Cambridge Assessment International Education

# Cambridge IGCSE™

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**CHEMISTRY** **0620/32**

Paper 3 Theory (Core) **May/June 2025**

**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 **20** pages. Any blank pages are indicated.

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**1** A list of substances is shown.

**aluminium**
**bromine**
**calcium**
**carbon dioxide**
**iron**
**magnesium**
**magnesium oxide**
**neon**
**oxygen**
**potassium**
**sulfur dioxide**

Answer the following questions about these substances. Each substance may be used once, more than once or not at all.

State which substance is:

**(a)** an element which forms an ion with a 2– charge

View solution

..... [1]

**(b)** an ionic compound

View solution

..... [1]

**(c)** used as a catalyst

View solution

..... [1]

**(d)** approximately 21% of clean, dry air

View solution

..... [1]

**(e)** a gas needed for photosynthesis

View solution

..... [1]

**(f)** the most reactive metal in the list

View solution

..... [1]

**(g)** a gas that is tested for using acidified aqueous potassium manganate(VII)

View solution

..... [1]

**(h)** a noble gas

View solution

..... [1]

**(i)** in Group VII.

View solution

..... [1]

[Total: 9]

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**2** This question is about sea water and the substances found in sea water.

**(a)** Table 2.1 shows the masses of some of the compounds formed when 500 $cm^3$ of sea water is evaporated.

View solution

**Table 2.1**

| compound | formula | mass of compound / g |
|---|---|---|
| sodium chloride | NaC$l$ | 7.0 |
| | $MgSO_4$ | 2.5 |
| potassium bromide | KBr | 1.5 |
| calcium carbonate | $CaCO_3$ | 1.0 |

Answer these questions using the information from Table 2.1.

**(i)** State the chemical name of $MgSO_4$.

..... [1]

**(ii)** The total mass of compounds formed from 500 $cm^3$ of sea water is 12.0 g.

Calculate the total mass of compounds formed from 750 $cm^3$ of sea water.

mass = ..... g [1]

**(iii)** State which compound in Table 2.1 reacts with an acid to produce carbon dioxide.

..... [1]

**(b)** Potassium bromide is found in sea water and contains bromide ions.

View solution

Describe a test for bromide ions.

test .....

.....

observations .....

.....

[2]

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**(c)** Calcium ions are in sea water.

View solution

Complete Fig. 2.1 to show:

- the electronic configuration of a calcium ion
- the charge on the ion.

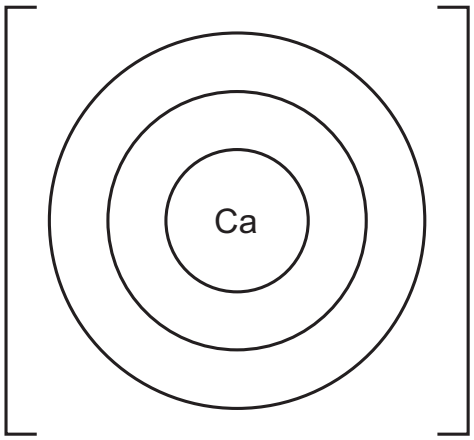


**Fig. 2.1**

[2]

**(d)** Sodium chloride is a solid at room temperature.

View solution

Describe the arrangement and motion of the particles in a solid.

arrangement .....

.....

motion .....

.....

[2]

**(e)** Sea water contains dissolved nitrate ions.

View solution

State **one** source of nitrate ions.

..... [1]

[Total: 10]

**3** This question is about phosphorus and its compounds.

View solution

**(a) (i)** Phosphorus is in Group V of the Periodic Table.

Explain why phosphorus is placed in this group.

.....

..... [1]

View solution

**(ii)** Two isotopes of phosphorus are shown in Fig. 3.1.

$^{31}_{15}P$ $^{32}_{15}P$

**Fig. 3.1**

Complete Table 3.1 to show the number of protons, neutrons and electrons in one atom of these isotopes.

**Table 3.1**

| | protons | neutrons | electrons |
|---|---|---|---|
| $^{31}_{15}P$ | | | |
| $^{32}_{15}P$ | | | |

[3]

View solution

**(iii)** Phosphorus burns in oxygen to produce phosphorus(V) oxide.

Complete the symbol equation for this reaction.

$$.....P + .....O_2 \rightarrow P_4O_{10}$$ [2]

View solution

**(iv)** State whether phosphorus(V) oxide is an acidic oxide or a basic oxide.

Give a reason for your answer.

.....

..... [1]

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**(b) (i)** Phosphorus is one element in NPK fertilisers.

View solution

Draw a circle around **one other** element that is also in NPK fertilisers.

**krypton** **nickel** **platinum** **potassium** [1]

View solution

**(ii)** State why farmers use fertilisers on fields where crops are grown.

..... [1]

View solution

**(c)** A compound of phosphorus has the formula $Ca_3(PO_4)_2$.

Complete Table 3.2 to calculate the relative formula mass of $Ca_3(PO_4)_2$.

**Table 3.2**

| atom | number of atoms | relative atomic mass | |
|---|---|---|---|
| oxygen | 8 | 16 | 8 × 16 = 128 |
| calcium | | 40 | |
| phosphorus | | 31 | |

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

[Total: 11]

**4** This question is about organic chemistry.

**(a) (i)** State the meaning of the term hydrocarbon.

View solution

.....

..... [1]

**(ii)** Petroleum is a mixture of hydrocarbons.

View solution

Outline how petroleum is separated into its useful components.

Include in your answer:

- the name of the separation technique
- the property of the hydrocarbons which allows them to be separated
- a description of how this technique separates the petroleum into its useful components.

.....

.....

.....

.....

.....

.....

.....

..... [4]

**(iii)** Some of the products obtained from petroleum are shown.

View solution

Draw a line from each product to its use.

| product | use |
|---|---|
| kerosene | making roads |
| bitumen | fuel for cars |
| gasoline | jet fuel |

[2]

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**(b)** Ethanol is an organic molecule.

View solution

**(i)** Draw the displayed formula of a molecule of ethanol.

[2]

View solution

**(ii)** Ethanol is manufactured by the reaction of steam with ethene.

State **two** conditions for this process.

1 .....

2 .....

[2]

View solution

**(c)** Fig. 4.1 shows the displayed formula of tetramethylsilane.

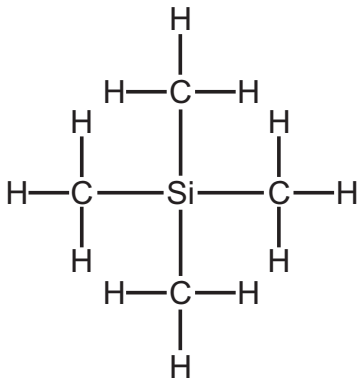


**Fig. 4.1**

**(i)** Deduce the molecular formula of tetramethylsilane.

..... [1]

**(ii)** Name the **two** elements in tetramethylsilane that are in the same group in the Periodic Table.

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

[Total: 13]

View solution

**5** This question is about zinc salts.

View solution

**(a)** Excess solid zinc oxide is added to dilute sulfuric acid to produce a salt.

**(i)** Complete the word equation for this reaction.

| | | | | | | |
|---|---|---|---|---|---|---|
| zinc oxide | + | sulfuric acid | → | ..... ..... | + | ..... |

[2]

**(ii)** Name the method used to remove excess solid zinc oxide from the reaction mixture.

..... [1]

**(iii)** Describe how crystals of the pure salt are made from an aqueous solution of the salt formed.

.....

.....

.....

..... [2]

**(b)** Fig. 5.1 shows the apparatus for the electrolysis of molten zinc chloride using inert electrodes.

View solution

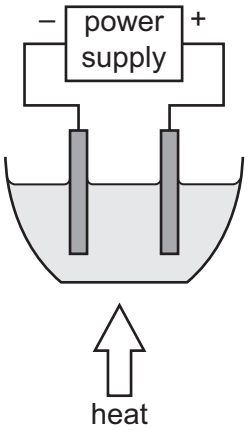


**Fig. 5.1**

**(i)** Label Fig. 5.1 to show the:

- cathode
- electrolyte.

[2]

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**(ii)** Name a suitable material for the inert electrodes.

..... [1]

**(iii)** Name the products formed at the positive and negative electrodes.

positive electrode .....

negative electrode .....

[2]

**(c)** Zinc chloride has ionic bonds.

View solution

State the meaning of the term ionic bond.

.....

..... [2]

[Total: 12]

**6** This question is about metals.

**(a) (i)** A student investigates the reaction of four different metals, **A**, **B**, **C** and **D**, with dilute hydrochloric acid.

View solution

All other conditions are the same in each test-tube.

The results of the experiment are shown in Fig. 6.1.

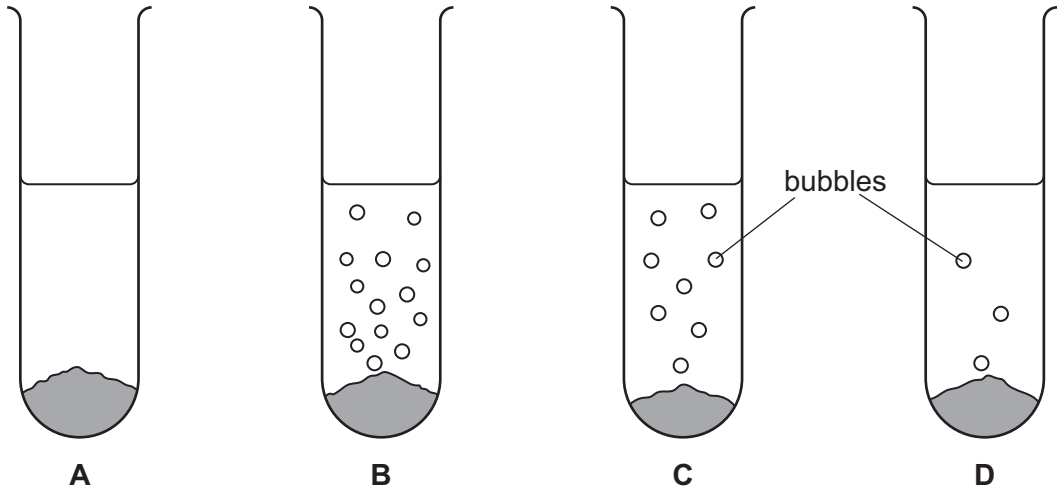


**Fig. 6.1**

Put the metals, **A**, **B**, **C** and **D**, in order of their reactivity.

most reactive .....

.....

.....

least reactive ..... [1]

**(ii)** The student wants to decrease the rate of the reaction in the experiment.

View solution

State **two** ways to decrease the rate of this reaction.

1 .....

2 .....

[2]

**(b)** In another experiment, a student adds potassium carbonate to dilute hydrochloric acid.

View solution

State the colour seen in the flame test for potassium ions.

..... [1]

**(c)** Brass is a mixture of two metals.

View solution

**(i)** State the name given to a mixture of metals such as brass.

..... [1]

**(ii)** Name the **two** metals in brass.

View solution

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

**(iii)** Magnalium is a mixture of magnesium and aluminium.

Suggest **one** property of magnalium that makes it more useful than pure magnesium metal.

..... [1]

[Total: 8]

View solution

**7** **(a)** Select **two** processes that show a chemical change.

View solution

Tick (✓) **two** boxes.

| | |
|---|---|
| boiling water | ☐ |
| burning methane | ☐ |
| dissolving salt | ☐ |
| mixing ink and water | ☐ |
| rusting of iron | ☐ |

[2]

**(b)** The reaction of hydrogen with nitrogen is a reversible reaction.

View solution

Write the symbol that shows a reversible reaction.

..... [1]

**(c)** Table 7.1 shows the results of four experiments.

View solution

**Table 7.1**

| experiment | initial temperature / °C | final temperature / °C |
|---|---|---|
| 1 | 18 | 23 |
| 2 | 19 | 17 |
| 3 | 18 | 14 |
| 4 | 19 | 29 |

**(i)** State which experiment shows the greatest temperature change.

..... [1]

**(ii)** State which experiment is the most endothermic.

View solution

..... [1]

**(iii)** In experiment 4, magnesium was added to dilute hydrochloric acid.

View solution

Complete the symbol equation.

$$Mg + .....HCl \rightarrow MgCl_2 + .....$$ [2]

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**(iv)** Fig. 7.1 shows an incomplete reaction pathway diagram for an endothermic reaction.

View solution

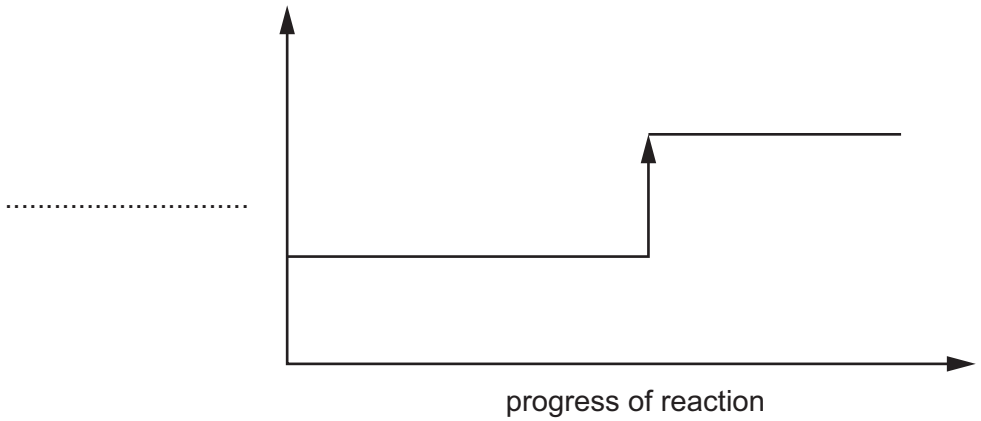


**Fig. 7.1**

Complete Fig. 7.1 by labelling:

- the vertical axis
- the reactants
- the products.

[2]

[Total: 9]

**8** This question is about water and air.

**(a)** Water needs to be treated to make it safe to drink.

View solution

Draw a line from each stage in the treatment of domestic water to the reason why it is carried out.

| stage | reason |
|---|---|
| addition of carbon | to kill microbes |
| sedimentation | to remove tastes and odours |
| chlorination | to remove solids |

[2]

**(b)** Describe how to test whether a sample of water is pure using melting point.

View solution

.....

.....

..... [2]

**(c)** Air may contain sulfur dioxide and particulates.

View solution

**(i)** State **one** harmful effect of each of these air pollutants.

sulfur dioxide .....

particulates .....

[2]

**(ii)** Describe how flue gas desulfurisation reduces emissions of sulfur dioxide gas.

.....

.....

..... [2]

[Total: 8]

View solution

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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.).