Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

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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.

[Turn over

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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

..... [1]

(b) an ionic compound

..... [1]

(c) used as a catalyst

..... [1]

(d) approximately 21% of clean, dry air

..... [1]

(e) a gas needed for photosynthesis

..... [1]

(f) the most reactive metal in the list

..... [1]

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

..... [1]

(h) a noble gas

..... [1]

(i) in Group VII.

..... [1]

[Total: 9]

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.

Table 2.1

compound	formula	mass of compound / g
sodium chloride	NaCl	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.

Describe a test for bromide ions.

test .....

.....

observations .....

.....

[2]

(c) Calcium ions are in sea water.

Complete Fig. 2.1 to show:

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

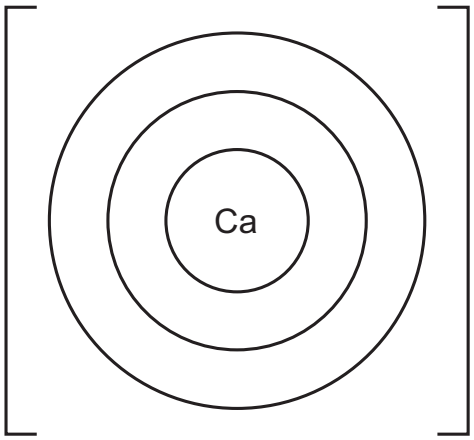

Fig. 2.1

[2]

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

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

arrangement .....

.....

motion .....

.....

[2]

(e) Sea water contains dissolved nitrate ions.

State **one** source of nitrate ions.

..... [1]

[Total: 10]

3 This question is about phosphorus and its compounds.

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

Explain why phosphorus is placed in this group.

.....

..... [1]

(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]

(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]

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

Give a reason for your answer.

.....

..... [1]

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

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

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

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

..... [1]

(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.

.....

..... [1]

(ii) Petroleum is a mixture of hydrocarbons.

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.

Draw a line from each product to its use.

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

[2]

(b) Ethanol is an organic molecule.

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

[2]

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

State **two** conditions for this process.

1 .....

2 .....

[2]

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

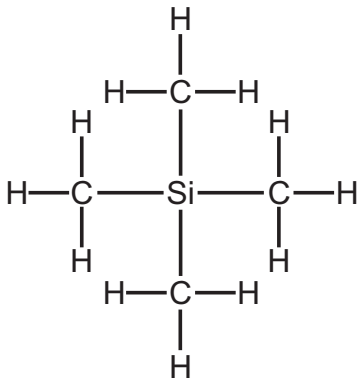

Fig. 4.1

(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]

5 This question is about zinc salts.

(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.

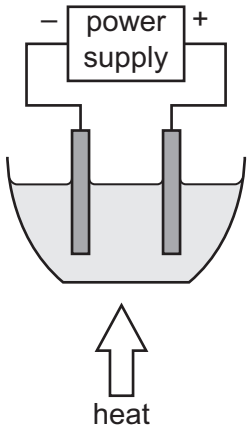

Fig. 5.1

(i) Label Fig. 5.1 to show the:

- cathode
- electrolyte.

[2]

(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.

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.

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

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

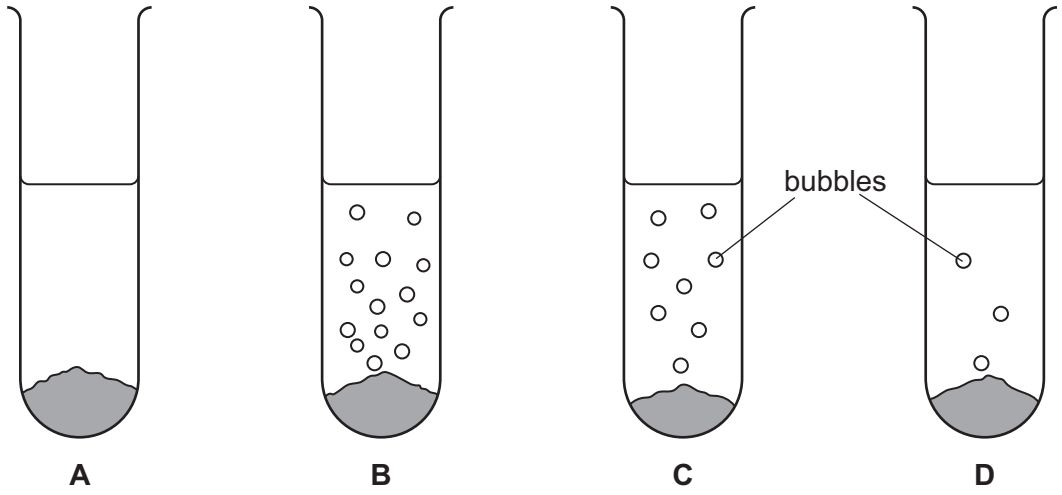

Fig. 6.1

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.

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.

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

..... [1]

(c) Brass is a mixture of two metals.

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

..... [1]

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

..... 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]

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

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.

Write the symbol that shows a reversible reaction.

..... [1]

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

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.

..... [1]

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

Complete the symbol equation.

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

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

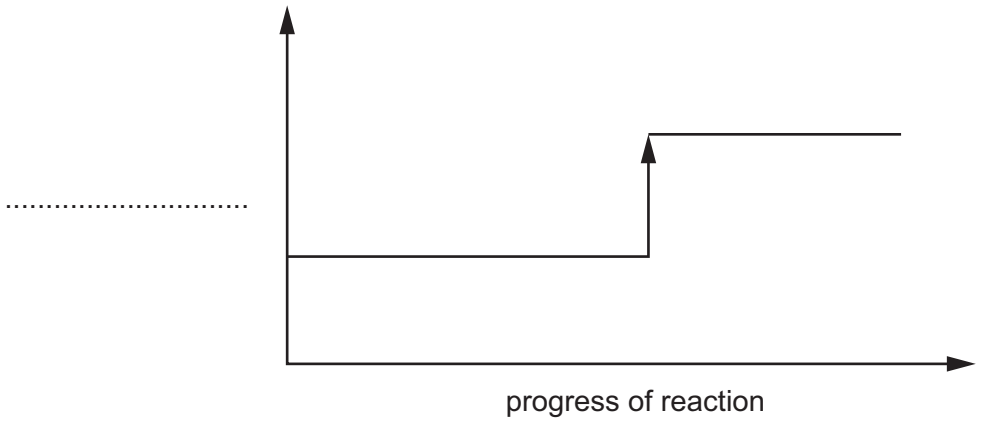

Fig. 7.1

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.

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.

.....

.....

..... [2]

(c) Air may contain sulfur dioxide and particulates.

(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]

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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 –	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.).