Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6930109130

PHYSICAL SCIENCE **0652/42**

Paper 4 Theory (Extended) **October/November 2023**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **24** pages. Any blank pages are indicated.

[Turn over

1 A list of processes is shown.

cracking **chromatography** **crystallisation** **diffusion**

fractional distillation **galvanising** **neutralisation**

oxidation **precipitation** **reduction**

Use the list of processes to answer the questions that follow.

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

State the process that:

(a) prevents rusting

..... [1]

(b) produces an alkene and hydrogen

..... [1]

(c) forms a solid when two aqueous solutions are mixed

..... [1]

(d) takes place when oxygen is lost

..... [1]

(e) takes place when limestone is added to acidic soil

..... [1]

(f) is used to separate liquids with different boiling points.

..... [1]

[Total: 6]

2 **(a)** A student measures the diameter of a wire.

Name an instrument used to measure accurately the diameter of the wire.

..... [1]

(b) The wire is wound into a spring.

The student investigates how the spring stretches when different loads are applied to it.

Fig. 2.1 shows a graph of the results of the investigation.

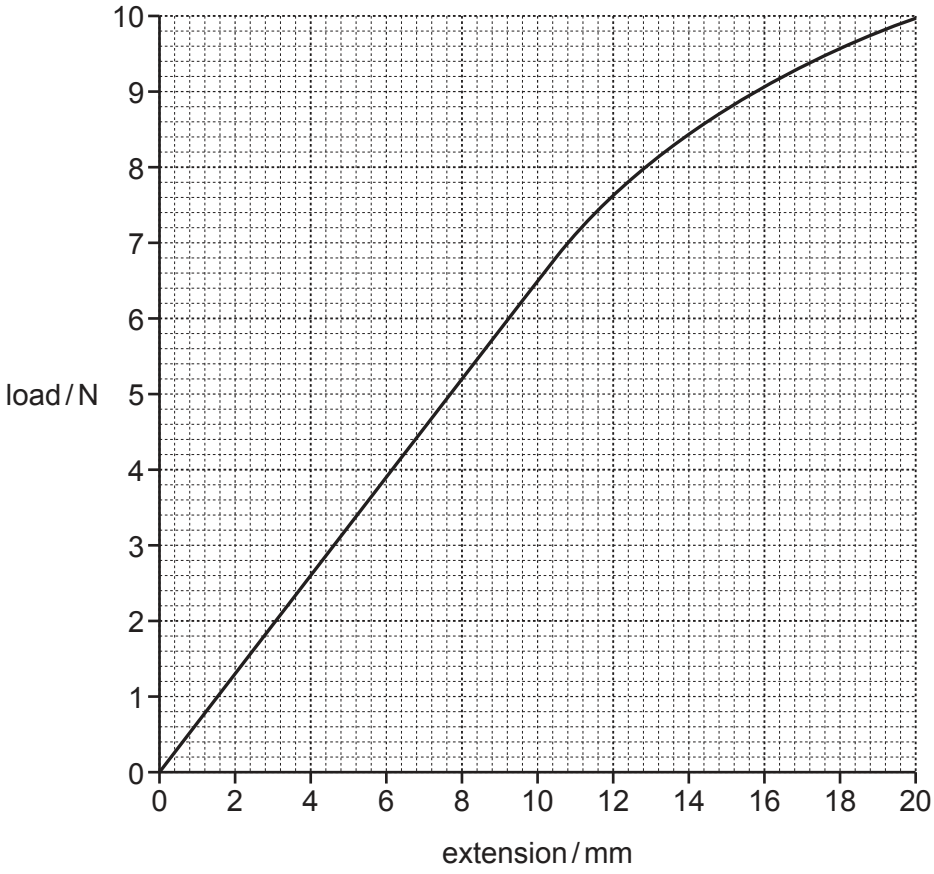

Fig. 2.1

(i) On the graph in Fig. 2.1, mark the limit of proportionality with an **X**. [1]

(ii) Use Fig. 2.1 to determine the spring constant of the spring and the unit.

Show your working on the graph.

spring constant = ... unit ..... [3]

[Total: 5]

3 **(a)** Melting points are used to assess the purity of substances.

State the effect impurities have on the melting point of a sample of a substance.

.....

..... [1]

(b) Sodium chloride is an ionic substance.

Fig. 3.1 represents part of the lattice structure of sodium chloride.

Key

⊕ ..... ion

⊖ ..... ion

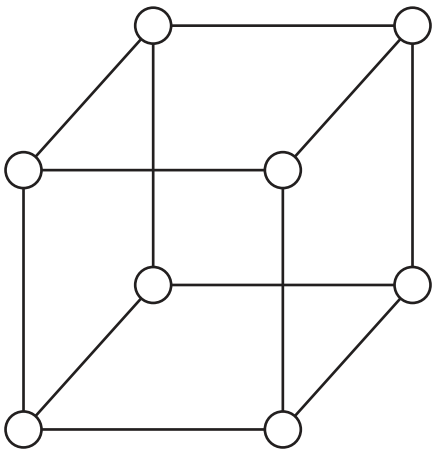

Fig. 3.1

Complete:

- the key in Fig. 3.1 to give the name of the positive ion and the name of the negative ion
- the diagram in Fig. 3.1 to show the arrangement of ions in sodium chloride.

[2]

(c) Chlorine is a simple covalent molecule.

The melting point of chlorine is –34 °C. The melting point of sodium chloride is 801 °C.

Explain the difference between the melting point of chlorine and the melting point of sodium chloride.

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

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4 **(a)** A ray of light is incident on the surface of a plane mirror as shown in Fig. 4.1.

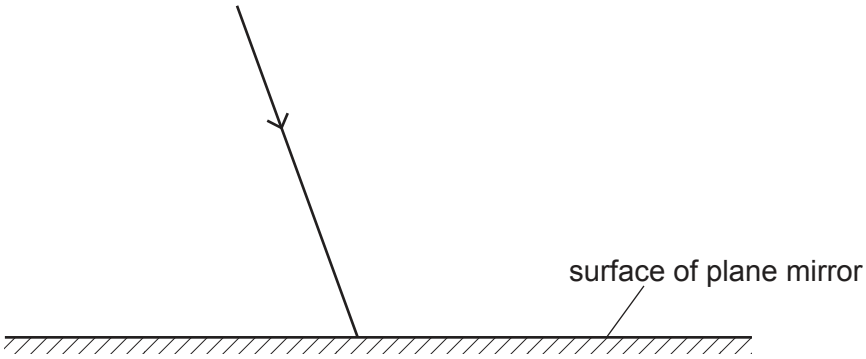

Fig. 4.1

On Fig. 4.1, draw and label:

- the normal to the point on the mirror where the ray is incident
- the reflected ray.

[2]

(b) Fig. 4.2 shows a curved mirror used to make a solar cooker.

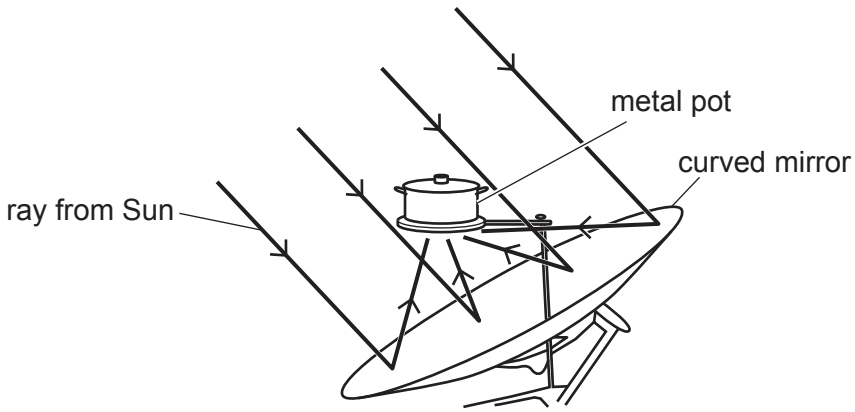

Fig. 4.2

The solar cooker uses electromagnetic radiation from the Sun to heat a metal pot containing water.

(i) Name the **two** types of electromagnetic radiation which transfer thermal energy from the Sun to the metal pot.

..... and ..... [1]

(ii) The metal pot is a good absorber of the radiation.

State **two** features of the surface of the metal pot that improve the absorption of radiation.

1 .....

2 .....

[2]

(iii) Thermal energy conducts through the metal pot to the water.

Describe in terms of particles how conduction takes place.

.....

.....

.....

..... [2]

(iv) Water in contact with the metal pot becomes hot and rises, forming a convection current.

Explain why the hot water rises.

.....

.....

.....

..... [2]

(v) The water in the metal pot boils. Many bubbles rise to the surface of the water.

Name the gas in the bubbles.

..... [1]

[Total: 10]

5 Ethanol is an alcohol.

(a) The equation for the formation of ethanol from ethene is shown.

$$C_2H_4(g) + H_2O(.....) \rightarrow C_2H_5OH(g)$$

(i) Complete the equation to show the state symbol for H_2O in this reaction. [1]

(ii) State the type of reaction shown by the equation.

..... [1]

(b) Ethanol is also formed by fermentation.

Describe the formation of ethanol by fermentation.

.....

.....

.....

..... [3]

(c) Alcohol is used as a fuel instead of gasoline in some cars. Gasoline is obtained from a fossil fuel.

State **two** reasons why the combustion of fossil fuels needs to be reduced.

1 .....

.....

2 .....

.....

[2]

(d) Alcohols and alkenes are two different homologous series.

Describe what is meant by a homologous series.

.....

.....

.....

..... [2]

(e) Draw a circle around the name of the compound which is an alcohol.

naphtha **nonane** **nonene** **nonanol**

[1]

[Total: 10]

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6 Fig. 6.1 shows an empty wheelbarrow.

A vertical force of 20 N is needed to just lift the wheelbarrow off the ground, as shown in Fig. 6.1.

The force is applied 0.80 m from the pivot.

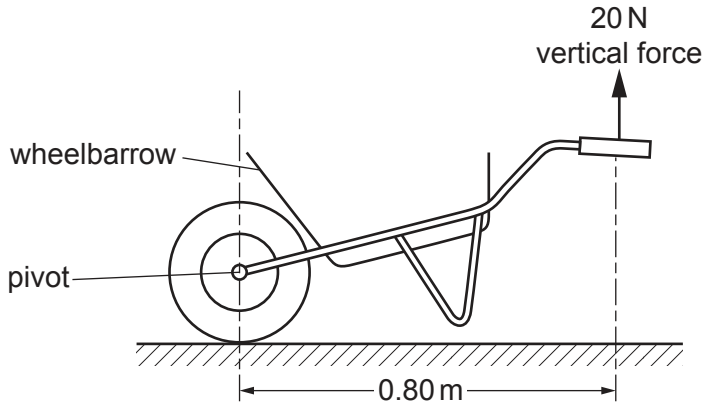

Fig. 6.1

(a) Determine the moment of the 20 N force about the pivot.

moment = ... Nm [1]

(b) A rock is put into the wheelbarrow.

The mass of the rock is 15 kg. The weight of the rock acts at a perpendicular distance of 0.30 m from the pivot.

A new vertical force **F** is needed to just lift the wheelbarrow and rock off the ground, as shown in Fig. 6.2.

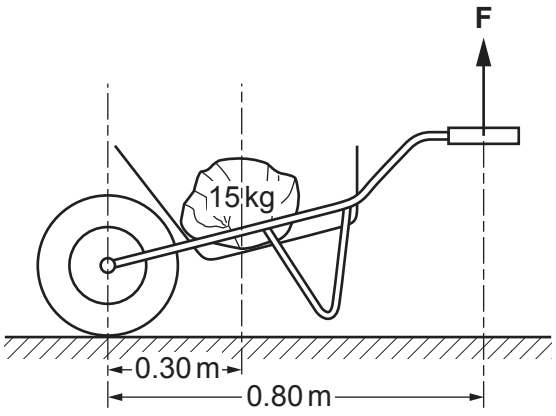

Fig. 6.2

(i) Determine the moment of force **F** about the pivot.

Show your working.
[g = 10 N / kg]

moment = ... Nm [3]

(ii) Calculate the magnitude of force **F**.

force **F** = ... N [1]

(c) (i) The density of the 15 kg rock is 2500 kg / m^3.

Calculate the volume of the rock.

volume of rock = ... m^3 [1]

(ii) Fig. 6.3 shows the same rock placed in a rectangular box which is partly filled with water. The sides of the box are 0.30 m. The height (depth) of the box is 0.40 m.

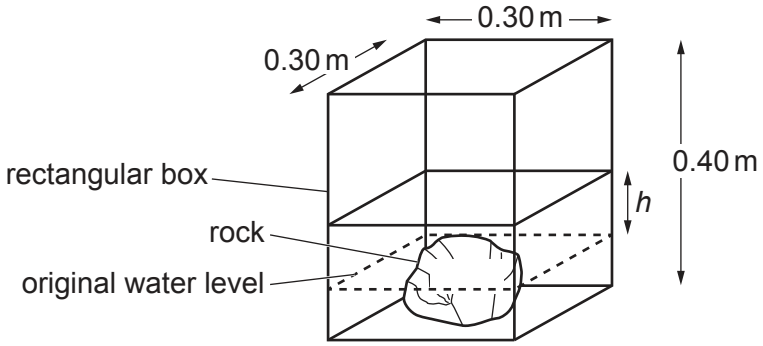

Fig. 6.3 (not to scale)

The rock sinks. The water level rises a distance h and covers the rock completely.

Use your answer to **(c)(i)** to calculate the rise in the water level h.

Give your answer to **two** significant figures.

h = ... m [2]

[Total: 8]

7 Sodium is in Group I and magnesium is in Group II of the Periodic Table.

(a) Explain why sodium is more reactive than magnesium.

.....

.....

.....

..... [2]

(b) Magnesium reacts with hydrochloric acid, HC*l*, to form magnesium chloride, MgCl_2, and one other product.

Write the symbol equation for this reaction.

..... [2]

(c) Table 7.1 shows the observations when dilute hydrochloric acid reacts with four different metals.

Table 7.1

metal	observation
calcium	fast, regular production of bubbles
copper	no bubbles
iron	slow, regular production of bubbles
nickel	very few bubbles

Deduce the order of reactivity for the four metals from most reactive to least reactive.

most reactive .....

.....

.....

least reactive .....

[2]

(d) Hydrochloric acid reacts with sodium carbonate to produce a gas, a salt and water.

(i) Describe a test for the gas produced and state the observation if the gas is present.

test .....

.....

observation .....

.....

[2]

(ii) State the name of the salt formed.

..... [1]

(e) Define an acid in terms of proton transfer.

..... [1]

[Total: 10]

8 Fig. 8.1 shows a cell, a resistor **R** and component **S** connected in series in an electrical circuit.

The potential difference between points **A** and **B** is used to control an electrical heater.

The e.m.f. of the cell is 1.2 V.

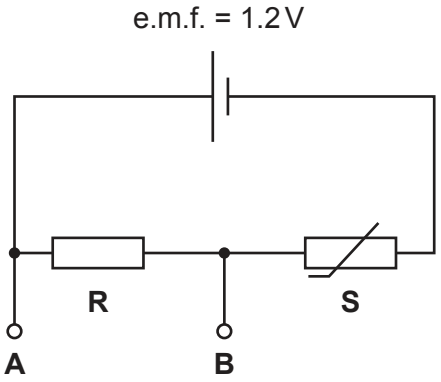

Fig. 8.1

(a) State the name of component **S**.

..... [1]

(b) **(i)** Component **S** has a resistance of 200 Ω.

When the temperature is 20 °C, the current in **R** is 0.0040 A.

Calculate the resistance of resistor **R**.

resistance of **R** = ... Ω [2]

(ii) Calculate the potential difference between **A** and **B** when the temperature is 20 °C.

potential difference = ... V [1]

(c) The temperature decreases to 18 °C.

The resistance of component **S** is now 220 Ω.

Calculate the new potential difference between **A** and **B**.

potential difference = ... V [3]

(d) The heater switches on when the potential difference between **A** and **B** decreases below a certain level.

Suggest a component to replace resistor **R** that allows a user to adjust the temperature at which the heater switches on.

..... [1]

[Total: 8]

9 Aluminium, A*l*, is obtained from aluminium oxide, Al_2O_3.

The equation for the reaction is shown.

$$2Al_2O_3 \rightarrow 4Al + 3O_2$$

(a) Calculate the mass of A*l* produced from 204 tonnes of Al_2O_3.

[A_r: A*l*, 27; O, 16; and 1 tonne = 1000 kg]

Use the following steps:

- Determine the relative molecular mass, M_r, of Al_2O_3.

M_r = ...

- Use the equation for the reaction to determine the stoichiometric ratio of Al_2O_3 : A*l*.

ratio = ... : .....

- Calculate the mass of A*l* produced from 204 tonnes of Al_2O_3.

mass of A*l* = ... tonnes
[3]

(b) State which anion test uses reduction with aluminium.

..... [1]

(c) State which property of aluminium makes it useful as a food container.

..... [1]

[Total: 5]

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10 Fig. 10.1 shows a circuit that produces a 220 V electrical supply from a car battery.

The circuit includes a step-up transformer.

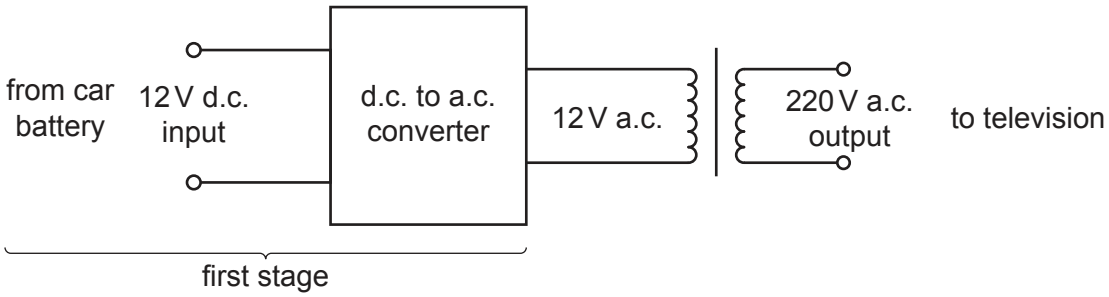

Fig. 10.1

(a) The transformer increases the voltage from 12 V to 220 V.

The primary coil contains 96 turns.

Calculate the number of turns in the secondary coil.

number of turns = ... turns [2]

(b) The television is connected to the 220 V output of the transformer.

The current in the secondary coil is 0.15 A.

Calculate the current in the primary coil of the transformer.

current = ... A [2]

(c) The first stage of the circuit converts a direct current (d.c.) to an alternating current (a.c.).

Explain why a transformer needs a.c. to work.

.....

.....

.....

..... [2]

(d) **(i)** The current from the output to the television is much smaller than the current from the battery to the input.

The wires connecting the battery to the input are much thicker than the wires from the output to the television.

Explain why the wires from the battery are thicker.

.....

.....

.....

..... [2]

(ii) The circuit is not 100% efficient.

Explain what is meant by 'not 100% efficient'.

.....

..... [1]

[Total: 9]

11 Copper has two stable isotopes, ^{63}Cu and ^{65}Cu.

(a) Define the term isotopes.

.....

.....

.....

..... [2]

(b) Copper(II) nitrate contains Cu^{2+} and NO_3^- ions.

Determine the formula of copper(II) nitrate.

..... [1]

[Total: 3]

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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 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.).