Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICAL SCIENCE **0652/31**

Paper 3 Theory (Core) **October/November 2024**

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)** A list of atoms and ions is shown.

Al **C** **Ca^{2+}** **Cl^{-}** **Cu** **Fe** **K^{+}** **Mg**

Use the symbols of the atoms or ions to answer the questions that follow.

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

State which atom or ion:

(i) is used in food containers because of its resistance to corrosion

..... [1]

(ii) is extracted from the ore bauxite by electrolysis

..... [1]

(iii) burns with a lilac flame

..... [1]

(iv) is a non-metal with two electron shells

..... [1]

(v) has the same number of electrons in its outer shell as argon

..... [1]

(vi) is a metal that is less reactive than hydrogen.

..... [1]

(b) Ammonia, NH_3, is a covalent molecule.

Complete Fig. 1.1 to show the dot-and-cross diagram for a molecule of NH_3.

Show outer shell electrons only.

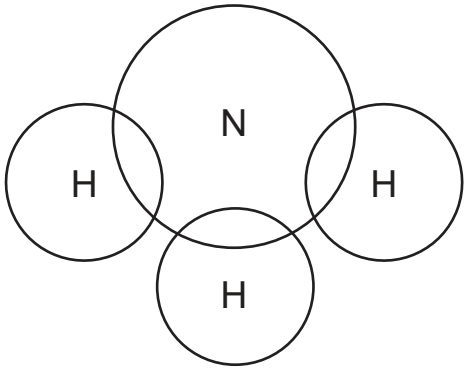

Fig. 1.1

[2]

(c) Describe a test for ammonia gas and state the observation if ammonia is present.

test .....

observation .....

.....

[2]

[Total: 10]

2 A cyclist starts from rest.

She travels with constant acceleration for 5.0 s and reaches a speed of 10 m / s.
She travels a distance of 25 m while accelerating.

The cyclist continues at 10 m / s for a further 30 s.

(a) Calculate the distance the cyclist travels while moving at 10 m / s for 30 s.

distance = ... m [2]

(b) On Fig. 2.1, plot a speed–time graph of the motion of the cyclist.

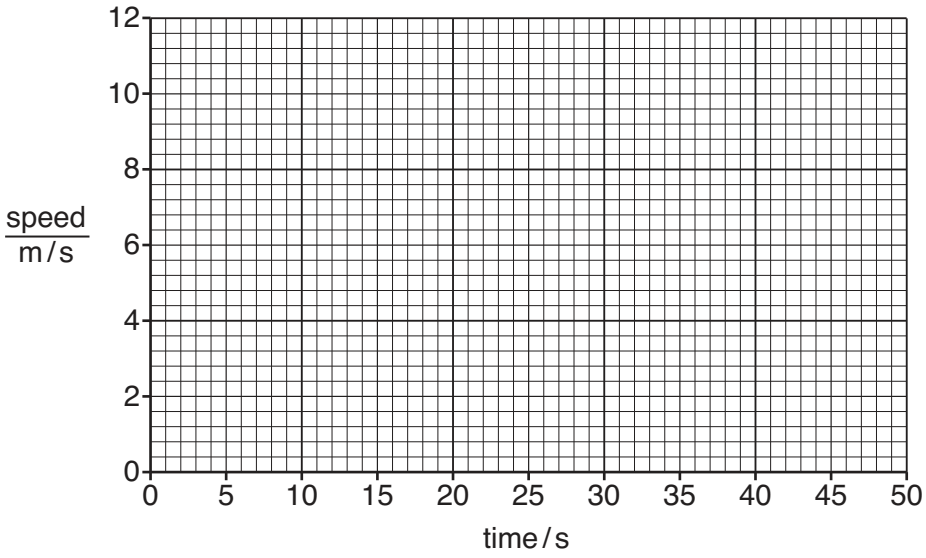

Fig. 2.1

[2]

(c) On your graph in Fig. 2.1, shade the area which represents the 25 m the cyclist travels while accelerating. [1]

(d) Another cyclist travels 50 m in 10 s while accelerating.

He travels a further 400 m in 50 s at constant speed.

Calculate the average speed of the cyclist.

average speed = ... m/s [2]

[Total: 7]

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3 **(a)** Fig. 3.1 shows an isotope of silicon.

$^{30}_{14}Si$

Fig. 3.1

(i) Define the term isotopes.

.....

.....

.....

..... [2]

(ii) Determine the number of protons in the isotope in Fig. 3.1.

..... [1]

(iii) Determine the number of neutrons in the isotope in Fig. 3.1.

..... [1]

(b) Complete Table 3.1.

Table 3.1

particle	relative charge	relative mass
proton		
neutron		
electron		

[3]

(c) Silicon is used with aluminium to form an alloy.

(i) Circle the term that best describes an alloy.

element **compound** **mixture** **pure** **solvent**

[1]

(ii) Complete the sentence.

An alloy of aluminium is used instead of pure aluminium because the properties of the alloy are ..... . [1]

[Total: 9]

4 **(a)** A crane lifts a large bucket containing concrete.
The volume of the concrete is 2.0 m^3.
The density of the concrete is 2600 kg / m^3.

Calculate the mass of the concrete.

mass = ... kg [2]

(b) Calculate the weight of a 55 kg concrete block.

[g = 10 N / kg]

weight = ... N [1]

(c) The energy supplied to the electric motor of the crane to lift a load is 20 000 J.

The gravitational potential energy of the load increases by 14 000 J.

(i) Explain how this information indicates that the crane is **not** 100% efficient.

.....

..... [1]

(ii) Circle the phrase in the list which correctly completes the sentence.

more energy **more force** **more power** **more resistance**

To lift the same load in less time, the electric motor of the crane needs _____ .
[1]

(d) Fig. 4.1 shows a crane which moves a load (**L**) from **P** to **Q**.

The crane has a counterweight (**C**).

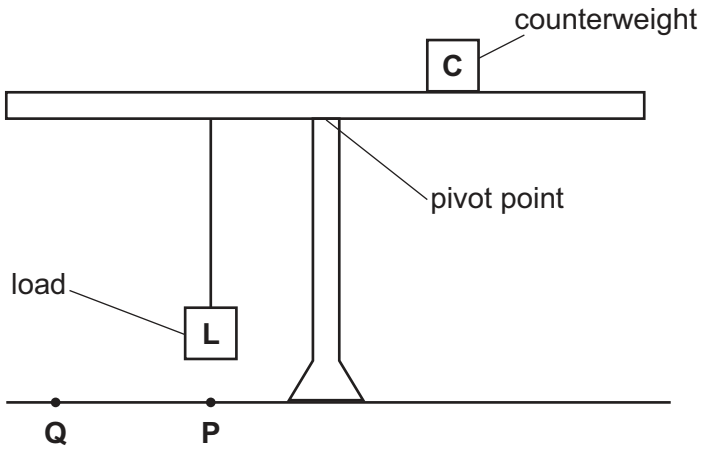

Fig. 4.1

The load is moved from **P** to **Q**.

Counterweight **C** is moved to the right to stop the crane falling over.

Explain in terms of moments why the counterweight is moved to the right.

explanation .....

.....

.....

..... [2]

[Total: 7]

5 Fig. 5.1 shows a microwave oven with food inside.

A microwave oven uses microwaves to cook food.

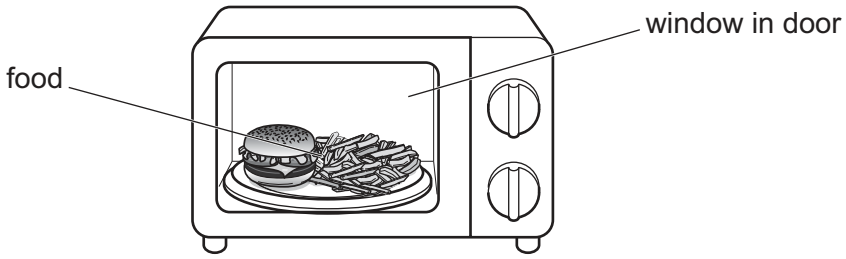

Fig. 5.1

(a) (i) Name the type of electromagnetic radiation which passes through the window so you can see the food cooking.

..... [1]

(ii) The food is too hot to eat and is allowed to cool for several minutes.

Name the type of electromagnetic radiation which is emitted by the food as it cools.

..... [1]

(b) Some hot food is put onto a cold plate.
Several minutes later the plate is hot.

State and describe the process which causes the plate to become hot.

.....

.....

.....

..... [2]

(c) (i) Fig. 5.2 shows a liquid-in-glass thermometer.

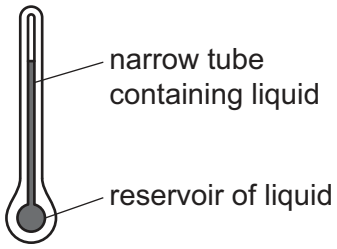

Fig. 5.2

Explain why the level of the liquid in the narrow tube changes when the thermometer is put in hot food.

.....

.....

.....

..... [2]

(ii) Another thermometer has a smaller reservoir of liquid than shown in Fig. 5.2. The diameter of the narrow tube is the same as shown in Fig. 5.2.
This thermometer is put into the same hot food.

Predict the difference, if any, in the level of liquid in the narrow tube of this thermometer.

.....

..... [1]

[Total: 7]

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6 **(a)** Fig. 6.1 shows the apparatus used for the electrolysis of an aqueous solution.

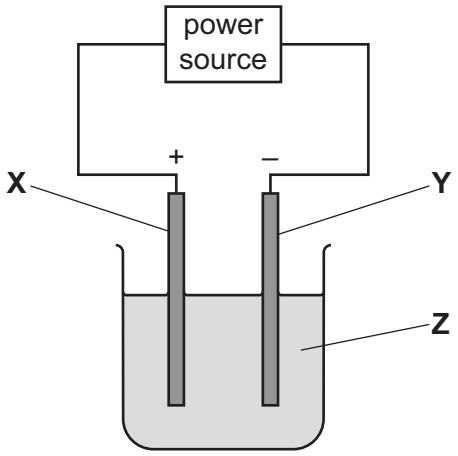

Fig. 6.1

(i) State the names of **X**, **Y** and **Z**.

X .....

Y .....

Z .....

[2]

(ii) Fig. 6.1 shows the electrolysis of an **aqueous** solution.

Circle the **other** type of substance that can be electrolysed.

gas **molten** **solid**

[1]

(iii) Name a suitable inert material to use for **X** and **Y**.

..... [1]

(b) A gas is produced during the electrolysis shown in Fig. 6.1.

Describe the observation that shows a gas is produced.

.....

..... [1]

[Total: 5]

7 **(a)** Fig. 7.1 shows an electromagnet. It consists of a core inside a coil made from turns of wire.

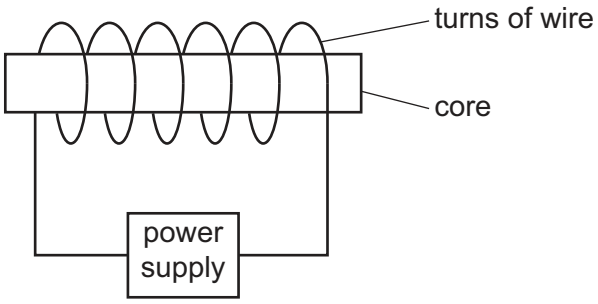

Fig. 7.1

(i) Circle **one** material from the list which makes the best core for the electromagnet.

air **aluminium** **soft iron** **steel** **zinc**

[1]

(ii) The best core for the electromagnet is chosen.

State **two** changes that increase the strength of the magnetic field of the electromagnet.

1 .....

.....

2 .....

.....

[2]

(b) The electromagnet is used to make a loudspeaker, as shown in Fig. 7.2.

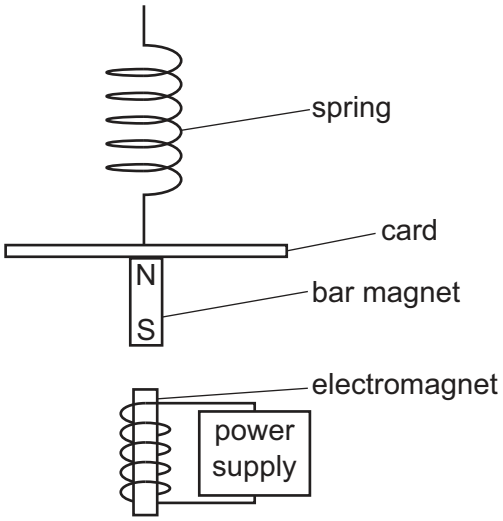

Fig. 7.2

A bar magnet is attached to a card.

The card hangs from a spring.

The electromagnet is a small distance below the bar magnet.

(i) There is a small current in the electromagnet. The card moves down a short distance.

Suggest how the card moves when the current in the electromagnet is:

increased .....

in the opposite direction. .....

[1]

(ii) A person hears the sound from the loudspeaker in Fig. 7.2.

Put the statements in the correct order, **1** to **4**, to describe how the person hears the sound.

	order
The sound wave makes the ear drum vibrate.	
The card makes the air vibrate.	
The electromagnet makes the bar magnet and card move up and down.	
The vibrations in the air travel as a sound wave.	

[2]

(c) State the lowest frequency that is audible to a healthy human ear.

..... Hz [1]

[Total: 7]

8 **(a)** Fig. 8.1 shows an apparatus used in an industrial process.

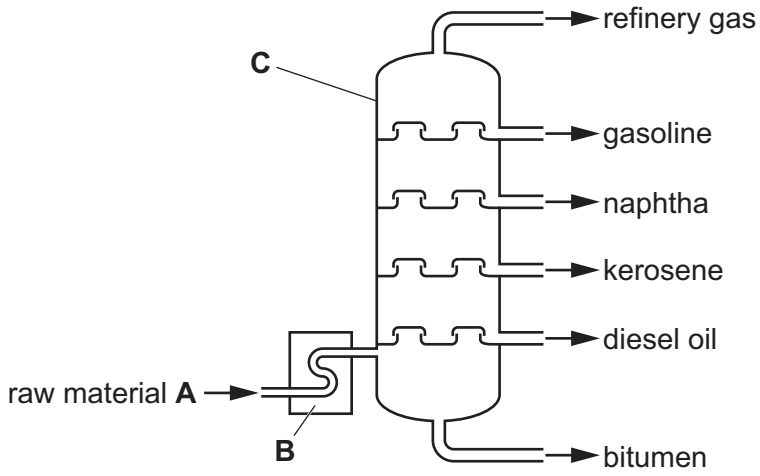

Fig. 8.1

(i) The raw material labelled **A** is a mixture of hydrocarbons.

Explain what is meant by hydrocarbon.

.....

..... [2]

(ii) Name the raw material labelled **A**.

..... [1]

(iii) Tick (✓) the process that happens in **B**.

cooling	☐
decomposition	☐
dissolving	☐
heating	☐

[1]

(iv) Name the method of separation that happens in **C**.

..... [1]

(v) State **one** use for bitumen.

..... [1]

(b) Gasoline is a carbon-containing substance. Gasoline is a fuel.

Explain why the complete combustion of gasoline is a concern.

.....

.....

.....

..... [2]

(c) Name a fuel that does **not** contain carbon.

..... [1]

[Total: 9]

9 **(a)** Fig. 9.1 shows two plastic rods, **A** and **B**.

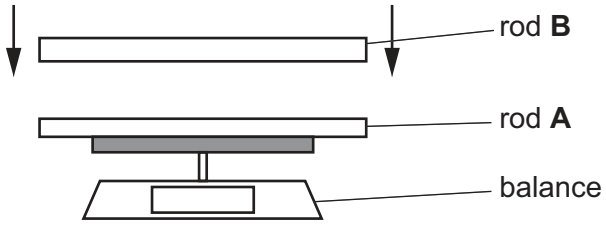

Fig. 9.1

Rod **A** is on a balance.
Rod **B** is moved closer to rod **A**.

Complete Table 9.1 to show how different charges on rods **A** and **B** change the reading on the balance when rod **B** is moved closer to rod **A**.

Only use the words **decrease**, **increase**, **unchanged**.

Table 9.1

charge on rod **A**	charge on rod **B**	change in reading on the balance
neutral	neutral	
positive	negative	
negative	positive	
positive	positive	

[2]

(b) A plastic rod is rubbed with a cloth. The rod becomes negatively charged.

Explain in terms of particles how the rod becomes negatively charged.

.....

.....

.....

..... [2]

(c) A metal rod is rubbed with a cloth.

Suggest why the metal rod does **not** become charged.

.....

..... [1]

[Total: 5]

10 Iron is a metal.

(a) **(i)** State the conditions needed for iron to rust.

.....

..... [2]

(ii) State a barrier method which prevents rusting.

..... [1]

(b) Fig. 10.1 shows the order of metals in the reactivity series.

Write an **X** to show the position of iron in the reactivity series.

potassium

sodium

calcium

magnesium

aluminium

zinc

copper

Fig. 10.1

[1]

(c) Write a word equation for the reaction of iron with dilute hydrochloric acid.

..... [2]

(d) Steel is made from iron.

State **one** use for mild steel.

..... [1]

[Total: 7]

11 **(a)** Some nuclei undergo radioactive decay.

State what is meant by radioactive decay.

.....

.....

..... [2]

(b) An isotope of radon has a half-life of 2 hours.

Tick (✓) the **two** correct statements about the nuclei in a sample of this isotope of radon.

All the nuclei decay in 2 hours. ☐

All the nuclei decay in 4 hours. ☐

Any one nucleus can decay at any time. ☐

Half the nuclei decay in 2 hours. ☐

[2]

(c) Alpha-particles, beta-particles and gamma-rays have different penetrating abilities.

(i) Name a material that absorbs alpha-particles but **not** beta-particles.

..... [1]

(ii) Name a material that absorbs alpha-particles and beta-particles but **not** gamma-rays.

..... [1]

(d) Name **one** method of detecting ionising radiation.

..... [1]

[Total: 7]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).