

WASSCE SC 2022 CHEMISTRY 1 OBJECTIVE TEST

- The by-product of fermentation of sugar is
A. carbon(IV)oxide. B. ethanoic acid.
C. propanol. D. propan-1,2,3- triol.
- Which of the following sugars is a product of the condensation of monosaccharides? A. Galactose
B. Maltose C. Glucose D. Fructose
- The cleansing effect of soap is **low** in acidic water because of
A. the formation of unionised fatty acid. B. increase in the *pH* of the soap molecules.
C. anti-biodegradable effect of hydrogen ions. D. the hardness of the acidic water.
- The following compounds are condensation polymers **except**
A. nylon. B. protein. C. starch. D. polythene.
- What amount of electricity is required to deposit **one** mole of aluminium from a solution of AlCl_3 ?
A. One Faraday B. One ampere C. Three Faradays D. Three amperes
- Which of the following compounds would react **rapidly** with bromine? A. Benzene B. Hexane
C. Hexene D. Hexanol.
- Alkanols can be manufactured from alkenes by the initial reaction of alkenes with
A. bromine in tetrachloromethane. B. concentrated tetraoxosulphate(VI) acid. C. aqueous potassium tetraoxomanganate(VII). D. sodium hydroxide solution.
- Which of the following statements about the standard hydrogen electrode is **not** correct?
A. The hydrogen gas is at a pressure of 1 atmosphere B. A solution containing 1 mol dm^{-3} of H^+ (aq) ions is used
C. A platinum electrode is used D. The temperature is kept at 20°C
- If 60g of **M** combines with 24g of oxygen, what would the empirical formula of the oxide be? [$O = 16.0$, $M = 120$]
A. MO B. MO_2 C. MO_3 D. MO_4
- The products of the electrolysis of dilute sodium chloride using carbon electrodes are

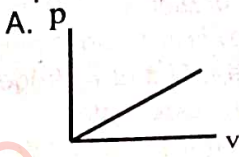
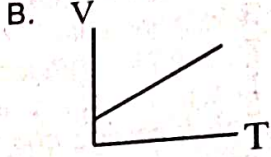
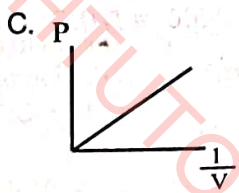
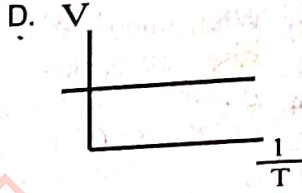
<u>Anode</u>	<u>Cathode</u>
A. chlorine	and sodium
B. oxygen	and hydrogen
C. chlorine	and hydrogen
D. hydrogen	and oxygen
- Determine the quantity of electricity used when a current of 0.20 amperes is passed through an electrolytic cell for 60 minutes. A. 12C B. 120C
C. 360C D. 720C
- Oxochlorated(I) acid is used as a bleaching agent because it is
A. a weak acid B. a reducing agent
C. an oxidising agent D. a strong acid
- The *IUPAC* name for $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{Cl})\text{CH}_2\text{CH}_3$ is
A. 2,4-dimethyl-3-chlorohexane. B. 3, 5-dimethyl -4-chlorohexane.
C. 4-chloro-3,5-dimethylhexane D. 3-chloro-2,4-dimethylhexane.
- A colourless gas with pungent smell is evolved when dilute hydrochloric acid is added to a sample of a salt. The gas evolved could turn
A. acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution colourless.
B. acidified KMnO_4 solution colourless
C. $\text{Fe}(\text{NO}_3)_2$ solution green. D. $\text{Pb}(\text{NO}_3)_2$ paper black.
- If 5.0 g of marble reacts with 25.0 cm^3 hydrochloric acid, which of the following combinations has the **fastest** reaction rate?
A. Marble chips and 2.0 mol dm^{-3} $\text{HCl}_{(\text{aq})}$
B. Marble chips and 2.5 mol dm^{-3} $\text{HCl}_{(\text{aq})}$
C. Powdered marble and 2.5 mol dm^{-3} $\text{HCl}_{(\text{aq})}$
D. Powdered marble and 2.0 mol dm^{-3} $\text{HCl}_{(\text{aq})}$
- Increasing the temperature generally
A. decrease the solubility of a solid in a liquid but increases the solubility of a gas in a liquid.
B. increases the solubility of a solid in a liquid but decreases the solubility of a gas in a liquid
C. increases the solubility of both a solid and a gas in a liquid.
D. decreases the solubility of both a solid and a gas in a liquid.
- A white precipitate was formed when $\text{BaCl}_2(\text{aq})$ was added to an aqueous solution of a salt X. The precipitate dissolved in dilute HCl with rapid effervescence. Salt X is **likely** to contain.
A. SO_4^{2-} ions. B. SO_3^{2-} ions C. NO_3^- ions. D. CO_3^{2-} ions.
- Before a reaction could take place, there should be
A. ionisation of reactant particles
B. breakage of bonds of products.
C. breakage of bonds of reactants
D. ionisation of product particles.
- Consider the following reaction equation:
 $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$
Silicon(IV) oxide is acting as
A. a basic oxide B. a reducing agent
C. an acidic oxide D. an oxidising agent
- Which of the following acids would form normal salt **only**?
A. Tetraoxosulphate(VI) acid
B. Trioxonitrate(V) acid
C. Tetraoxophosphate(V) acid
D. Trioxosulphate(IV)acid
- What is the partial pressure of oxygen at *s.t.p.* in gaseous mixture containing 100 cm^3 of oxygen and 900 cm^3 of nitrogen gas?
A. 1.0atm B. 0.1atm
C. 9.0atm D. 0.9 atm
- Graphite is used as a dry lubricant due to the presence of
A. mobile electrons B. free electrons.
C. octahedral structures. D. layered structures.
- Which of the following gases is alkaline?
A. NO_2 B. CO_2 C. NH_3 D. N_2O
- Which of the following statements about an equilibrium system is **correct**?
A. Forward and backward reactions occur at the same rate.
B. The concentrations of reactants and products can be changed by adding a catalyst.
D. The concentrations of reactants and products are not affected by a change in temperature.
- Consider the following reaction equation:
 $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}); \Delta H = -92\text{kJ}$
Increasing the temperature of the reaction would
A. shift the equilibrium to the right. B. increase

- the yield of ammonia. C. decrease the amount of hydrogen. D. decrease the yield of ammonia.
- When air in a syringe is compressed such that there is **no** change in temperature, the
 - air liquefies.
 - pressure increases
 - intermolecular space increases.
 - density decreases.
 - Which of the following statements about liquids is/are **true**?
 - Liquids maintain their volume at constant temperature
 - Liquids have fixed shape.
 - Liquids do not diffuse.
 - Change in pressure affects volume of liquids.
 - I only
 - IV only
 - I and IV only
 - II and III only
 - A hydrogen chloride gas reacted with oxygen gas to yield water and chlorine gas. The mole ratio of the hydrogen chloride gas to water is
 - 1:3
 - 2:1
 - 3:1
 - 4:1
 - What number of moles of oxygen would exert a pressure of 10 atm at 320 K in an 8.2 dm^3 cylinder? [$R = 0.082\text{ atm dm}^3\text{ mol}^{-1}\text{ K}^{-1}$]
 - 0.32
 - 1.52
 - 3.13
 - 31.25
 - If 50 cm^3 of a saturated solution of KNO_3 at 40°C contained 5.05 g of the salt, its solubility at the same temperature would be [$\text{KNO}_3 = 101$]
 - 1.0 mol dm^{-3}
 - 1.5 mol dm^{-3}
 - 2.0 mol dm^{-3}
 - 5.0 mol dm^{-3}
 - Which of the following elements would displace copper from a solution of copper ions?
 - Silver
 - Gold
 - Lead
 - Mercury
 - What is the percentage composition of carbon in $\text{Ca}(\text{HCO}_3)_2$? [$\text{Ca} = 40.0$, $\text{O} = 16.0$, $\text{C} = 12.0$, $\text{H} = 1.0$]
 - 22.2%
 - 14.8%
 - 7.4%
 - 3.7%
 - Which of the following bond types is intermolecular?
 - Covalent bond
 - Hydrogen bond
 - Ionic bond
 - Metallic bond
 - The **maximum** number of covalent bonds formed by nitrogen is
 - 1.
 - 2.
 - 3.
 - 4.
 - The **IUPAC** name of the compound $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2$ is
 - 2-methyl but-1-ene
 - 2-methyl but-2-ene
 - 3-methyl but-1-ene
 - 3-methyl but-2-ene.
 - Ionization energy increases across the period in the periodic table because
 - atomic number increases.
 - effective nuclear charge increases.
 - mass number decreases.
 - screening effect decreases.
 - Which of the following properties indicate that an element is a metal.
 - reacts with oxygen to form an acidic oxide
 - forms ionic chlorides.
 - has variable oxidation states.
 - displaces hydrogen from dilute HCl .
 - I and III only
 - I and II only
 - II and IV only
 - I, II, III and IV
 - The electron configuration of carbon atom in its excited state is
 - $1s^2, 2s^2, 2p_x^2, 2p_y^0$
 - $1s^2, 2s^2, 2p_x^1, 2p_y^1$
 - $1s^2, 2s^1, 2p_x^1, 2p_y^1, 2p_z^1$
 - $1s^1, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$
 - An oxide has the following properties.
 - is a white powder.
 - reacts with HCl .
 - reacts with NaOH .
 - is insoluble in water.

The oxide is

- alkaline
- amphoteric
- acidic
- neutral.

- Which of the following statements about atoms of a metal is **correct**?
 - readily accept electrons.
 - are soft.
 - are held together by covalent bond.
 - are held together by a sea of electron cloud.

- Which of the following sketches is a graphical representation of Boyle's law?
 - 
 - 
 - 
 - 

- The atom with the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4$ is in
 - period 4, p-block.
 - period 3, p-block.
 - period 4, d-block.
 - period 3, d-block.
- Electropositivity of elements across the periodic table normally
 - remains constant down the group.
 - increases across the period.
 - decreases across the period.
 - decreases down the group.
- Consider the following table:

Substance	Melting point/ $^\circ\text{C}$	Boiling point/ $^\circ\text{C}$
P	-78	-25
Q	-8	40
R	-6	150
S	44	280

Which of the substances is a liquid at room temperature and rapidly evaporates on exposure to air?

- P
- Q
- R
- S

- Which of the following oxides is amphoteric?
 - Carbon(II)oxide
 - Nitrogen(IV)oxide
 - Lead(II)oxide
 - Calcium oxide
- Which of the following processes occur during fractional distillation of petroleum?
 - Condensation and diffusion
 - Diffusion and evaporation
 - Diffusion and Sublimation
 - Evaporation and condensation
- If the molar mass of $\text{X}(\text{HCO}_3)_2$ is 162 g mol^{-1} , determine the relative atomic mass of X. [$\text{H} = 1.0$, $\text{C} = 12.0$, $\text{O} = 16.0$]
 - 40
 - 48
 - 61
 - 101
- Charcoal is used in the decolourisation of sugar because of its
 - absorption property
 - amorphous property
 - oxidizing property
 - adsorption property
- The **first** definition of an element was made by
 - J. Dalton
 - A. Lavoisier.
 - R. Boyle
 - J.J. Thompson
- Which of the following scientists formulated the law of conservation of mass
 - A. Lavoisier
 - J. Dalton
 - R. Boyle
 - J. Proust

ANSWERS TO WASSCE SC 2022 CHEMISTRY 1 OBJECTIVE TEST

1. A
2. B
3. A
4. D
5. $Al^{3+} + 3e^- \rightarrow Al(s)$
 $3F \rightarrow 1 \text{ mole}$
6. C
7. C
8. D
9. C
10. B
11. From

$$Q = It$$

$$I = 0.20$$

$$t = 60 \times 60 = 3600s$$

$$Q = 0.2 \times 3600 = 720^\circ C \quad \text{Ans} = D.$$

33. B
34. C
35. C
36. B
37. C
38. C
39. B
40. D
41. C
42. A
43. C
44. B
45. C
46. D
47. $x + 2 [1 + 12 + 48] = 162$
 $x = 162 - 122 = 40 \quad \text{Ans} = A$
48. D
49. C
50. A

12. C
13. D
14. B
15. C
16. B
17. B
18. C
19. C
20. D

21. Partial pressure = $\frac{\text{Volume of gas} \times P_T}{\text{Total volume}}$

$$P_T = 1 \text{ atm}$$

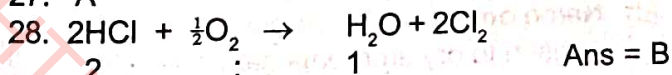
$$\text{Volume of } O_2 = 100 \text{ cm}^3$$

$$\text{Total Volume} = 100 + 900$$

$$\text{Partial pressure of } O_2 = \frac{100}{1000} \times 1$$

$$= 0.1 \text{ atm} \quad \text{Ans} = B$$

22. D
23. C
24. A
25. D
26. B
27. A



29. $n = \frac{PV}{RT} = \frac{10 \times 8.2}{0.082 \times 320} = 3.13$ Ans = C

30. Solubility = $\frac{\text{mass}}{\text{molar mass}} \times \frac{1000}{\text{Vol}(\text{cm}^3)}$
 $= \frac{5.05}{101} \times \frac{1000}{50}$
 $= 1.0 \text{ mol dm}^{-3} \quad \text{Ans} = A$

31. C

32. $Ca(HCO_3)_2$
 $= 40 + 2 [1 + 12 + 48]$
 $= 162 \text{ gmol}^{-1}$
 $\% \text{ carbon} = \frac{24}{162} \times 100 = 14.8\%$ Ans = B

SECTION A

- 1.(a)(i) Define an acid according to the *Lewis concept*.
(ii) Give **one** example of a Lewis acid.
- (b) Explain *salting out* in soap preparation.
- (c) State the reagent and condition necessary for the following conversion:
 $H-C \equiv C-H \rightarrow Ag-C \equiv C-Ag$
- (d) What is the percentage abundance of an isotope?
- (e) (i) Why does the element with atomic number 18 **not** have an oxide?
(ii) Explain why chlorine(I) oxide has a low melting point.
- (f) Describe a test to distinguish between *concentrated HNO₃* and *concentrated H₂SO₄*.
- (g) State **two** differences between an *electrochemical cell* and an *electric cell*.
- (h) How does the trend in ionisation energy affect the reactivity of group I elements?
- (i) Define the term *molecular formula*.
- (j) (i) State which of the gases H₂ and NH₃ would deviate **more** from ideal behaviour.
(ii) Give reasons for the answer stated in 1(j)(i).

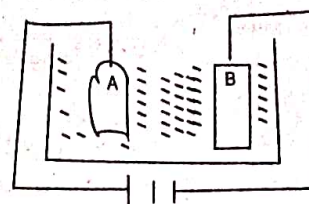
SECTION B

- 2.(a)(i) Define the *first ionisation energy of an element*.
(ii) Consider the following table and use it to answer the question that follows.

Element	Li	Be	B	C	N	O	F	Ne
Atomic No.	3	4	5	6	7	8	9	10
1 st I.E/KJmol ⁻¹	520	900	801	1086	1402	1314	1681	2081

Explain briefly why the first ionisation energy of **B** is less than that of **Be** despite the fact that the atomic number of **B** is greater than that of **Be**.

- (b) When Titanium chloride was electrolysed by passing 0.12 A current through the solution for 500 seconds, 0.015g of titanium was deposited. What is the charge on the titanium ion?
[1F = 96500C, Ti = 48.0]
- (c) (i) Aluminium can be obtained by the application of electrolysis. State that electrolyte which yields aluminium on electrolysis.
(ii) Name **two** major factors which favour the siting of an aluminium smelter in a country.
- (d) (i) Define the term *paramagnetism*.
(ii) Consider the following ions:
 $24^{Cr^{2+}}$, $24^{Cr^{6+}}$
(I) Deduce the number of unpaired electrons in **each** of the ions. (II) State which of the ions will have a **greater** power of paramagnetism. (III) Give a reason for the answer stated in 2(d)(ii)(II).
3. (a)(i) Define the term *Avogadro's number*.
(ii) If 2.30g of an oxide of nitrogen, *x* contains 3.01×10^{22} molecules, calculate the molar mass of *x*.
(iii) Deduce the formula of *x*.
[N_A = 6.02×10^{23} , N = 14.0, O = 16.0]
- (b) (i) Describe **briefly** what happens when **each** of the following substances are added to water.
(I) CCl₄ (II) SiCl₄
- (ii) Explain **briefly** why the reactions in 3(b)(I)(II) are different.
- (c) Study the diagram below and answer the questions that follow.



- (i) What is the set-up used for?
- (ii) Mention **two** compounds that could be used as electrolytes in the cell.
- (iii) Write a half-cell equation for the reaction at the anode.
- (iv) Calculate the electrochemical equivalent of copper if the cathode gained mass of 3.2g when 50 amperes of current was passed for 3 mins 13 seconds.
- 4(a)(i) State **two** conditions used in the Haber process.
(ii) Explain **briefly** the effect of increasing the pressure on the rate of reaction in the Haber process.
- (b) (i) A mixture of nitrogen (IV) oxide and oxygen is bubbled into warm water to produce trioxonitrate (V) oxide, write a balanced chemical equation for the reaction.
(ii) Using a balanced chemical equation **only**, explain what would happen if nitrogen (IV) oxide is bubbled into warm water.
(iii) Compare the gases evolved when trioxonitrate (V) acid decomposes under **each** of the following properties: (I) pH (II) Solubility in water (III) Reaction with carbon(II)oxide.
- (c) (i) Name **two** oxides of sulphur.
(ii) Write a balanced equation for the reaction between **each** of the named oxides in 4(c)(i) and water.
- (d) Name **one** calcium compound:
(i) used to dry ammonia gas;
(ii) used in the manufacture of cement;
(iii) that causes hardness in water;
(iv) referred to as plaster of Paris.
- 5.(a) Describe the observation that would be made when:
(i) sulphur is heated from room temperature till 119 °C;
(ii) 50% trioxonitrate(V) acid acts on copper tunings.
- (b)(i) State **two** gaseous pollutants that can be generated by burning coal.
(ii) What gas is responsible for **most** of the explosions in coal mines?
(iii) The mining of coal leads to environmental pollution. State **two** environmental effects of the mining activity.

- (iv) Explain briefly why coal burns more easily when it is in pieces than in lump form.
- (v) Name the non-volatile residue after the destructive distillation of coal.
- (c)(i) Describe a chemical test for water.
- (ii) State the effect of:

(I) boiling a temporary hard water, (II) adding sodium trioxocarbonate(IV) crystals to permanent hard water.

- (iii) Write an equation for the process in 5(c)(ii)(I).
- (d) With the aid of a labelled diagram, describe briefly the laboratory preparation of oxygen gas.

SECTION A

ANSWERS TO WASSCE SC 2022 CHEMISTRY 2 ESSAY

- (1)(a)(i) According to the Lewis concept, an acid is a substance which is able to attach itself to an unshared pair of electrons to form a new compound.
- (ii) AlCl_3 , Aluminium chloride (iv)
- (b) Salting is the act of adding concentrated sodium chloride to soap in order to decrease the solubility.
- (c) Ammonial solution of AgNO_3 at room temperature.
- (d) Percentage abundance of an isotope is the percentage of naturally occurring atoms with specific atomic mass of element.
- (e)(i) Element with atomic number 18 has all its valence shells filled and therefore is inert. Inert elements do not have oxides. (ii) Since Cl_2 is a covalent compound, the molecular forces between Cl_2 are weak.
- (f) - (conc) HNO_3 produces brown fumes (of NO_2) when copper tunings are added to it/copper (II) salt is added but H_2SO_4 will not react with the copper tuning/copper(II)salt; no precipitate is formed.
- When conc. H_2SO_4 is added to sugar, it chars the sugar but Conc. HNO_3 will not.
- Add BaCl_2 solution to each acid, while precipitate indicates H_2SO_4 , no precipitate indicate HNO_3 .

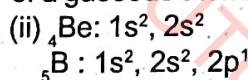
(g) Electrochemical cell	Electrolytic cell
- The anode is negative	- The anode is positive
- Cathode is positive	- Cathode is Negative
- Chemical energy is converted to electrical energy	- Electrical energy is converted to Chemical energy
- The two half cells are in separate containers and connected by a salt bridge	- The two half cells are in the same container.
- It is a spontaneous reaction.	Not spontaneous
- Current is generated from within the cell	- Current is generated from external source/battery

- (h) Group 1 elements react by forming positive ions; the higher the ionisation energy, the more difficult it is to lose the electron, hence the lower the reactivity of the elements. OR Ionisation energy decreases down group 1 elements; the lower the ionisation energy, the easier to lose an electron, hence the higher the reactivity of the elements. OR the ionisation energy increases across the period and decreases down the period which makes sodium more reactive.
- (i) Molecular formula shows the actual number of atoms of each element in a molecule. OR Molecular formula is a chemical formula that shows all the atoms present in a chemical compound.
- (j) (i) NH_3 will deviate more.
- (ii) Because it has a large volume and also it has a stronger intermolecular hydrogen bond forces. OR Due to its strong intermolecular hydrogen

bond strong forces of attraction between H_2 and NH_3 .

SECTION B

- 2(a)(i) First ionisation energy is the energy required to remove one electron from a mole of a gaseous atom. OR It is the minimum energy required to convert one mole of a gaseous plus 1 ions. OR It is the amount of energy needed to extract the first loose bonding electron in the outermost shell of a gaseous atom.



The electron to be removed from Be is in the 2s orbital which is closer to the nucleus, nuclear attraction is greater. Hence, first ionisation energy is greater but the electron to be removed from B is in the 2p orbital which is farther away from the nucleus. Hence, nuclear attraction is weaker; hence, first ionisation energy is smaller. OR 2p has less energy than 2s. So, it is easier to remove an electron from 2p as nuclear charge is weaker in 2p because 2p is further away from the nucleus. Hence, first ionisation energy is small. OR The outermost shell in Be is filled up unlike B which has only one electron and this makes it easier for one electron to be taken out (donated). Hence, the ionisation energy of Be is higher than that of B.

(b) $M = \frac{m \cdot m \cdot l}{CF}$

$M = 0.015\text{g}, t = 500, I = 0.12\text{A}$

Molar mass (m.m) $\text{Ti} = 48$

make C the subject of the formula

$$C = \frac{m \cdot m \cdot l}{F \cdot M} = \frac{48 \times 0.12 \times 500}{96500 \times 0.015}$$

$$= \frac{2880}{1447.5} \approx 1.99 \text{ approximately} = 2$$

\therefore charge on Ti ion is +2.

- (c) (i) Alumina (Al_2O_3) mixed with molten cryolite (Na_3AlF_6)
- (ii) - Abundant deposit of bauxite, - Cheap source of electricity - Nearness to source of material
- (d)(i) Paramagnetism is a form of magnetism whereby some materials are weakly attracted by an externally applied magnetic field, and form internal, induced magnetic fields in the direction of the applied magnetic field. OR It is a property of metal which makes it weakly attracted to an applied magnetic field.
- (ii) i. $24\text{Cr}^{2+} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$
unpaired electrons = 4
- ii. $24\text{Cr}^{6+} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6$
unpaired electrons = 0

II. 24Cr^{2+}

II. The greater the number of unpaired electrons in the 3d-orbital, the greater the paramagnetism.

3.(a)(i) Avogadro's number is the number of particles (atoms, molecules, ions, etc.) present in one mole of a substance. **OR** It is the number of particles in 12.0g of carbon-12. **OR** It is the number of atoms in one mole of a substance.

$$(ii) \frac{\text{Mass}}{\text{molar mass}} = \frac{N_n}{N_a}$$

$$\frac{2.30}{x} = \frac{3.0 \times 10^{22}}{6.02 \times 10^{23}}$$

$$\therefore x = \frac{2.30 \times 6.02 \times 10^{23}}{3.01 \times 10^{22}} = \frac{2.30 \times 60.2}{3.01}$$

$$= 46 \text{ g/mol}$$

$$(iii) (\text{NO}_2)_n = 46 \text{ g/mol}$$

$$(14 + 16 \times 2)n = 46 \text{ g/mol}$$

$$(14 + 32)n = 46 \text{ g/mol}$$

$$\frac{46n}{46} = \frac{46}{46} \text{ g/mol}$$

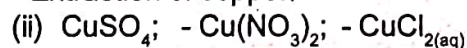
$$= (\text{NO}_2)_1 = \text{NO}_2$$

(b)(i) (I) Two layers are formed/ There is no reaction/ Immiscible.

(II) There is a reaction/hydrolysis with steamy fumes/white fumes.

(ii) The reaction occurs by interaction of the lone pair of electrons of water binding to the central atom (silicon or carbon)/attaching to the central atom. In silicon, the 3d-orbital is available to accept the pairs of electrons, but in carbon, there is no vacant orbitals for bonding. **OR** Water is polar, hence the reaction with SiCl_4 . But CCl_4 is non-polar; hence, there is no reaction. **OR** CCl_4 is an organic substance while SiCl_4 is an inorganic substance.

(c)(i) - Purification of metals/copper; - Electroplating
- Extraction of copper.



(iv) Following Faraday's first law of electrolysis

$$M \propto It$$

$$M = ZIt \Rightarrow Z = \frac{M}{It}$$

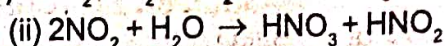
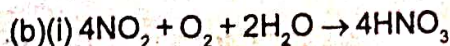
$$t = (3 \times 60) + (13) = 180 + 13 = 193$$

$$Z = \frac{3.2}{50 \times 193} = \frac{3.2}{9650}$$

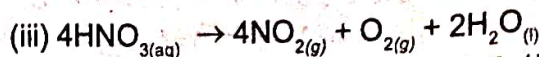
$$= 3.32 \times 10^{-4} = 0.000332$$

4.(a)(i) - Temperature: 350 - 500°C/high temperature
- Pressure: 150 - 1000 atm/high pressure
- Catalyst: finely divided iron

(ii) If the pressure is increased, the equilibrium position moves to the right so the yield of ammonia increases. The rate of reaction also increases because the gas molecules are close together, so successful collisions are more frequent.



A mixture of two acids will be produced

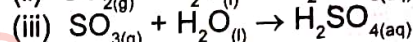
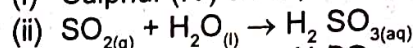


- Oxygen is **neutral** while NO_2 is **acidic**/ The pH of O_2 is 7 while the pH of NO_2 is **less than 7**.

- NO_2 is **soluble** while O_2 is **sparingly soluble** in water.

- O_2 reacts with CO to form CO_2 while NO_2 reacts with CO to form a **mixture of N_2 and CO_2** .

(c) (i) - Sulphur (IV) oxide, - Sulphur (VI) oxide,



(d) **Calcium compounds:**

(i) **Used to dry ammonia gas** - Calcium oxide;
- Quick lime

(ii) **Used in the manufacture of cement**

- Calcium trioxocarbonate (IV); - Limestone;

- Calcium oxide; - Quick lime

(iii) **That cause hardness in water** - Calcium tetraoxosulphate (VI); - Calcium hydrogen trioxocarbonate (IV); - Calcium chloride

(iv) **Referred to as plaster of Paris** - Calcium tetraoxosulphate (VI) dihydrate

5(a)(i) Its colour darkens from pale yellow to amber colour while its crystals become needle-like and at 119°C, it begins to melt.

(ii) The solution turns green, bubbles of colourless gas rise from the bottom of the mixture, but brown fumes of NO_2 are produced and the solution later turns blue.

(b)(i) - SO_2 ; - NO_2 ; - CO(carbon (II) oxide); - CO_2 ; - H_2S

(ii) Methane (CH_4)

(iii) (a) It leads to pollution.

(b) It causes erosion.

(iv) It has more surface area than it occupies, leading to a faster rate of reaction of the coal.

(v) Ammonial liquor

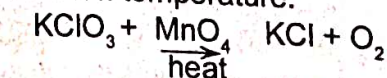
(c)(i) When water is added to white Anhydrous CuSO_4 , it turns blue.

(ii) (I) Calcium and magnesium found in the hardwater is removed and forms a white precipitate.

(II)



(d) Oxygen can be prepared by heating KClO_3 in the presence of manganese(IV) oxide which acts as a catalyst to produce KCl gas and oxygen gas. The reaction takes place at a much faster rate due to low temperature.



WASSCE SC 2022 CHEMISTRY 3 PRACTICAL ALTERNATIVE A

- A is an aqueous solution of iodine. B is $0.100 \text{ mol dm}^{-3}$ sodium trioxosulphate (II).
 - Put B into the burette. Pipette 20.0 cm^3 or 25.0 cm^3 of A into a conical flask. Add B from the burette until the reddish-brown colour fades to pale yellow, then add B slowly from the burette until one drop of B causes the blue colour to disappear, leaving a colourless solution. Repeat the titration to obtain concordant titre values. Tabulate your results and calculate the average volume of B used. The equation for the reaction is:

$$2\text{Na}_2\text{S}_2\text{O}_3(\text{aq}) + \text{I}_2(\text{aq}) \rightarrow \text{Na}_2\text{S}_4\text{O}_6(\text{aq}) + 2\text{NaI}(\text{aq})$$
 - From your results and the information provided, calculate the: (i) concentration in mol dm^{-3} of iodine in A; (ii) mass in grammes of iodine in 1.00 dm^3 of A. [$I = 127.0$]
- C contains **two** cations and **one** anion.
 - Dissolve all of C in about 10 cm^3 of distilled water. Carry out the following exercises on portions of the resulting solution:
 - To about 2 cm^3 of the solution, add $\text{NaOH}(\text{aq})$ in drops then in excess. Warm gently the resulting mixture.
 - To about 2 cm^3 of the solution, add $\text{BaCl}_2(\text{aq})$ followed by excess dilute HCl.
 - From your results, identify the cations and anion in the sample.
- Describe **one** chemical test to distinguish between *carbon (IV) oxide* and *sulphur (IV) oxide*.
 - State the laboratory method of collection of **each** of the following gases: (I) H_2 ; (II) NH_3 ; (III) HCl.
 - Give a reason for **each** of the answers stated in 3(b)(i).
 - State the method used in separating **each** of the following mixtures: (i) **two** miscible liquids; (ii) soluble salt and insoluble salt.
 - Explain **briefly** why a solution of KCl does not give off a gas when mixed with NaHCO_3 solution, but a solution of AlCl_3 does.

ANSWERS TO WASSCE SC 2022 CHEMISTRY 3 PRACTICAL ALTERNATIVE A

- 1.(a) Volume of pipette used, $V_A = 25.0 \text{ cm}^3$

Burette Reading	Rough titre	1st titre	2nd titre
Final burette reading (cm^3)	25.60	32.80	26.40
Initial burette reading (cm^3)	1.20	8.70	2.30
Volume of $\text{Na}_2\text{S}_2\text{O}_3$ used	24.40	24.10	24.10

$$\text{Average burette reading} = \frac{24.10 + 24.10}{2}$$

$$\text{Average volume of } \text{Na}_2\text{S}_2\text{O}_3 \text{ used} = 24.10 \text{ cm}^3 \text{ i.e. } V_B = 24.10 \text{ cm}^3$$

- (b)(i) Given $C_B = 0.1 \text{ mol dm}^{-3}$; $V_B = 24.10 \text{ cm}^3$; $V_A = 25.0 \text{ cm}^3$; $C_A = ?$

$$\text{From equation: } n_A = \frac{n_B}{2}$$

$$\therefore \text{Using } \frac{C_A V_A}{C_B V_B} = \frac{n_A}{n_B} = \frac{C_A \times 25}{0.1 \times 24.10} = \frac{1}{2}$$

$$C_A = \frac{0.1 \times 24.10}{25 \times 2}$$

$$= 0.042 \text{ mol dm}^{-3}$$

$$\therefore \text{Concentration of iodine in A} = 0.042 \text{ mol dm}^{-3}$$

- (ii) mass in grammes of iodine in dm^3 of A = molarity x molar of iodine
 $= 0.042 \times 127(2)$
 $= 12.2428 \text{ g/dm}^3$

- 2(a)

Test	Observation	Inference
C + 10 cm^3 of distilled water	Salt dissolves	C is soluble
2 cm^3 of C solution + $\text{NaOH}(\text{aq})$ in drops then in excess	Dirty green gelatinous precipitate insoluble in excess	Fe^{2+} confirmed
Solution from a(i) + heat	Gas with choking smell evolves	NH_4^+ confirmed
2 cm^3 of Solution from (a) + $\text{BaCl}_2(\text{aq})$ + excess dilute HCl	A white precipitate is observed which is insoluble in dilute HCl	SO_4^{2-} confirmed

- (b) Cation are $\rightarrow \text{NH}_4^+$ and Fe^{2+}
 Anion is $\rightarrow \text{SO}_4^{2-}$

3(a) Bubble the unknown gas through lime water. If the gas is carbon(IV)oxide, the lime water turns milky. The other is definitely SO_2 .

(b) (i) H_2 : Collected over water in a gas jar by downward displacement at water.

NH_3 : Collected through quicklime by upward delivery or downward displacement at air.

HCl : Collected by downward delivery or upward displacement at air.

(ii) - H_2 is lighter than water or air.

- NH_3 is lighter than air.

- HCl is heavier than air.

(c) (i) **The method used in separating two miscible liquids:** Distillation

(ii) **The method used in separating soluble salt and insoluble salt:** Filtration

(d) KCl is a salt formed from a strong acid and strong base; it usually remains neutral in solution, as compared to AlCl_3 which is salt from weak acid and strong base, that is alkaline in a solution, thus reacting with the acid salt NaHCO_3 .