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CHEMISTRY **0620/43**

Paper 4 Theory (Extended) **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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1 A list of symbol equations and word equations, **A** to **I**, is shown.

A $CH_2=CH_2 + H_2 \rightarrow C_2H_6$

B ethane + chlorine → chloroethane + hydrogen chloride

C $Cu^{2+} + 2e^- \rightarrow Cu$

D glucose → ethanol + carbon dioxide

E carbon dioxide + water → glucose + oxygen

F nitrogen + hydrogen → ammonia

G $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

H $2C_8H_{18} + 17O_2 \rightarrow 16CO + 18H_2O$

I glucose + oxygen → carbon dioxide + water

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

Give the letter, **A** to **I**, for the equation that represents:

(a) a reaction that occurs in the blast furnace

View solution

..... [1]

(b) a reaction catalysed by nickel

View solution

..... [1]

(c) an addition reaction

View solution

..... [1]

(d) photosynthesis

View solution

..... [1]

(e) a reaction that occurs in the Haber process

View solution

..... [1]

(f) a substitution reaction

View solution

..... [1]

(g) incomplete combustion

View solution

..... [1]

[Total: 7]

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2 This question is about elements.

(a) Identify an element that:

(i) is approximately 21% of clean, dry air

..... [1]

(ii) is in Group 1 and Period 4 of the Periodic Table

..... [1]

(iii) contains atoms with exactly 24 protons

..... [1]

(iv) removes tastes and odours from the domestic water supply

..... [1]

(v) exists as diamond

..... [1]

(vi) forms an insoluble chloride salt.

..... [1]

(b) Boron has two isotopes.

(i) State the meaning of the term isotopes.

.....

..... [2]

(ii) The isotopes of boron have mass numbers of 10 and 11.

The relative atomic mass of boron is 10.8.

Calculate the percentage abundance of the isotope of boron with a mass number of 10.

percentage abundance = ... [1]

[Total: 9]

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3 This question is about structure and bonding.

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(a) Sodium oxide is an ionic compound.

(i) Complete the dot-and-cross diagrams in Figure 3.1 to show the bonding in sodium oxide. The inner shells of electrons are shown.

Show the charge on each ion.

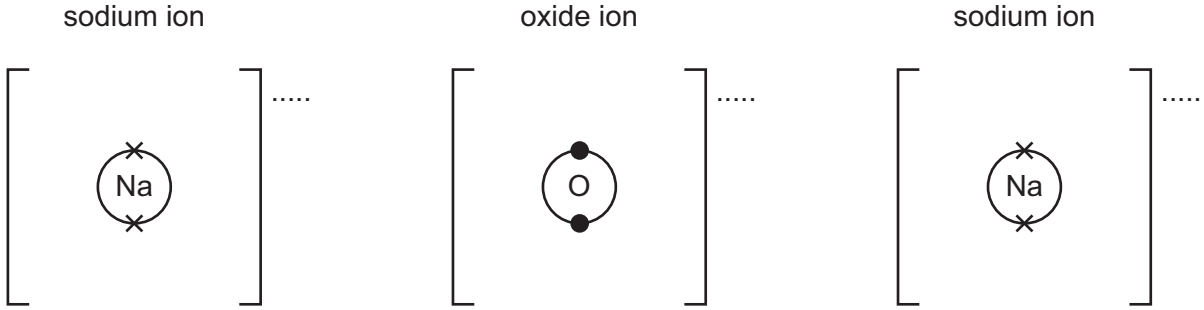

Figure 3.1

[3]

View solution

(ii) Sodium oxide is held together by ionic bonds.

State the meaning of the term ionic bond.

.....

..... [2]

View solution

(iii) The ions in sodium oxide are present in a giant ionic lattice.

State the meaning of the term giant ionic lattice.

..... [1]

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(b) Oxygen, O_2, consists of simple molecules.

View solution

(i) Complete the dot–and-cross diagram in Figure 3.2 of a molecule of oxygen.

Show outer shell electrons only.

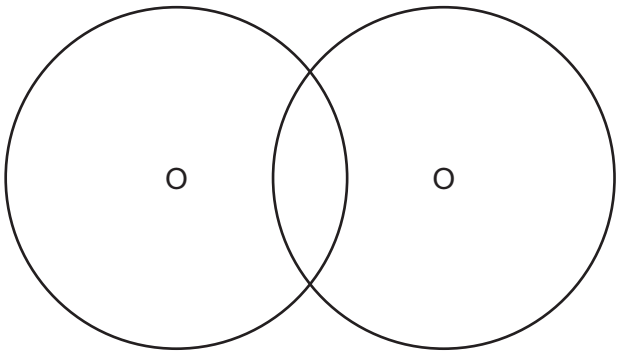

Figure 3.2

[2]

(ii) Oxygen has a low melting point.

State the general term for the weak forces of attraction that cause oxygen to have a low melting point.

..... [1]

[Total: 9]

View solution

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4 Aqueous hydrogen peroxide, H_2O_2, decomposes to produce water and oxygen gas.

The reaction is catalysed by manganese(IV) oxide.

A student adds powdered manganese(IV) oxide to aqueous hydrogen peroxide in a conical flask as shown in Figure 4.1.

The mass of the conical flask and its contents is measured at regular time intervals.

The mass decreases as time increases.

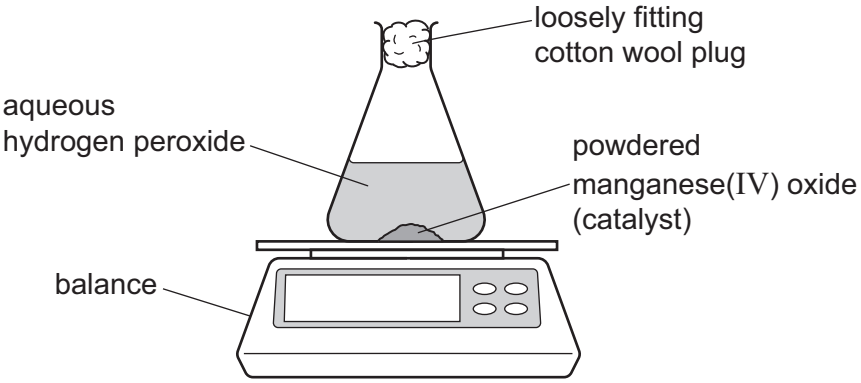

Figure 4.1

(a) (i) State the meaning of the term aqueous.

View solution

..... [1]

(ii) Complete the symbol equation for the decomposition of aqueous hydrogen peroxide.

View solution

$$.....H_2O_2(aq) \rightarrow .....H_2O(l) + O_2(g)$$

[1]

(iii) State why there is a decrease in mass of the conical flask and its contents during the experiment.

View solution

..... [1]

(b) The rate of reaction is highest at the start of the reaction. The rate of reaction decreases as time increases. The rate of reaction eventually becomes zero because the reaction stops.

View solution

Explain why the rate of reaction decreases as time increases.

.....

..... [1]

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(c) The experiment is repeated at a higher temperature. All other conditions remain the same.

View solution

Explain why the rate of reaction is greater at the higher temperature.

.....

.....

.....

.....

..... [3]

(d) Oxygen is also produced by thermal decomposition of potassium manganate(VII), $KMnO_4$.

(i) State the meaning of (VII) in potassium manganate(VII).

View solution

.....

..... [2]

(ii) The equation for the reaction is shown.

View solution

$$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$$

Calculate the mass of $KMnO_4$ used to produce 0.64 g of O_2.

[M_r: $KMnO_4$, 158; O_2, 32]

Use the following steps.

- Calculate the number of moles of O_2 produced.

..... mol

- Calculate the number of moles of $KMnO_4$ used.

..... mol

- Calculate the mass of $KMnO_4$ used.

..... g
[3]

[Total: 12]

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5 This question is about the effects of electricity on chemical substances.

View solution

(a) Concentrated aqueous lithium bromide undergoes electrolysis when electricity is passed through it.

The products are:

- bromine gas at the anode
- hydrogen gas at the cathode.

(i) Give the term used to describe any liquid that undergoes electrolysis when electricity is passed through it.

..... [1]

(ii) State **two** properties of a substance that make it suitable to use as an electrode.

1 .....

2 .....
[2]

(iii) Write an ionic half-equation for the formation of bromine at the anode.

..... [2]

(iv) Explain why hydrogen gas is produced at the cathode.

.....

..... [2]

(v) Name the type of particle responsible for the transfer of charge in any liquid that undergoes electrolysis.

..... [1]

(vi) Name the products formed when electricity is passed through **molten** lithium bromide.

at the anode .....

at the cathode .....
[2]

View solution

(b) Bauxite is an ore containing aluminium.

Name the compound of aluminium that is present in bauxite.

..... [1]

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(c) Aluminium is extracted by electrolysis using cryolite.

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State **two** reasons why cryolite is used in this electrolysis.

1 .....

2 .....
[2]

[Total: 13]

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6 This question is about oxides.

(a) Aluminium oxide, Al_2O_3, is an amphoteric oxide.

View solution

(i) State the meaning of the term amphoteric.

..... [1]

(ii) Aluminium oxide is used to make calcium aluminate.

View solution

Calcium aluminate contains calcium ions, Ca^{2+}, and aluminate ions, AlO_2^-.

Write the formula of calcium aluminate.

..... [1]

(iii) When aluminium oxide reacts with dilute hydrochloric acid, aqueous aluminium chloride and one other product are formed.

View solution

Write the symbol equation for the reaction between aluminium oxide and dilute hydrochloric acid.

..... [2]

(iv) When aqueous silver nitrate is added to aqueous aluminium chloride, a precipitate of silver chloride, AgCl, is produced.

View solution

Write an ionic equation for this precipitation reaction. Include state symbols.

..... [2]

(b) Ammonium dichromate, $(NH_4)_2Cr_2O_7$, decomposes when it is heated. The products are chromium(III) oxide, Cr_2O_3, nitrogen and water.

View solution

Ammonium dichromate is an orange solid.

(i) Identify the element which causes ammonium dichromate to be coloured.

..... [1]

(ii) Write the symbol equation for the reaction that occurs when ammonium dichromate is heated.

View solution

..... [2]

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(c) A mixture of sulfur dioxide, SO_2, oxygen, O_2, and sulfur trioxide, SO_3, is allowed to reach equilibrium in a closed system in the presence of a catalyst.

View solution

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction is exothermic.

(i) State what is meant by the term closed system.

..... [1]

(ii) Complete Table 6.1 using the words **increases**, **decreases** or **no change**.

View solution

Table 6.1

change in condition	effect on the equilibrium yield of $SO_3(g)$
decrease the pressure	
increase the temperature	
remove the catalyst	

[3]

(iii) Name the industrial process in which sulfur dioxide is converted into sulfur trioxide.

..... [1]

[Total: 14]

View solution

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7 This question is about organic chemistry.

(a) The equation for the reaction between butane and chlorine is shown.

View solution

$$C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$$

(i) Give the general formula of the homologous series which has butane as a member.

..... [1]

(ii) State the condition required for the reaction between butane and chlorine to occur at room temperature.

View solution

..... [1]

(iii) State the term given to organic compounds with the same molecular formula but different structural formulas.

View solution

..... [1]

(iv) Butane reacts with chlorine to make **two** organic compounds with the molecular formula C_4H_9Cl.

View solution

Draw the displayed formula for each of these organic compounds.

[2]

(b) The structure of compound **A** is shown in Figure 7.1.

View solution

compound **A**

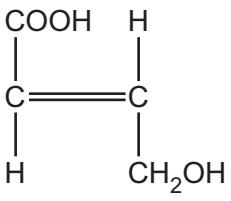

Figure 7.1

(i) Deduce the empirical formula of compound **A**.

..... [1]

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(ii) State what is observed when compound **A** is added to the following substances.

aqueous bromine .....

aqueous sodium carbonate .....

[2]

(iii) Compound **A** can undergo addition polymerisation to form polymer **B**.

Draw the section of polymer **B** that contains **two** repeat units.

[3]

(iv) Polyesters are condensation polymers.

Condensation polymers are made from two monomers.

Name the **two** types of monomers used to produce polyesters.

1 .....

2 .....

[2]

View solution

(c) Organic compound **D** has the following composition by mass.

C, 88.9%; H, 11.1%

Calculate the empirical formula of compound **D**.

empirical formula = ... [3]

[Total: 16]

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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.).