Cambridge
IGCSE

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICAL SCIENCE 0652/41

Paper 4 (Extended) October/November 2018

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.

CAMBRIDGE
International Examinations

[Turn over

1 (a) State what is meant by the *moment of a force*.

....

....

.... [2]

(b) Fig. 1.1 shows a uniform metre ruler of negligible weight.

The ruler can rotate about a pivot at the 95.0 cm mark.
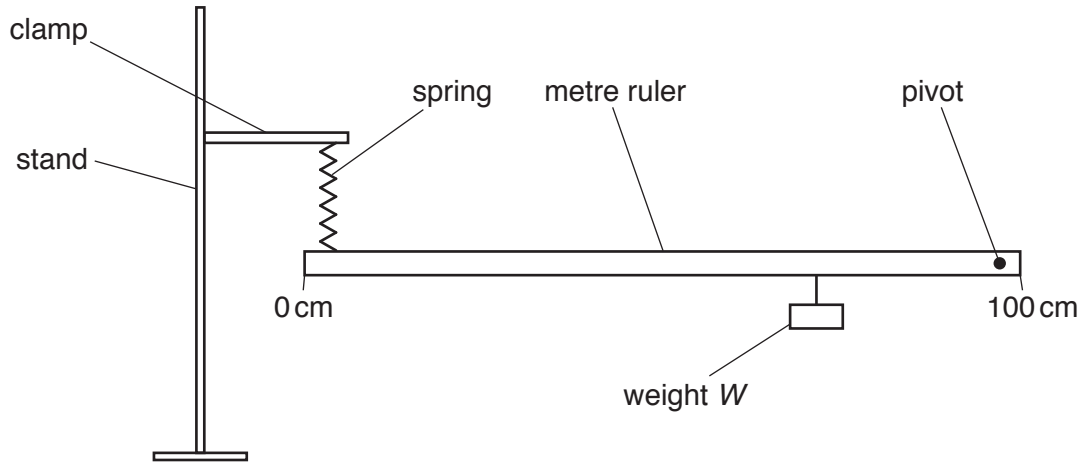
Fig. 1.1

The spring is attached to the ruler at the 5.0 cm mark.

When a weight *W* of 3.6 N is attached to the ruler at the 75.0 cm mark, the ruler is horizontal.

(i) On Fig. 1.1, draw an arrow to show the position and direction of the force applied to the ruler by the spring. [1]

(ii) Calculate the moment produced by *W* about the pivot.

Show your working and give the unit.

moment = ... unit .... [3]

(iii) Use your answer to **(ii)** to calculate the force applied to the ruler by the spring.

force = ... N [2]

(iv) Describe what is observed when the weight *W* is moved along the ruler towards the spring.

Give a reason for your answer.

....

....

.... [2]

[Total: 10]

4

2 Iron is a metal.

(a) Describe the bonding in iron.

You may draw a labelled diagram to help your answer.

....

....

.... [3]

(b) Iron rusts to form iron(III) oxide.

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

.... [2]

(ii) Iron is galvanised to prevent rusting.

Name the metal used to galvanise iron and explain how this metal helps prevent rusting.

metal ....

explanation ....

....
[3]

(iii) Suggest why sodium would **not** be a suitable metal to use to prevent iron from rusting.

....

.... [1]

(c) Table 2.1 shows the colour and typical use of two compounds, **A** and **B**.

Table 2.1

	compound **A**	compound **B**
colour of compound	white solid	green solid
typical use	preservative	catalyst

State which compound, **A** or **B**, is most likely to contain iron.

Explain your answer.

compound ....

explanation ....

....
[2]

(d) Explain why aluminium resists corrosion.

....

....

.... [2]

(e) An alloy of iron is stronger and less malleable than iron metal.

Explain, in terms of atoms, how the structure of an alloy makes it less malleable than iron metal.

....

....

....

.... [3]

[Total: 16]

3 A student calibrates an unmarked liquid-in-glass thermometer.

He places the thermometer bulb in ice at 0 °C and marks the position of the end of the liquid thread.

He then places the thermometer bulb in steam at 100 °C and marks the position of the end of the liquid thread.

(a) Explain why the student places the thermometer bulb in melting ice and in steam.

....

.... [1]

(b) Fig. 3.1 shows the thermometer next to a ruler.

Line **A** is the mark made when the thermometer bulb is in the ice.

Line **B** is the mark made when the thermometer bulb is in the steam.
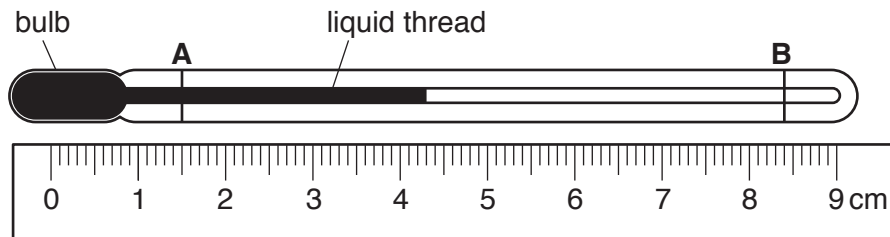
Fig. 3.1

Calculate the temperature when the liquid thread is at the position shown in Fig. 3.1.

temperature = ... °C [3]

(c) Fig. 3.2 shows a different thermometer with a scale marked on it.
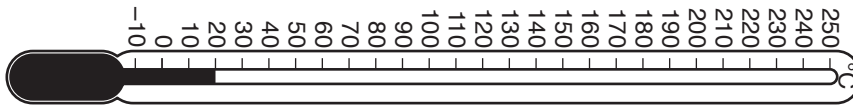
Fig. 3.2

   (i) State the range of this thermometer.

range = ... °C [1]

   (ii) Describe **one** change in the design of a liquid-in-glass thermometer that would increase its sensitivity.

....

.... [1]

[Total: 6]

4 (a) Use words from the box to complete the sentences about making a water-soluble salt.

acidic	**alkaline**	**cooled**	**condensed**	**heated**
insoluble	**larger**	**neutral**	**smaller**	**soluble**

You may use each word once, more than once or not at all.

Acid in a conical flask is reacted with a base that is ....

The reaction is complete when the solution is ....

The solution is then .... to evaporate some of the water.

Slower evaporation forms .... crystals than faster evaporation.

[4]

(b) State the meaning of the term *acid*, using ideas of proton transfer.

....

.... [1]

(c) Table 4.1 shows the solubility in water of some salts and other compounds.

Table 4.1

salts and other compounds	solubility
most salts of sodium	soluble
most carbonates	insoluble
most sulfates	soluble

A student wants to make magnesium carbonate using magnesium sulfate and sodium carbonate.

Use information from Table 4.1 to suggest why the student cannot use the process described in **(a)** to make magnesium carbonate.

....

.... [1]

[Total: 6]

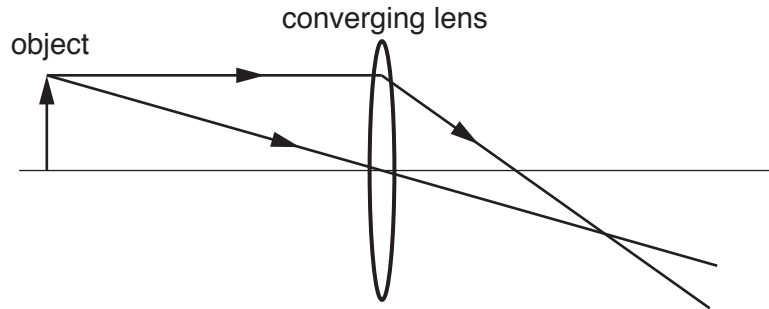**5** Fig. 5.1 is a ray diagram showing how an image is formed by a converging lens.

Fig. 5.1

(a) (i) On Fig. 5.1, mark the principal focus of the lens and label it **F**. [1]

(ii) On Fig. 5.1, draw the image of the object formed by the lens and label it **I**. [2]

(iii) State how Fig. 5.1 shows that the image is real.

....

.... [1]

(b) The object is moved closer to the lens and a virtual image is formed.

(i) Describe, in terms of rays, how a virtual image is seen by an observer.

....

.... [1]

(ii) State **one** use of the converging lens when it produces a virtual image in this way.

....

.... [1]

[Total: 6]

6 Ethane combusts in excess oxygen. The reaction is shown by the following equation.

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

(a) Calculate the volume at room temperature and pressure of the carbon dioxide produced by the complete combustion of 2.0 kg of ethane.

Show your working in the box.

[A_r: C, 12; H, 1; O, 16]

[At room temperature and pressure 1 mole of any gas has a volume of 24 dm³.]

volume of carbon dioxide gas = ... dm³ [4]

(b) (i) Suggest the products formed when ethane combusts in a limited supply of oxygen.

....

.... [2]

(ii) State **one** adverse effect of the combustion of ethane on the environment.

....

.... [1]

[Total: 7]

7 Fig. 7.1 shows a circuit diagram.

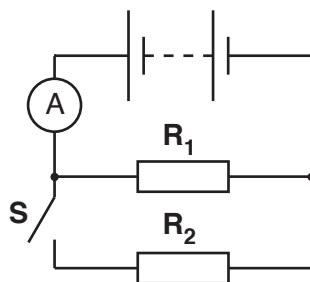The battery of cells has an e.m.f. of 6.0 V.

Fig. 7.1

(a) Resistor **R₁** has a resistance of 5.0 Ω.

Calculate the current through the ammeter when switch **S** is open.

Show your working.

current = ... A [2]

(b) When switch **S** is closed, the current through the ammeter is 3.0 A.

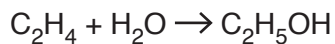Calculate the resistance of resistor **R₂**.

Show your working.

resistance = ... Ω [2]

(c) Calculate the power output from the battery when switch **S** is closed.

Show your working.

power = ... W [2]

[Total: 6]

 [Turn over

8 Ethanol is produced in the following reaction.

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

A small amount of phosphoric acid is also added to the reaction mixture.

(a) Suggest why phosphoric acid is added. Give a reason for your answer.

....

....

.... [2]

(b) Ethanol reacts with sodium to form the compound sodium ethoxide.

The formula of an ethoxide ion is $CH_3CH_2O^-$.

Use this information and your knowledge of the Periodic Table to deduce the formula of sodium ethoxide.

formula of sodium ethoxide .... [1]

(c) C_2H_4 also reacts with bromine. During the reaction the bromine is decolourised.

(i) Name this type of reaction.

.... [1]

(ii) Name the homologous series that includes C_2H_4.

.... [1]

[Total: 5]

9 Fig. 9.1 shows the structure of a simple transformer.

1 ....

output to
external
circuit

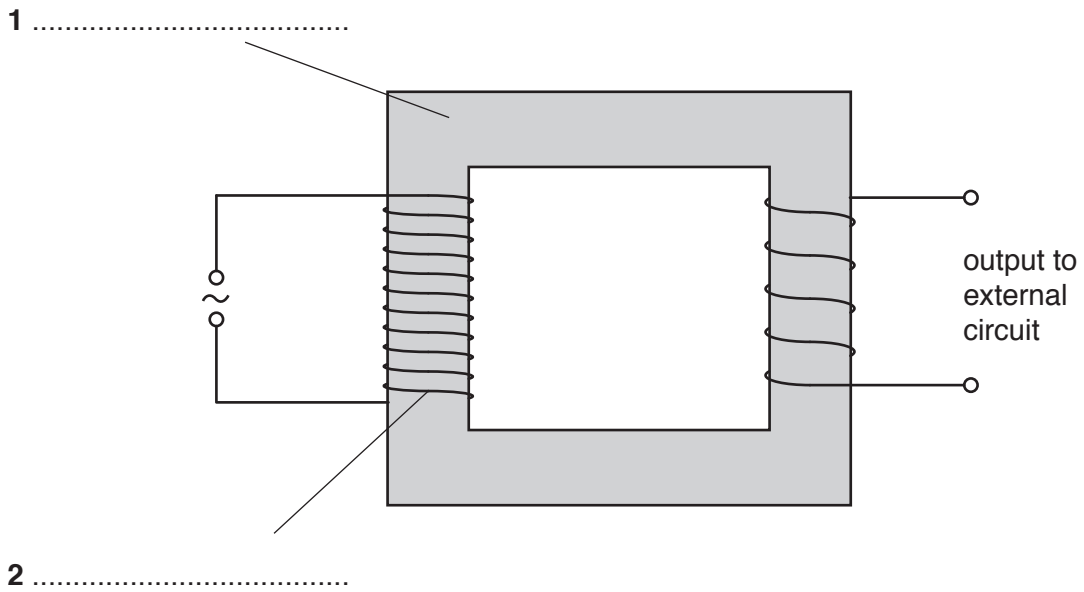**2** ....

Fig. 9.1

(a) (i) On Fig. 9.1, complete labels **1** and **2**. [2]

(ii) State the evidence from Fig. 9.1 that shows the output voltage is smaller than the supply voltage.

....

.... [1]

(b) Explain how an a.c. power supply produces a power output from the transformer.

....

....

....

....

.... [4]

(c) Suggest **one** use of this type of transformer.

....

.... [1]

[Total: 8]

10 Plants use the process of photosynthesis to produce glucose.

(a) Complete the **word** equation for the reaction by writing in the boxes.

+ | | → glucose + | | [2]
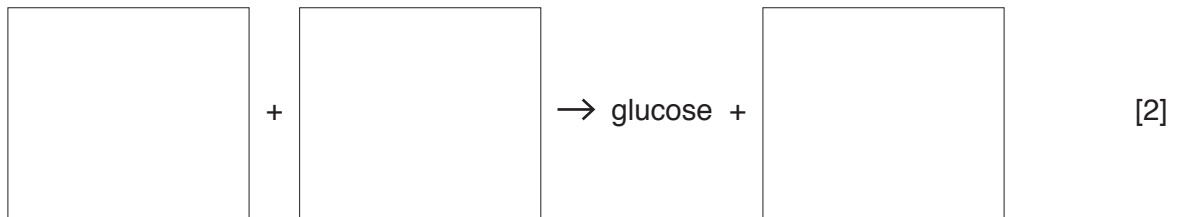
(b) State the source of energy for this reaction.

.... [1]

[Total: 3]

11 A student places a radiation detector 1 mm from a radioactive source. The detector is connected to a counter.

She zeroes the counter and then records the count after 5 minutes. She repeats the experiment three more times.

Her results are shown in Table 11.1.

Table 11.1

experiment number	count after 5 minutes
1	2489
2	2470
3	2501
4	2481

She observes that the counts are different each time.

(a) State the nature of radioactive decay that causes variation in the count.

....[1]

(b) The student removes the radioactive source and repeats the experiment with no source present another four times.

Her results are shown in Table 11.2.

Table 11.2

experiment number	count after 5 minutes
5	14
6	10
7	12
8	9

State why radiation is still detected when the radioactive source is removed.

....

.... [1]

(c) She places the radioactive source at a point 10 cm away from the detector and repeats the experiment another four times.

Her results are shown in Table 11.3.

Table 11.3

experiment number	count after 5 minutes
9	15
10	11
11	10
12	14

Use the information from the experiments to identify the type of radiation emitted by the radioactive source. Give a reason for your answer.

type of radiation ....

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

[Total: 4]

12 Complete Table 12.1 to identify each oxide as acidic, basic, neutral or amphoteric.

Table 12.1

oxide	acidic, basic, neutral or amphoteric
aluminium oxide	
carbon monoxide	
iron oxide	
sulfur dioxide	

[3]

[Total: 3]

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19

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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 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* 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 T*l* 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 F*l* 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.).