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CHEMISTRY **5070/22**

Paper 2 Theory **May/June 2026**

1 hour 45 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 **20** pages. Any blank pages are indicated.

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1 Choose from the following compounds to answer the questions.

Al_2O_3

CH_3COOH

C_2H_4

C_3H_8

CuO

H_2

K_2O

$LiBr$

NH_2OH

NH_3

SO_2

Each compound can be used once, more than once or not at all.

State which compound:

(a) is an amphoteric oxide

..... [1]

(b) has a molecule containing only two atoms

..... [1]

(c) has a molecule with only 10 electrons

..... [1]

(d) has an element with an oxidation number of +3

..... [1]

(e) is an alkane.

..... [1]

[Total: 5]

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2 Potassium superoxide, KO_2, reacts with carbon dioxide to make potassium carbonate and oxygen.

$$4KO_2(s) + 2CO_2(g) \rightarrow 2K_2CO_3(s) + 3O_2(g)$$

(a) A sample of 13.0 g of potassium superoxide reacts with excess carbon dioxide.

Calculate the volume of oxygen, measured at r.t.p., that is formed.

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

volume of oxygen = ... dm^3 [3]

(b) Potassium superoxide is an ionic compound.

Deduce the formula of a superoxide ion.

..... [1]

(c) Potassium superoxide has a giant ionic lattice.

Explain what is meant by the term giant ionic lattice.

.....

.....

..... [1]

(d) Describe the separation, arrangement and motion of particles in **solid** carbon dioxide.

.....

.....

.....

.....

.....

..... [3]

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(e) Draw a dot-and-cross diagram to show the electronic configuration in a molecule of carbon dioxide.

Show only the outer shell electrons.

[2]

(f) Explain why carbon dioxide has a low boiling point.

.....

..... [1]

[Total: 11]

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Turn over

3 The equation for one of the reactions that happens in a catalytic converter is shown.

$$2NO(g) \rightarrow O_2(g) + N_2(g)$$

This decomposition reaction is exothermic.

(a) Complete the reaction pathway diagram in Figure 3.1 for this decomposition reaction.

Label the:

- axes
- reactants and products
- enthalpy change, ΔH.



Figure 3.1

[3]

(b) The rate of the decomposition reaction is increased by using a catalyst.

Explain how a catalyst increases the rate of the decomposition reaction.

.....

..... [1]

(c) Suggest why it is important that the solid catalyst in a catalytic converter has a large surface area.

.....

..... [1]

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(d) The rate of the decomposition reaction increases when the pressure of the reactants is increased at constant temperature.

Explain why.

.....

.....

..... [2]

(e) The rate of the decomposition reaction increases when the temperature of the reactants is increased at constant pressure.

Explain why.

.....

.....

..... [2]

[Total: 9]

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4 Copper(II) sulfate is an ionic compound.

(a) The electrolysis of aqueous copper(II) sulfate is done using copper or graphite electrodes.

Complete Table 4.1 about the observations made in the two electrolysis reactions.

Table 4.1

	observation at anode	observation at cathode
using copper electrodes		
using graphite electrodes		

[4]

(b) Molten barium iodide is electrolysed using graphite electrodes.

Construct ionic half-equations to show the reactions at the anode and at the cathode.

anode .....

cathode .....

[2]

(c) Graphite is a suitable material for the electrodes used in electrolysis because it is inert and has good electrical conductivity.

(i) State the meaning of the word inert.

..... [1]

(ii) Name one metal that is used as an inert electrode.

..... [1]

(d) The ionic equation for the reaction between magnesium and aqueous copper(II) sulfate is shown.

$$Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$$

(i) State the oxidation number of copper in copper(II) sulfate.

..... [1]

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(ii) The reaction is an example of a redox reaction.

Explain how the equation shows that both oxidation and reduction take place during the reaction.

oxidation .....

.....

reduction .....

.....

[2]

[Total: 11]

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5 Zinc chloride is prepared by reacting excess zinc with warm dilute hydrochloric acid.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

(a) Use the equation to predict **one** observation made during this reaction.

..... [1]

(b) Explain why an excess of zinc is used in this preparation.

..... [1]

(c) A sample of 3.24 g of zinc is added to 50.0 cm^3 of 1.50 mol / dm^3 hydrochloric acid.

Show by calculation that the zinc is in excess.

[3]

(d) State how excess zinc is removed from the reaction mixture.

..... [1]

(e) Describe how pure dry zinc chloride crystals are prepared from aqueous zinc chloride.

.....

.....

.....

.....

..... [3]

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(f) The formula of a sample of zinc chloride crystals is $ZnCl_2 \cdot 3H_2O$.

Calculate the percentage by mass of water of crystallisation in these crystals.

percentage by mass = ... [3]

(g) Describe the effect of adding aqueous ammonia drop by drop until in excess to a sample of aqueous zinc chloride.

.....

.....

..... [2]

[Total: 14]

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6 Copper and aluminium are metals.

Both metals have good electrical conductivity.

(a) Explain why both metals have good electrical conductivity.

Use ideas about structure and bonding.

.....

..... [1]

(b) Copper is a transition element but aluminium is **not**.

Aluminium has a lower melting point and boiling point than copper.

(i) Suggest one **other** difference between the physical properties of these two metals.

..... [1]

(ii) Suggest **one** difference between the chemical properties of these two metals.

..... [1]

(c) Copper is used to make the alloy brass.

(i) Name the main element mixed with copper to make brass.

..... [1]

(ii) Brass is harder than pure copper.

Explain why.

Use ideas about structure and bonding.

.....

.....

..... [2]

(d) Aluminium is used to manufacture food containers because of its resistance to corrosion.

(i) Explain why aluminium is resistant to corrosion.

.....

.....

..... [2]

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(ii) State one **other** use for aluminium and explain why aluminium is suitable for this use.

use .....

explanation .....

.....

[2]

(e) Aluminium is manufactured by the electrolysis of purified bauxite mixed with cryolite. Carbon electrodes are used.

(i) Explain why cryolite is added to the purified bauxite.

.....

..... [1]

(ii) Explain why the carbon anodes need to be regularly replaced.

.....

..... [1]

[Total: 12]

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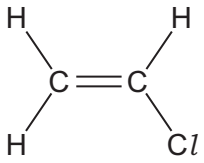
7 Chloroethene is a monomer used to make poly(chloroethene).

The displayed formula of chloroethene is shown.



(a) Draw the structure of poly(chloroethene).

[2]

(b) There is an accumulation of plastics such as poly(chloroethene) in the oceans.

Suggest **two** properties of poly(chloroethene) that explain this accumulation.

1 .....

2 .....

[2]

(c) Burning is used for the disposal of some plastics.

This method of disposal causes environmental challenges.

(i) One of these challenges is the production of greenhouse gases.

Name a greenhouse gas produced by burning plastics.

..... [1]

(ii) Another environmental challenge is the production of toxic gases.

Name **one** toxic gas produced during the burning of plastics.

..... [1]

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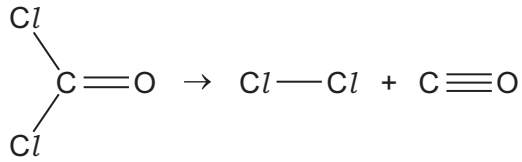
(d) Phosgene, $COCl_2$, decomposes when heated strongly.



Show that the enthalpy change for the reaction is +101 kJ / mol.

Use the bond energies shown in Table 7.1.

Table 7.1

bond	bond energy in kJ / mol
C=O	740
C—Cl	340
Cl—Cl	242
C≡O	1077

[3]

[Total: 9]

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8 This question is about carboxylic acids.

(a) Vinegar is an aqueous solution containing ethanoic acid.

During the production of vinegar, ethanoic acid is formed from ethanol.

Water is also formed as a product.

Describe the formation of ethanoic acid from ethanol during the production of vinegar.

Include a symbol equation for the formation of ethanoic acid from ethanol and the conditions for the production of vinegar.

.....

.....

.....

..... [2]

(b) Draw the displayed formula of butanoic acid.

[1]

(c) Ethyl ethanoate is a structural isomer of butanoic acid.

State the meaning of the term structural isomer.

.....

..... [1]

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(d) Propanoic acid reacts with butan-1-ol to make an ester.

(i) Name the ester made in this reaction.

..... [1]

(ii) Draw the structural formula of the ester made in this reaction.

[1]

(iii) State **one** condition needed for this esterification reaction.

..... [1]

(e) Deduce the molecular formula of an unbranched carboxylic acid that has only eight carbon atoms in its molecule and no other functional groups.

..... [2]

[Total: 9]

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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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