

About



**(PURE)
CHEMISTRY**
(YEARLY)






About **Thinking Process**

When solving problems, we first analyse the questions and then gather relevant information until we are able to determine the answers. But for presentation reason, we need to organise, rearrange and then present ONLY the required workings and solutions.

Thinking process reveals the extra but relevant information which is not required as part of the solutions.

About **MCQ with HELPs**

Explanations are given so that students know exactly why the answer is the right one.

 period	2009 to 2022
 contents	June & November, Paper 1 & 2, Worked Solutions
 form	Year By Year
 compiled for	O Levels
 special features	Thinking Process, MCQ with HELPs

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'O' Level (Pure) Chemistry 5070 (Yearly)*Revised Syllabus*

-  June **2009** Paper 1 & 2
November **2009** Paper 1 & 2
-  June **2010** Paper 1 & 2
November **2010** Paper 1 & 2
-  June **2011** Paper 1 & 2
November **2011** Paper 1 & 2
-  June **2012** Paper 1 & 2
November **2012** Paper 1 & 2
-  June **2013** Paper 1 & 2
November **2013** Paper 1 & 2
-  June **2014** Paper 1 & 2
November **2014** Paper 1 & 2
-  June **2015** Paper 1 & 2
November **2015** Paper 1 & 2
-  June **2016** Paper 1 & 2
November **2016** Paper 1 & 2
-  June **2017** Paper 1 & 2
November **2017** Paper 1 & 2
-  June **2018** Paper 1 & 2
November **2018** Paper 1 & 2
-  June **2019** Paper 1 & 2
November **2019** Paper 1 & 2
-  June **2020** Paper 1 & 2
November **2020** Paper 1 & 2
-  June **2021** Paper 1 & 2
November **2021** Paper 1 & 2
-  June **2022** Paper 1 & 2
November **2022** Paper 1 & 2

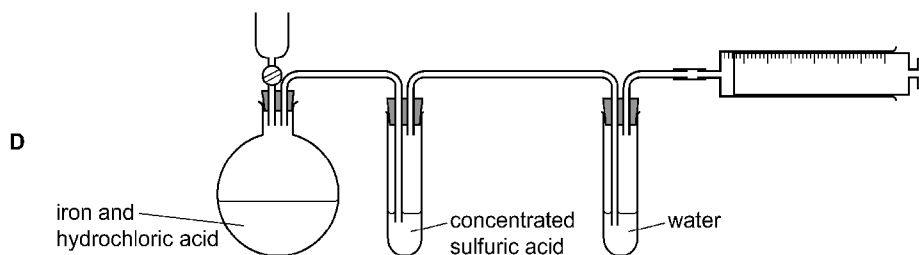
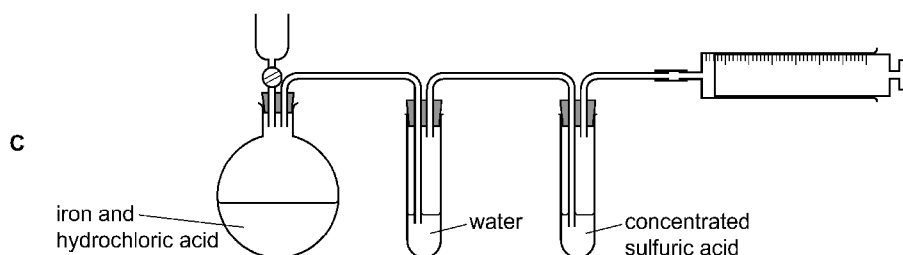
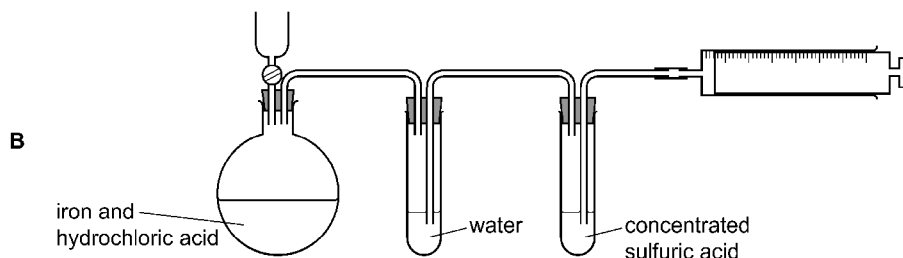
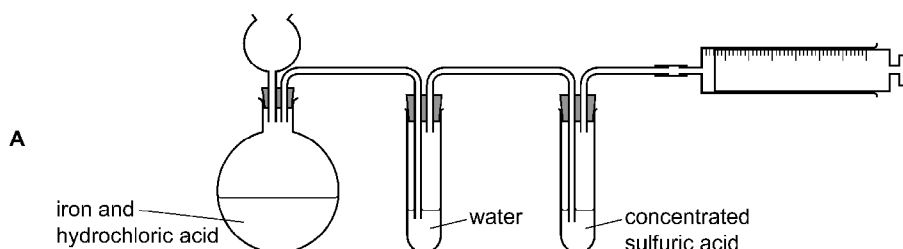
NOVEMBER 2022 PAPER 1

M C Q S e c t i o n

1. Which piece of apparatus would be the most suitable for measuring exactly 37.00 cm^3 of aqueous ammonia?
- A a 50 cm^3 burette
 B a 50 cm^3 pipette
 C a 50 cm^3 gas syringe
 D a 50 cm^3 measuring cylinder

[Topic 2]

2. When iron reacts with dilute hydrochloric acid, hydrogen is formed. Impurities in the iron mean that some hydrogen sulfide gas is also formed. Hydrogen sulfide gas is soluble in water. Water vapour can be removed from a mixture of gases using concentrated sulfuric acid. Which diagram shows apparatus suitable to prepare a pure, dry sample of hydrogen?



[Topic 2]

1. A A burette is most suitable to measure exactly 37.00 cm^3 of ammonia. Pipette measures exact volumes while a liquid cannot be measured in a gas syringe. Burette is more accurate than a measuring cylinder.

2. C To prepare a dry sample of hydrogen gas, a gas tube from the flask must first be immersed in water to remove any hydrogen sulfide gas. The remaining mixture should then be immersed in concentrated sulfuric acid to remove any water vapors. Dry H_2 gas is then collected in the gas syringe.

3. A The green precipitate indicate presence of chromium(III) and Iron (II) ions. Since they dissolve in excess, Chromium(III) ions are confirmed. A gas that turns litmus paper blue confirms the presence of ammonia and thus ammonium ion. As a white precipitate is formed when nitric acid and barium nitrate are added, sulfate ion is also present in the sample.

4. B A gas condenses into a liquid while a liquid boils to a gas. A liquid freezes into a solid while solid melts to a liquid.

3. The following tests are carried out on a sample of green crystals.

The crystals are dissolved in water and the resulting solution is divided into two portions.

- Aqueous sodium hydroxide is added to the first portion. A green precipitate, soluble in excess aqueous sodium hydroxide, is formed.

The solution formed is heated and a gas is produced which turns litmus paper blue.

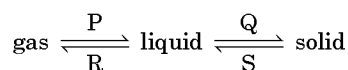
- Dilute nitric acid is added to the second portion followed by aqueous barium nitrate. A white precipitate is formed.

Which three ions are present in the green crystals?

- A ammonium, chromium(III), sulfate
 B ammonium, iron(II), sulfate
 C chromium(III), carbonate, sulfate
 D iron(II), nitrate, sulfate

[Topic 2]

4. Changes of state occur between solids, liquids and gases.



Which changes are occurring at P, Q, R and S?

	P	Q	R	S
A	boiling	melting	freezing	condensing
B	condensing	freezing	boiling	melting
C	freezing	condensing	boiling	melting
D	melting	boiling	condensing	freezing

[Topic 1]

5. The table shows information about some oxides.

	structure	effect of water
oxide	simple molecular	dissolves to form an acid

For which of the elements nitrogen, phosphorus, sulfur and silicon could this information about their oxides be correct?

- A phosphorus and sulfur only
 B nitrogen and silicon only

- C nitrogen, phosphorus and sulfur only

- D nitrogen, phosphorus, sulfur and silicon

[Topic 3]

6. Which statement about iodine atoms and iodide ions is correct?

- A They are both isotopes of iodine.
 B They undergo the same chemical reactions.
 C They have the same number of protons.
 D They have the same physical properties.

[Topic 3]

7. The table contains information about four substances.

Which substance is an ionic compound?

	state at room temperature	conducts electricity at room temperature	conducts electricity when molten	conducts electricity when in aqueous solution
A	liquid	✗	✗	✓
B	solid	✓	✓	✓
C	solid	✓	✓	insoluble
D	solid	✗	✓	✓

[Topic 3]

5. C Nitrogen, phosphorus and sulfur forms oxides with simple molecular structures that form acidic solutions when dissolved in water. Silicon dioxide has a giant molecular structure. The covalent bonds in SiO₂ are so extensive that it is only poorly soluble in water.

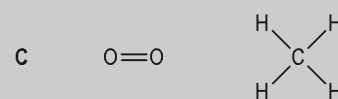
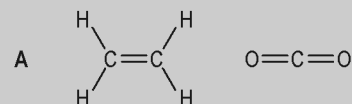
6. C Iodine atoms gain an electron to become iodide ions. The number of protons remains the same in the two species.

7. D Ionic compounds are solids at room temperature and can conduct electricity only in molten and aqueous state.

8. C Nucleon number = Number of protons and nucleons = 235

9. D Charges on the ions:
 O = 2⁻, Al = 3⁺

10. A By looking at the structural formulas, it is easy to determine the number of bonds.



8. What is the nucleon number of the isotope of uranium, ${}^{235}_{92}\text{U}$?

A 92 B 143
C 235 D 327

[Topic 3]

9. An ionic compound has the formula Al_2O_3 .

What are the charges on the ions?

A Al^+ O^- B Al^{2+} O^{2-}
C Al^{2+} O^{3-} D Al^{3+} O^{2-}

[Topic 4]

10. Which two pairs of atoms are held together by the same number of bonds?

	first pair of atoms	second pair of atoms
A	the two carbon atoms in a C_2H_4 molecule	the carbon atom and one oxygen atom in a CO_2 molecule
B	the two nitrogen atoms in an N_2 molecule	the two hydrogen atoms in an H_2 molecule
C	the two oxygen atoms in an O_2 molecule	the carbon atom and one hydrogen atom in a CH_4 molecule
D	the two oxygen atoms in an O_2 molecule	the two nitrogen atoms in an N_2 molecule

[Topic 3]

11. Boron trifluoride, BF_3 , is a simple molecule. There are three covalent bonds in each BF_3 molecule. Each of these bonds is made by sharing one electron from the boron atom and one electron from a fluorine atom.

What is unusual about the bonding in boron trifluoride?

- A It is unusual for a non-metal such as fluorine to form covalent bonds.
B The boron atom in each molecule does **not** gain the electronic configuration of a noble gas.
C The covalent bonds do **not** consist of shared pairs of electrons.
D The fluorine atoms in each molecule do **not** gain the electronic configuration of a noble gas.

[Topic 3]

12. Which equation is correct for the reaction between carbon dioxide and magnesium hydroxide?

A $\text{CO}_2 + \text{Mg}(\text{OH})_2 \rightarrow \text{MgCO}_3 + \text{H}_2\text{O}$
B $\text{CO}_2 + 2\text{Mg}(\text{OH})_2 \rightarrow 2\text{MgCO}_3 + 2\text{H}_2\text{O}$
C $2\text{CO}_2 + \text{Mg}(\text{OH})_2 \rightarrow \text{MgCO}_3 + \text{H}_2\text{O}$
D $2\text{CO}_2 + \text{Mg}(\text{OH})_2 \rightarrow 2\text{MgCO}_3 + \text{H}_2\text{O}$

[Topic 4]

13. Which mass of oxygen gas combines with exactly 16 g of sulfur to form sulfur dioxide, SO_2 ?

A 4 g B 8 g
C 16 g D 32 g

[Topic 4]

14. Which compound has an empirical formula that is different from its molecular formula?

A butanol, $\text{C}_4\text{H}_{10}\text{O}$
B hydrogen peroxide, H_2O_2
C nitrogen dioxide, NO_2
D water, H_2O

[Topic 4]

15. 4.0 g of sodium hydroxide, NaOH , is dissolved in 250 cm^3 of water in a graduated flask.

A 25 cm^3 sample of this solution is titrated with 0.50 mol/dm^3 hydrochloric acid.

Which volume of hydrochloric acid is required to exactly neutralise the alkali?

A 10 cm^3 B 20 cm^3
C 40 cm^3 D 200 cm^3

[Topic 4]

16. Dilute aqueous solutions of potassium chloride and magnesium chloride are mixed together.

A sample of the mixture is electrolysed using inert electrodes.

What are possible products at each of the electrodes?

	anode	cathode
A	chlorine	oxygen
B	chlorine	potassium
C	oxygen	hydrogen
D	oxygen	magnesium

[Topic 9]



MCQ Answers

11. B Electronic configuration of Boron = 2, 3

In BF_3 , the configuration of boron ion is 2, 6 which is not similar to electronic configuration of any noble gas.

12. A Among the given equations, only equation A is balanced.

13. C $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$

Moles of Sulfur

$$= \frac{16}{32} = 0.5$$

Moles of Oxygen = 0.5

Mass of Oxygen

$$= 0.5 \times 32 = 16 \text{ g}$$

14. B Empirical formulae:

Butanol: $\text{C}_4\text{H}_{10}\text{O}$

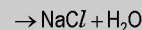
Hydrogen peroxide: HO

Nitrogen dioxide: NO_2

Water: H_2O

15. B

$\text{HCl} + \text{NaOH}$



$\text{HCl} : \text{NaOH} \ 1 : 1$

Moles of NaOH in

$$250 \text{ cm}^3 : \frac{4}{40} = 0.1$$

Moles of NaOH in

$$25 \text{ cm}^3 = 0.01$$

\therefore Moles of HCl

reacted = 0.01

$$\text{Volume of HCl} = \frac{0.01}{0.5}$$

$$= 0.02 \text{ dm}^3 = 20 \text{ cm}^3$$

16. C When aqueous solution of KCl and MgCl_2 is electrolysed, oxygen and hydrogen is liberated at the anode and cathode, respectively.

NOVEMBER 2022 PAPER 2**T H E O R Y S e c t i o n****Section A [45 marks]**Answer **all** the questions in this section.**Question 1**

The diagram shows part of the Periodic Table.

I	II							III	IV	V	VI	VII	VIII
									C	N	O	F	
	Mg							Al				Cl	Ar
K	Ca				Cr		Fe						Br
												I	
							Pt						

Answer the following questions using only the symbols of the elements in the diagram.

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

Give the symbol of the element that:

- (a) is a catalyst in the Haber process [1]
- (b) is used to make food containers because of its resistance to corrosion [1]
- (c) is about one percent by volume of dry air [1]
- (d) is extracted from haematite [1]
- (e) forms an ion with a charge of -2 . [1]

[Total: 5] [Topic: 5]

Solution

- (a) Fe
- (b) Al
- (c) Ar
- (d) Fe
- (e) O

COMMENT on ANSWER

“(a) Iron is used as a catalyst in Haber process and Vanadium oxide is used as a catalyst in Contact process.

(b) Aluminium forms a layer of aluminium oxide over it which makes it resistant to corrosion and suitable to make food containers.

(d) Haematite is an iron ore used to extract Iron from it.”

Question 2

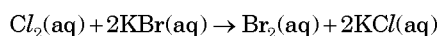
This question is about halogens and halogen compounds.

- (a) (i) Draw a dot-and-cross diagram to show the arrangement of electrons in a chlorine molecule.

Show only the outer shell electrons. [2]

- (ii) State **one** use of chlorine. [1]

- (b) Aqueous chlorine reacts with aqueous potassium bromide.



- (i) State the colour of $\text{Br}_2(\text{aq})$. [1]

- (ii) Explain, using ideas about the reactivity of the halogens, why aqueous bromine does **not** react with aqueous potassium chloride. [1]

- (c) Bromine is a liquid at room temperature.

Describe the arrangement and separation of the particles in a liquid. [2]

- (d) Chlorofluorocarbons (CFCs) are atmospheric pollutants which deplete the ozone layer.

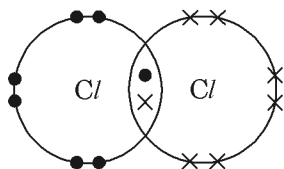
Explain the importance of the ozone layer.

Describe **one** problem caused by the depletion of the ozone layer. [2]

[Total: 9] [Topic: 5 & 11]

Solution

- (a) (i)



- (ii) Chlorine is used to kill bacteria in water treatment.

- (b) (i) Orange.

- (ii) Bromine is less reactive than chlorine.

- (c) Arrangement: Random Arrangement.

Separation: Particles in liquid bromine are closer together with some of them touching one another.

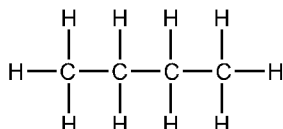
- (d) Importance: Ozone layer is important to reduce the amount of ultraviolet radiations reaching the Earth.

Problem: If more ultraviolet radiations reaches the earth, chances of sun burn, eye cataracts and skin cancer increases.

Question 3

The alkanes are a homologous series of hydrocarbons.

- (a) Give the general formula for the alkanes. [1]
- (b) The structure of one isomer of an alkane is shown.



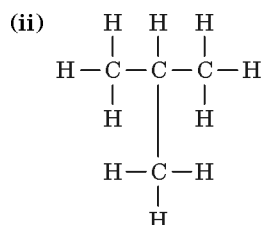
- (i) Name this alkane. [1]
- (ii) Draw the structure of a different isomer of this alkane. Show all of the atoms and all of the bonds. [1]
- (c) The fractional distillation of petroleum (crude oil) produces fractions containing alkanes of different chain lengths.
- (i) Separation by fractional distillation depends on a physical property of the fractions.
Name this physical property. [1]
- (ii) Naphtha is one fraction separated from petroleum (crude oil).
State the main use of the naphtha fraction. [1]
- (d) Larger alkane molecules are cracked to form smaller alkane molecules.
- (i) Explain the importance of cracking larger alkanes into smaller alkanes. [1]
- (ii) State two conditions needed for cracking. [2]
- (e) Alkanes react with chlorine in the presence of ultraviolet light to form compounds that contain carbon, hydrogen and chlorine.
A compound contains 37.8% carbon, 6.30% hydrogen and 55.9% chlorine by mass.
Calculate the empirical formula of this compound. [2]

[Total: 10] [Topic: 12 & 4]

Solution

(a) $\text{C}_n\text{H}_{2n+2}$

- (b) (i) Butane.



- (c) (i) Boiling point.
- (ii) Naphtha is used as a chemical feedstock.
- (d) (i) Cracking larger alkanes into smaller ones is important as the smaller alkanes are more in demand as fuels.

- (ii) 1. High temperature.
2. Catalyst and high pressure.

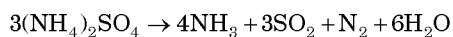
(e) Element	C	H	Cl
Percentage	37.8	6.30	55.9
Ar	12	1	35.5
No. of moles	$\frac{37.8}{12}$	$\frac{6.30}{1}$	$\frac{55.9}{35.5}$
=	3.15	6.30	1.57
Simple ratio	$\frac{3.15}{1.57}$	$\frac{6.3}{1.57}$	$\frac{1.57}{1.57}$
=	2	4	1

∴ Empirical formula is C_2H_4Cl

Question 4

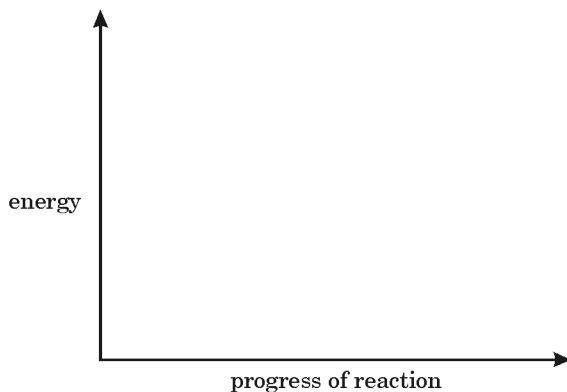
This question is about ammonium sulfate, $(NH_4)_2SO_4$.

- (a) Ammonium sulfate is a fertiliser.
Explain why farmers put fertilisers on soil where crops are grown. [1]
- (b) Explain why farmers do **not** add calcium hydroxide to the soil immediately after adding ammonium sulfate. [2]
- (c) Calculate the percentage by mass of nitrogen in ammonium sulfate.
Give your answer to **three** significant figures. [3]
- (d) Complete the equation for the reaction of ammonium sulfate with aqueous sodium hydroxide.
 $(NH_4)_2SO_4 + 2NaOH \rightarrow \dots + \dots + \dots$ [2]
- (e) Ammonium sulfate decomposes when heated. The reaction is endothermic.



Complete and label the energy profile diagram for this reaction to include:

- the reactant and products
- the enthalpy change of the reaction.



[2]

[Total: 10] [Topic: 11 & 10]