readings on the voltmeter shown in Fig. 5.2 are recorded.

When the test junction is placed in melting ice, the reading on the voltmeter is 1.1 mV.
When the test junction is in boiling water, the reading is 9.2 mV.

Calculate the temperature of the freezing mixture.

temperature = ... °C [3]

(c) (i) Describe **one** situation where a thermocouple thermometer is more suitable for use than a liquid-in-glass thermometer.

.....

.....[1]

(ii) Explain why the thermocouple thermometer is more suitable in the situation you have described in **(c)(i)**.

.....

.....[1]

[Turn over

6 **(a)** The properties of a compound are listed.

- soluble in organic solvents
- insoluble in water
- low melting point
- low boiling point

Predict the electrical conductivity and the type of bonding in this compound.

electrical conductivity .....

type of bonding .....
[1]

(b) Diamond and graphite are two forms of the element carbon.

Fig. 6.1 shows the structure of graphite.

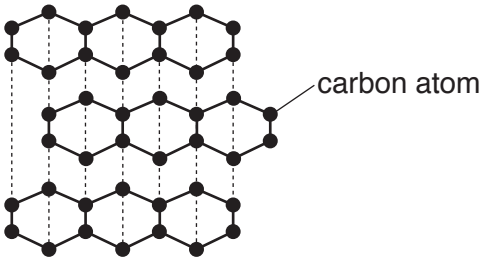

Fig. 6.1

(i) Describe the structure of diamond.

.....

.....

.....

.....[2]

(ii) Graphite is used in pencils but diamond is not.

Explain in terms of its structure and bonding why **graphite** is used in pencils.

.....

.....

.....

.....

.....

.....[3]

(c) Carbon can be used as a fuel.

Write the **word** equation for the complete combustion of carbon.

.....[1]

(d) Combustion is an example of oxidation.

State the meaning of the term *oxidation*.

.....

.....[1]

7 **(a)** Fig. 7.1 shows a small lamp at the bottom of a swimming pool. Three rays of light are shown coming from the lamp.

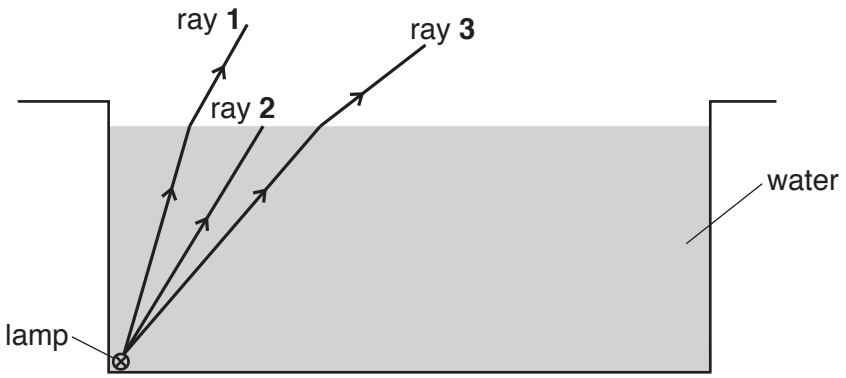

Fig. 7.1

On Fig. 7.1, draw the path of ray 2 after it reaches the surface of the water. [1]

(b) Fig. 7.2 shows two more rays from the same lamp.

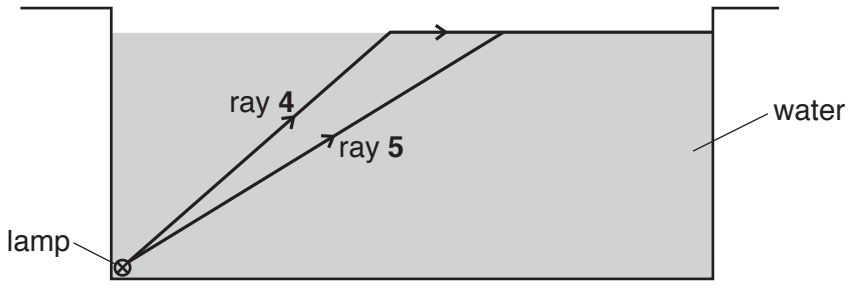

Fig. 7.2

(i) Complete Fig. 7.2 to show the critical angle and label it **C**. [1]

(ii) On Fig. 7.2, draw the path of ray 5 after it reaches the surface of the water. [1]

(c) A boy stands by the swimming pool and shines a narrow beam of light at the water.

The angle of incidence at the surface of the water is 38°.

The refractive index of water $n = 1.34$.

Calculate the angle of refraction.

angle of refraction = ... ° [3]

8 Fig. 8.1 shows part of the reactivity series of metals.

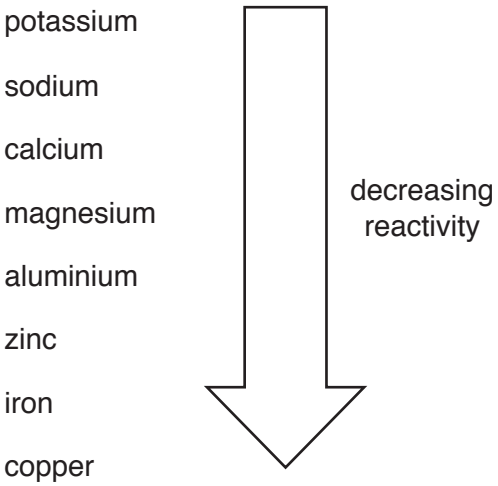

Fig. 8.1

(a) Magnesium reacts slowly with cold water to form hydrogen gas and magnesium hydroxide solution.

Use the reactivity series to predict what will happen when calcium reacts with cold water.

.....

.....

.....

.....[2]

(b) A student puts a piece of aluminium in one test-tube and a piece of zinc in another. Dilute hydrochloric acid is added to both test-tubes.

The zinc reacts immediately.

Suggest why the aluminium does **not** react immediately.

.....

.....[1]

(c) Aluminium is used in aircraft parts.

State **two** properties of aluminium that make it suitable for use in aircraft parts.

1 .....

2 .....
[2]

(d) Some metals can be extracted from their ores by reacting them with carbon.

Explain why aluminium **cannot** be extracted from its ore using carbon.

.....

.....[1]

(e) Aluminium oxide reacts with hydrochloric acid. It also reacts with sodium hydroxide solution.

Each reaction produces a salt and water.

Use this information to state whether aluminium oxide is acidic, alkaline, neutral or amphoteric.

.....[1]

9 Fig. 9.1 shows a circuit diagram.

The battery has an e.m.f. of 3.0 V.

Resistor **R** has a resistance of 2.5 Ω.

S is a 50 cm length of resistance wire.

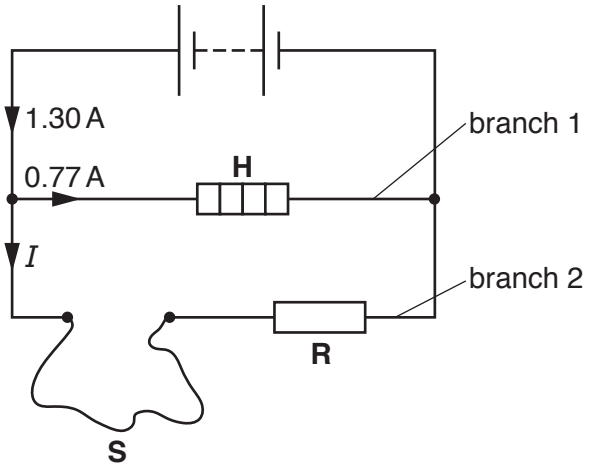

Fig. 9.1

(a) (i) Calculate the current I.

I ..... A [1]

(ii) Use your answer from **(a)(i)** to calculate the resistance of branch **2**.

resistance = ... Ω [2]

(iii) Calculate the resistance of resistance wire **S**.

resistance = ... Ω [1]

(b) The resistance wire **S** is replaced with a wire of the same material but of twice the cross-sectional area.

(i) Calculate the length of wire that should be used if it is to have the same resistance as resistance wire **S**.

length = ... cm [1]

(ii) Calculate the power dissipated by the heater **H**.

power = ... W [2]

10 Air can become polluted.

Table 10.1 lists some air pollutants released into the atmosphere from car exhausts.

Table 10.1

pollutant	source
oxides of nitrogen	Nitrogen and oxygen react in the high temperatures in car engines.
carbon monoxide	....
sulfur dioxide	....

(a) Complete Table 10.1 to show the sources of carbon monoxide and sulfur dioxide. [2]

(b) State **one** adverse effect that oxides of nitrogen have in the atmosphere.

.....[1]

(c) Harmful oxides of nitrogen can be removed from car exhausts using a catalytic converter.

(i) Explain the catalytic removal of harmful oxides of nitrogen from car exhaust gases.

.....

.....

.....

.....

.....[3]

(ii) Carbon monoxide is also removed from car exhausts using a catalytic converter.

Suggest the product of this reaction.

.....[1]

(d) Fig. 10.1 is an incomplete diagram of the outer shell of electrons (a dot-and-cross diagram) in a nitrogen molecule, N_2.

Complete Fig. 10.1.

You only need to show the outer shell electrons.

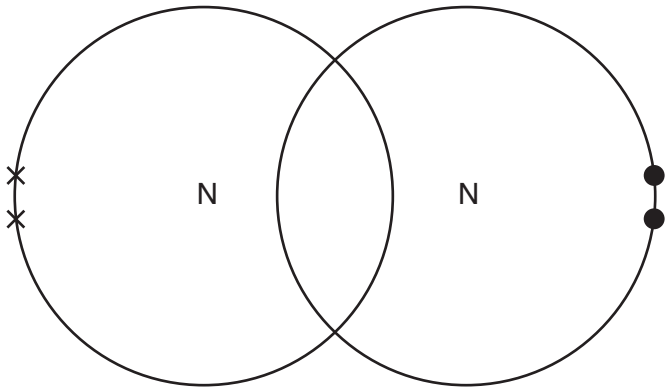

Fig. 10.1

[1]

11 $^{209}_{84}Po$ is an isotope of polonium.

(a) State the number of

(i) protons in the nucleus of this isotope, ... [1]

(ii) neutrons in the nucleus of this isotope. ..... [1]

(b) The isotope decays by α-emission.

Complete the equation which shows this process.

$$^{209}_{84}Po \rightarrow {}^{.....}_{82}Pb + {}^{.....}_{.....}\alpha$$ [2]

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.).