



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

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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.

This document consists of **17** printed pages and **3** blank pages.

- 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.

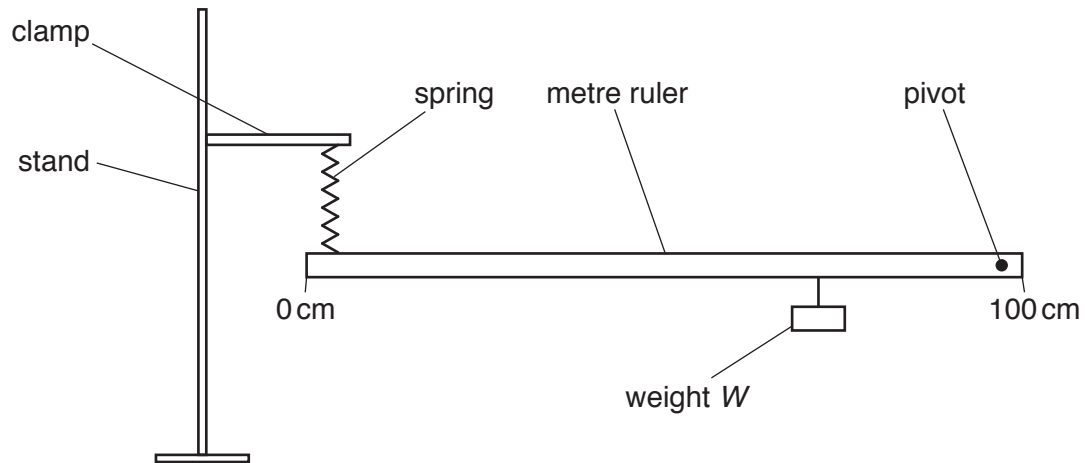


Fig. 1.1

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]

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.

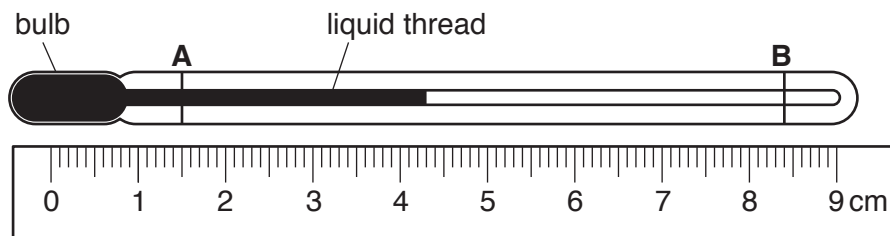


Fig. 3.1

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

temperature = $^{\circ}\text{C}$ [3]

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

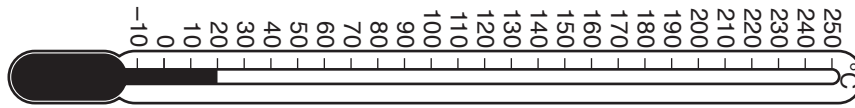


Fig. 3.2

(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.

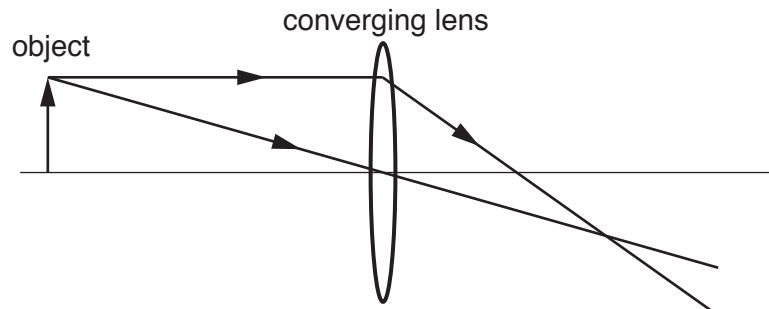


Fig. 5.1

- (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.



- (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 6.0V.

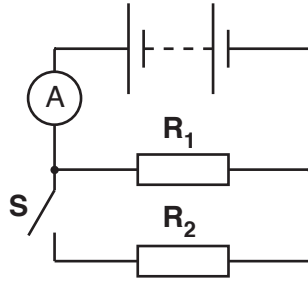


Fig. 7.1

(a) Resistor R_1 has a resistance of 5.0Ω .

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 3.0A.

Calculate the resistance of resistor R_2 .

Show your working.

resistance = Ω [2]

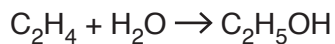
(c) Calculate the power output from the battery when switch **S** is closed.

Show your working.

power = W [2]

[Total: 6]

- 8 Ethanol is produced in the following reaction.



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 $\text{CH}_3\text{CH}_2\text{O}^-$.

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.

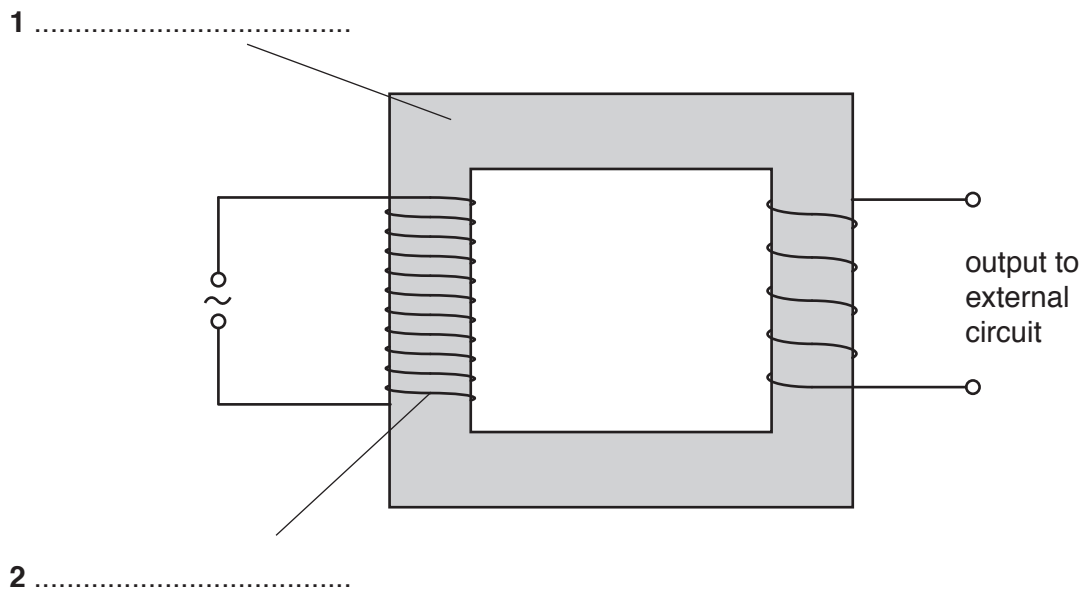


Fig. 9.1

(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]

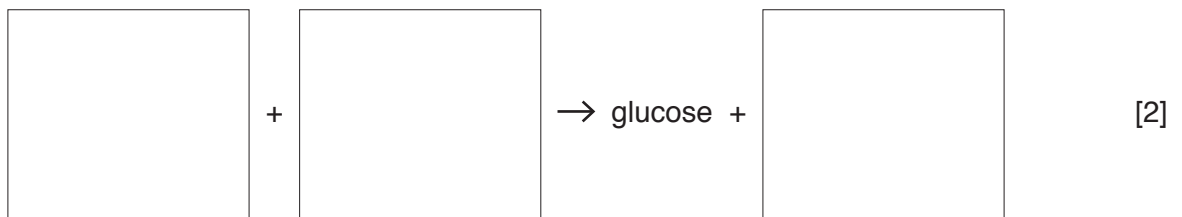
(c) Suggest **one** use of this type of transformer.

.....
 [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.



(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 10cm 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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The Periodic Table of Elements

| | | Group | | | | | | | | | | | | | | | |
|----------------------------|-----------------------------|--|---------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|-----------------------------|------------------------------|------------------------------|---------------------------|
| I | II | | | | | | | | | | | III | IV | V | VI | VII | VIII |
| 3 Li lithium 7 | 4 Be beryllium 9 | Key atomic number atomic symbol name relative atomic mass | | | | | | | | | | 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 — | — | — | — | — |

1
H
hydrogen
1

| | | | | | | | | | | | | | | |
|------------------------------|----------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|------------------------------|---------------------------|-------------------------------|------------------------------|------------------------------|
| 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 |
| 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 — |

lanthanoids

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).