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# Cambridge IGCSE™

CANDIDATE NAME

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**CHEMISTRY** **0620/33**

Paper 3 Theory (Core) **May/June 2026**

**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. Do **not** use correction fluid or tape.
- 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 **16** pages. Any blank pages are indicated.

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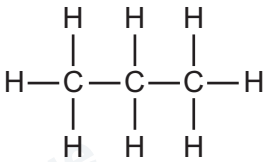
**[Turn over**

**1** Six substances, **A** to **F**, are shown in Figure 1.1.

**A**

$O_2$

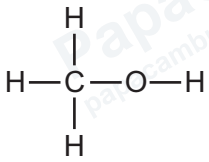
**B**



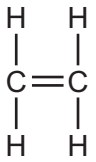
**C**

$NH_3$

**D**



**E**



**F**

$H_2O$

**Figure 1.1**

Answer the following questions about these substances.

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

**(a)** State which substance:

**(i)** is an alkene

..... [1]

**(ii)** reacts with methane in a combustion reaction

..... [1]

**(iii)** is in the same homologous series as ethanol

..... [1]

**(iv)** is a gas that is approximately 21% of clean, dry air

..... [1]

**(v)** turns damp red litmus paper blue

..... [1]

**(vi)** is in a homologous series with the general formula $C_nH_{2n}$.

..... [1]

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**(b)** State which **two** substances are hydrocarbons.

..... and ..... [2]

[Total: 8]

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**2** The halogens are in Group VII of the Periodic Table.

**(a)** Halogens exist as diatomic molecules.

Explain what is meant by the term diatomic.

..... [1]

**(b)** **(i)** Aqueous bromine reacts with aqueous sodium iodide.

Complete the symbol equation for this reaction.

$Br_2 + 2NaI \rightarrow$ ..... + ..... [2]

**(ii)** Identify the type of reaction that takes place when aqueous bromine reacts with aqueous sodium iodide.

Draw a circle around your chosen answer.

**addition** **displacement** **neutralisation** **substitution** [1]

**(iii)** Explain why aqueous iodine does **not** react with aqueous sodium bromide.

.....

..... [1]

**(c)** Complete Figure 2.1 to show the dot-and-cross diagram for a molecule of fluorine.

Show outer shell electrons only.

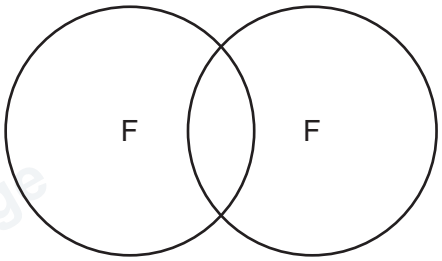


**Figure 2.1**

[2]

**(d)** Fluorine forms fluoride ions.

State the electronic configuration of a fluoride ion.

..... [1]

[Total: 8]

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**3** The equation for the reaction of calcium carbonate with dilute hydrochloric acid is shown.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

**(a) (i)** State the meaning of the symbol (aq) in this equation.

..... [1]

**(ii)** Name the salt formed when calcium carbonate reacts with dilute hydrochloric acid.

..... [1]

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**(b)** A student investigates the reaction of large pieces of calcium carbonate with dilute hydrochloric acid. The calcium carbonate is in excess.

Figure 3.1 shows how the mass of large pieces of calcium carbonate changes as the reaction proceeds.

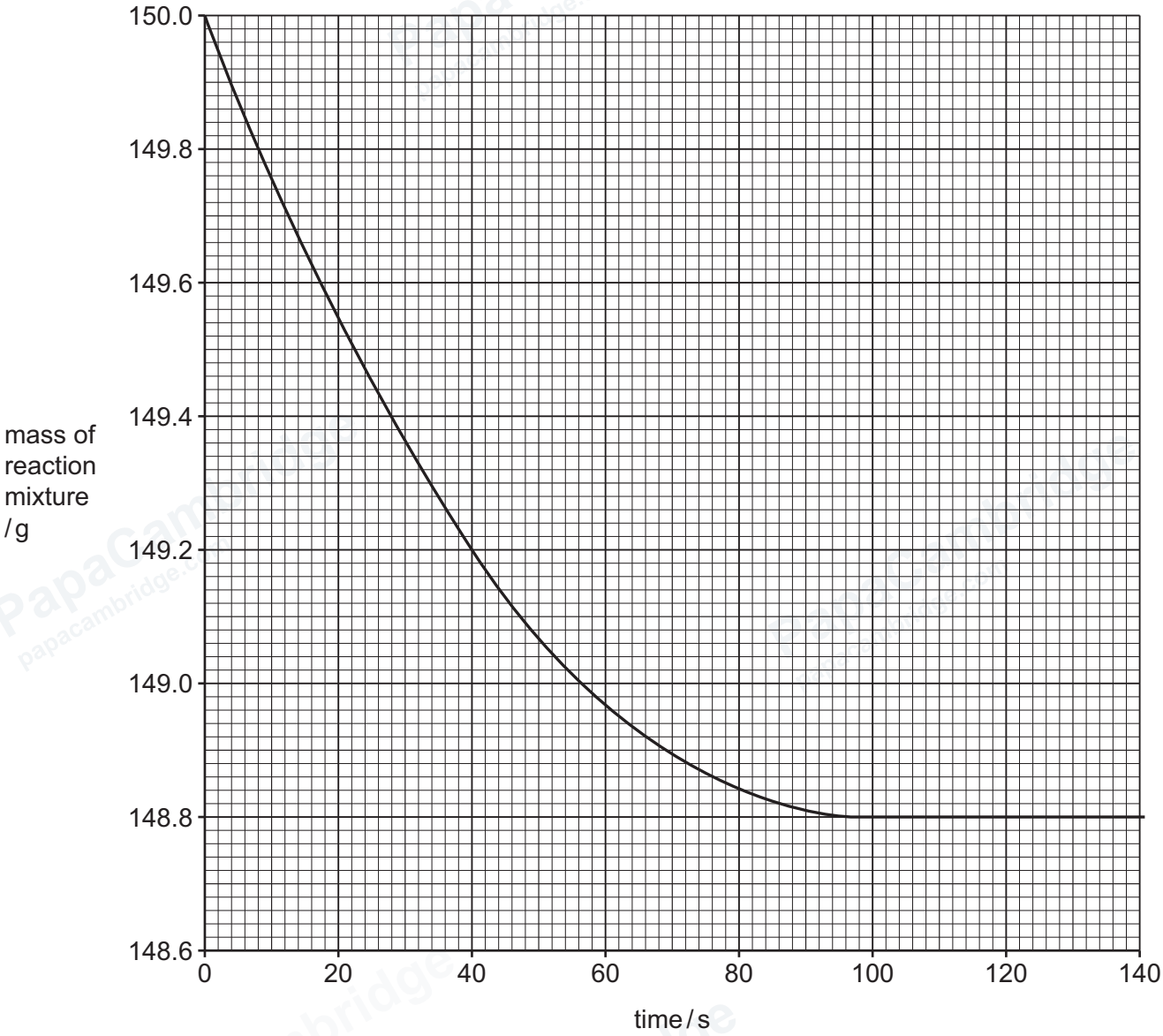


**Figure 3.1**

**(i)** State why the mass of the reaction mixture decreases.

..... [1]

**(ii)** Deduce the mass of the reaction mixture at 40 s.

mass = ..... g [1]

**(iii)** On Figure 3.1, draw an **X** to show where the rate of reaction is the fastest. [1]

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**(iv)** The student repeats the experiment using the same volume of dilute hydrochloric acid but with smaller pieces of calcium carbonate.

Draw a line on the grid in Figure 3.1 to show how the mass of the reaction mixture changes when smaller pieces of calcium carbonate are used. [2]

**(v)** State how the rate of reaction differs, if at all, when a higher temperature is used.

..... [1]

**(vi)** State how the rate of reaction differs, if at all, when a catalyst is added.

..... [1]

**(c)** Changing the concentration of a reactant changes the rate of a reaction.

Identify the unit of concentration.

Draw a circle around your answer.

**mol / dm$^3$** **dm$^3$ / mol** **mol / dm** **dm / mol$^3$** [1]

**(d) (i)** Sodium hydroxide is an alkali.

State the meaning of the term alkali.

..... [1]

**(ii)** Dilute aqueous sodium hydroxide is added to a solution of thymolphthalein indicator in acid until the sodium hydroxide is in excess.

State the colour change seen.

from ..... to ..... [2]

[Total: 13]

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**4** Table 4.1 shows the properties of some alkanes.

**Table 4.1**

| alkane | number of carbon atoms in one molecule | melting point in °C | boiling point in °C | density of liquid alkane in g/cm$^3$ |
|---|---|---|---|---|
| methane | 1 | –182 | –162 | 0.47 |
| ethane | 2 | –183 | –88 | 0.57 |
| propane | 3 | –188 | | 0.59 |
| butane | 4 | | 0 | 0.60 |
| pentane | 5 | –130 | 36 | 0.63 |

Use the information in Table 4.1 to answer the following questions.

**(a) (i)** Predict the boiling point of propane.

..... [1]

**(ii)** Suggest why it is difficult to predict the melting point of butane.

..... [1]

**(iii)** State the trend in the density of the alkanes as the number of carbon atoms increases.

..... [1]

**(iv)** Deduce the physical state of pentane at –1 °C.

Give a reason for your answer.

physical state .....

reason .....

.....

[2]

**(v)** Give the general formula for alkanes.

..... [1]

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**(b)** Compound **N** is unsaturated.

Figure 4.1 shows the displayed formula of compound **N**.

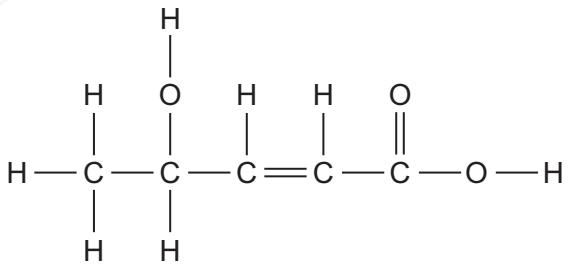

**Figure 4.1**

**(i)** On Figure 4.1 draw a circle around the carboxylic acid functional group. [1]

**(ii)** Deduce the molecular formula of compound **N**.

..... [1]

**(iii)** State why compound **N** is unsaturated.

..... [1]

**(c)** Outline how ethanol is manufactured from ethene and steam.

In your answer, include:

- the name of this reaction
- **two** conditions that are needed.

name of reaction .....

condition 1 .....

condition 2 .....

[3]

[Total: 12]

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**5** Three states of matter are solid, liquid and gas.

**(a)** State **two** general properties of a gas.

1 .....

.....

2 .....

.....

[2]

**(b)** Complete Table 5.1 to describe the arrangement and motion of particles in a solid and a liquid.

**Table 5.1**

| physical state | arrangement of particles | motion of particles |
|---|---|---|
| solid | | |
| liquid | | |

[4]

**(c)** Draw a line from each statement to the correct change of state.

| statement | change of state |
|---|---|
| liquid oxygen changes into solid oxygen | melting |
| solid copper changes into liquid copper | condensing |
| bromine gas changes into liquid bromine | freezing |

[2]

**(d)** A gas syringe contains 80 $cm^3$ of nitrogen gas.

State how the volume of nitrogen gas changes, if at all, when the pressure is increased at a constant temperature.

..... [1]

[Total: 9]

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**6** Titanium is a metal.

**(a) (i)** State the period number of titanium in the Periodic Table.

..... [1]

**(ii)** Deduce the number of electrons, neutrons and protons in the titanium ion shown.

$^{48}_{22}Ti^{2+}$

number of electrons .....

number of neutrons .....

number of protons .....

[3]

**(b)** Titanium is a transition element.

State **two** properties of transition elements that are different from Group I metals.

1 .....

2 .....

[2]

**(c) (i)** Titanium reacts with oxygen to form titanium(III) oxide.

Complete the symbol equation for this reaction.

$$.....Ti + .....O_2 \rightarrow 2Ti_2O_3$$ [1]

**(ii)** State if titanium(III) oxide is an acidic oxide or a basic oxide.

Give a reason for your answer.

.....

..... [1]

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**(d)** Another compound of titanium is titanium(III) chloride.

Molten titanium(III) chloride is electrolysed using graphite electrodes.

Name the products formed at each electrode during the electrolysis of molten titanium(III) chloride, and give the observations at the positive electrode.

product at the negative electrode .....

product at the positive electrode .....

observations at the positive electrode .....

.....

[3]

**(e)** Titanium forms a compound with the nitrate ion. The formula of the compound is $Ti(NO_3)_2$.

Complete Table 6.1 to calculate the relative formula mass of $Ti(NO_3)_2$.

**Table 6.1**

| type of atom | number of atoms | relative atomic mass | |
|---|---|---|---|
| titanium | 1 | 48 | 1 × 48 = 48 |
| nitrogen | | 14 | |
| oxygen | | 16 | |

relative formula mass = ..... [2]

[Total: 13]

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**7** **(a)** Natural water sources can be polluted with sewage and nitrates.

State why sewage and nitrates in river water are harmful.

sewage .....

.....

nitrates .....

.....
[2]

**(b)** Some fertilisers contain nitrates.

State why fertilisers are used.

..... [1]

**(c)** Sea water contains sodium ions.

Name the test to identify sodium ions. Give the observations for a positive result.

test .....

observations .....
[2]

**(d)** The domestic water supply is treated to make it safe to drink.

**(i)** Describe how solids are removed from the domestic water supply.

..... [1]

**(ii)** Name the substance added to the domestic water supply to remove tastes and odours.

..... [1]

**(e)** State the colour change when water is added to anhydrous copper(II) sulfate.

from ..... to ..... [2]

[Total: 9]

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**8** **(a)** Stainless steel is an alloy of iron.

**(i)** Give **one** reason why alloys are more useful than pure metals.

..... [1]

**(ii)** Brass is an alloy.

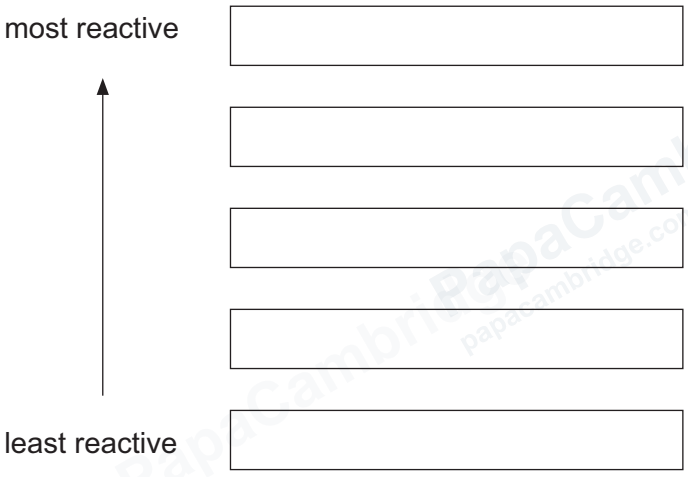
Name the **two** metals in brass.

..... and ..... [2]

**(b)** Five metals are shown.

**copper** **gold** **iron** **magnesium** **zinc**

Put these metals in order of their reactivity.
Put the most reactive metal at the top.




[2]

**(c)** Iron is extracted from its ore in a blast furnace.

**(i)** Name the ore used in the blast furnace to extract iron.

..... [1]

**(ii)** State **one** reason why coke is added to the blast furnace during the extraction process.

..... [1]

**(iii)** Name the compound used to reduce iron(III) oxide in the blast furnace.

..... [1]

[Total: 8]

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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.).



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