Chemistry

Past Paper Questions and Answers by Topic

Multiple Choice Questions
Matching Items

Form I

1. Introduction to Chemistry
2. Laboratory Techniques and Safety
3. Heat Sources and Flames
4. The Scientific Procedure
5. Formula, Elements, Mixtures and Compounds
6. Air, Combustion, Rusting and Fire Fighting

Form II

7. Oxygen
8. Hydrogen
9. Water
10. Fuels and Energy
11. Atomic Structure
12. Periodic Classification
13. Formula Bonding and Nomenclature

Form III

14. Chemical Equations
15. Hardness of Water
16. Acids, bases and salts
17. The Mole Concept and Related Calculations
18. Volumetric Analysis
19. Ionic Theory and Electrolysis
20. Chemical Kinetics, Equilibrium and Energetics
21. Extraction of Metals
22. Compounds of Metals

Form IV

23. Non Metals and Their Compounds
24. Organic Chemistry
25. Soil Chemistry
26. Pollution
27. Qualitative Analysis

Chemistry	2011	2012	2013	2014	2015	2016	2017	2018
Exam Marks per Topic								
Multiple choice questions	10	10	10	10	10	10	10	
Matching items	10	10	10	10	10	10	10	
1. Introduction to Chemistry								
2. Laboratory Techniques and Safety				3				
3. Heat Sources and Flames								
4. The Scientific Procedure								
5. Matter, Elements, Mixtures and Compounds			6	6	3		3	
6. Air, Combustion, Rusting and Fire Fighting					3			
7. Oxygen					3			
8. Hydrogen					3			
9. Water						3	3	
10. Fuels and Energy		6			3	3		
11. Atomic Structure	12	6	6		6		3	
12. Periodic Classification	6	6	3	3	3			
13. Formula Bonding and Nomenclature	6	6	6	3	3	3		
14. Chemical Equations				3		16	9	
15. Hardness of Water			3	3	3	3	3	
16. Acids, bases and salts		3		3	6	6	13	
17. The Mole Concept and Related Calculations		3	3	6		13		
18. Volumetric Analysis	6		3	3	3		16	
19. Ionic Theory and Electrolysis	6	6	3	16	3	3	6	
20. Chemical Kinetics, Equilibrium and Energetics	13	6	3	3	3	3	3	
21. Extraction of Metals	3	16	6	3	16	3	6	
22. Compounds of Metals		6		6	6	12	3	
23. Non Metals and Their Compounds	3	3	13	6	3	6	6	
24. Organic Chemistry	6	13	9	3	6	6	6	
25. Soil Chemistry	3		6	16	13	3	3	
26. Pollution	13	6			26	16	3	
27. Qualitative Analysis								

Multiple Choice Questions
1 mark per question

2020

1. For each of the items (i) - (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) Which of the following pairs constitute the best methods for treating and purifying water?
A Chlorination and aeration
B Chlorination and decantation
C Chlorination and filtration
D Chlorination and sedimentation
E Chlorination and distillation

(ii) A good fuel is the one which has
A high speed of continuous energy supply.
B high energy value supplied
C low carbon dioxide supplied
D high carbon dioxide production.
E high content of non-combustible material.

(iii) A rapid chemical reaction that releases energy in form of light and heat is called
A combustion.
B decomposition.
C displacement.
D neutralization.
E precipitation.

(iv) Which one is the molecular formula for prop-1-yne?
A C_3H_6
B CH_3CCH
C C_3H_4
D HCH_2CCH
E CH_3CHCH_2

(v) Which of the following is **not** a component of the First Aid Kit?
A Goggles
B A pair of scissors
C Dropper
D Gloves
E Razor blade

(vi) Which of the following is the correct sequence of the last two steps you should follow during the scientific procedure?
A Hypothesis formulation and conclusion
B Observation and problem identification
C Experimentation and conclusion
D Problem identification and hypothesis formulation
E Interpretation of data and conclusion.

(vii) Consider the following reagents:

1. H_2O_2
2. H_2O
3. MnO_4
4. MnO_2

Which reagents are involved in the preparation of oxygen gas in the laboratory?

A 1 and 2
B 3 and 4
C 1 and 3
D 2 and 3
E 1 and 4

(viii) Why oxygen differs from other gases?

A It neither burns nor support combustion.
B It supports combustion but does not burn.
C It burns but does not support combustion.
D It burns and supports combustion.
E It explodes and support combustion.

(ix) What is the best way of preparing hydrogen gas in the laboratory?

A By reacting strong metals and dilute acids.
B By reacting metals and acids.
C By reacting moderate metals and concentrated acids.
D By reacting moderate metals and dilute acids.
E By reacting strong metals and strong acids.

(x) What volume of hydrogen gas will be produced when 1.3 g of zinc granules react completely with excess dilute sulphuric acid at s.t.p?

A 130 cm^3
B 224 cm^3
C 440 cm^3
D 220 cm^3
E 448 cm^3

2019

1. For each of the items (i) - (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) "Water is referred to as the universal solvent". What does this mean?

A Water is neither acidic nor basic as compared to other liquids.
B Water exists in three states of matter than any other liquid
C Water dissolves both organic and inorganic solutes.
D Water is used more domestically than any other liquids
E Water dissolves more substances than any other known liquids.

(ii) When methane undergoes substitutional reaction with excess chlorine, what is the final product?

A Chloromethane
B Dichloromethane
C Trichloromethane
D Tetrachloromethane
E Monochloromethane

(iii) Why is hydrogen gas collected over water and by upward delivery method?

A It is insoluble in water and less dense than air.
B It is soluble in water and denser than air.
C It is insoluble in water and denser than air.
D It is soluble in water and less dense than air.
E It is soluble in both water and air.

(iv) Consider the following fuels which are used for different purposes:

1. Coal
2. Fire wood
3. Petrol
4. Charcoal.

Which fuels originate from fossils?

A 1 and 3
B 1 and 4
C 2 and 4
D 2 and 3
E 1 and 2

(v) The following are the uses of chromatography **except**

A to analyse blood in crime scenes.
B to detect different fibres.
C to detect water pollution.
D to bleach dye/colour.
E to test the purity of organic substances.

(vi) What is the proper set of apparati that you would use to grind granules of a solid substance into fine powder in the laboratory?

A Pestle and filter funnel
B Separating funnel and mortar
C Pestle and filter paper
D Pestle and mortar
E Thistle funnel and mortar

(vii) Oxygen gas can be produced at a large scale by

A condensation of air.
B condensation of liquefied air.
C liquefaction of steam.
D Fractional distillation of liquefied air.
E evaporation of liquefied air.

(viii) Which of the following sets of processes uses a gas that ignites with a "pop sound when a lighted splint is passed through it?

A Balloon filling, welding and diving
B Hardening oil, balloon filling and welding
C Hardening oil, balloon filling and diving
D Fueling rocket, diving and welding
E Balloon filling fueling rocket and diving

(ix) Which statement is the most correct about a chemistry laboratory?

A Is a special room designed for conducting chemical tests.
B Is a special room designed for science practicals.
C Is a special room designed for keeping apparatuses.
D Is a special room where data analysis is carried out.
E Is a special room where students learn chemistry.

(x) Which role does organic matter play in the soil?

A Improving water infiltration of the soil
B Accelerating break down of organic matter.
C Reserving nutrients thus providing soil fertility
D Converting nitrogen into nitrates.
E Providing a room for organic material such as nylons.

2018

1. For each of the items (i) - (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) Which of the following is an agricultural chemical product made by the application of chemistry?
A Drugs B Pesticides C Clothes
D Yeasts E Cement.

(ii) A current of 0.2 A was passed through an electrolyte for 16 minutes and 40 seconds. What is the quantity of electricity produced in coulombs?
A 2000 C B 1000 C C 200 C
D 0.20 C E 7686 C.

(iii) Substance X liberates chlorine gas from acidified potassium chloride. The behaviour of X is described as
A an oxidising agent B an oxidising and reducing agent
C catalyst D a reducing agent
E bleaching agent.

(iv) Which carbonate is the most stable to heat?
A Calcium carbonate B Copper (II) carbonate
C Lead (II) carbonate D Zinc carbonate
E Iron (II) carbonate.

(v) Aluminium does not react with water and does not corrode much in air because
A it is below hydrogen in the reactivity series
B it forms a stable carbonate which prevents reactions
C the metal is covered with a protective coating of an oxide
D aluminium ions have positive charges
E it is very stable.

(vi) Which of the following compounds does NOT belong to the alkenes homologous series?
A C_2H_4 B C_3H_6 C C_4H_8
D C_5H_{10} E C_6H_{14}.

(vii) In the following equilibrium equation, $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ the forward reaction is exothermic. Which change would increase the production of sulphur trioxide at equilibrium?
A Increasing temperature.
B Decreasing temperature.
C Decreasing sulphur trioxide concentration
D Decreasing pressure
E Adding a catalyst.

(viii) When a burning fuel produces blue colour it means there is
A adequate supply of oxygen with production of soot.
B inadequate supply of oxygen without production of soot.
C inadequate supply of oxygen with production of soot.
D adequate supply of oxygen with production of less heat.
E adequate supply of oxygen with production of more heat.

(ix) Which equation represents the combustion of methane with the products collected at 120°C?
A $CH_{4(l)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$
B $CH_{4(g)} + 2O_{2(l)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$
C $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$
D $CH_{4(l)} + 2O_{2(l)} \rightarrow CO_{2(l)} + 2H_2O_{(g)}$
E $CH_{4(l)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$.

(x) Which substance can be reduced when heated with carbon?
A Aluminium B Calcium carbonate
C Iron (III) oxide D Magnesium oxide
E Sodium oxide.

2017

1. For each of the items (i) - (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) Which of the following sets of elements is arranged in order of increasing electronegativity?
A Chlorine, fluorine, nitrogen, oxygen, carbon
B Fluorine, chlorine, oxygen, nitrogen, carbon
C Carbon, nitrogen, oxygen, chlorine, fluorine
D Nitrogen, oxygen, carbon, fluorine, chlorine
E Fluorine, nitrogen, oxygen, chlorine, carbon.

(ii) Which type of a fire is associated with electrical equipment.
A Class E B Class C C Class F
D Class B E Class A.

(iii) Which of the following is the electronic configuration of an element Y found in period 3 and group II of the periodic table?
A 2:8 B 2:8:2 C 2:6
D 2:8:8:2 E 2:8:4

(iv) Technicians prefer to use blue flame in welding because
A it is bright and non-sooty
B it is light and non-sooty.
C it is very hot and large.
D it is very hot and non-sooty.
E it is not expensive.

(v) WHich method could be used to separate the products in the following equation?
$Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(S)} + 2KNO_{3(aq)}$.
colourless colourless yellow colourless
A Chromatography B Crystallisation C Distillation
D Filtration E Condensation.

(vi) The metal nitrate which will NOT give a metal oxide on heating is
A calcium nitrate B silver nitrate C lead nitrate
D copper nitrate E zinc nitrate.

(vii) Which of the following compounds does NOT belong to the alkane homologous series?
A C_2H_4 B CH_4 C C_4H_{10}
D C_3H_8 E C_5H_{12}.

(viii) Which of the following is NOT among the composition of air?
A Noble gases B Carbon dioxide C Nitrogen
D Hydrogen E Water vapour.

(ix) Chlorine ion, Cl^- differs from chlorine atom because it has

A more protons. B less protons. C more electrons.
D less electrons. E more neutrons.

(x) Which of the following pairs of compounds can be used in the preparation of calcium sulphate?

A Calcium carbonate and sodium sulphate
B Calcium chloride and ammonium sulphate
C Calcium hydroxide and barium sulphate
D Calcium nitrate and lead (II) sulphate
E Calcium chloride and barium sulphate.

2016

1. For each of the items (i) – (x), choose the correct answer from the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) Which of the following is True about the following equilibrium? $H_2O_{(l)} \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$

A Water molecules have stopped changing into ions.
B Water molecules have all changed into ions.
C Concentrations of water molecules and ions are equal.
D Concentrations of water molecules and ions are constant.
E Water molecules are moving slow.

(ii) The property of metal to be drawn into wires is called

A conductivity B malleability C ductility
D decorating E expansion.

(iii) If a stead current of 2 amperes was passed through an aqueous solution of iron (II) sulphate for 15 minutes, the mass of iron deposited at the cathode will be

A 30 g. B 56 g. C 0.54 g.
D 28 g. E 0.52 g.

(iv) What will happen when zinc is placed in aqueous copper (II) sulphate?

A Copper atoms are oxidised B Zinc atoms are oxidised
C Copper ions are oxidised D Zinc ions are oxidised
E Sulphur atoms are oxidised.

(v) Which of the following pair of gas can be prepared in the laboratory and collected over water?

A Oxygen and Ammonia B Hydrogen and Hydrochloric acid
C Hydrogen and Oxygen D Oxygen and Hydrogen chloride
E Hydrogen and Ammonia.

(vi) Two substances are allotropes of carbon if

A both reduce heated iron (III) oxide to iron
B have different crystalline structure
C have equal masses
D have equal shape
E have the same arrangement of atoms.

(vii) The apparatus suitable for measuring specific volumes of liquids is called

A Burette B Volumetric flask C Pipette
D Measuring cylinder E Graduated beaker.

(viii) Which among the following the reaction, $Cu^{2+}_{(aq)} + Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$ represents?

A Synthesis. B Precipitation. C Neutralization.
D Displacement. E Decomposition.

(ix) The occurrence of two or more compounds with the same molecular formula but different molecular structures is known as

A Amphoterism B Isomerism C Allotropy
D Polymorphism E Isotopy.

(x) Which of the following sets of symbols represent isotopes of a single element?

A $^{16}_{8}X$, $^{17}_{8}X$, $^{18}_{8}X$ B $^{16}_{9}Z$, $^{17}_{8}Z$, $^{16}_{9}Z$
C $^{16}_{7}P$, $^{16}_{8}P$, $^{18}_{9}P$ D $^{16}_{7}K$, $^{17}_{8}K$, $^{18}_{9}K$
E $^{16}_{7}U$, $^{16}_{8}U$, $^{18}_{10}U$.

2015

1. For each of the items (i) - (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided.

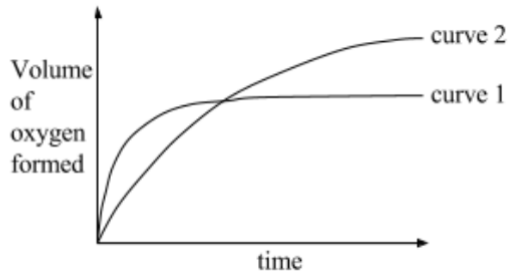
(i) The mass number of a carbon atom that contains six protons, eight neutrons, and six electrons is

A 6 B 14 C 8
D 12 E 20.

(ii) How many moles of oxygen are required for the complete combustion of 2.2 g of C_3H_8 to form carbon dioxide and water?

A 0.050 moles B 0.15 moles C 0.25 moles
D 0.50 moles E 0.025 moles.

(iii) In the graph below, curve 1 was obtained from the decomposition of 100 cm^3 of 1.0M hydrogen peroxide solution catalysed by manganese (IV) oxide, $2H_2O_2 \rightarrow 2H_2O+O_2$.



Which alteration/change to the original experimental conditions would produce curve 2?

A Lowering the temperature
B Using less manganese IV oxide
C Increasing the temperature
D Adding some 0.1 M H_2O_2
E Using a different catalyst.

(iv) How long must a current of 4.00 A be applied to a solution of $Cu^{2+}_{(aq)}$ to produce 2.0 grams of copper metal?

A 2.4×10^4s B 1.5×10^3s C 7.6×10^2s
D 3.8×10^2s E 12×10^4s.

(v) Which of the following hydrocarbons does NOT belong to the same homologous series as the others?

A CH_4 B C_3H_8 C C_4H_{10}
D C_6H_{12} E C_2H_{12}.

(vi) A solution of pH 1.6 is best described as

A weak acid B strong base C weak base
D strong acid E neutral solution.

(vii) Which among the following equations correctly shows the reaction between chlorine gas and water?

A $Cl_{2(g)} + H_2O_{(l)} \rightarrow Cl_{2(g)}$
B $2Cl_{2(g)} + 2H_2O_{(l)} \rightarrow 4Cl^-_{(aq)} + O_{2(g)} + 2H_{2(g)}$
C $Cl_{2(g)} + H_2O_{(l)} \rightarrow HCl_{(aq)} + HOCL_{(aq)}$
D $2Cl_{2(g)} + 2H_2O_{(l)} \rightarrow 2HOCl_{2(aq)} + H_{2(aq)}$
E $2Cl_{2(g)} + 3H_2O_{(l)} \rightarrow Cl_{2(g)} + 2H_3O^+$.

(viii) Hygroscopic and deliquescent substances can be used as

A oxidising agents B drying agents C reducing agents
D weak electrolytes E catalyst.

(ix) Which among the following pair of substances are allotropes?

A H_2O and H_2O_2 B ^{12}C and ^{14}C C P_4 and P_8
D H_2 and $2H^+$ E H^+ and H_3O.

(x) Water can be obtained from a solution of common salt by

A evaporation B simple distillation C filtration
D condensation E fractional distillation.

2014

1. For each of the items (i) – (x), choose the correct answer from the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) An element in the periodic table with atomic number 18 belongs to which of the following?

A Group I and period I.
B Group O and period III.
C Group III and period III.
D Group V and period IV.
E Group VII and period IV.

(ii) The ionic equation when aqueous ammonium chloride reacts with sodium hydroxide solution is represented as:

A $2NH^{+}_{4(aq)} + 2Cl^{-}_{(aq)} \rightarrow 2NH_{3(g)} + Cl_{2(g)} + H_{2(g)}$
B $NH^{+}_{4(aq)} + OH^{-}_{(aq)} \rightarrow NH_{3(g)} + H_2O_{(l)}$
C $Na^{+}_{(aq)} + Cl^{-}_{(aq)} \rightarrow NaCl_{(g)}$
D $H^{+}_{(aq)} + OH^{-}_{(aq)} \rightarrow H_2O_{(l)}$
E $2NH^{+}_{4(aq)} + 2Cl^{-}_{(aq)} \rightarrow 2NH_{3(g)} + 2HCl_{(g)}$.

(iii) The reason why white anhydrous copper (II) sulphate turns blue when exposed in atmosphere is that it,

A reacts with carbon dioxide.
B reacts with oxygen.
C becomes dry.
D absorbs water vapour.
E decomposes.

(iv) Chemical change means;

A the change is reversible.
B can easily be separated.
C the change is complete.
D new substance is produced.
E produces no change of mass.

(v) If a stead current of 2 amperes was passed through an aqueous solution of iron (II) sulphate for 15 minutes, then the mass of iron deposited at the cathode will be:

A 54 g. B 56 g. C 0.54 g.
D 28 g. E 0.52 g.

(vi) 10 cm^3 of 0.4 M sodium hydroxide are added to 40 cm^3 of 0.2 M hydrochloric acid. The resulting mixture will be

A Neutral B Alkaline C Dilute D Acidic E Amphoteric

(vii) The only metal which does not react with dilute hydrochloric acid is

A Magnesium B Aluminum C Copper
D Zinc E Sodium.

(viii) Which of the following solutions is the most concentrated?

A 50 g of calcium carbonate in 100 cm^3 of water
B 60 g of sodium chloride in 200 cm^3 of water
C 65 g of potassium nitrate in 100 cm^3 of water
D 120 g of potassium sulphate in 200 cm^3 of water
E 50 g of sodium hydroxide in 200 cm^3 of water.

(ix) Alcohols react with carboxylic acids to form a group of organic compounds called

A alkynes B aldehydes C ethers
D esters E alkanols.

(x) Which of the following statement is true about water gas?

A It is poisonous.
B Contains hydrogen.
C Is the same as biogas.
D Contains hydrogen and nitrogen.
E Contains carbon monoxide and hydrogen.

2013

1. For each of the items (i) – (x), choose the correct answer from the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) Which action should be taken immediately after concentrated sulphuric acid spilled on the skin?

A Its should be rinsed off with large quantities of running water.
B It should be neutralized with solid $CaCO_3$
C It should be neutralized with concentrated NaOH.
D The affected area should be wrapped tightly and shown to a medical health provider.
E It should be neutralized with concentrated KOH.

(ii) In the titration of a monoprotic acid with a solution of sodium hydroxide of known concentration, what quantities will be equal at the equivalence point?

A concentration of hydroxide solution and hydronium ions.
B number of moles of hydroxide ions added and number of moles of hydronium ion initially present.
C number of moles of hydroxide solution added and volume of acid solution initially present.
D number of moles of hydroxide ion added and the number of moles of monoprotic acid initially present.
E volume of sodium hydroxide solution added and volume of acid solution initially present.

(iii) The charge of one mole of electrons is represented by the term

A one ampere B one coulomb C one volt
D one faraday E one gram.

(iv) 65.25 g sample of $CuSO_4.5H_2O$ (M = 249.7) was dissolved in water to make 0.800 L of solution. What volume of this solution must be diluted with water to make 1.00 L of 0.100 M $CuSO_4$?

A 3.27 ml B 383 ml C 209 ml
D 65.25 ml E 306 ml.

(v) Consider the system at equilibrium: $H_2O_{(l)} \leftrightharpoons H_2O_{(g)}$ for which $\Delta H > 0$. Which change(s) will increase the yield of $H_2O_{(g)}$.

A Increase in temperature
B Increase in the volume of the container
C Increase in temperature and volume of the container
D Increasing surface area of oxygen
E Increasing surface area of reactants.

(vi) As water is added to an acid, the acid becomes

A more acidic and its pH goes down B more acidic and its pH goes up
C less acidic and its pH goes up D less acidic and its pH goes down
E neutral and its pH becomes 7.

(vii) Three elements, X, Y and Z, are in the same period of the periodic table. The oxide of X is amphoteric, the oxide of Y is basic and the oxide of Z is acidic. Which of the following shows the elements arranged in order of increasing atomic number?

A X, Y, Z B Y, Z, Y C Z, X, Y
D Y, X, Z E X, Z, Y.

(viii) Which of the following compounds contains only two elements?

A Magnesium hydroxide B Magnesium nitride
C Magnesium phosphate D Magnesium sulphite
E Magnesium sulphate.

(ix) An atom has 26 protons, 26 electrons and 30 neutrons. The atom has

A atomic number 26, mass number 52 B atomic number 56, mass number 30
C atomic number 30, mass number 82 D atomic number 52, mass number 56
E atomic number 26, mass number 56.

(x) The following equation is a propagation step in the chlorination of methane:

A $Cl_2 \rightarrow Cl^{\bullet} + Cl^{\bullet}$ B $CH^{\bullet}_3 + Cl^{\bullet} \rightarrow CH_3Cl$
C $CH^{\bullet}_3 + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$ D $CH_4 + Cl^{\bullet} \rightarrow CH_3Cl + H^{\bullet}$
E $CH^{\bullet}_3 + Cl_2 \rightarrow Ch_2Cl + Cl^{\bullet}$.

2012

1. For each of the items (i) – (x), choose the correct answer from the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) Which one of the following sets of laboratory apparatus are used for measure volume?
- A Crucible, U-tube and volumetric flask
- B Test tubes, beakers and glass jar
- C Thistle funnel, separating funnel and beaker
- D Burette, pipette and measuring cylinder
- E Conical flask, test tube and measuring cylinder.

(ii) The empirical formula of certain compound in CH_3. Its molar mass is 30 g. What will be its molecular formular?

A CH_4 B C_2H_4 C C_2H_6
D C_2H_8 D C_4H_{12}

(iii) In order to produce the greatest amount of hydrogen in a short time, one gram of magnesium ribbon should react with
- A 10 cm^3 of 0.5 M sulphuric acid
- B 40 cm^3 of 0.5 M acetic acid solution
- C 40 cm^3 of 0.5 M sulphuric acid solution
- D 20 cm^3 of 1 M sulphuric acid solution
- E 20 cm^3 of 1 M acetic acid solution.

(iv) Fractional distillation process of a mixture of water and ethanol is possible because
- A water and ethanol have the same boiling point
- B water has lower boiling point than ethanol
- C ethanol has lower boiling point than water
- D water and ethanol form partially immiscible liquid solution
- E water and ethanol are immiscible liquids.

(v) Which of the following substances represent a group of acidic oxides?
- A Carbon dioxide, carbon monoxide and sulphur dioxide
- B Sulphur trioxide, nitrogen dioxide and nnitrogen monoxide
- C Carbon dioxide, sulphur dioxide and dinitrogen oxide
- D Sulphur trioxide, carbon dioxide and nitrogen dioxide
- E Carbon monoxide, nitrogen oxide and sulphur dioxide.

(vi) What will the molarity of a solution which contains 26.5 g of anhydrous sodium carbonate in 5 dm^3 of solution?

A 0.05 M B 0.25 M C 5.30 M
B 0.025 M E 0.50 M

(vii) The Brownian movement is taken to be the evidence of the:
- A theory of association of water molecules
- B theory of ionization of electrolytes
- C theory of colloidal suspensions
- D kinetic theory of behavior of substances
- E Brownian theory.

(viii) One off the isotopes of an element X has an atomic number Z and a mass number A. What is the number of neutrons contained in the nucleus of the element X?

A Z B A C A + Z
D A – Z E Z – A

(ix) C_2H_4Cl can be represented in different structures which are called

A homologous series B isomers
C structural formulae D identical structures
E condensed structures.

(x) _____ is the general term used to explain a mixture of different metals.

A Alloy B Allotrope C Amphoteric
D Amorphous E Isotope.

2011

1. For each of the items (i) – (x), choose the correct answer from the given alternatives and write its letter beside the item number.

(i) The volume of 0.2 M H_2SO_4 acid required to neutralize completely 25.00 cm^3 of 0.05 M KOH is
A 0.626 cm^3 B 6.125 cm^3 C 6.315 cm^3
D 3.125 cm^3 E 12.500 cm^3.

(ii) The Brownian movement is taken to be an evidence of the
A newton theory
B theory of colloidal suspension
C theory of association of water molecules
D kinetic theory of behaviour of substances
E theory of ionization.

(iii) A mixture of ammonium chloride salt and sand can be separated by using a method known as
A evaporation B sorting
C fractional distillation D sublimation
E decantation.

(iv) Which of the following statements is not true about hydrogen gas?
A Is a neutral gas, almost insoluble in water.
B Is a reducing agent.
C Burns in air to form steam.
D Diffuses more rapidly than carbon dioxide.
E Is prepared by the action of dilute nitric acid on zinc metal.

(v) An electric current was passed through a concentrated solution of hydrochloric acid using carbon electrodes. The substance liberated at the anode was
A copper B hydrogen C oxygen
D sodium E chlorine.

(vi) When an atom gains an electron it becomes
A an anion B a cation C a molecule
D an isotope E a proton.

(vii) The magnesium salt responsible for permanent hardness of water is
A hydrogen carbonate B sulphate C nitrate
D carbonate E chloride.

(viii) The biochemical oxidation of ammonia salts to nitrate compounds in the soil is known as
A nitrogen assimilation B nitrification C nitration
D denitrification E decomposition.

(ix) An example of a homologous series is
A ethene, ethyne and propyne
B propane, butane and pentyne
C ethene, propane and butyne
D ethane, propene and butane
E methane, ethane, propane.

(x) A Bunsen burner flame will produce a luminous flame when
A the air hole of the Bunsen burner is fully closed
B sufficient gas is supplied to the Bunsen burner
C the air hole of the Bunsen burner is fully opened
D the gas tap is partially opened
E the gas tap is fully opened.

2010

1. For each of the items (i) - (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) 1.4 g of potassium hydroxide is dissolved in water to form 250 cm^3 of solution. What is the molarity of this solution?
A 0.01 M
B 0.1 M
C 1.4 M
D 5.6 M
E 6.0 M

(ii) In the blast furnace carbon monoxide is prepared by passing carbon dioxide over a red-hot coke. Carbon dioxide is
A an accelerator
B an oxidizing agent
C a reducing agent
D a catalyst
E oxidized.

(iii) A catalyst can be described as a substance
A that alters the rate of reaction
B that slows down the rate of reaction
C used in every reaction so as to speed up rate of reaction
D that starts and speeds up the rate of reaction
E that terminates chemical reaction.

(iv) A covalent bond is formed when
A a metal combines with a non-metal
B potassium and oxygen combine
C ammonia is formed
D two metals combine
E atom looses an electron.

(v) A solvent can be obtained from a solution by
A evaporation followed by decantation
B filtration and condensation
C evaporation and filtration
D evaporation and condensation
E crystallization followed by sublimation.

(vi) Aqueous sugar solution is a poor conductor of electricity because
A water and sugar are covalent compounds
B water is a non-electrolyte
C sugar is a non-electrolyte
D sugar is covalent when in liquid form
E sugar dissolves completely in water.

(vii) The process of giving away water of crystallization to the atmosphere by a chemical substance is called
A efflorescence
B deliquescence
C hygroscopic
D sublimation
E vapourisation.

(viii) Copper can be separated from a mixture of zinc and copper by adding to the mixture
A concentrated H_2SO_4
B dilute H_2SO_4
C aqueous solution of $ZnSO_4$
D concentrated HNO_3
E a catalyst.

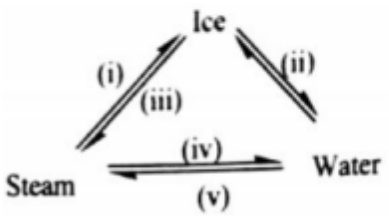
(ix) Among the factors that determine the ions to be discharged at electrodes when salt solutions are electrolysed are their
A non metallic nature
B relative concentrations in the solution
C relative ionic masses
D electronic configuration
E position in the periodic table.

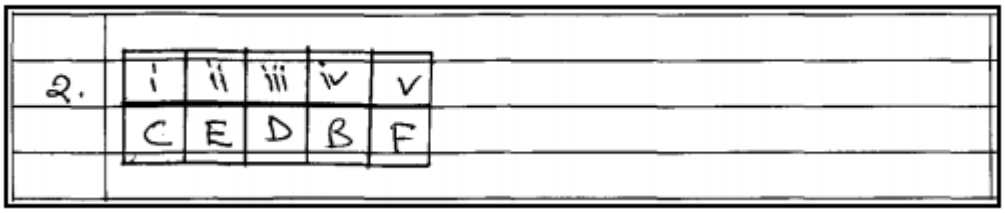
(x) The mass of sodium hydroxide contained in 25 cm^3 of 0.1 M NaOH is
A 0.5 gm
B 2.85 gm
C 250 gm
D 0.2 gm
E 25 gm

Matching Items
10 marks

2020

2. Match the physical processes represented by arrows (i) - (v) in **List A** with the corresponding terms in **List B** by writing the letter of the correct response beside the item number in the answer booklet provided.

List A	List B
	A Freezing B Condensation C Deposition D Sublimation E Melting F Evaporation G Conversion



2019

2. Match the descriptions in **LIST A** with the corresponding scientific procedures in **LIST B** by writing the letter of the correct response beside the item number in the answer booklet provided.

LIST A	LIST B
(i) A statement of how the results relate to the hypothesis. (ii) A series of investigations. (iii) A statement that identifies an even, fact or situation. (iv) A tentative explanation. (v) A step in which the researcher explains the results.	A Conclusion B Data analysis C Data collection D Experimentation E Hypothesis F Observation G Problem identification

2018

2. Match the items in **LIST A** with the responses in **LIST B** by writing the letter of the correct response beside the item number in the answer booklet provided.

LIST A	LIST B
(i) An element which is extracted by Frasch process.	A Carbon dioxide
(ii) A gas with pungent choking smell and forms misty.	B Carboxylic acids
(iii) A substance used for sterilization of drinking water.	C Iron (III) oxide
(iv) An alkaline gas.	D Nitrogen
(v) A compound used in domestic water-softening.	E Diamond
(vi) A compound prepared by fermentation of carbohydrates.	F Sodium carbonate
(vii) The compounds with a general formula of $C_nH_{2n+1}COOH$.	G Hydrogen chloride
(viii) The hardest allotrope of carbon.	H Sulphur
(ix) A gas which turns lime-water milky.	I Graphite
(x) A substance which is amorphous form of carbon.	J Ethanol
	K Chlorine
	L Calcium
	M Ammonia gas
	N Plastic sulphur
	O Coke

2017

2. Match the items in **LIST A** with the responses in **LIST B** by writing the letter of the correct response beside the item number in the answer booklet provided.

LIST A	LIST B
(i) An element with electronic configuration of 2:8	A Fluorine
(ii) An element in which its oxide can be prepared by the action of nitric acid and heat.	B Rhombic
(iii) An element which acts as an oxidant or reductant.	C Amorphous
(iv) A gas that explodes when a flame is applied in the presence of air.	D Diamond
(v) A gas which is prepared in the laboratory by isolation from air.	E Argon
(vi) An element with atomic mass of 40.	F Zinc
(vii) An element which reacts with water to produce hydroxide and hydrogen gas.	G Phosphorus
(viii) A element which is used in making jewellers.	H Nitrogen
(ix) An element which is an allotrope of sulphur.	I Hydrogen
(x) The most electronegative element.	J Mercury
	K Neon
	L Sulphur
	M Oxygen
	N Potassium
	O Chlorine

2016

2. Match the items in **List A** with the responses in **List B** by writing the letter of the correct response beside the item number in the answer booklet provided.

List A		List B	
(i)	Atoms of the same element that contain different numbers of neutrons.	A	Atomic number
(ii)	The elements that display both metallic and non-metallic characteristics.	B	Electron
(iii)	Sub atomic particle NOT found in the nucleus of the atom.	C	Radical
(iv)	The number of protons found in the nucleus of the atom.	D	Metalloids
(v)	The total number of protons and neutrons in the nucleus of the atom.	E	Isotopes
(vi)	The number of unpaired electrons on an atom.	F	Mass number
(vii)	The elements which are incredibly stable and rarely react.	G	Neutron
(viii)	The non- metals that form diatomic molecules.	H	Allotropes
(ix)	Sub atomic particle with no charge.	I	Noble gases
(x)	A group of atoms with unpaired electrons.	J	Period
		K	Group
		L	Proton
		M	Valence
		N	Atomic radii
		O	Halogens

2015

2. Match the items in **LIST A** with the responses in **LIST B** by writing the letter of the correct response beside the item number.

LIST A		LIST B
(i)	Its hydroxide is used in soil treatment.	A Barium
(ii)	It is obtained from its ore in the blast furnace.	B Lithium
(iii)	It gives a lilac colour when placed in a non-luminous flame.	C Iron
(iv)	It forms an insoluble sulphate.	D Potassium
(v)	It is in the same group in the periodic table with nitrogen.	E Oxygen
(vi)	It reacts with hydrogen to form a compound which is a liquid at room temperature.	F Fluorine
(vii)	It is used in filament lamps.	G Sulphur
(viii)	It is the strongest oxidizing agent among the halogens.	H Argon
(ix)	It exists in three main forms.	I Phosphorus
(x)	Its chloride is added to food in order to give taste.	J Sodium
		K Magnesium
		L Carbon
		M Neon
		N Silicon
		O Calcium

Answers:

i.
ii. C
iii. D
iv. A

v. I
vi.
vii.
viii.
ix.
x.

2014

2. Match the items in **List A** which the responses in **List B** by writing the letter of the correct response beside the item number in the answer booklet provided.

List A		List B
(i)	Its nitrate decomposes to the metal, nitrogen dioxide and oxygen.	A Potassium
(ii)	Its chloride is used as a drying agent for most gases.	B Copper
(iii)	Its carbonate is used to remove hardness of water.	C Argon
(iv)	Has maximum valency of five.	D Calcium
(v)	Burn with a lilac colour flame.	E Sulphur
(vi)	Used in the manufacture of ammonia.	F Chlorine
(vii)	Exists in two main physical forms.	G Carbon
(viii)	Greenish-yellow gas.	H Boron
(ix)	The second abundant element in the earth's crust.	I Silicon
(x)	Reacts with steam only at red heat to produce metal oxide and hydrogen gas.	J Zinc
		K Beryllium
		L Neon
		M Hydrogen
		N Helium
		O Sodium
		P Lead
		Q Iodine
		R Manganese
		S Phosphorus
		T Silver

2013

2. Match the items in **List A** with the responses in **List B** by writing the letter of the correct response beside the item number in the answer book provided.

List A		List B
(i)	Atoms of the same element that contain different numbers of neutrons.	A Atomic number
(ii)	Display both metallic and non metallic characteristics.	B Covalent bond
(iii)	Sub-atomic particle not found in the nucleus of the atom.	C Electron
(iv)	The number of protons found in the nucleus of the atom.	D Radical
(v)	The total number of protons and neutrons in the nucleus of the atom.	E Metalloids
(vi)	The number of unpaired electrons on an atom.	F Isotopes
(vii)	Incredibly stable and rarely reacts.	G Mass number
(viii)	Form diatomic molecules.	H Neutron
(ix)	Sub-atomic particle with no charge.	I Allotropes
(x)	A group of atoms with unpaired electrons.	J Noble gases
		K Period
		L Group
		M Proton
		N Valence
		O Ions
		P Atomic radii
		Q Molecules
		R Group II elements
		S Transition metals
		T Halogens

2012

2. Match the items in **List A** with the responses in **List B** by writing the letter of the correct response beside the item number in the answer booklet provided.

List A		List B
(i)	Its hydride is the only alkaline gas.	A Sodium
(ii)	Possesses 11 electrons.	B Aluminum
(iii)	Most electronegative element.	C Iron
(iv)	Extracted by Frasch process.	D Gold
(v)	A noble gas.	E Oxygen
(vi)	Exists in oxidation state of +3 in haematite.	F Flourine
(vii)	Least reactive metal in the reactivity series of metals.	G Sulphur
(viii)	A non metal which is a good conductor of heat and electricity.	H Argon
(ix)	Vital for all living things	J Ozone
(x)	Its oxide is yellow when hot and white when cold.	I Iodine
		K Mercury
		L Chlorine
		M Magnesium
		N Calcium
		O Nitrogen
		P Carbon
		Q Lithium
		R Potassium
		S Hydrogen
		T Zinc

2011

2. Match the items in **List A** with the responses in **List B** by writing the letter of the correct response beside the item number.

List A		List B
(i)	Methyl orange indicator	A Citric acid
(ii)	Calcium hydroxide	B Dilute base
(iii)	pH 2	C Normal salt
(iv)	Neutralization reaction	D Acidic salt
(v)	Molar solution	E $H^+ + OH^- \rightarrow H_2O$
(vi)	Sodium hydrogen sulphate	F Slaked lime
(vii)	An acid found in certain fruits	G Strong base + weak acid
(viii)	Sodium sulphate	H Strong acid
(ix)	Precipitation reaction	I Concentrated base
(x)	0.01M sodium hydroxide	J 36.5 g of HCl in 1000 cm^3 of solution
		K Composition reaction
		L Basic salt
		M Caustic potash
		N Strong acid + weak base
		O Concentrated acid
		P Decolourization
		Q 36.6 g of HCl in 1000 cm^3 of water
		R $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$
		S Ethanoic acid
		T Neutral salt

2010

2. Match the items in **LIST A** with the responses in **LIST B** by writing the letter of the correct response beside the item number.

LIST A	LIST B
(i) Oxygen	A Green-yellow gas which rapidly bleaches damp litmus paper
(ii) Sulphur dioxide	B Heats with cracking sound
(iii) Ammonia	C It rekindles a glowing splint of wood
(iv) Hydrogen Chloride	D Colourless gas, extremely poisonous since it combines with hemoglobin in red blood cells.
(v) Carbon monoxide	E Brown-ring test
(vi) Nitrogen	F Produces a white precipitates of silver chloride in a drop of a solution of silver nitrate
(vii) Hydrogen	G It is the only alkaline gas
(viii) Chlorine	H Substitution reaction
(ix) Nitrogen dioxide	I Explodes with air when flame applied
(x) Carbon dioxide	J Sweet - aroma smell
	K It is a brown gas
	L It is very irritating smell and decolorizes potassium manganate (VII) solution with no precipitation left
	M It turns lime water milky
	N Colourless, odourless, non-poisonous gas commonly used as a refrigerant
	O Characteristic yellow flame
	P Good solvent for fats and grease, non-poisonous
	Q Blackens lead (II) ethanoate paper
	R Turns brown on exposure to air
	S Freezes at 0°C and boils at 100°C
	T Rotten-egg smell

1. Introduction to Chemistry

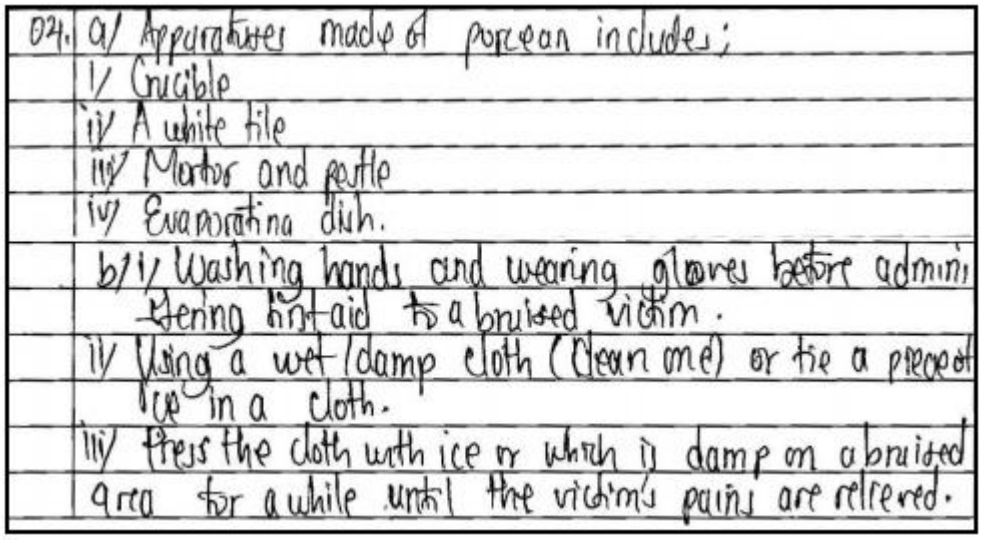
No questions 2011 - 2017

2. Laboratory Techniques and Safety

2020

4. (a) Give four laboratory apparatuses that are made up of porcelain/ceramic material.

(b) Outline three steps of administering First Aid to a person having a bruise on his leg resulting from a fist/hand blow. **(7 marks)**



2019

13. Explain how to handle chemicals having the warning signs of flammable, corrosive, harmful, explosive and toxic in the laboratory.

13.	Chemicals are compounds formed after chemical reactions to take place. Warning signs are precaution signs used to warn the user. In term of chemical warning signs refers to precaution signs to warn the user of a particular chemical. Warning signs are usually labbled on the reagents of a particular chemical. Each chemical have their properties and effects. There are warning signs such as flammable, harmful, corrosive, explorsive and toxic as found in laboureteries. Each chemical with a warning sign has its way to handle so that to not cause problems. The following are ways to handle Chemicals according to their specific warning signs.
	Flammable chemicals: These are chemicals which catch fire easily when brough near with a burning portion. Flammable chemicals should not left open near the burning flame as it evaporate flammable gases. But also should not bee brought near the burning frame as it can catch fire easily. Example of flammable chemicals are butane and petrol especially liquidified petroleum gas.
	Corrosive chemicals: Are substances that can corrode surfaces such as skin and table when comes into contact. when handling such substance put it away from your friend and wear protective clothes such as gloves to prevent it from coming into contact with a skin. Example of corrosive chemicals are concentrated sulphuric acid and concentrated hydrochloric acids.
	Harmful chemicals: These are substances which can harm the body when enter in the body through any opening for example inhaling harmful gases. These chemicals should bee handled by making sure that they can not bee taken into the body by means of inhaling, swallowing or coming into contact with open skin. Example of these chemicals are chlorine gas and carbonmonoxide fumes can be prevented using face masks.

12	Toxic chemicals : Toxic chemicals are substances whi
	ch can cause death thereby when taken in the body through
	mouth. Toxic substances should not be touched by bare hand
	hence one can bring it into contact with mouth hence when handli
	ng it one should use gloves. Example of toxic substance is
	Jik
	Explosive chemicals : Are substances which explode
	when not handled well. Explosive chemicals should be
	handled with care to prevent them from falling down also sho
	uld not be kept in glass containers because can easily
	explode and cause injuries to people due to glass particles.
	Generally Chemical warning signs are very important
	because they inform users so that one can know on how to
	handle the equipments well. Therefore people should be aware
	of warning signs so as to know the effects caused by each
	warning signs and how they can handle to prevent accidents in
	the laboratories.

2014

3. (a) (i) Why chemistry laboratory exits open outward?
(ii) State the uses of any four items found in a First Aid Kit.

3. a/ i/ Chemistry laboratory exists open outwards in order to allow odour gases out of the room and help a person easily escape from the room whenever there is a laboratory accident.

ii/ – A razor blade and a pair of scisor, used to cut the dressing materials such as bandages when dressing a wound to a victim.

- Pain killers are used to reduce pain for an injured person.
- Soap is used to wash hands before and after giving first aid to avoid contamination of micro organisms
- Adhesive bandages are used to cover a wound to avoid direct contamination of bacteria and other microorganisms.

b/ i/ Mercury
Copper
Zinc
Magnesium
Calcium

Increasing reactivity series.

ii/ Zinc reacts with steam to form an oxide which is white when cold and yellow when hot.

3. Heat Sources and Flames

No questions 2011 - 2017

4. The Scientific Procedure

No questions 2011 – 2017

5. Matter, Elements, Mixtures and Compounds

2020

3. (a) Giving an example for each, give four uses of matter in daily life.

(b) Why are chemical symbols useful in Chemistry? Give three reasons. **(7 marks)**

from one of the candidates.

3a. Four uses of matter in daily life.

1. Matter is used in industries.
Since matter is anything that has mass and occupies space. different materials like cotton being one of the matter it can be used in industries.

2. Matter it helps in rain formation.
Matter has three state which are liquid - solid and gas, when liquid (water), turns to vapour it leads to clouds then leading to rain

3a. 3. Matter can be used as working materials.
Forexample flour is a matter, which is used in our homes for cooking food like Ugali which is also a matter.

4. Matter can be used in studying activities.
Forexample for a student to study, he or she need books which are also matter, therefore - through different kind of matter like pen, pencil one can get his or her studies well.

b. Chemical symbol is useful because
1. It helps to show the correct proportional of the chemical element reacted.

2. It saves time when chemical symbol is used.
Forexample instead of writting Magnesium one uses Mg

3. It helps a person to balance the chemical equation when it is written in words it cannot be balanced.

2019

9. (a) Write the chemical symbols for beryllium, boron, neon, nitrogen and phosphorus.

(b) Why some of the elements in 9(a) are assigned symbols with only one letter while others bear symbols with two letters? **(7 marks)**

09. a) The chemical symbols are:
i) Beryllium - Be
ii) Boron - B
iii) Neon - Ne
iv) Nitrogen - N
v) Phosphorus - P

09 b) some symbols are assigned with a single letter since they were considered as the english names that uses the first letter in naming them.
While
others are bearing two letters so as to easily differentiate them from the ones which have equal begining letters.
example Beryllium and Boron, Neon and Nitrogen.

2018

5. (a) Suggest one method of separating each of the following:
(i) Green solution from leaves.
(ii) Alcohol from water.

(b) Elements K, L, M and N have atomic numbers 6, 8, 9 and 20 respectively. Classify each element into its respective period and group.

5 a/ i/ Green solution from leaves = Chromatography method
ii/ Alcohol from water = Fractional distillation method

5. b/

Element	Atomic number	Period	Group
K	6	2	IV
L	8	2	VI
M	9	2	VII
N	20	4	II

6. (a) Give one example in each of the following:
   (i) Alkali earth metals.
   (ii) Noble gases.
   (iii) Transition elements.

   (b) Write the names of the following processes of changing matter from one state to another.
   (i) Gas to liquid.
   (ii) Gas to solid.
   (iii) Solid to gas.

6. (a) (i) – Calcium.
– Magnesium

(ii) – Neon
– Argon.

(iii) – Copper.
– Zinc.

(b) (i) Condensation.
(ii) Deposition.
(iii) Sublimation.

2017
3 marks

11. (a) Briefly explain why the mixture with equal boiling point cannot be separated by simple fractional distillation.

11. a, A mixture withe equal boiling point cannot be separated by simple fractional distillation because both liquids will evaporate and condense at same temperature hence they will not be sepdrated successfully.

b, i, $2NH_4Cl_{(aq)} + Ca(OH)_{2(aq)} \rightarrow CaCl_{2(aq)} + 2H_2O_{(l)} + 2NH_{3(g)}$

ii, Uses of AMMONIA:
I. In production of nitrogenous fertilizers like urea
II. In manufacture of nitric acid

2015 – Q6

(b) Suggest one best method for separating each of the following mixtures:
- (i) Common salt and water
- (ii) Iodine and sand.
- (iii) Pieces of iron and sand.

6 a) i) The crop is Parsley

ii) In Least acidic, the crop is celery

iii) In neutral soil, the crop is tomato

b) i) Common salt and water can be separated by simple distillation

ii) Iodine and sand are separated by sublimation

iii) Pieces of iron and sand are separated by the Magnetization method.

2014 – Q4

(b) Give two examples in each of the following solution.
- (i) Gaseous solution.
- (ii) Solid solution.

4 (a) Data given

Volume of base = $20cm^3$ (V_B)

Volume of Acid = $25cm^3$ (V_A)

Molarity of Base = ? (M_B)

Molarity of Acid = 0.1 M

From the balanced chemical equation

$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

Number of moles of Base (n_B) = 1

Number of moles of Acid (n_A) = 1

By using

$\frac{M_A V_A}{M_B V_B} = \frac{n_A}{n_B}$ but $n_A = n_B = 1$

Then

$M_B = \frac{M_A V_A}{V_B} = \frac{0.1 \times 25}{20_4} = \frac{0.5}{4} = \frac{5}{40}$

$\therefore M_B = 0.125\ M$

but concentration of NaOH is moles per dm^3

= Molarity = $\frac{\text{Concentration}}{\text{Molar mass}}$ but Mr of NaOH = 40

$\therefore$ concentration (mol/dm^3) = 0.125×40

= 5 mol/dm^3

(b) (i) Gaseous solution examples are Water gas and producer gas

(ii) Solid solution examples are Bronze and Brass

2014 – Q6

(b) A student accidently broke a beaker containing copper (II) sulphate crystals. He decided to separate the blue crystals from the small pieces of glass by first dissolving the mixture and then filtering. What were his next steps?

6 (a)	When aluminium chloride reacts with water it forms an insoluble hydroxide of aluminium hydroxide as white precipitate and white fumes of a colourless gas of hydrogen chloride.
	$AlCl_{3(aq)} + 3H_2O_{(l)} \rightarrow Al(OH)_{3(s)} + 3HCl_{(g)}$

2013 – Q5

(b) Suggest one method for the separation of each of the following:
(i) Iodine and sand.
(ii) Green solution from leaves.
(iii) Alcohol and water.
(iv) Iron fillings and powdered calcium carbonate.

Correct answer is not available

2015 – Q10

(b) Giving three reasons, explain why air is said to be a mixture of gases.

10(a) 1 mole of O_2 = 6.02×10^{23} particles.
0.5 = x ?

$= 0.5 \times 6.02 \times 10^{23}$.
3.01×10^{23} molecules.

∴ 0.5 moles of O_2 = 3.01×10^{23} molecules of O_2.

1 mol of O_2 = $2 \times 6.02 \times 10^{23}$ atoms.
0.5 = x ?
$= 0.5 \times 2 \times 6.02 \times 10^{23}$
$= 6.02 \times 10^{23}$ atoms.
∴ 0.5 mol of O_2 has 6.02×10^{23} atoms

10(b) (i) The composition of air cannot be represented by a simple chemical formula.
(ii) The composition of air varies ie The components of air do not have a fixed ratio and it component can mix in any ratio hence it is a mixture.
(iii) The components of air can be separated by physical means ie fractional distillation of liquified air.

6. Air, Combustion, Rusting and Fire Fighting

2015

3 marks

3. (a) (i) State two conditions required for iron to rust.
(ii) List two methods which are used to prevent rusting of iron.

3. (a) (i) → presence of moisture
→ presence of air (oxygen)

(ii) → electroplating
→ painting

(b) (i) It conduct electric current
(ii) It is more ductile
(iii) It has low density

7. Oxygen

2015

3 marks

8. (a) Give the names or formula of the two chemicals that would be used in the laboratory to make each of the following gases. State a simple test that could be used to identify each gas.
(i) Oxygen.
(ii) Hydrogen.
(iii) Carbon dioxide.

8. a) i) The chemical that would be used is hydrogen peroxide using Manganese dioxide catalyst. And also Copper nitrate by thermal decomposition.

TEST OF OXYGEN GAS

-When a glowing wooden splint is brought near oxygen it is relighted this tests the presence of oxygen gas.

ii) a) HCl reacted with metal (Na)
b) H_2SO_4 reacted with metal (Mg)

TEST OF THE GAS.

When a glowing wooden splint is brought at the top of test tube containing hydrogen gas it burns with pop sound.

iii) a) When $NaHCO_3$ is reacted with HNO3.
ii) When $MgCO_3$ is reacted with ~~HCl~~ HCl.

THE TEST OF THE ~~GAS~~

When lime water on a glass rod gets exposed to carbon dioxide turns milky this is due to precipitate of calcium carbonate.

b) i) Methyl orange will be suitable since it is a strong acid and a weak base.
ii) Any indicator such as methyl orange and phenolphthalein will be suitable since it involves a strong acid and a strong base.
iii) Phenolphthalein indicator will be suitable since it involves weak acid and strong base.

8. Hydrogen

2015
3 marks

8. (a) Give the names or formula of the two chemicals that would be used in the laboratory to make each of the following gases. State a simple test that could be used to identify each gas.
(i) Oxygen.
(ii) Hydrogen.
(iii) Carbon dioxide.

8. a) i) The chemical that would be used is hydrogen peroxide using Manganese dioxide catalyst. And also copper nitrate by thermal decomposition.

TEST OF OXYGEN GAS

- When a glowing wooden splint is brought near oxygen it is relighted thus tests the presence of oxygen gas.

ii) a) HCl reacted with metal (Na)
b) H_2SO_4 reacted with metal (Mg)

- The TEST OF THE GAS.

When a glowing wooden splint is brought at the top of test tube containing hydrogen gas it burns with pop sound.

iii) a) When $NaHCO_3$ is reacted with HNO_3.
ii) When $MgCO_3$ is reacted with ~~HCl~~ HCl.

THE TEST OF THE ~~GAS~~

When lime water on a glass rod gets exposed to carbon dioxide turns milky this is due to precipitates of calcium carbonate.

b) i) Methyl orange will be suitable since it is a strong acid and a weak base.
ii) Any indicator such as methyl orange and phenolphthalein will be suitable since it involves a strong acid and a strong base.
iii) Phenolphthalein indicator will be suitable since it involves weak acid and strong base.

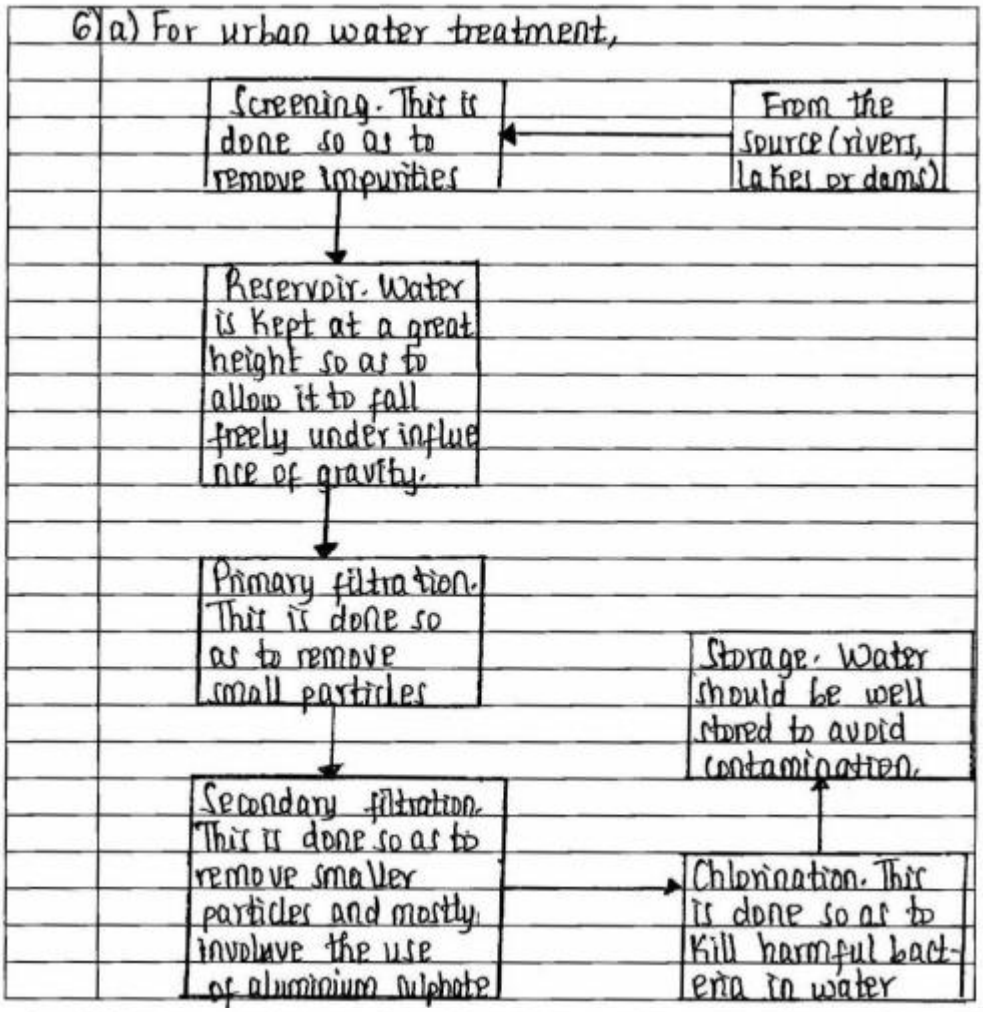
9. Water

2020

6. (a) Briefly explain the basic steps you would follow in water treatment.

(b) Outline how to test for the purity of water. **(7 marks)**

6) a) For urban water treatment,



6) For domestic water treatment,

i) Sedimentation. This involves removal of particles by allow the solvent to settle then only clear solvent is poured into another container leaving sediments behind.

ii) Filtration. The water should be filtered so as to remove smaller particles which could not be removed through sedimentation.

iii) Boiling. Water should finally be boiled so as to kill harmful bacteria which may cause diseases when consumed along with water.

2017

3 marks

7. (a) State three main physical properties of water and show the usefulness of each property.

7. (a) i/ Water dissolves most of solutes/substance than any other solvents (Universal solvent). This property help in the separation of different mixtures

ii/ Water has a very high heat capacity and specific heat capacity: This property makes water a good coolant liquid in car engines and other machines

iii/ Water freezes at 0°c and boils at 100°c. This property helps in fractional distillation of miscible liquid which contain water. For instance separation of alcohol and water.

(b) Application of electrolysis

i/ Electrolysis is used in production of gases like oxygen and hydrogen gases

ii/ Electrolysis is used in purification of metals such as Copper and Zinc.

iii/ Electrolysis is used in electroplating different metals to avoid rusting and to make them attractive.

2016

10. (a) Give two chemical tests of water and the expected result to be observed.

10. Fuels and Energy

2019

12. (a) Which ways are the fossil fuels detrimental to the environment? Give four points.

(b) Briefly explain how biogas is produced by using domestic waste. **(7 marks)**

12 (a) (i) Combustion of fossil fuels release carbon dioxide and sulphur dioxide which pollute the air causing acidic rain.

(ii) Where fossil fuels such as coal are mined trees and other plants are cleared thus destructing the environment.

(iii) Spills of petroleum during mining in the sea destructs marine ecosystem for instance exchange of gas between the water and air.

(iv) Residues of fossil fuels for instance from petroleum refinery industry once dumped either in water or or land pollutes and affect the environment.

(b) Domestic waste esperially sewage are fermented in a large confined container (biogas plant) usually constructed under ground. Upon fermentation the wastes release methane among other traces of gases. Methane is the main component of biogas and it is piped off and stored ready for use.

When fermentation ceases the waste are taken out and being processed to make fertilizer or else, new wastes are then put in the container for further production of biogas

2016

3 marks

(b) State the main raw material and the process involved in the manufacture of the following products:
(i) Wood charcoal.
(ii) Coke.
(iii) Lampblack.

2015

4. (a) Give three examples in each of the following:
(i) Solid fuel
(ii) Gaseous fuel.

4a)	Coal
	Wood
	Charcoal
4aii)	Producer gas Water gas, Natural gas
4b)	Increase in pressure gives a better yield of methanol because
	pressure affects the side where there is high number of molecules
	In case of the reaction given, the reactants have more molecules
	than the product (methanol), hence due to high pressure, the
	reaction will be more forward and therefore more methanol
	will be produced and yielded.

4bii)	The reaction is exothermic, this means low temperature favours
	more forward reaction in the equation given since exothermic
	reaction is the reaction which proceeds by releasing temperature
	to the environment hence needs low temperatures for the
	reactants to yield the product.
4biii)	A high temperature will not give a better yield of methanol
	since the equation involves exothermic reaction. While low
	temperature will favour or give better yield of methanol due
	to the nature of the reaction (exothermic)

2012

(b) It is not advisable to sleep inside a house which is not well ventilated with a burning wooden charcoal. Give a reason for that and write the chemical equation to represent your answer.

6. (a) Give the name of the process of making coke from coal. Write one characteristic which make coke a better fuel than coal.

11. Atomic Structure

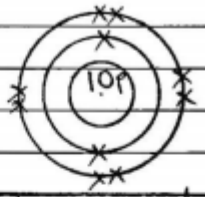
2020

10. (a) Draw diagrams to show the atomic structures of the elements with atomic number 1, 10, 16 and 19.

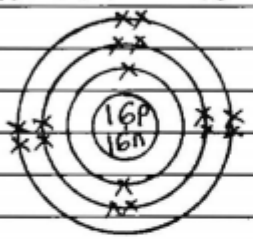
(b) Element X has 20 electrons and a mass number of 40. Work out the number of each type of nucleons present. **(7 marks)**

10. a) i) Atomic number 1.

ii) Atomic number 10 = 2:8.

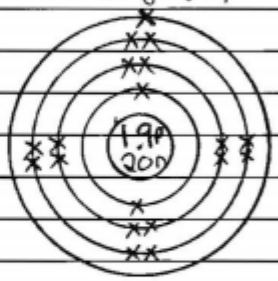


iii) Atomic number 16 = 2:8:6



X - electron.

iv) Atomic number 19
= 2: 8: 8: 1



b) Data

no. of electrons = 20

Mass number = 40

no. of protons = ?

no. of neutrons = ?

From,

no. of protons = no. of electrons = Atomic number
= 20

no. of neutrons + no. of protons = Mass number

$X + 20 = 40$

$X = 40 - 20$

$X = 20$

∴ number of protons = 20.

number of neutrons = 20.

2017

3 marks

9. (a) An atom M has an atomic number 14 and mass number 28.
   (i) What is the number of protons and neutrons?
   (ii) Write the electronic configuration of atom M.

09. a) i, The number of
- Protons is 14
- Neutrons is 14

ii, Electronic configuration of M is 2 : 8 : 4

09. b) Reaction equation for the decomposition is

$$[2H_2O_{2(aq)}] \longrightarrow [2H_2O_{(l)}] + [O_{2(g)}]$$

From the equation.

2 moles of H_2O_2 produced 1 mole of O_2

2 moles of H_2O_2 ≡ 1 mole of O_2

But 1 mole of a gas at s.t.p = $22.4dm^3$

∴ 2 moles of H_2O_2 ≡ $22.4dm^3$

n ≡ $1.12dm^3$

$$n = \frac{1.12 \times 2 \text{ moles}}{22.4}$$

n = 0.1 mole.

∴ The amount of H_2O_2 decomposed was 0.1 mole.

Then: 2 moles of H_2O_2 ≡ 2 moles of $2H_2O$.

2 moles of H_2O_2 ≡ 2 (2H) + O)

≡ 2 (18)

≡ 36g.

2 moles of H_2O_2 ≡ 36g

0.1 mole of H_2O_2 ≡ g

$$g = \frac{0.1 \text{ mole} \times 36g}{2 \text{ moles}}$$

∴ g = 1.8g mass of water produced

09 (b) But from:

Density = mass / volume where density of water = 1 g/cm³

volume = mass / density

Volume = 1.8 g / 1 g/cm³

= 1.8 cm³

∴ The volume of water produced was 1.8 cm³

2015

5. (a) (i) Explain, in terms of electronic configurations, why sodium and potassium elements have similar chemical properties.

(ii) State the trend in reactivity of group I elements in the Periodic Table and give reasons for it.

5 (a)(i) Sodium and potassium elements have similar chemical properties because they belong to the same group: since the outermost shell of sodium has one electron and potassium has one electron in the outermost shell so they belong to the same group and the elements with same group have the similar chemical properties,

Sodium (Na): 2:8:1

Potassium (K): 2:8:8:1.

(ii) The reactivity trend of group I element ~~decrease~~ increase when going down the group due to the decreasing of ionization energy when going down the group

(b)

s/n	Name of element	Atomic number	Electronic configuration
(i)	lithium	3	2:1
(ii)	Aluminium	13	2:8:3
(iii)	chlorine	17	2:8:7

2015 – Q10

(b) Protons neutrons and electrons particles are located in the atoms; fill in the missing information in Table 4 about these particles.

Table 4

Particles	Relative mass	Relative charge	Location
Proton			
Electron	$\frac{1}{1840}$		
Neutron		0	In the nucleus

10. (a) (i) The samples which contain hard water are Sample A and Sample D

(ii) The sample which contain hard temporary water is a Sample A. This is because it forms a lather with a soap solution when it is hot (boiled).

(b) TABLE 4

Particles	Relative Mass	Relative charge	Location
Proton	1	+1	In the nucleus
Electron	1/1840	-1	In the shell
Neutron	1	0	In the nucleus

2013

4. (a) Consider elements with atomic number 1, 11, 12 and 17.
   (i) What are the types of oxides formed by elements with atomic number 11 and 12?
   (ii) Write an equation which represents a reaction between the element with atomic number 1 and 17.
   (iii) Write a balanced chemical equation between the oxide of the element with atomic number 11 and aqueous solution of the compound formed in 4 (a) (ii).

2013 – Q11

(b) Fill in the missing value in the following table.

Particle	Relative mass	Charge
Proton		
Neutron		
Electron	$\frac{1}{1836}$	

11 (a) (i) $Cl_{2(g)} + 2H_2O_{(l)} + SO_{2(g)} \rightarrow 2HCl_{(aq)} + H_2SO_{4(aq)}$

- In this reaction Chlorine is an oxidizing agent because it gains electrons to formation of $HCl_{(aq)}$. Suphur dioxide is a reducing agent because it has lost some electrons to form $H_2SO_{4(aq)}$

11 (a)(ii) $SO_{2(g)} + 2H_2S_{(g)} \rightarrow 2H_2O_{(l)} + 3S_{(s)}$

- sulphur dioxide is an oxidizing agent in this reaction because it has given out its oxygen molecules for water to ber formed.
- Hydrogen sulphide is a reducing agent because it has removed oxygen from the $SO_{2(g)}$.

11 (b)

Particle	Relative Mass	
Proton	1	+1
Neutron	1	No charge(0)
Electron	$\frac{1}{1836}$	-1

2012

4. Study the following part of the periodic table and then answer the questions that follow.
Note: The letters used are not scientific symbols for the elements concerned.

Group

I	II	III	IV	V	VI	VII	O
						N	
	K				Q		P
L							

(a) Identify and write down the electronic configuration for the elements K, N, P and L.

(b) What type of bond will exist in a compound formed when Q combines with L? Write the chemical formula for the compound formed and list two chemical properties for the compound formed.

2011

7. Study the portion of periodic table given in the following table and answer the questions that follow:

Group	I	II	III	IV	V	VI	VII	0
Period 2	Li	Be	B	C	N	O	F	Ne
Period 3	Na	Mg	Al	Si	P	S	Cl	Ar

(a) Explain how the ionisation energy of elements vary from Be to Mg and from B to O.

(b) Name the types of the bond formed when S combine with O. Give two properties of compounds of such a bond.

10. (a) Name the particles that form the nucleus part of an atom. What is the difference between them?

(b) Observe the following compounds; NaCl and HCl. Give the name of the type of bond holding together the elements in each of the two compounds and list three differences between the bonds.

12. Periodic Classification

2015

3 marks – Q5

(b) Use the knowledge of periodic Table to complete Table 1.

Table 1

S/n	Name of element	Atomic number	Electronic configuration
(i)	Lithium		
(ii)		13	
(iii)			2.8.7

5 (a)(i) Sodium and potassium elements have similar chemical properties because they belong to the same group: since the outermost shell of sodium has one electron and potassium has one electron in the outermost shell so they belong to the same group and the elements with same group have the similar chemical properties.
Sodium (Na): 2:8:1
Potassium (K): 2:8:8:1.

(ii) The reactivity trend of group I element decrease increase when going down the group due to the the decreasing of ionization energy when going down the group

(b)

S/n	Name of element	Atomic number	Electronic configuration
(i)	lithium	3	2:1
(ii)	Aluminium	13	2:8:3
(iii)	chlorine	17	2:8:7

2014

5. (a) Study the following part of the periodic table and List down the names of all the missing elements.

Table 1

H							He
Li	Be	B				F	
		Al	Si	P	S	Cl	Ar

5 a) Name of the missing elements

i/ Carbon.

ii/ Nitrogen

iii/ Oxygen

iv/ Neon

v/ Sodium.

vi/ Magnesium.

b) i/ $2SO_2(s) + O_2(g) \longrightarrow 2SO_3(g)$

$SO_3(g) + H_2SO_4(l) \longrightarrow H_2S_2O_7(l)$

$H_2S_2O_7(l) + H_2O(l) \longrightarrow 2H_2SO_4(aq)$

5 b) ii/ Sulphur trioxide is not dissolved directly in water to obtain sulphuric acid in contact process because their would be formation of fumes of sulphuric acid since the reaction is exothermic therefore making it difficult to collect the acid.

2013

3. (a) Study the following portion of the periodic table with some elements represented by letters and answer the questions that follow.

I	II	III	IV	V	VI	VII	O
						B	
	A				C	D	

(i) State how electronegativity varies from A to C and from B to D

(ii) Write the electronic configurations of A, C^{2-}, D and B.

3 (a) (i) From A to C – Electronegativity increase.
From B to D – Electronegativity decrease.

(ii) Electronic configuration of A is 2:8:2
Electronic configuration of C^{2-} is 2:8:8
Electronic configuration of D is 2:8:7
Electronic configuration of B is 2:7

(b) (i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(s)}$

(ii) Carbon monoxide is formed when carbondioxide gas is reduced by coke or carbon.

$CO_2 + C \longrightarrow CO$
(s) (g)

(iii). Calcium Oxide + Silicadioxide → Slag.

3 (a) (i) From A to C – Electronegativity increase.
From B to D – Electronegativity decrease.

(ii) Electronic configuration of A is 2:8:2
Electronic configuration of C^{2-} is 2:8:8
Electronic configuration of D is 2:8:7
Electronic configuration of B is 2:7

(b) (i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(s)}$

(ii) Carbon monoxide is formed when carbondioxide gas is reduced by coke or carbon.

$CO_2 + C \longrightarrow CO$
(s) (g)

(iii). Calcium Oxide + Silicadioxide → Slag.

2012

4. Study the following part of the periodic table and then answer the questions that follow.
Note: The letters used are not scientific symbols for the elements concerned.

Group

I	II	III	IV	V	VI	VII	O
						N	
	K				Q		P
L							

(a) Identify and write down the electronic configuration for the elements K, N, P and L.

(b) What type of bond will exist in a compound formed when Q combines with L? Write the chemical formula for the compound formed and list two chemical properties for the compound formed.

2011

7. Study the portion of periodic table given in the following table and answer the questions that follow:

Group	I	II	III	IV	V	VI	VII	0
Period 2	Li	Be	B	C	N	O	F	Ne
Period 3	Na	Mg	Al	Si	P	S	Cl	Ar

(a) Explain how the ionisation energy of elements vary from Be to Mg and from B to O.

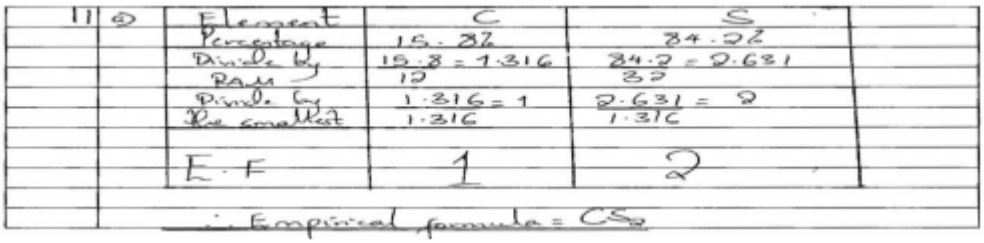
(b) Name the types of the bond formed when S combine with O. Give two properties of compounds of such a bond.

13. Formula Bonding and Nomenclature

2020

11. A certain compound having a relative molecular mass of 76 was found to contain 15.8% of carbon and 84.2% of sulphur. Based on this information:
(a) determine the empirical formula and molecular formula of the compound.

(b) give the IUPAC name of the compound. **(7 marks)**



11 a) Molecular formula:

(E.F)n = Molar mass

$(CS_2)_n = 76$

$(12+(32)2)n = 76$

$(12+64)n = 76$

$\frac{76n}{76} = \frac{76}{76}$

$n = 1$

$= (CS_2)_1$

$= CS_2$

∴ Molecular formula = CS_2

b) Carbon disulphide

2019

10. (a) Give three advantages of using chemical equations over word equations.

(b) You are provided with a compound of 22.2% zinc, 11.6% sulphur, 22.3% oxygen, and the rest percentage is water of crystallization. Calculate the molecular formula of the compound if its molecular mass is 283. **(7 marks)**

10 (a) - Help us to determine relative quantities of substances used in a reaction.

- Help us to determine states of the substances in the reaction (i.e either solid, aquoes or gas or liquid)

- Help us to balance the chemical equation

% of H_2O = 100 − 56.1 = 43.9

(b)

ELEMENTS	Zn	S	O	H_2O
% comp	22.2	11.6	22.3	43.9
RAM	65	32	16	18
% comp/RAm	$\frac{22.2}{65}$	$\frac{11.6}{32}$	$\frac{22.3}{16}$	$\frac{43.9}{18}$
	0.342	0.363	1.394	2.439
	$\frac{0.342}{0.342}$	$\frac{0.363}{0.342}$	$\frac{1.394}{0.342}$	$\frac{2.439}{0.342}$
	1	1	4	7

Empirical formula is $ZnSO_4 \cdot 7H_2O$

from ~~ef~~ = n(sum of RAM)

Molecular mass = n(sum of RAm)

$283 = n(65 + 32 + (4 \times 16) + (7 \times 18))$

$283 = n(287)$

$n \approx 1$

from $mf = n \times ef$

$mf = 1 \times (ZnSO_4 \cdot 7H_2O)$

∴ Molecular formula is $ZnSO_4 \cdot 7H_2O$

2019

7. An atom of element X having atomic number 11 combines with an atom of element Y having atomic number 9 to form a compound.

   (a) Write the formula of the compound and state the type of bond formed in the compound.

   (b) Give four properties of the compound formed in 7(a). **(7 marks)**

7.	a) XY
	Bond - Ionic bond, the bond that is formed due to transfer of electrons from a metal to a non-metal which is more electronegative.
	b) i) It is soluble in water and insoluble in organic solvents
	ii) It has high melting and boiling point.
	iii) It is a good conductor of electricity when in molten or in aqueous state.
	iv) It exists as a solid or in crystalline form.

2016

3 marks

7. (a) Determine the empirical formula of a substance that has the following composition by mass; 49.5% manganese and 50.5% oxygen.

2015

9. (a) (i) What type of a chemical bond is found between fluorine atoms in a fluorine molecule?

(ii) Name other type(s) of chemical bond formed by fluorine with other elements. Give an example of a compound in which fluorine form this type of bond.

9: a) i) The type of chemical bond found in fluorine molecule is covalent bond.

9: a(ii) The other type of chemical bond is electrovalent bond.

Example; Potassium fluoride, formula is K_2F

b). i)

	C	H	CL
Mass	24.24	4.04	71.72
R.A.M	12	1	35.5
Mass / R.A.M	24.24 / 12	4.04 / 1	71.72 / 35.5
Divide small number by all	2.02 / 2.02	4.04 / 2.02	2.02 / 2.02
	1	2	1

∴ Empirical formula = $C_1H_2CL_1 = CH_2CL$

Molecular formula = n(Empirical formula).

But Molecular formula = Vapour density X2

= 49.5 X 2

= 99

Then from; Molecular formula = n(Empirical formula).

$99 = n(CH_2CL)$

Empirical formula = Relative Molecular Mass

$\Rightarrow CH_2CL = C + H_2 + CL$

$= 12 + 2(1) + 35.5$

$= 49.5$

To get n:

$99 = n(49.5)$

$n = 99/49.5$

$= 2.$

9: b) i) Then, Molecular Formula = $n(CH_2CL)$

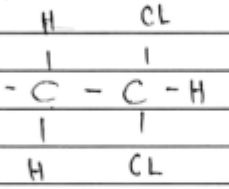
$= 2(CH_2CL)$

$= C_2H_4Cl_2.$

∴ The molecular formula of the compound X is $C_2H_4Cl_2$.

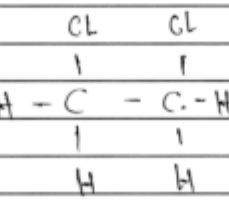
ii) The open structure isomers of $C_2H_4Cl_2$

a)



Name; 1,1-dichloroethane.

b)



Name; 1,2-dichloroethane.

2014 – Q9

(b) An organic compound P consist of 52.2% of carbon, 13% of hydrogen and 34.8% of oxygen. The vapour density of P is 23. Calculate the molecular formula of the compound P and write possible isomer(s) from the molecular formula determined.

2013

4. (a) Consider elements with atomic number 1, 11, 12 and 17.
   (i) What are the types of oxides formed by elements with atomic number 11 and 12?
   (ii) Write an equation which represents a reaction between the element with atomic number 1 and 17.
   (iii) Write a balanced chemical equation between the oxide of the element with atomic number 11 and aqueous solution of the compound formed in 4 (a) (ii).

11. (a) For each of the following reactions, identify which of the gases, chlorine, sulphur dioxide, and hydrogen sulphide is either an oxidizing agent or reducing agent. Explain how you arrived at your answers.
   (i) $Cl_{2(g)} + 2H_2O_{(l)} + SO_{2(g)} \rightarrow 2HCl_{(g)} + H_2SO_{4(aq)}$.
   (ii) $SO_{2(g)} + 2H_2S_{(g)} \rightarrow 2H_2O_{(l)} + 3S_{(s)}$.

11 (a) (i) $Cl_{2(g)} + 2H_2O_{(l)} + SO_{2(g)} \rightarrow 2HCl_{(aq)} + H_2SO_{4(aq)}$

- In this reaction Chlorine is an oxidizing agent because it gains electrons to formation of $HCl_{(aq)}$. Suphur dioxide is a reducing agent because it has lost some electrons to form $H_2SO_4(aq)$

11 (a)(ii) $SO_{2(g)} + 2H_2S_{(g)} \rightarrow 2H_2O_{(l)} + 3S_{(s)}$

- sulphur dioxide is an oxidizing agent in this reaction because it has given out its oxygen molecules for water to be formed.
- Hydrogen sulphide is a reducing agent because it has removed oxygen from the $SO_{2(g)}$.

11 (b)

Particle	Relative Mass	
Proton	1	+1
Neutron	1	No charge(0)
Electron	$\frac{1}{1836}$	-1

2012

4. Study the following part of the periodic table and then answer the questions that follow.
Note: The letters used are not scientific symbols for the elements concerned.

Group

I	II	III	IV	V	VI	VII	O
						N	
	K				Q		P
L							

(a) Identify and write down the electronic configuration for the elements K, N, P and L.

(b) What type of bond will exist in a compound formed when Q combines with L? Write the chemical formula for the compound formed and list two chemical properties for the compound formed.

2011

6. (a) Element Y with atomic number 5 has isotopes A and B whose atomic masses are 10.010 and 11.013 respectively. The proportion in nature of A is 20 % and that of B is 80 %. Calculate the relative atomic mass of Y and write its electronic configuration.

(b) Explain why solid $CaCl_2$ does not conduct electricity while its aqueous solution does?

14. Chemical Equations

2020

7. (a) Briefly explain five importance of balancing chemical equations.

(b) Give a balanced chemical equation for the reaction between sodium carbonate and hydrochloric acid. **(7 marks)**

7. a) Importance of balancing chemical equations:

i) It helps to obtain accurate products formed due to a chemical reaction.

ii) It helps to calculate the accurate number of moles of the reactants or products in a chemical reaction.

iii) It helps to determine the total accurate mass of the reactants reacted to give the products.

iv) It helps to identify the total volume of the reactants and products formed.

v) It helps to determine the accurate molarity of the products formed in response to molarity of reactants used.

b) A balanced chemical equation:

$Na_2CO_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$

2019

11. A Form Three student conducted experiments in the laboratory to synthesize nitrogen, ammonia and ethane. The experimental results were tabulated as follows:

Experiment	Reagents	Conditions	Products
1	Lead nitrate	Heat	Lead oxide, oxygen gas and nitrogen gas
2	Gaseous hydrogen and gaseous nitrogen	Catalyst	Ammonia gas
3	Ethene gas and hydrogen gas	Catalyst	Ethane

Write word equations with corresponding chemical equations to summarize the reactions taking place in each of the experiments 1 to 3. **(7 marks)**

11. Experiment 1:

Lead Nitrate $\xrightarrow{\Delta}$ Lead oxide + Oxygen gas + Nitrogen gas.

$2Pb(NO_3)_2(s) \xrightarrow{\Delta} 2PbO(s) + O_2(g) + 4NO_2(g)$

Experiment 2:

Nitrogen gas + Hydrogen gas $\xrightarrow{\text{catalyst}}$ Ammonia gas.

$N_2(g) + 3H_2(g) \xrightarrow{\text{catalyst}} 2NH_3(g)$

Experiment 3:

Ethene gas + Hydrogen gas $\xrightarrow{\text{catalyst}}$ Ethane.

$C_2H_4(g) + H_2(g) \xrightarrow{\text{catalyst}} C_2H_6(g)$

2017

3 marks – Q4

(b) Write balanced chemical equations to show how chlorine reacts with the following:

(i) water.

(ii) aqueous iron (II) chloride solution.

(iii) hydrogen sulphide.

4. a) The steps which used to extract moderate reactive metals.

i. Concentration of the ore.
- Here we remove oaith impurities.

ii. Roasting of the ore
- Here the ore is heated in presence of oxygen morder to get metal oxide and remove sulphides

iii. Reduction of the ore.
- The obtained ore is reduced by using carbon monoxide and other agents in order to get free element

$Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 2Fe + 3CO_{2(g)}$

iv. Purification of the metal.
- The obtained metal is purified to remove remained contaminants in order to make it pure.

b) chlorine reacts with water to form chloric (1) acid and Hydrogen chloride gas.

$Cl_{2(g)} + H_2O_{(l)} \longrightarrow HOCl_{(aq)} + HCl_{(g)}$

4 b. ii. The gas reacts with aqueous iron(II) chloride by oxidizing it to iron(III) chloride and colour turns from light green to reddish brown

$Cl_{2(g)} + 2FeCl_{2(aq)} \rightarrow 2FeCl_{3(aq)}$

(light green) (reddish-brown)

iii. The gas reacts with hydrogen sulphide by ~~oxidizing~~ reducing ~~to~~ with sulphur to element and it self reduced to Hydrogen chloride gas. Yellow precipitate is observed of sulphur metal.

$Cl_{2(g)} + H_2S_{(g)} \rightarrow 2HCl_{(g)} + S_{(s)}$

(Yellow ppt)

8. (a) You are provided with CH_3CH_2OH, $CH_3CH_2CH_3$, CH_3COOH, and $CH_2=CH_2$.

(i) Which compounds are gases at room temperature?

(ii) How can you distinguish compound $CH_3CH_2CH_3$ and $CH_2=CH_2$?

(iii) Which compound would react with sodium carbonate? Write the balanced chemical equation for the reaction.

8 a) i) Compounds which are gaseous at room temperature are $CH_2=CH_2$ and $CH_3CH_2CH_3$

ii) $CH_3CH_2CH_3$ can be distinguished from $CH_2=CH_2$ as $CH_2=CH_2$ decolorises Potassium permanganate ~~solution~~ Pro forming CH_2OHCH_2OH whereas $CH_3CH_2CH_3$ can not decolorize the $KMnO_4$ solution

iii) A compound which will react with Na_2CO_3 is CH_3COOH as per equation

$2CH_3COOH_{(aq)} + Na_2CO_{3(s)} \rightarrow 2CH_3COONa_{(aq)} + CO_{2(g)} + H_2O_{(l)}$

b) i) The catalyst speeds up the rate of reaction by lowering the activation energy, that is the minimum amount of energy required to start ~~at~~ a reaction. Since the activation energy is lowered, the rate of reaction increases.

8 b) ii) The possible catalyst is MnO_2 (Manganese(IV) oxide)

iii) The possible catalyst used remains unchanged chemically as the amount of catalyst (MnO_2) before reaction is the same even at the end of reaction as per equation

$$2H_2O_{2(aq)} + MnO_{2(s)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + MnO_{2(s)}$$

Overall reaction: $2H_2O_{2(aq)} \xrightarrow{MnO_2} 2H_2O_{(l)} + O_{2(g)}$

Hence the catalyst remains unchanged.

10. (a) Complete the following equations and determine the type of chemical reaction involved in each case.

(i) $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow$

(ii) $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow$

(iii) $N_{2(g)} + H_{2(g)} \rightarrow$

10. (a) (i) $Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$

This is displacement reaction

(ii) $AgNO_{3(aq)} + NaCl_{(aq)} \longrightarrow AgCl_{(s)} + NaNO_{3(aq)}$

This is precipitation reaction.

(iii) $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$

This is Combination reaction

10 (b) Given values

Electric current (I) = 5A

Mass of deposited metal of Silver (m) = 3·24g

Electrochemical equivalent of Silve (Z) = $1{\cdot}118 \times 10^{-3} gc^{-1}$

time taken (t) = ?

Solution:

$Q = It$

$m = ZIt$ where m = Mass of Silver

Z = Electrochemical equivalent of Silver

I = Current

t = time taken

$\frac{m}{ZI} = \frac{ZIt}{ZI}$ $t = m/ZI$

$t = \frac{3{\cdot}24g}{1{\cdot}118 \times 10^{-3} g/c \times 5A}$

$t = \left(\frac{3{\cdot}24}{5{\cdot}590 \times 10^{-3}}\right) s$

$t = \left(\frac{3{\cdot}24 \times 10^{3}}{5{\cdot}590 \times 10^{-3}}\right) s$

$t = (0{\cdot}5796 \times 10^{3}) s$

$t = 579{\cdot}6s$

∴ time taken is 579·6 seconds

2016

5. (a) Give the name of the type of reaction represented by each of the following chemical equations.

(i) $C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$.

(ii) $2Pb(NO_3)_{2(s)} \xrightarrow{\Delta} 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$.

(iii) $Zn_{(s)} + CuSO_{4(aq)} \rightarrow ZnSO_{4(aq)} + Cu_{(s)}$.

13 mark

13. 0.48 g of a metal, **M** was placed in a test tube and hot copper (II) sulphate solution was added to it and stirred until the reaction stopped. The metal (**M**) displaced copper from copper (II) sulphate solution. Copper was filtered, washed with water, dried at 100°C and the mass found to be 1.27 g. Given that, the balanced chemical reaction that occurred is $M_{(s)} + CuSO_{4(aq)} \longrightarrow MSO_{4(aq)} + Cu_{(s)}$.

(a) Calculate;

(i) the number of moles of copper that were formed and the number of moles of **M** that were used in the reaction.

(ii) the relative atomic mass of **M** and hence identify metal **M**.

(b) State the appearance of the metal formed (Cu).

(c) With ionic equations, explain why the reaction can be considered to involve both oxidation and reduction.

2014

3 marks – Q7

(b) State and describe the type of reaction in the following chemical equations:

(i) $Fe_{(s)} + CuSO_{4(aq)} \rightarrow FeSO_{4(aq)} + Cu_{(s)}$.

(ii) $Na_2SO_{4(aq)} + BaCl_{2(aq)} \rightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$.

7a. ii) Maswa water because

a) It has high content of Ca^{2+} and Mg^{2+} in its water

b) It has highest content of SO_4^{2-} which cause permanent hardness of water.

iii) - By adding sodium carbonate.

- By Ion exchanger method in industries.

b) i) Displacement reaction because Iron has displaced Copper from its salt to form Iron Sulphate.

ii) Precipitation reaction because the Two aqueous solution of Sodium and Barium reacted to form one soluble salt and insoluble salt of Barium Sulphate.

15. Hardness of Water

2019

5. (a) Distinguish temporary hardness from permanent hardness of water.

(b) With the help of chemical equations, explain how you can remove each type of water hardness in g(a). **(7 marks)**

5. (a) Temporary hardness of water is the hardness of water which can be removed by boiling and its caused by hydrogen carbonates of calcium or magnesium, WHILE, Parmanent hardness of water is the hardness of water which can not be removed by boiling and its caused by sulphates of calcium and magnesium.

(b) (i) Temporary hardness of water can be removed by boiling.

$Ca(HCO_3)_{2(aq)} \xrightarrow{\Delta} CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)}$

(ii) Parmanent hardness of water can be removed by addition of washing soda.

$CaSO_{4(aq)} + Na_2CO_{3(aq)} \rightarrow CaCO_{3(s)} + Na_2SO_{4(aq)}$

2017

3 marks

(b) With the aid of a chemical equation, briefly explain how
(i) temporary hardness of water can be removed by boiling.
(ii) permanent hardness of water can be removed by chemical means.

2016

(b) 25 cm^3 samples of water A, B, C and D were tested with soap solution. The volume of soap solution required to produce a lather that lasted for a minute was recorded. Fresh samples of each were boiled and tested again with soap solution. The results are shown in Table 1.

Table 1

Water sample	Volume of soap solution required (cm^3) before boiling	Volume of soap solution required (cm^3) after boiling
A	5.0	5.0
B	1.0	1.0
C	11.0	8.0
D	9.0	1.0

(i) Which sample probably contains temporary hardness of water only?
(ii) Which sample probably contains both permanent and temporary hardness of water? Give a reason for your answer.

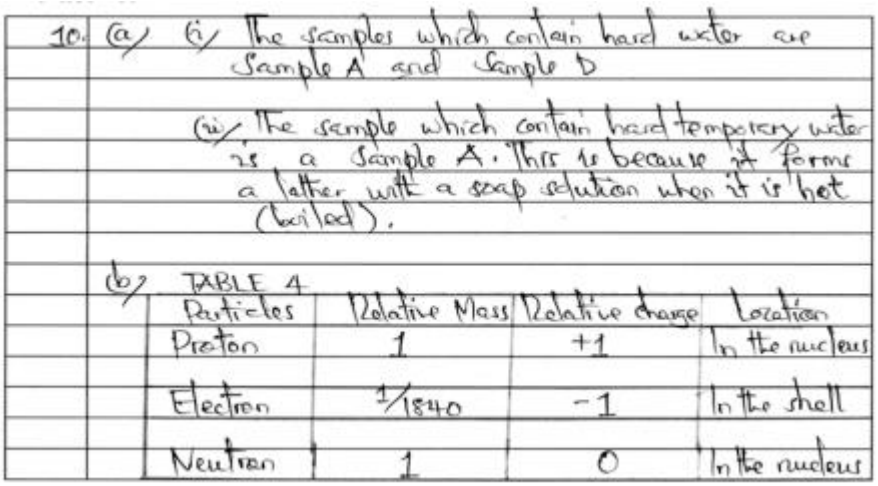
2015

10. (a) A student tested four samples of water, each 5 cm^3 from different areas of Kahama district by shaking with 3 drops of soap solution. The experiment was repeated by boiling each sample of water (5 cm^3) with 3 drops of soap solution. The observations were recorded in Table 3.

Table 3

Sample	Observation with soap solution	Observation for boiled sample with soap solution
A	No later	Lather
B	Lather	Lather
C	Lather	Lather
D	No lather	No lather

(i) Which samples contain hard water?
(ii) Which sample contains temporary hard water? Give a reason.



10. (a) (i) The samples which contain hard water are Sample A and Sample D

(ii) The sample which contain hard temporary water is a Sample A. This is because it forms a lather with a soap solution when it is hot (boiled).

(b) TABLE 4

Particles	Relative Mass	Relative charge	Location
Proton	1	+1	In the nucleus
Electron	1/1840	-1	In the shell
Neutron	1	0	In the nucleus

2014

7. (a) Table 2 gives some information about the composition of three samples of water from wells in Kahama, Maswa and Bukombe districts.

Table 2

Ions	Mineral content of water in mg per litre		
	Kahama	Maswa	Bukombe
Calcium, Ca^{2+}	28	82	18
Magnesium, Mg^{2+}	14	41	13
Chloride, Cl^{-}	53	7	22
Sodium, Na^{+}	7	143	39
Hydrogencarbonate, HCO_3^{-}	281	5	93
Sulphate, SO_4^{2-}	2	14	16

(i) State two ways in which these ions get into the samples of water.
(ii) Giving two reasons, state the hardest sample of water.
(iii) State two ways that can be used to remove ions in (ii).

7a.	ii) Maswa water because a) It has high content of Ca^{2+} and Mg^{2+} in its water b) It has highest content of SO_4^{2-} which cause permanent hardness of water.
	iii) - By adding sodium carbonate. - By Ion exchanger method in industries.
b)	i) Displacement reaction because Iron has displaced Copper from its salt to form Iron Sulphate.
	ii) Precipitation reaction because the Two aqueous solution of Sodium and Barium reacted to form one soluble salt and insoluble salt of Barium Sulphate.

2013

5. (a) Giving four reasons, explain why people who use hard water can expect higher costs than people who use soft water.

16. Acids, bases and salts

2019

4. (a) Distinguish normal salts from acidic salts based on how they are formed.

(b) Give four uses of salts in daily life. **(7 marks)**

4 a)	Normal salt	Acidic salt
	- Is a type of salt which is formed when hydrogen ion are replaced by metal or ammonium ion	- Is a type of salt which is formed when part of hydrogen ion are replaced by metal or ammonium ion
4 b)	i) It is used as fertilizer	
	ii) It increase Food flavour	
	iii) It is used in softening hard water	
	iv) It is used in hospital for joining broken bones	

2018

11. (a) With the aid of a chemical equation, describe how you would prepare pure solid sodium chloride by the action of an acid and a base.

(b) (i) Why petroleum and coal are non-renewable sources of energy?
(ii) Give three alternatives to non-renewable sources of energy.

11a) Pure solid sodium chloride can be prepared as follows:

→ An alkali such as sodium hydroxide (NaOH) is reacted with hydrochloric acid (HCl) to form sodium chloride salt which is aqueous, together with water as follows:

$$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

→ The sodium chloride salt is then purified or crystallized if solid crystals are required as it will evaporate its water of crystallization.

11b) i) Petroleum and coal are non-renewable energy sources because once they are extracted from the earth, they can not be regenerated through natural process for a short time(period).

11b) ii) The alternatives are;

→ Solar energy

→ Geothermal energy

→ Tidal energy.

2018

3. (a) Define the following terms:
   - (i) Neutralization.
   - (ii) Unsaturated solution.
   - (iii) Thermal decomposition.

   (b)
   - (i) List two advantages of liming.
   - (ii) State two roles of climate in soil formation.

3 a/ i/ Neutralization is the reaction between acid and base to form water and salt only.

Example; $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

ii/ Unsaturated solution is the solution which dissolve more solute at a given temperature

iii/ Thermal decomposition is the breaking down of large substance to form smaller substances by using heat.

Example $CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}$

3 (b) i/ Advantages of Liming are:-

- It helps to controll the soil pH to suit the cultivation of crops.

3 (b)i/ • It increase the soil nutrients which are ~~neeee~~ necessary for plant growth.

ii/ Roles of climates in the soil formation:-

1. It facilitates the weathering process, high temperature make easy for weathering to take place through exfoliation. Through exfoliation weathered materials for soil formation are obtained

2. It facilitates the decomposition of organic matters to form humus. Rain water (rainfall) provide moisture, which enable microorganism to decompose organic matters easily.

2017
13 marks

13. Using four examples, explain how the process of neutralization is important in day to day life.

13. Neutralisation is the reaction between acid and base to produce salt and water only. The process of neutralization is important in our daily life since it assists in finding solutions to different problems occuring in our society. These situations include:

Treating insect stings some insects such as wasps or bees can injuin a person by injecting its sting into the body. The wasp sting has acidic components that can harm the body therefore a base is used to neutralize the action of the acid. The base commonly used in baking powder. When the sting is basic, the acid used to neutalize is vinegar.

Treating stomach pains after eating. The pains in the stomach are a result of excessive production of hydrochloric acid in the body. Therefore antacids are normally used to neutralize the hydrochloric acid. The antacids are taken at a calculated amount to ensure that the neutralization process is balanced. The antacids include

13. hydroxides of aluminium and magnesium. The hydroxide of Magnesium is commonly known as Milk of Magnesia.

Regulating soil pH for the proper growth of crops. Most crops grow well in soil with moderate pH. Some soil lower the pH due to acidic rains hence causing them to acidic soils. The acid soils can be treated by putting ashes, dry grasse and leaves. The basic components from ashes, and dry vegetation will neutralize the acidity in the soil to normal neutral pH.

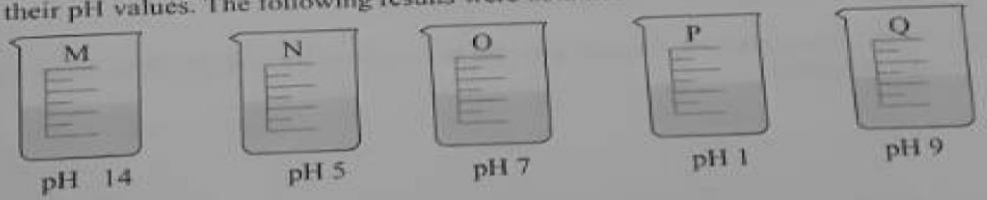
Treating accidental spills most especially in the ~~laboratory~~ laboratory. When acids such as sulphuric or hydrochloric acid have fallen down on the floor, a base can be used to neutralize the acids so that it ~~we~~ will not be having any effect when a person passes there. The bases that are commonly used include ammonium hydroxide and sodium hydroxide.

Conclusively, a ~~neup~~ neutral pH is 7.0. The acidic range of pH is from 0 to 6.5 while the basic range of pH is from 7.5 to 14. In the universal indicator, the acidic pH is characterized with red, orange or yellow colour depending with the strength while the basic pH is having blue, indigo or violet according to the strength of the base. The neutral colour in the universal indicator is Green.

2016

4. (a) Differentiate dilute hydrochloric acid from dilute sulphuric acid.

(b) A student tested five solutions M, N, O, P and Q with a universal indicator solution to find their pH values. The following results were obtained:



Which of the above solutions was?

(i) Neutral solution.
(ii) Strong acid.
(iii) Strong alkali.
(iv) Weak acid.

2015

6. (a) Table 2 indicates the pH values of soil for some crops to grow.

Table 2

Crops	Soil pH
Tomato	7.0
Bean	6.0
Cabbage	5.4
Cauliflower	5.6
Celery	6.3
Lettuce	6.1
Onions	5.7
Swede	5.3
Parsley	5.1

Which crop grows best in the:

(i) Most acidic soil?

(ii) Least acidic soil?

(iii) Neutral soil?

6 a) i) The crop is Parsley

ii) In Least acidic, the crop is celery

iii) In neutral soil, the crop is tomato

b) i) Common salt and water can be separated by simple distillation

ii) Iodine and sand are separated by sublimation

iii) Pieces of iron and sand are separated by the Magnetization method

2015 – Q7

(b) Give three applications of the process of neutralization in daily life.

7. a) i) When concentrated sulphuric acid is exposed to the atmosphere, will absorb water vapour from the atmosphere and become dilute. This is due to its hygroscopic property.

ii) When iron(II) sulphate is exposed to air, it turns from blue/green into brownish. This occur because of the oxidation of iron (II) to iron (III) by oxygen in air. That is $Fe^{2+} \longrightarrow Fe^{3+} + e^-$

iii) When a bottle containing $AgNO_3$ is left open, so whitish precipitate of silver will be formed and the volume of $AgNO_3$ will decrease. This is due to the decomposition of silver nitrate.

That is $AgNO_{3(aq)} \longrightarrow \underset{\text{Precipitates}}{Ag_{(s)}} + NO_{2(g)} + O_{2(g)}$

b) Application of neutralization in daily life

i) Treating/managing the soil pH in farms.

ii) In treating heartburns in which a person may take ashes to neutralize the acid.

iii) When strung by a bee a person may apply ashes to reduce pain.

2014

9. (a) Differentiate between:
   (i) A base and an alkali.
   (ii) Atom and isotopes.

2012

7. (a) (i) People suffering from heart burn usually use wood ashes for relief. Mention characteristic which makes the ashes to be used for heart burn relief.
   (ii) Give four compounds found in laboratories which show the same characteristics as ashes.

17. The Mole Concept and Related Calculations

2019

3. (a) How many chlorine molecules are in 20 cm^3 of chlorine gas at s.t.p.?

   (b) Calculate the number of ions present in 5 g of copper II nitrate. **(7 marks)**

3. a)

Given $20cm^3$ of Cl_2 at s.t.p

from

GMV at s.t.p

1mole of gas = $22.4dm^3$ = $22400cm^3$

$1mol = 22400cm^3$

$Xmol = 20cm^3$

$X = \frac{20cm^3 \times 1mol}{22400cm^3} = 8.93 \times 10^{-4}$ moles

from

$N = n \times L_A$, where N = Number of molecules

n = no of moles

L_A = Avogadro's Constant

$N = 8.93 \times 10^{-4}$ moles $\times 6.02 \times 10^{23}$

$= 5.376 \times 10^{20}$ molecules

∴ There are 5.376×10^{20} molecules of Chlorine gas

8. b) Given

5g of $Cu(NO_3)_2$

$Cu(NO_3)_2 \longrightarrow Cu^{2+} + 2NO_3^-$

1 mole produces three moles of ions

$Cu(NO_3)_2 = Cu + 2(NO_3) = Cu + 2(N+3O)$

$= 64 + 2(14 + 48) = 64 + 2(62)$

$= 188$ g/mol

188g $\longrightarrow$ 3 moles of ions

5g $\longrightarrow$ X moles

$X = \frac{5 \times 3}{188} = 0.07979$ moles

From

$N = n \times L_A$, where N = no of ions

n = no of moles

L_A = Avogadro's constant

$N = 0.07979 \text{ moles} \times 6.02 \times 10^{23}$

$= 4.8 \times 10^{22}$ ions

$N = 4.8 \times 10^{22}$ ions

∴ There are 4.8×10^{22} ions

2018

12. Three moles of nitrogen gas combined with five moles of hydrogen gas to form ammonium gas by the Haber process
    (a) Which reactant is present in smaller amount?
    (b) Calculate the grams of the reactant left in the container.
    (c) How many moles of NH_3 are produced?
    (d) How many litres of NH_3 are produced at STP?

12. Haber process;

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

overall equation.

Given;

3mols - Nitrogen

5 mols - Hydrogen

a) If; 1 mole of $N_2 \longrightarrow$ 3 moles of H_2

3 mols of $N_2 \xrightarrow{\times}$?

x = $\frac{3 \text{ mols of } N_2 \times 3 \text{ mols of } H_2}{1 \text{ mole of } N_2}$

= 9 mols of H_2 will be needed

But there are only 5 mols of Hydrogen gas present.

∴ The reactant which is present in smaller amount is Hydrogen gas.

b) If;

1 mol of $N_2 \longrightarrow$ 3 mols of H_2.

? mols of $N_2 \longrightarrow$ 5 mols of H_2.

x = $\frac{5 \text{ mols of } H_2 \times 1 \text{ mol of } N_2}{3 \text{ mols of } H_2}$.

∴ x = 1.667 mols of Nitrogen are used.

12. b) ∴ 1.667 moles of N_2 are used out of 3 moles.

Remaining moles = 3 mole − 1.667 mols

⇒ 1.333 mols remained.

but; $n = \frac{\text{mass}}{\text{Molar mass}}$

but; Molar mass $N_2 = 2 \times 14$

$\therefore = 28\,g\,mol^{-1}$

$1.333\,mols = \frac{\text{mass}}{28\,g\,mol^{-1}}$

mass = $28\,g\,mol^{-1} \times 1.333\,mols$

= 37.324 grams.

∴ The grams of the reactant left in the container is 37.324 grams.

c) but; 1 mol of $N_2 \longrightarrow$ 3 mols of H_2

? ⟶ 5 mols of H_2

$x = \frac{5\,mols\ of\ H_2 \times 1\,mol\ of\ N_2}{3\,mols\ of\ H_2}$

= 1.667 mols of N_2.

but; 3 mols of $H_2 \longrightarrow$ 2 moles of NH_3

5 mols of $H_2 \longrightarrow$?

$x = \frac{5\,mols\ of\ H_2 \times 2\,moles\ of\ NH_3}{3\,mols\ of\ H_2}$

$= \frac{10\,mols\ of\ NH_3}{3} = 3.333\,mols$

The moles of NH_3 produced are 3.333mol of ammonia gas.

2018

7. (a) Define the following:
   (i) Mole.
   (ii) Molar mass.

(b) 112 dm^3 of oxygen gas was collected at s.t.p. When a sample of lead nitrate was completely decomposed by heat. Calculate the volume of nitrogen dioxide gas produced.

7. a) i) Mole is the amount of substance containing as many particulate entities as there are carbon atoms in 12g of Carbon-12.

7. a) ii) Molar mass is the mass contained in one mole of substance.

b) Data.

Volume of Oxygen = 112 dm^3

Volume of nitrogen dioxide = ?

$2Pb(NO_3)_{2(s)} \longrightarrow 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

∴ Mole ratio Oxygen : Nitrogen dioxide

1 : 4

from, 1 mole contains 22.4 dm^3 at stp

1 mol ≡ 22.4 dm^3

? ≡ 112 dm^3

$$\frac{112\ dm^3 \times 1\ mol}{22.4\ dm^3} = 5\ mol$$

∴ There are 5 moles of Oxygen

from, mole ratio 1 : 4

5 : ?

$$= \frac{5 \times 4}{1} = 20\ mol$$

1 mol — 22.4 dm^3

20 mol — ?

$$\frac{20\ mol \times 22.4\ dm^3}{1\ mol}$$

∴ 448 dm^3

∴ Volume of nitrogen dioxide is 448 dm^3

2017

5. (a) Copper can be obtained from the ore, copper pyrites ($CuFeS_2$). The ore is heated in a limited amount of air giving the following reaction:
$4CuFeS_2 + 11O_2 \rightarrow 4Cu + 2Fe_2O_3 + 8SO_2$.

(i) Calculate the maximum mass of copper that can be obtained from 367 kg of copper pyrites.

(ii) State why the gaseous product from this reaction must not be allowed to escape into the atmosphere.

(b) Find the oxidation state of sulphur in the sulphate ion, SO_4^{2-}.

5 a) Soln

i) $4CuFeS_2 + 11O_2 \rightarrow 4Cu + 2Fe_2O_3 + 8SO_2$

Mass of $CuFeS_2$ = 367kg

↳ (64 + 56 + 64) = 184 g/mol

Cu = 64 g/mol

∴ 4(184 g/mol) of $CuFeS_2$ ⟶ 4(64) g/mol of Cu.

∴ 367,000g of $CuFeS_2$ ⟶ ?

⇒ $\frac{367,000 \times 4(64)}{4(184)}$

= 127,652.29 = 127.65kg

∴ Maximum mass of copper = 127.65 kg.

ii) This is because the gas is harmful to the environment ; that is it is a greenhouse gas which leads to green house effect hence global warming due to trapping of solar radiations preventing them from escaping to outer space thus warming the earth's surface (the lower atmosphere).

b) Soln

SO_4^{2-}

⇒ (S x 1) + (-2 x 4) = -2

⇒ S - 8 = -2

S = -2 + 8

S = +6.

∴ Oxidation state of sulphur is +6.

2016

13 marks

13. 0.48 g of a metal, **M** was placed in a test tube and hot copper (II) sulphate solution was added to it and stirred until the reaction stopped. The metal (**M**) displaced copper from copper (II) sulphate solution. Copper was filtered, washed with water, dried at 100°C and the mass found to be 1.27 g. Given that, the balanced chemical reaction that occurred is $M_{(s)} + CuSO_{4(aq)} \longrightarrow MSO_{4(aq)} + Cu_{(s)}$.

(a) Calculate;

(i) the number of moles of copper that were formed and the number of moles of **M** that were used in the reaction.

(ii) the relative atomic mass of **M** and hence identify metal **M**.

(b) State the appearance of the metal formed (Cu).

(c) With ionic equations, explain why the reaction can be considered to involve both oxidation and reduction.

2014

3 marks each

10. (a) Aluminium reacts with oxygen to form aluminium oxide. How many grams of potassium chlorate would be heated to produce enough oxygen to form 5.1 g of aluminium oxide?

(b) The preparation of chlorine gas can be represented by the following equation: $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_20 + Cl_2$. How many moles of HCl are needed to react with 25 g of MnO_2?

10(b) Given.

$MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$.

Molar mass of MnO_2 = $Mn + 2O$

= $55 + (2 \times 16) = 55 + 32$

= 87 g/mol.

Moles = $\frac{\text{Mass}}{\text{Molar mass}} = \frac{25\text{ g}}{87} = 0.287$ moles

So, 25 g of MnO_2 has 0.287 moles.

So,

1 mol of MnO_2 reacted with 4 moles of HCl.

0.287 moles X x

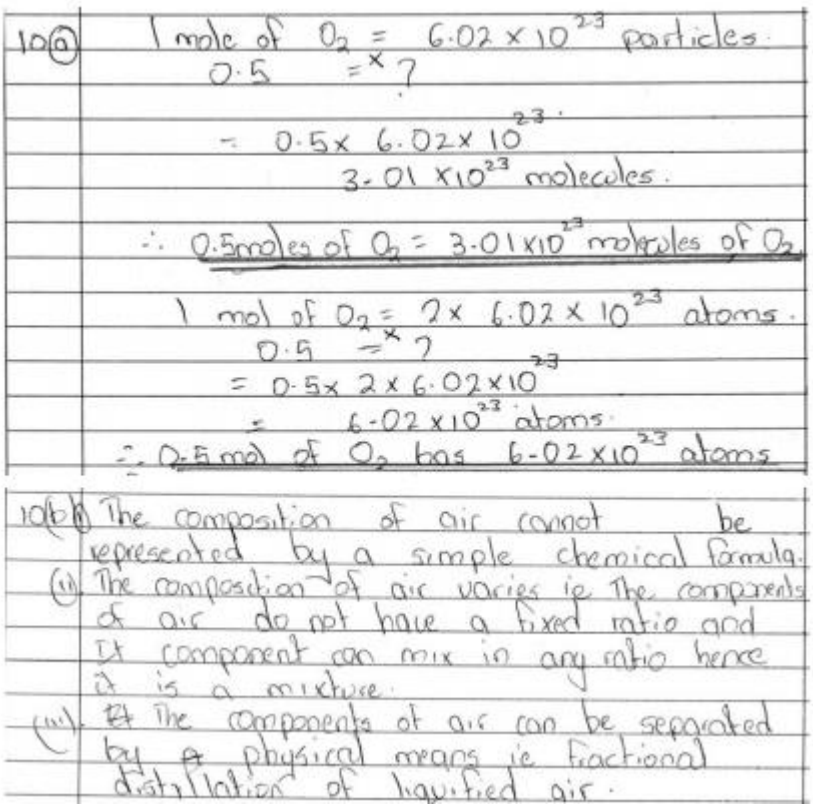
$x = 0.287 \times 4$

$x = 1.148$ moles

∴ 1.148 moles of HCl are needed to react with 25 g of MnO_2.

2013

10. (a) Calculate the number of oxygen molecules and atoms in 0.5 moles of oxygen gas at room temperature.



2012

(b) How many molecules are there in 11.2 litres of carbon dioxide at STP?

18. Volumetric Analysis

2020

8. (a) Calculate the concentration in g/dm^3 of vinegar (CH_3COOH) if 25.0 cm^3 of 0.1 M sodium hydroxide reacts with 12.5 cm^3 of vinegar.

(b) By giving a reason, suggest the suitable indicator for the reaction in 8(a) above.

(7 marks)

8. (a). From chemical formula.

$CH_3COOH_{(aq)} + NaOH_{(aq)} \longrightarrow CH_3COONa_{(aq)} + H_2O_{(l)}$

1 : 1 : 1 : 1

M_a = required.

$M_b = 0.1\ mol/dm^3$

$V_a = 12.5\ cm^3$

$V_b = 25.0\ cm^3$

from $\frac{M_aV_a}{M_bV_b} = \frac{n_a}{n_b}$.

$\frac{M_aV_a}{n_a} = \frac{M_bV_b}{n_b}$.

$\frac{M_a \times 12.5}{n_a} = \frac{0.1 \times 25}{1}$

$\frac{M_a \times 12.5}{1} = 0.1 \times 25$.

$12.5\ M_a = 2.5$

$M_a = 2.5 / 12.5$

$= 0.2\ M$.

from Molarity $= \frac{conc}{mr}$

Molarmass of CH_3COOH

$= 2 \times 12 + 4 + 16 \times 2$

$= 24 + 4 + 32$

$= 60\ g/mol$.

$0.2 = \frac{x}{60}$

$0.2 \times 60 = x$

$x = 12\ g/dm^3$.

∴ The concentration of the acid is $12\ g/dm^3$.

(b) Suitable indicator is P.O.P (phenolphthalein indicator)

Because the neutralization involves vinegar which is weak acid and sodium hydroxide which is a strong base.

i.e Weak acid + strong base.

2020

5. (a) What is the molarity of a solution containing 10% by mass of calcium hydroxide in 0.5 dm^3 of solution?

(b) 25 cm^3 of a molar solution of sodium hydroxide is diluted to 85 cm^3. Calculate the concentration of the solution after dilution. (Give your answer in two decimal places).

(7 marks)

5. a) solution,

V. of solution = $0.5\,dm^3$.

Molar mass = $Ca(OH)_2$.

= $40 + 17 \times 2 = 40 + 34 = 74\,g/mol$.

Mass = 10% of molar mass.

= $\frac{10}{100} \times 74 = 7.4\,g$.

Concentration = mass / volume

= $7.4 / 0.5\ g/dm^3$.

= $14.8\ g/dm^3$

Molarity = $\frac{\text{Concentration}}{\text{molar mass}}$

= $\frac{14.8}{74}$

= $0.2\,M$.

∴ Molarity of solution = $0.2\,M$.

5. b) solution;

Data

$V_b = 25\,cm^3$.

$V_d = 85\,cm^3$.

Molar solution = $1\,M = M_b$.

Concentration after dilution = ?.

From;

$M_b V_b = M_d V_d$.

$1 \times 25 = M_d \times 85$.

$M_d = \frac{25}{85}$

$M_d = 0.29\,M$.

∴ Concentration after dilution = $0.29\,M$.

2017

3 marks – Q9

(b) Calculate the volume of water which was produced when 1,120 cm^3 of oxygen at s.t.p. was liberated during the decomposition of hydrogen peroxide. The density of water = 1.0 g/cm^3.

09. a) i, The number of

- Protons is 14
- Neutrons is 14

ii, Electronic configuration of M is 2 : 8 : 4

09. b) Reaction equation for the decomposition is

$$[2H_2O_{2(aq)}] \longrightarrow [2H_2O_{(l)}] + [O_{2(g)}]$$

From the equation.

2 moles of H_2O_2 produced 1 mole of O_2

2 moles of H_2O_2 ≡ 1 mole of O_2

But 1 mole of a gas at S.t.p = $22.4dm^3$

∴ 2 moles of H_2O_2 ≡ $22.4dm^3$

n ≡ $1.12dm^3$

$$n = \frac{1.12 \times 2 \text{ moles}}{22.4}$$

n = 0.1 mole.

∴ The amount of H_2O_2 decomposed was 0.1 mole.

Then: 2 moles of H_2O_2 ≡ 2 moles of $2H_2O$.

2 moles of H_2O_2 ≡ 2 (2H + O)

≡ 2 (18)

≡ 36g.

2 moles of H_2O_2 ≡ 36g

0.1 mole of H_2O_2 ≡ g

$$g = \frac{0.1 \text{ mole} \times 36g}{2 \text{ moles.}}$$

∴ g = 18g mass of water produced

09 b) But from:

Density = mass / volume where density of water = 1 g/cm³

Volume = mass / density

Volume = 1.8 g / 1 g/cm³

= 1.8 cm³

∴ The volume of water produced was 1.8 cm³

13 Marks

12. A student attempted to prepare hydrogen gas by reacting zinc metal with dilute sulphuric acid. In this experiment zinc metal granules of about 0.5 cm diameter and 0.20 moles of acid were used. The rate of formation of hydrogen gas was found to be slow.

(a) Explain three ways in which the rate of formation of hydrogen gas could be increased.

(b) If the student wanted 36 cm^3 of hydrogen gas at s.t.p, what amount of the acid would be required.

12. a) The rate of formation of hydrogen gas could be increased by;

i) Increasing the temperature.

As you increase the temperature in the reaction, the particles gain kinetic energy which inturn makes the particles to move side to side and collide thereore increasing the rate of hydrogen gas produced.

ii) Increasing the concentration of the acid.

The sulphuric acid used once increased its concentration more hydrogen gas would be produced at a time. Example the use of concentrated sulphuric acid would increase the rate of formation of hydrogen gas.

12a) iii) Increasing the surface area of the zinc granules.

As you increase the surface area of the zinc granules, more of the zinc would react easily with the acid hence formation of more hydrogen gas. This can be done by decreasing the diameter of the zinc granules.

b) Data given;

number of moles of acid = 0.20 moles.

Volume of hydrogen gas = 36 cm^3.

Equation:-

$$Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$$

number of moles = $\frac{\text{Volume of } H_2}{\text{G.M.V}}$

$= \frac{36\,cm^3}{22.4\,dm^3/mol}$

$= \frac{0.036\,dm^3}{22.4\,dm^3/mol}$

$= \left(\frac{36}{22400}\right)$ moles

$= 0.0016$ moles of $H_{2(g)}$

1 mole $H_2SO_4 \longrightarrow$ 1 mole of $H_{2(g)}$

1 : 1

number of moles of H_2SO_4 is 0.0016

2015 – Q8

(b) Suggest a suitable indicator for the following titrations:

(i) Hydrochloric acid against ammonia solution.

(ii) Sulphuric acid against sodium hydroxide solution.

(iii) Ethanoic acid against potassium hydroxide solution.

8. a) i) The chemical that would be used is hydrogen peroxide using Manganese dioxide catalyst. And also Copper nitrate by thermal decomposition.

TEST OF OXYGEN GAS

- When a glowing wooden splint is brought near oxygen it is relighted this tests the presence of oxygen gas.

ii) a) HCl reacted with metal (Na) Extra

b) H_2SO_4 reacted with metal (Mg)

=> the TEST OF THE GAS.

When a glowing wooden splint is brought at the top of test tube containing hydrogen gas it burns with pop sound.

iii) a) When $NaHCO_3$ is reacted with HNO_3.

ii) When $MgCO_3$ is reacted with ~~HCl~~. Hcl.

THE TEST OF THE GAS

When lime water on a glass rod gets exposed to carbon dioxide turns milky this is due to precipitates of calcium carbonate.

b) i) Methyl orange will be suitable since it is a strong acid and a weak base.

ii) Any indicator such as methyl orange and phenolphthalein will be suitable since it involves a strong acid and a strong base.

iii) Phenolphthalein indicator will be suitable since it involves weak acid and strong base.

2014

4. (a) 20 cm^3 of a solution containing 7 g dm^{-3} of sodium hydroxide were exactly neutralized by 25 cm^3 of 0.10 M hydrochloric acid. Calculate the concentration of sodium hydroxide in moles per dm^3.

4 (a) Data given
Volume of base = 20cm^3 (V_B)
Volume of Acid = 25cm^3 (V_A)
Molarity of Base = ? (M_B)
Molarity of Acid = 0.1 M

From the balanced chemical equation
$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

Number of moles of Base (n_B) = 1
Number of moles of Acid (n_A) = 1

By using
$\frac{M_A V_A}{M_B V_B} = \frac{n_A}{n_B}$ but $n_A = n_B = 1$

Then
$M_B = \frac{M_A V_A}{V_B} = \frac{0.1 \times 25}{20} = \frac{0.5}{4} = \frac{5}{40}$

$\therefore M_B = 0.125\ M$

but concentration of NaOH is moles per dm^3
= Molarity = $\frac{\text{concentration}}{\text{Molar mass}}$ but Mr of NaOH = 40

$\therefore$ concentration (mol/dm^3) = 0.125 × 40
= 5 mol/dm^3

(b) (i) heterogeneous solution examples are Water gas and producer gas

(ii) Solid Solution examples are Bronze and Brass

2013

8. (a) 25 cm^3 of 0.1 M HCl were neutralized by 23 cm^3 of sodium hydroxide solution. Calculate the concentration of the alkali in grams per litre.

2011

(b) The thermal decomposition of calcium carbonate can be represented by the following equation: $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$. Calculate the volume of carbon dioxide (measured at s.t.p) liberated when 150 g of calcium carbonate are completely decomposed.

(b) With reasons suggest suitable indicators for the titrations of sodium hydroxide against sulphuric acid and ammonia solution against hydrochloric acid.

19. Ionic Theory and Electrolysis

2020

9. A Form Three student conducted an experiment to prepare a gas in the laboratory by decomposing a certain compound using electricity. She allowed a steady electric current to flow through the solution for 3 hours at s.t.p. If the volume the gas obtained was 4.12 dm^3 and the gas relighted a glowing splint;

(a) name the gas that was produced.

(b) calculate the electric current that was flowing in the solution. **(7 marks)**

9.a) The gas produced was Oxygen gas.

b) Soln

Volume of gas produced (Vol) = $4.12dm^3$

Time taken (t) = 3 hours. (10800 seconds)

Electric current flowed (I) = Required

$M = \frac{Q}{VF} \cdot \frac{Mr}{1}$ $\quad \frac{M}{Mr} = \frac{Q}{VF}$ $\quad n = \frac{Vol}{GMV}$

$n = \frac{Q}{VF}$ ①

$\frac{Vol}{GMV} = \frac{Q}{V \times F}$

Quantity of charge $= \frac{Vol \times V \times F}{GMV}$

$= \frac{4.12dm^3 \times 4 \times 96500\,C}{22.4dm^3}$

Taken that the oxidation was, $4OH^-_{(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)} + 4\bar{e}$

9. b) Quantity of charge = 70996.42857 C

Quantity of charge = Current (I) × Time taken (t)

$70996.42857C = I \times 10800s$

$I = \frac{70996.42857C}{10800s}$

$I = 6.574A$

∴ The current that was flowing was 6.574A.

2017

3 marks – Q10

(b) How long a current of 5A should be passed through a solution of silver chloride in order to deposit 3.24 g of silver metal at the cathode? Given that, the electrochemical equivalent of silver = $1.118 \times 10^{-3} ge^{-1}$.

10. (a) (i) $Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$

This is displacement reaction

(ii) $AgNO_{3(aq)} + NaCl_{(aq)} \longrightarrow AgCl_{(s)} + NaNO_{3(aq)}$

This is precipitation reaction.

(iii) $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$

This is Combination reaction

10 (b) Given values

Electric current (I) = 5A

Mass of deposited metal of Silver (m) = 3.24g

Electrochemical equivalent of Silve (Z) = $1.118 \times 10^{-3} gc^{-1}$

time taken (t) = ?

Solution:

$Q = It$

$m = ZIt$ where m = Mass of Silver

Z = Electrochemical equivalent of Silver

I = Current

t = time taken

$m = ZIt$

$\frac{m}{ZI} = \frac{ZIt}{ZI}$ $t = m/ZI$

$t = \frac{3.24g}{1.118 \times 10^{-3} g/c \times 5A}$

$t = \left(\frac{3.24}{5.590 \times 10^{-3}}\right) s$

$t = \left(\frac{3.24 \times 10^{3}}{5.590 \times 10^{-3}}\right) s$

$t = (0.5796 \times 10^{3}) s$

$t = 579.6s$

$\therefore$ time taken is 579.6 seconds

(b) State three industrial application of electrolysis.

2016

(b) (i) Draw a labelled diagram of a simple electrolytic cell which show how copper is purified.

(ii) Write balanced ionic equations to show the electrode reactions which occur when copper is purified.

2015

11. (a) A steady current of 2A was passed through a solution containing ions of a metal (X^{2+}) for nine minutes. The mass of metal X that was liberated were 0.3552 g. Calculate the molar mass of metal X.

11. (a) Solution

Data given

Current, $I = 2A$

Metal, X^{2+}

time, $t = 9\ min\ (9 \times 60\ sec)$

Mass, $m = 0.3552\ g$, R.A.M of $X = ?$

Then, from 1st Law of electrolysis

$m = ZIt$

$\therefore Z = \frac{m}{It}$

$= \frac{0.3552g}{2A \times 540s}$

$Z = 3.3 \times 10^{-4}\ g/c$

But

$Z = \frac{RAM}{V \times F}$ $\quad V = 2$, $F = 96500C$

$\therefore RAM = Z \times V \times F$

$= 3.3 \times 10^{-4}\ g/c \times 2 \times 96500C$

$= 3.3 \times 2 \times 9.65 \times 10^{-4} \times 10^{4}$

$= 63.69\ g/mol$

$\approx 64\ g/mol$

$\therefore$ The Molar mass of element X is approximately to be 64 g/mol.

2014

13 marks

12. Assume that you are a chemist in a chemical plant that deals with the production of chlorine gas. You want to produce 100 litres of chlorine gas per hour so that you can reach the company's goal of producing 2400 litres every day. What current of electricity will you allow to flow per hour?

12: from the firs faraday's first law of electrolysis

$M \propto Q$.

where Q = Quantity of charge
M = mass of substance.

12: $m = \frac{Ar\,It}{V \cdot f}$.

Where Ar = relative atomic mass of element.
I = current
t = time
V = valency of an element
f = faraday's.

... remember that 1 hour = 3600sec

$I = \frac{316.9449 \times 1 \times 96500\,C}{36.5 \times 3600}$

$I = \frac{30585096}{127800}$

$I = 239.32A$

∴ the current of electricity will you allow to flow per hour is 239.32A

2013
3 marks

9. (a) A current of 0.5 A were made to flow through silver voltameter for 30 minutes. Calculate the mass of silver deposited and the equivalent weight of silver.

9. (a) Given:

Current = 0·5A

time = 30 min × 60 = 1800s

Mass = ?

Equivalent weight = ?

From Mass = $\frac{Ar \times It}{V \times F}$

$= \frac{108 \times 0{\cdot}5 \times 1800s}{1 \times 96500}$

∴ Mass of silver liberated = 1g.

Equivalent weigh = $\frac{Ar}{V}$

$= \frac{108}{1}$

∴ Equivalent weight of silver = 108g.

(b) (i) Addition reaction.

Is the reaction of unsaturated hydrocarbon where by double or tripple bond are broken to form single bond.

Example $C_2H_4 + H_2 \xrightarrow{\text{nickel}} C_2H_6$

ethene methane.

2012

3 marks each

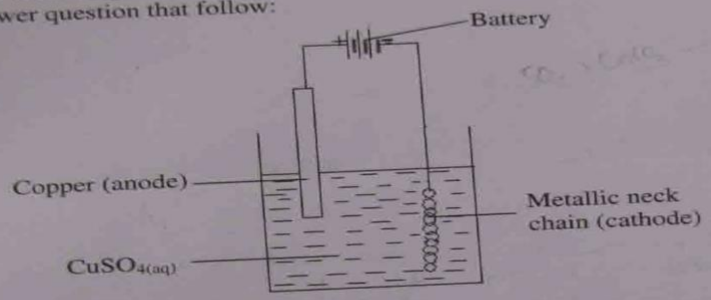
5. (a) A solution of sodium hydroxide was electrolysed using platinum electrodes. Write the reactions which took place at the electrodes and give a reason why the solution becomes alkaline.

(b) Electric current was passed through a solution of sodium hydroxide using platinum electrodes. Draw a labelled electrolytic cell for this electrolysis. Indicate the directions of the movement of ions.

2011

11. (a) 289500 coulombs were required to deposit one mole of a metallic element Q from its aqueous salt solution. Calculate the valence of Q.

(b) The following experiment was used to electroplate a metallic neck chain. Study it and answer question that follow:



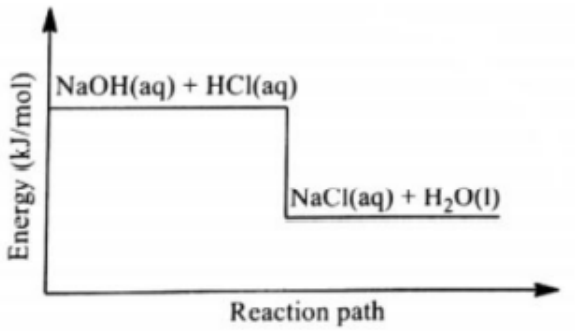
Explain what happened to the anode and cathode and write ionic equations for the reactions which occurred at the electrodes.

20. Chemical Kinetics, Equilibrium and Energetics

2020

12. (a) Ammonia gas is manufactured by reacting nitrogen gas with hydrogen gas in the presence of a catalyst. Write a balanced chemical equation for the reaction and explain the role played by the catalyst in this reaction.

(b) The following figure shows the reaction path between sodium hydroxide and hydrochloric acid.



Giving a reason, classify the reaction based on energetics and predict the effects of cooling the system while increasing pressure at the same time. **(7 marks)**

12. a) $N_{2(g)} + 3H_{2(g)} \xrightarrow{\text{finely divided Fe}} 2NH_{3(g)}$

The role of the finely divided iron catalyst is to speed up the rate of forward reaction inorder to produce more ammonia gas.

b) The reaction is Exothermic.

Because the energy value of the reactants is greater than the products therefore there is some excess energy lost to the surrounding in form of heat in converting the reactants to the products thus it is an exothermic reaction.

By cooling the system the rate of the reaction will increase because the reaction is exothermic so it is favoured by low temperature but increasing pressure

b) will have no effect on the rate of reaction because the moles on the left side of the equation and of the right are equal.

2019

6. In the industrial preparation of sulphur trioxide, equilibrium is established between sulphur dioxide and oxygen gas as follows:

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ $\Delta H = -94.9$ kJ/mol

(a) (i) Is the forward reaction an endothermic or exothermic process? Give a reason.

(ii) How would you adjust temperature and pressure to maximize the proportion of the product at equilibrium?

(b) (i) Why is it unfavourable to work with very high pressure and very low temperature in the Contact process?

(ii) What catalyst is used to speed up the rate of formation of sulphur trioxide before attaining equilibrium? **(7 marks)**

6. a) i) Foward reaction is exothermic due to negative heat change. This means the reaction liberate heat energy to the surroundings.

ii) - I will decrease the temperature so as to increase the production of $2SO_3$. This is because decrease in temperature will cause foreard reaction to be dominant. All this is because the reaction is exothermic.

6. a) ii) - I will increase the pressure so as to maximize proportions of product. This is because increase in pressure favours the reaction forming fewer molecules. Hence, due to increase in pressure, foward reaction will be favoured.

b) i) It is because using very high pressure is very expensive. Also, using low temperature will cause the reaction to take a long period of time.

ii) Catalyst used is Vanadium Pentaoxide (V_2O_5).

2017

12. A student attempted to prepare hydrogen gas by reacting zinc metal with dilute sulphuric acid. In this experiment zinc metal granules of about 0.5 cm diameter and 0.20 moles of acid were used. The rate of formation of hydrogen gas was found to be slow.

(a) Explain three ways in which the rate of formation of hydrogen gas could be increased.

(b) If the student wanted 36 cm^3 of hydrogen gas at s.t.p, what amount of the acid would be required.

12. a) The rate of formation of hydrogen gas could be increased by;

i) Increasing the temperature.

As you increase the temperature in the reaction, the particles gain kinetic energy which inturn makes the particles to move side to side and collide thereore increasing the rate of hydrogen gas produced.

ii) Increasing the concentration of the acid.

The sulphuric acid used once increased its concentration more hydrogen gas would be produced at a time. Example the use of concentrated sulphuric acid would increase the rate of formation of hydrogen gas.

12a) iii) Increasing the surface area of the zinc granules.

As you increase the surface are of the zinc granules, more of the zinc would react easily with the acid hence formation of more hydrogen gas. This can be done by decreasing the diameter of the zinc granules.

b) Data given;

number of moles of acid = 0.20 moles.

Volume of hydrogen gas = 36 cm^3.

Equation;

$$Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$$

$$\text{number of moles} = \frac{\text{Volume of } H_2}{\text{G.M.V}}$$

$$= \frac{36\,cm^3}{22.4\,dm^3/mol}$$

$$= \frac{0.036\,dm^3}{22.4\,dm^3/mol}$$

$$= \left(\frac{36}{22400}\right) \text{ moles}$$

$$= 0.0016 \text{ moles of } H_{2(g)}$$

1 mole H_2SO_4 ⟶ 1 mole of $H_{2(g)}$

1 : 1.

number of moles of H_2SO_4 is 0.0016

3 marks – Q8

(b) Hydrogen peroxide breaks down slowly to form water and oxygen; the reaction can be speed up by using a catalyst.

(i) How does the catalyst speed up the rate of reaction?

(ii) Name a possible catalyst that can be used to speed up the reaction.

(iii) Show that the catalyst always remains unchanged at the end of the reaction.

8 a) i) Compounds which are gaseous at room temperature are $CH_2=CH_2$ and $CH_3CH_2CH_3$

ii) $CH_3CH_2CH_3$ can be distinguished from $CH_2=CH_2$ as $CH_2=CH_2$ decolorises Potassium permanganate solution forming CH_2OHCH_2OH whereas $CH_3CH_2CH_3$ can not decolorize the $KMnO_4$ solution

iii) A compound which will react with Na_2CO_3 is CH_3COOH as per equation

$$2CH_3COOH_{(aq)} + Na_2CO_{3(s)} \longrightarrow 2CH_3COONa_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

b) i) The catalyst speeds up the rate of reaction by lowering the activation energy, that is the minimum amount of energy required to start a reaction. Since the activation energy is lowered, the rate of reaction increases.

8 b) ii) The possible catalyst is MnO_2 (Manganese(IV) oxide)

iii) The possible catalyst used remains unchanged chemically as the amount of catalyst (MnO_2) before reaction is the same even at the end of reaction as per equation

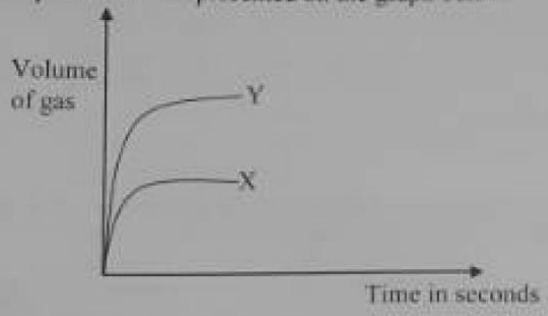
$$2H_2O_{2(aq)} + MnO_{2(s)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + MnO_{2(s)}$$

Overall reaction: $2H_2O_{2(aq)} \xrightarrow{MnO_2} 2H_2O_{(l)} + O_{2(g)}$

Hence the catalyst remains unchanged.

2016

(b) John measured the volume of gas produced when 5 g of two chemicals X and Y were added separately to hydrogen peroxide under identical conditions. His results for this experiment are represented on the graph below.



John claimed that Y is a better catalyst than X. His partner Steven did not agree.

(i) Why does Steven think that John's conclusion is wrong?

(ii) After the experiment, Steven recovered 5 g of X and 1 g of Y from the two experiments. He claimed that this shows that John was wrong. Does Steven's claim true? Give a reason.

2015 – Q4

(b) The reaction which produces methanol from carbon monoxide and hydrogen is represented by the equation $CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$ $\Delta H = -94kJmol^{-1}$. The reaction is carried out at high pressure to give a good yield of methanol.

(i) Explain why increase in pressure gives a better yield of methanol.

(ii) The value of ΔH is negative. What does this tell about the reaction?

(iii) With a reason, state whether a high temperature or low temperature will give a better yield of methanol.

4a) Coal
Wood
Charcoal

4aii) Producer gas, Watergas, Natural gas

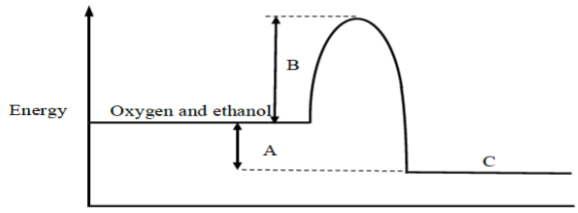
4b) Increase in pressure gives a better yield of methanol because pressure affects the side where there is high number of molecules In case of the reaction given, the reactants have more molecules than the product (methanol), hence due to high pressure, the reaction will be more forward and therefore more methanol will be produced and yielded.

4bii) The reaction is exothermic, this means low temperature favours more forward reaction in the equation given since exothermic reaction is the reaction which proceeds by releasing temperature to the environment hence needs low temperatures for the reactants to yield the product.

4biii) A high temperature will not give a better yield of methanol since the equation involves exothermic reaction. While low temperature will favour or give better yield of methanol due to the nature of the reaction (exothermic)

2014 – Q11

(b) Oxygen and ethanol react to produce carbon dioxide and water according to the following energy level diagram:



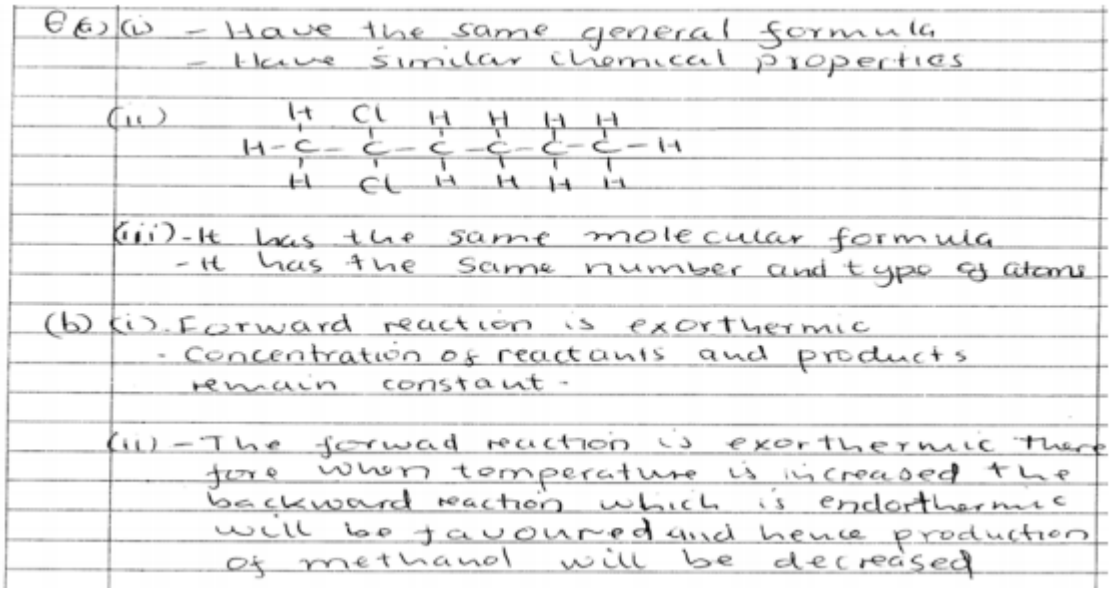
(i) What is represented by letter A, B and C?

(ii) What type of reaction is represented by this energy level diagram?

2013 – Q6

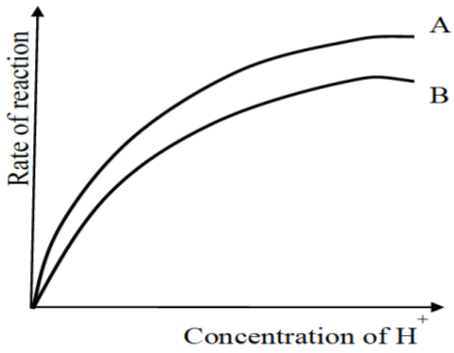
(b) Carbon monoxide and hydrogen are used in the manufacture of methanol and the equilibrium is established according to the following equation.
$CO_{(g)} + 2H_{2(g)} \leftrightharpoons CH_3OH_{(g)}$ $\Delta H = -80$ kJ mol^{-1}.

(i) Give two features of the reaction at equilibrium.
(ii) Explain why an increase in temperature causes a decrease in equilibrium yield of methanol.



2012

9. Two experiments were carried out using the same mass of magnesium ribbon and the same volume of acids of the same concentration. The acids were 1M hydrochloric acid and 1M ethanoic acid. The results were as shown in the following figure:



(a) If the experiments were conducted within the same time, is there a difference in volumes of hydrogen gas collected at the same room temperature and pressure? Give reasons for your answer.

(b) When same mass, volume and concentration of powdered magnesium and ethanoic acid are allowed to react, new graph is formed. Giving reason (s), suggest the position of that graph whether will be above, between or below graphs A and B.

2011
13 marks

12. Consider the following equation:

$A_{(g)} + B_{(g)} \rightleftharpoons D_{(g)} \quad \Delta H = - X \text{ kJ}.$

Use Le Chatelier's principle to describe how the rate of production of D can be altered.

21. Extraction of Metals

2019

14. Explain six measures for minimizing the environmental degradation caused by extraction of metals in tanzania.

14. Extraction of metals is the obtaining of metals from their ores underground. These metals are extracted by drilling, undergroundmining to the ores which contain such metals. Example Iron can be extracted from the following ores namely haematite (Fe_2O_3), Magnetite (Fe_3O_4) Iron pyrites (FeS_2), Copper can also be extracted from Copper pyrites ($CuFeS_2$). On the other hand Sodium can be extracted from rock salts like (NaCl) Sodium chloride. In Tanzania, metals are extracted in most regions since there is gold, Tanzanite (Arusha), aimong others. The following are the six measure to minimize degradation caused by extraction of metals in Tanzania;

The government should enforce laws and policies to those people who extract minerals without protecting the environment, forexample those using bombs, explosives in the extraction of metals. The government should ensure that all activities concerning extraction of metals are carried in areas set for such activities and not anywhere predicted to have such metals.

Creation of public awareness on the importance of the environment by encouraging miners to use proper methods of extraction of metals so as to minimise the degradation of the environment. People should be educated to plant trees whenever they cut trees and also plant trees in areas with no trees so as to avoid soil erosions among a few.

Holes, pits and drills made during extraction of metals should be filled with the soil and rocks so as to avoid soil erosion after the completion of extracting the metals. Holes and pits should not be left unfilled because they may cause death of people, animals (both wild and

14. domestic animals. This will also prevent water logging which becomes breeding sites of mosquitoes that cause malaria to human beings.

Employment of new methods of extracting metals from their ores which do not involve the use of bombs and explosives to break the hard rocks so as to reduce the degradation of the environment. The methods to be used in extraction should be those of less effects to the environment such as placer mining methods.

Regular maintenance and checkups of the machines such as drillers, caterpillars, scarvetors, lorriess and heavy tracks used in mining activities so that they emit less smoke to the environment. The exhaust systems of the machines should be well maintained so that harmfull gases or heavy smokes are lowly emitted to the environment.

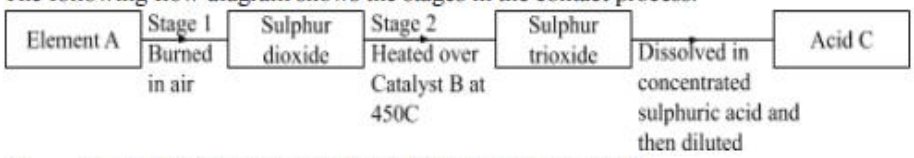
Using sustainable sources of energy such as natural gas, water energy, wind energy in activities concerning extraction of metals so as to run heavy machines, Trucks among a few. Sustainable energy sources produces little or no at smoke to the environment when compared to coal and petrol. This will reduce the degradation of the environment.

Conclusively, so as to protect the environment from destruction through extraction of metals, people should be educated on the importance of the environment, avoid deforestation, maintenance of the machines regularly and lastly the government should enforce laws and policies so as to curb those who will destruct the environment in one way or another.

2018

4. (a) Copper obtained from copper pyrites ($CuFeS_2$) is impure for electrical wiring and has to be purified by electrolysis.
   (i) Name the electrolyte and the electrodes used during electrolysis.
   (ii) Write the observations that can be made during the electrolysis.

   (b) The following flow diagram shows the stages in the contact process.



   (i) Give the names of element A, catalyst B and an acid C.
   (ii) Write a balanced chemical equation for the formation of sulphur trioxide in stage 2.

4. a) Electrolysis of copper from Copper Pyrites ($CuFeS_2$)

i) Required

Electrolyte - Copper (II) Sulphate solution

Electrodes - Blister copper/impure copper serving as an anode

- Pure copper rod which serve as the cathode.

4. a) ii) Observations during electrolysis

The anode (blister copper) dissolves into solution leaving other substances which are not copper. In this Copper atoms are oxidized to Copper ions according to equation

$$Cu_{(s)} \longrightarrow Cu^{2+}_{(aq)} + 2e^-$$

Also the mass of cathode (Pure copper rod) will be increasing due to deposition of copper atoms around it as result of reduction of Copper ions from solution in respect to equation

$$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$$

lastly, the blue colour of copper two sulphate will remain unaltered to end of chemical electrolysis because no ions are drawn from it but drawn from anode and deposited to cathode

b) i) Names

Element A is Sulphur

Catalyst B is Vanadium Pentaoxide

Acid C is Concentrated Sulphuric acid

ii) equation for SO_3 formation

$$2SO_{2(g)} + O_{2(g)} \xrightarrow[450^{\circ}C]{V_2O_5} 2SO_{3(g)}$$

2017

3 marks

4. (a) State four steps employed in the extraction of moderate reactive metals.

4. a) The steps which used to extract moderate reactive metals.

i. Concentration of the ore.
- Here we remove earth impurities.

ii. Roasting of the ore
- Here the ore is heated in presence of oxygen mordet to get metal oxide and remove sulphides

iii. Reduction of the ore.
- The obtained ore is reduced by using carbon monoxide and other agents in order to get free element

$Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(aq)} + 3CO_{2(g)}$

iv. Purification of the metal.
- The obtained metal is purified to remove remained contaminants in order to make it pure.

b) chlorine reacts with water to form Chloric (1) acid and Hydrogen chloride gas.

$Cl_{2(g)} + H_2O_{(l)} \rightarrow HOCl_{(aq)} + HCl_{(g)}$

4 b) ii. The gas reacts with aqueous iron (II) chloride by oxidizing it to iron (III) chloride and colour turns from light green to reddish brown.

$Cl_{2(g)} + 2FeCl_{2(aq)} \rightarrow 2FeCl_{3(aq)}$

(Light green) (reddish-brown)

iii. The gas reacts with hydrogen sulphide by ~~oxidizing~~ reducing ~~to~~ with sulphur to element and it self reduced to Hydrogen chloride gas. Yellow precipitate is observed of sulphur metal.

$Cl_{2(g)} + H_2S_{(g)} \rightarrow 2HCl_{(g)} + S_{(s)}$

(Yellow ppt)

5. (a) Copper can be obtained from the ore, copper pyrites ($CuFeS_2$). The ore is heated in a limited amount of air giving the following reaction:
$4CuFeS_2 + 11O_2 \rightarrow 4Cu + 2Fe_2O_3 + 8SO_2$.

(i) Calculate the maximum mass of copper that can be obtained from 367 kg of copper pyrites.

(ii) State why the gaseous product from this reaction must not be allowed to escape into the atmosphere.

5 a) Soln

i) $4CuFeS_2 + 11O_2 \rightarrow 4Cu + 2Fe_2O_3 + 8SO_2$

Mass of $CuFeS_2$ = 367kg

↳ (64 + 56 + 64) = 184 g/mol

Cu = 64 g/mol

∴ 4(184 g/mol) of $CuFeS_2$ ⟶ 4(64) g/mol of Cu.

∴ 367,000g of $CuFeS_2$ ⟶ ?

$$\Rightarrow \frac{367,000 \times 4(64)}{4(184)} = 127,652.29 = 127.65kg$$

∴ Maximum mass of copper = 127.65 kg.

ii) This is because the gas is harmful to the environment; that is it is a greenhouse gas which leads to green house effect hence global warming due to trapping of solar radiations preventing them from escaping to outer space thus warming the earth's surface (the lower atmosphere).

b) Soln

SO_4^{2-}

$\Rightarrow (S \times 1) + (-2 \times 4) = -2$

$\Rightarrow S - 8 = -2$

$S = -2 + 8$

$S = +6$.

∴ Oxidation state of Sulphur is +6.

2016

(b) Give one reason why aluminium is chosen to make each of the following items:
(i) Cooking foil.
(ii) Overhead electric cables.
(iii) Window frames.

2015 – Q3

(b) State three properties that make aluminium useful in overhead cables.

3.	(a) (i) → presence of moisture
	→ presence of air (oxygen)
	(ii) → electroplating
	→ painting
	(b) (i) It conduct electric current
	(ii) It is more ductile
	(iii) It has low density

13 marks

12. Describe the extraction of iron from the haematite ore and write all the chemical equations for the reactions involved in each stage of extraction.

12 The extraction of iron is mainly obtained from the ore called haematite (Fe_2O_3). The following are the stages involved in the extraction of iron

(i) Concentration of the ore

(ii) Roasting

(iii) Extraction of the iron by reduction using carbon

(iv) Refining of the crude (pig) iron.

(i) Concentration of the ore.

- The haematite ore is firstly concentrated to remove earth impurities and other non-magnetic impurities. The stage does not involve physical alteration of the ore

(ii) Roasting

In this stage, the ore is heated in the presence of oxygen (air) below its melting point. The following reactions take place during this stage

- The moisture present in the ore is removed by evaporation

$$Fe_2O_3 \cdot xH_2O_{(s)} \xrightarrow{\Delta} Fe_2O_{3(s)} + xH_2O_{(g)}$$

- Iron carbonate which might be probably present in the ore as impurity is decomposed into iron(II) oxide

$$FeCO_{3(s)} \xrightarrow{\Delta} FeO_{(s)} + CO_{2(g)}$$

- The ferrous oxide (FeO) formed by the decomposition of iron(II) carbonate is oxidized into iron(III) oxide. This reduces the chances for the iron to be lost since FeO react with sand to form slag.

$$4FeO_{(s)} + O_{2(g)} \longrightarrow 2Fe_2O_{3(s)}$$

- Non-metallic impurities such as antimony, arsenic and sulphur are oxidized into their respective oxides and escape as gases. For example

$$4As_{(s)} + 3O_{2(g)} \longrightarrow 2As_2O_{3(g)}$$

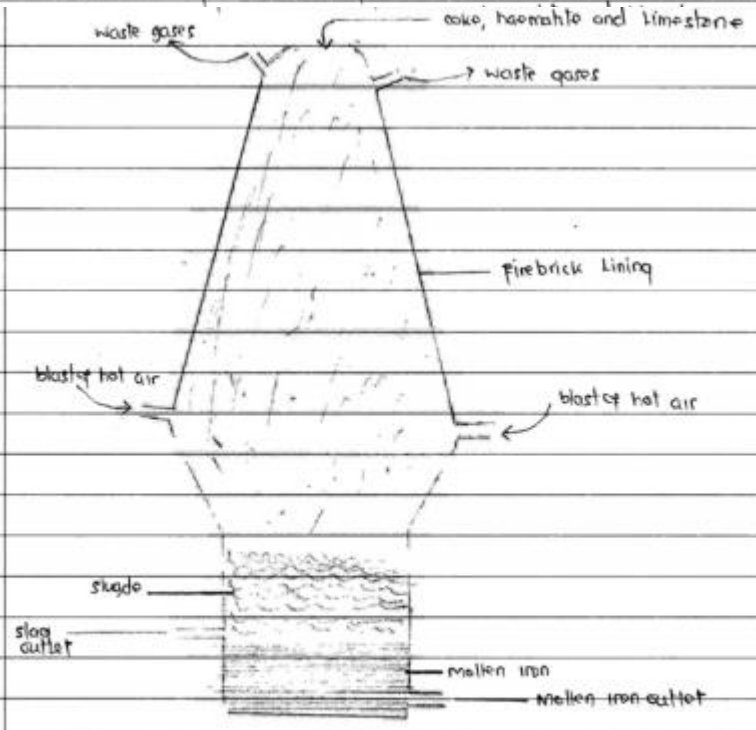
12 $4Sb_{(s)} + 5O_{2(g)} \longrightarrow 2Sb_2O_{5(s)}$

$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$

After that the remaining haematite is taken for smelting

(ii) Smelting of the ore to produce iron

The reduction process of haematite take place in the blast furnace. This is a tall structure which is about 30M tall and 15M in diameter. It has two pipes near the top for removing waste gases, a charging door at the top and two pipes at the bottom for the removal of molten pig iron and slag. The following is the structure of the blast furnace.



The coke, limestone and haematite are mixed together and put into the blast furnace through the charging door at the top. The blast furnace is divided into three main zones due to their

12 temperature differences. They include

(i) The upper zone of reduction

The temperature at this zone varies from 300°c – 800°c. The following reactions take place in the upper zone of reduction.

- The carbon (coke) reacts with oxygen to form carbon dioxide $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$
- The carbon dioxide formed react with coke to produce carbon monoxide

$$CO_{2(g)} + C_{(s)} \longrightarrow 2CO_{(g)}$$

- The haematite iron (III) oxide is reduced to iron by the carbon monoxide

$$Fe_2O_{3(l)} + 3CO_{(g)} \longrightarrow 2Fe_{(l)} + 3CO_{2(g)}$$

- Some of the lime stone is decomposed at 800°c to form calcium oxide

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(l)} + CO_{2(g)}$$

- The carbon dioxide formed then react with coke to produce carbon monoxide

$$C_{(s)} + CO_{2(g)} \longrightarrow 2CO$$

12 $4Sb_{(s)} + 5O_{2(g)} \longrightarrow 2Sb_2O_{5(s)}$

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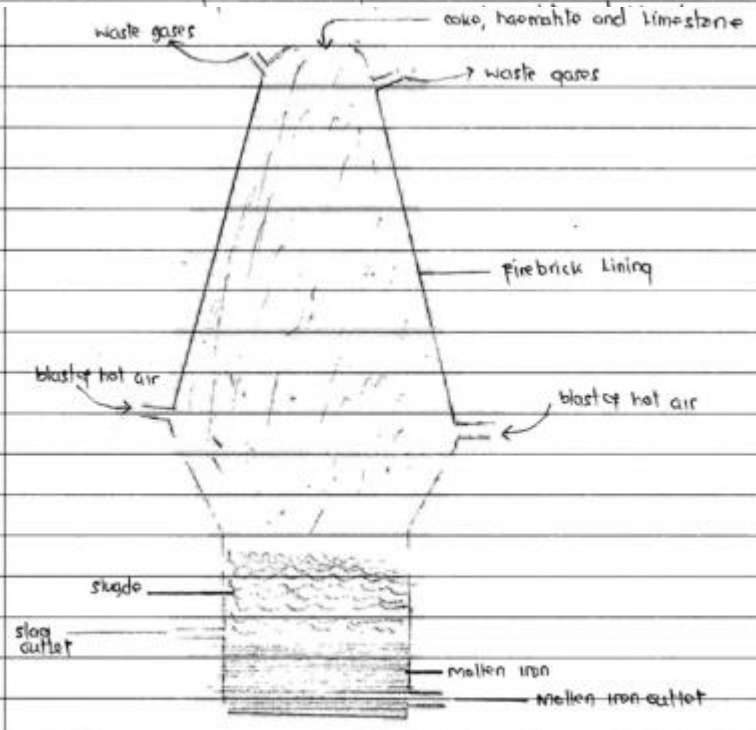

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- Some of the lime stone is decomposed at 800°c to form calcium oxide

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(l)} + CO_{2(g)}$$

- The carbon dioxide formed then react with coke to produce carbon monoxide

$$C_{(s)} + CO_{2(g)} \longrightarrow 2CO_{(g)}$$

(ii) Middle zone of reduction

The temperature in this zone is ranging from 800°c – 1200°c. The following reactions take place in this zone

- The limestone continue to decompose into calcium oxide

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(l)} + CO_{2(g)}$$

- The quicklime formed react with sand to form fusible slag. In this reaction, the quicklime acts as a flux.

$$CaO_{(l)} + SiO_{2(g)} \longrightarrow CaSiO_{3(l)}$$

12 The slag being less denser float over the molten iron

(iii) Lower zone of reduction

It is the hottest zone of the furnace with the temperature ranging from 1200°c to 1500°c. The following reactions take place in the lower zone of reduction.

- The spongy iron melts into molten iron.
- The iron (II) oxide is reduced to iron by carbon

$$2FeO_{(s)} + C_{(s)} \longrightarrow 2Fe + CO_2$$

The iron obtained in this furnace is impure and hence it is called pig iron. The iron being more denser sinks at the bottom of the furnace and removed from the bottom pipe. It is prevented from being oxidized by a layer of fusible slag. The slag and the pig iron are then removed periodically.

(iv) Refining of the pig iron

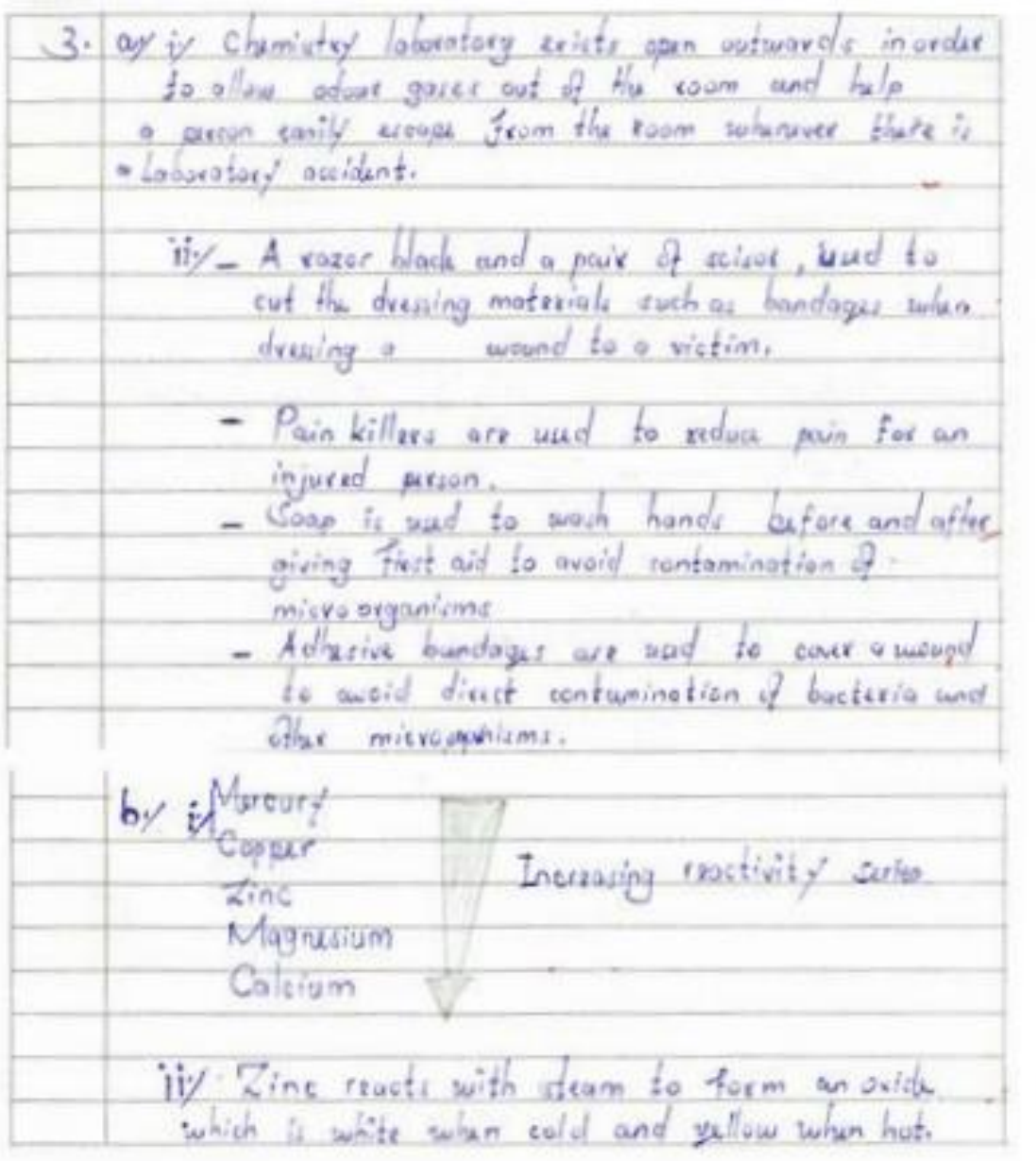
The pig iron is then refined and purified by resmelting using another blast furnace. The iron obtained is called cast iron as it is relatively pure compared to the pig iron.

2014

3 marks – Q3

(b) (i) Arrange the following metals in order of increasing reactivity; zinc, magnesium, calcium, copper and mercury.

(ii) Which one of the metals in (b) (i) above reacts with steam to form an oxide which is white when cold and yellow when hot?



3. a/ i/ Chemistry laboratory exists open outwards in order to allow adour gases out of the room and help a person easily escape from the room whenever there is a laboratory accident.

ii/ – A razor blade and a pair of scisor, used to cut the dressing materials such as bandages when dressing a wound to a victim.

– Pain killers are used to reduce pain for an injured person.

– Soap is used to wash hands before and after giving first aid to avoid contamination of micro organisms

– Adhesive bandages are used to cover a wound to avoid direct contamination of bacteria and other microorganisms.

b/ i/ Mercury
Copper
Zinc
Magnesium
Calcium

Increasing reactivity series

ii/ Zinc reacts with steam to form an oxide which is white when cold and yellow when hot.

2013 – Q3

(b) In the blast furnace, iron ore can be reduced using coke at a temperature of about 1300°C.

(i) Write an equation for the exothermic reaction that causes this high temperature.

(ii) State how carbon monoxide is formed.

(iii) Write a word equation for the formation of slag.

3 (a) (i) From A to C – Electronegativity increase.
From B to D – Electronegativity decrease.

(ii) Electronic configuration of A is 2:8:2
Electronic configuration of C^{2-} is 2:8:8
Electronic configuration of D is 2:8:7
Electronic configuration of B is 2:7

(b) (i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(s)}$

(ii) Carbon monoxide is formed when carbondioxide gas is reduced by coke or carbon.

$$CO_2 + C \longrightarrow CO$$
$$(s) \quad (g)$$

(iii) Calcium Oxide + Silicadioxide $\longrightarrow$ Slag.

7. (a) Briefly explain how aluminum is obtained from its oxide.

7(a) Fint step is purification of bauxite (AL_2O_3) in which the following process occur.

(i) bauxite react with sodium hydroxide.

$$AL_2O_{3(s)} + NaOH_{(aq)} \rightarrow NaALO_{2(aq)} + H_2O_{(aq)}$$

(ii) then the steam of carbon is passed through

$$NaAL\,O_{2(aq)} + H_2O + CO_{2(g)} \rightarrow AL(OH)_{3(aq)} + NaCO_{3(aq)}$$

(iii) Then $AL(OH)_3$ is calcinated

$$AL(OH)_3 \rightarrow AL_2O_3 + H_2O$$

7(a) The last step in electrolysis of purified AL_2O_3 The following reaction occur during electrolysis.

Ions present in AL_2O_3
cation; AL^{3+} and Anion O^{2-}

Reaction at anode.

$O^{2-} - 2e$

$2O^{2-} - 4e^- \rightarrow O_2$
(aq) (g)

Reaction at cathode.

$Al^{3+} + 3e^- \rightarrow AL$
(s)

Aluminium is taken from cathode electrode.

(b) (i) $Na_{(s)} + C_2H_5OH_{(aq)} \rightarrow C_2H_5ONa_{(aq)} + H_{2(g)}$

(ii) $C_2H_5OH_{(aq)} \xrightarrow{KMnO_4} C_2H_5COOH_{(aq)}$

(iii) $C_2H_5OH_{(aq)} + CH_3COOH_{(aq)} \rightarrow CH_3COOC_3H_7 + H_2O_{(l)}$

2012

(b) (i) State the difference between physical strength and chemical strength of metals.
(ii) Giving example, explain why preparation of metallic oxides by direct method is not intensively used.

13 marks

13. Describe four common stages for the extraction of metals. Does the extraction of gold follow all four stages? Give reasons.

2011

3 marks

8. (a) Briefly describe how sodium is extracted in Down's cell. Write all the necessary equations.

22. Compounds of Metals

2017

3 marks

6. (a) List two classes of oxides. Give one example in each case.

6(a) Classes of oxides include:
- Basic oxides
Example: Calcium oxide (CaO)
- Acidic oxides.
Example: Carbondioxide (CO_2).

(b) Tetrachloromethane = CCl_4.
The type of bond in CCl_4 is
- Covalent bond.

2016

(b) Briefly explain what will be observed when silver nitrate solution is added to aqueous solution of sodium chloride.

9. (a) Name two elements which are expected to show similar chemical reactions with magnesium. What is the basis for your choice?

11. (a) State the meaning of the following and give one example in each case.
(i) Amphoteric oxide.

(ii) Acidic oxide.

(b) A student investigated different reactivity of a set of metals by placing pieces of each metal in metal nitrate solution. Table 2 shows some of the results.

Table 2

Solution	Aluminium	Barium	Lithium	Magnesium
Aluminium nitrate	X	√		√
Barium nitrate		X	√	X
Lithium nitrate	X		X	
Magnesium nitrate	X	√	√	X

Where: √ = reaction observed and X = no reaction.

(i) Use the results given to arrange the metals in order of reactivity starting with the most reactive metal.
(ii) Use the reactivity series in 11 (b) (i) to complete Table 2.

2015

7. (a) Briefly explain what will happen when
(i) concentrated sulphuric acid is exposed to the atmosphere?
(ii) iron (II) sulphate is exposed to air for a long time?
(iii) a bottle containing $AgNO_3$ is left open?

7. a) i) When concentrated sulphuric acid is exposed to the atmosphere, will absorb water vapour from the atmosphere and become dilute. This is due to its hygroscopic property.
ii) When iron(II) sulphate is exposed to air, it turns from blue/green into brownish. This occur because of the oxidation of iron (II) to iron (III) by oxygen in air. That is $Fe^{2+} \rightarrow Fe^{3+} + e^-$
iii) When a bottle containing $AgNO_3$ is left open, so whitish precipitate of silver will be formed and the volume of $AgNO_3$ will decrease. This is due to the decomposition of silver nitrate.
That is $AgNO_{3(aq)} \rightarrow Ag_{(s)} + NO_{2(g)} + O_{2(g)}$
Precipitates
b) Application of neutralization in daily life
i) Treating/managing the soil pH in farms.
ii) In treating heartburns in which a person may take ashes to neutralize the acid.
iii) When stung by a bee a person may apply ashes to reduce pain.

8. (a) Give the names or formula of the two chemicals that would be used in the laboratory to make each of the following gases. State a simple test that could be used to identify each gas.
(i) Oxygen.
(ii) Hydrogen.
(iii) Carbon dioxide.

8. a) i) The chemical that would be used is hydrogen peroxide using Manganese dioxide catalyst. And also copper nitrate by thermal decomposition.

TEST OF OXYGEN GAS

- When a glowing wooden splint is brought near oxygen it is relighted this tests the presence of oxygen gas.

ii) a) HCl reacted with metal (Na)
b) H_2SO_4 reacted with metal (Mg)

- The TEST OF THE GAS.

When a glowing wooden splint is brought at the top of test tube containing hydrogen gas it burns with pop sound.

iii) a) When $NaHCO_3$ is reacted with HNO_3.
ii) When $MgCO_3$ is reacted with ~~HCl~~. HCl.

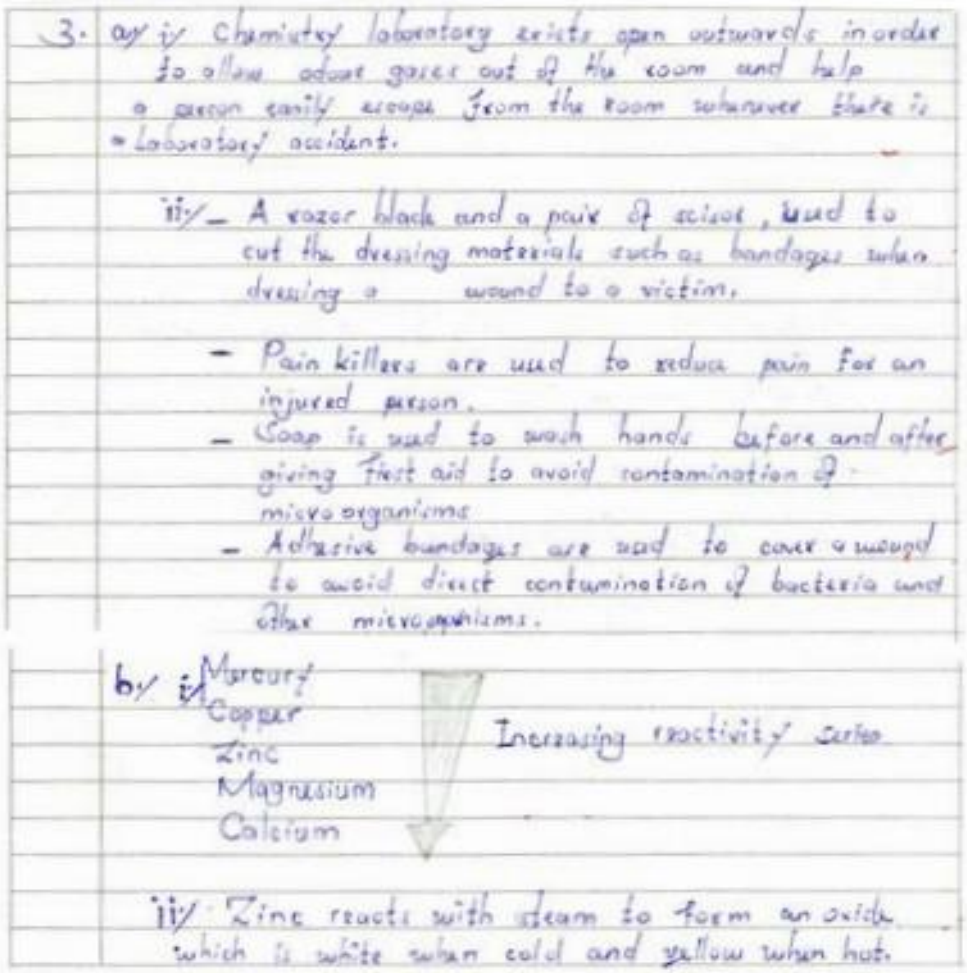
THE TEST OF THE ~~GAS~~

When lime water on a glass rod gets exposed to carbon dioxide turns milky this is due to precipitates of calcium carbonate.

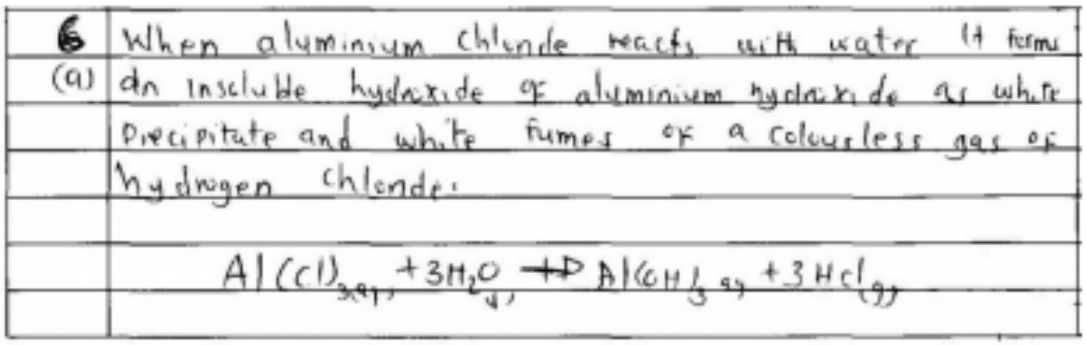
b) i) Methyl orange will be suitable since it is a strong acid and a weak base.
ii) Any indicator such as methyl orange and phenolphthalein will be suitable since it involves a strong acid and a strong base.
iii) Phenolphthalein indicator will be suitable since it involves weak acid and strong base.

2014

(b) (i) Arrange the following metals in order of increasing reactivity; zinc, magnesium, calcium, copper and mercury.
(ii) Which one of the metals in (b) (i) above reacts with steam to form an oxide which is white when cold and yellow when hot?



6. (a) With the aid of chemical equations, explain what will happen when aluminium chloride reacts with water.



2012

(b) (i) State the difference between physical strength and chemical strength of metals.
(ii) Giving example, explain why preparation of metallic oxides by direct method is not intensively used.

8. (a) (i) Name the products formed when nitrates of potassium and zinc decompose by heat.
(ii) Suggest why the nitrates of zinc and potassium behave differently on heating.

(b) Mention two uses of sodium nitrate.

23. Non-Metals and Their Compounds

2020

14. Despite its corrosiveness, sulphuric acid is very important in industry. Explain the importance of sulphuric acid in industries by giving six points. **(15 marks)**

Up Sulphuric acid is a strong acid with a chemical formula of (H_2SO_4) it very strong acid it is corrosive and toxic. Sulphuric acid is dense oil liquid also known as oil of vitriol and when on concentrated form it does not have effect on litmus paper. Sulphuric acid of obtained by a so called contact process which involves series of stage until sulphuric acid is fully formed. Though sulphuric acid as corrosive and even toxic but still it has wide range of use and importances. The following are the importance of sulphuric acid in industries;

Manufacturing of fertilizers, Sulphuric acid is widely used in manufacturing of fertilizer containing sulphate by being reacted with other compounds and lead to formation of compounds used as fertilizer, and lead to high yield in agriculture example of there fertilizer are sulphate of Ammonia commonly known as (SA).

Manufacturing of lead-acid batteries, The lead acid battery use sulphuric acid as an electrolyte so as to produce chemical reaction in the battery and constitute electric current used to power various electrical appliances example the car batteries use sulphuric acid as at electrolyte in generating current.

Extraction of metals, Sulphuric acid is used to extract metals which have impurities and pure metals are extracted by means of sulphuric acid, hence different industrial involves use of sulphuric acid so to extract different metals, example; rusted iron sheet can be extracted again by using sulphuric acid.

Drying agent in different industrial processes, Sulphuric acid is used a drying agent in industrial processes which require drying agent so to remove traces of water such as hydrogen and oxygen as well as any moisture content, example on large

scale industrial manufacture of gases Sulphuric acid is used a chief drying agent.

Sulphuric acid is used in production of ethene, Sulphuric acid dehydrates ethanol at high temperature to produce ethene and water, the reaction of sulphuric acid on ethanol to produce ethene is used large scale production. example large scale production of ethene requires production of sulphuric acid on ethanol and produce high yields of ethene.

Sulphuric acid is used production gases such as hydrogen chloride gas, Production of hydrogen chloride gas commonly with its chemical formula is $(HCl)_g$ is produced by action of concentrated sulphuric acid on rock salt ($NaCl$) and produce hydrogen chloride gas and is governed by reaction $H_2SO_4 + NaCl \rightarrow NaHSO_4 + HCl$ so sulphuric acid produce hydrogen chloride gas (ex) which has wide variety of use.

Conclusively sulphuric acid has wide range of uses despite of it dangers of being high corrosive. So carelessness should be avoided when dealing with sulphuric acid since it still useful in day to day activities and manufacturing of important products, used for different activities.

2020

13. Carbon is one of the elements that have allotropes. Explain how the allotropes of carbon differ from each other. **(15 marks)**

13. SECTION I C

Carbon is an element which found at the periodic table of the elements, it has 6 atomic number, in Group IV and period II, the carbon can exists in three allotropes.

Allotropes

= Others are the elements which exists in the same physical state but different physical forms. Allotropes of carbon are Diamond Graphite and Amorphous carbon, and those allotropes of carbon has different properties, though they are of the same origin.

Allotropes of Carbon

i / Diamond. allotrope.

ii / Graphite. allotrope.

iii / Amorphous carbon. (coke, coal and charcoal).

i / Diamond

this is among the allotrope of carbon, in which the ~~two~~ four - electrons found in the outermost shell of the carbon, are attached with other elements to form bond. So in this allotropy there is no movement of electrons, because all the four electrons are attached to the bond.

Properties of diamond

i / There is no moving of electrons.

ii / It's all four electrons are attached to the bond

ii / Graphite

this is the allotropy of carbon in which the the three of the four electrons of the outermost shell, are attached to the bond while the one remained electrons, moves, in which this electron is known as delocalized electron, in which due to it's movement aids the graphite to conduct electricity

Properties of Graphite

i / It is greasy and slippery due to it's delocalized

iii / Amorphous carbon.

This is the last allotropy of carbon in which all the four electrons of this, are involved in bond formation. Examples of these amorphous carbons are charcoal, coal and coke.

iii) Amorphous carbon.

This is the last allotropy of carbon in which all the four electrons of this, are involved in bond formation - Examples of this amorphous carbons are charcoal, coal and coke.

The followings are the differences of the Carbon allotropes.

Differences

Graphite	Diamond	Amorphous carbon
i) It conducts electricity, due to it's delocalized electron.	Does not conduct electricity due to the absence of delocalized electron	Does not conduct electricity
ii) It is soft and slippery due to it's delocalized electron.	It is hard, thus it is used in making the glass cutters.	It is moderately hard, compared to graphite.
iii) It's four electrons at outermost shell the three of them are involved in the bond formation while one remains freely.	All it's four electrons are involved in bond formation.	All it's four electrons are involved in bond formation.
iv) Used as electrodes due to conductivity	Use to cut glasses due to it's hardness	Used as the fuel source.

Generally, the allotropes of carbon have differences which made them to differ from each other, though they are of the same physical state.

2019

8. Explain each of the following statements and in each give its balanced chemical equation?
   (i) Sulphur dioxide in solution is a powerful reducing agent.
   (ii) Sulphur dioxide in solution acts as a bleaching agent.
   (iii) Sulphur dioxide can reduce chlorine and itself become oxidized.
   (iv) When hydrogen sulphide is passed through sulphur dioxide gas, yellow deposits are produced. **(7 marks)**

8. i) Sulphur dioxide in water forms Sulphorous acid which is very unstable and reduces other elements itself being oxidized to Sulphuric acid

$$H_2O_{(l)} + SO_{2(g)} \rightarrow \underset{\text{Unstable}}{H_2SO_{3(aq)}} \quad \text{Sulphorous acid}$$

$$2H_2SO_{3(aq)} + O_{2(g)} \rightarrow \underset{\text{stable}}{2H_2SO_{4(aq)}} \quad \text{Sulphuric acid}$$

8 ii) When Sulphur dioxide dissolves in water it forms Sulphorous acid which is very unstable and it removes oxgen from dye material thus bleaching it itself being oxidized to Sulphuric acid.

$$SO_{2(g)} + H_2O_{(l)} \rightarrow \underset{\text{Unstable}}{H_2SO_{3(aq)}}$$

$$H_2SO_{3(aq)} + \text{Dye} \rightarrow \underset{\text{compound}}{\text{Complex colourless}} + \underset{\text{stable}}{H_2SO_{4(aq)}}$$

$\langle$Dye - Oxygen$\rangle$

8. (iii) Sulphur dioxide with halogenated water like chlorine water forms an acid and Sulphuric acid. It lowers the oxidation state of chlorine gas from Zero to negative one in hydrochloric acid and itself oxidized to sulphuric acid

$$SO_{2(g)} + Cl_{2(g)} + 2H_2O_{(l)} \rightarrow 2HCl_{(aq)} + H_2SO_{4(aq)}$$

8 iv) Sulphur dioxide oxidises hydrogen Sulphide gas to water and itself is reduced to Suphur which are yellow deposits. This reaction takes place in presence of moisture as a catalist.

$$2H_2S_{(g)} + SO_{2(g)} \rightarrow 2H_2O_{(l)} + 3S_{(s)}$$

yellow deposits

2018

9. (a) (i) Name the products formed when hydrogen sulphide reacts with chlorine gas.
(ii) Mention two uses of hydrochloric acid.

(b) (i) Name the compound which causes temporary hardness of water and the compound which causes permanent hardness of water.
(ii) Write one balanced chemical equation in each case to show how to remove temporary and permanent hardness of water.

9 a) i) The products formed are hydrogen chloride gas and sulphur.

ii) - Used in manufacture of chloride salts.

- Used in removing rust from metals.

9 b) i) Compound causing temporary hardness of water is Calcium bicarbonate ($Ca(HCO_3)_2$)

Compound causing permanent hardness of water is Calcium sulphate ($CaSO_4$)

ii) Removal of temporary hardness of water by boiling

$$Ca(HCO_3)_{2(aq)} \xrightarrow{\Delta} CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)}$$

Removal of permanent hardness of water by addition of washing soda (Na_2CO_3)

$$CaSO_{4(aq)} + Na_2CO_{3(aq)} \longrightarrow CaCO_{3(s)} + Na_2SO_{4(aq)}$$

2017

3 marks – Q5

(b) Find the oxidation state of sulphur in the sulphate ion, SO_4^{2-}.

8 a) i) Compounds which are gaseous at room temperature are $CH_2=CH_2$ and $CH_3CH_2CH_3$

ii) $CH_3CH_2CH_3$ can be distinguished from $CH_2=CH_2$ as $CH_2=CH_2$ decolorises Potassium permanganate solution forming CH_2OHCH_2OH whereas $CH_3CH_2CH_3$ can not decolorize the $KMnO_4$ solution

iii) A compound which will react with Na_2CO_3 is CH_3COOH as per equation

$$2CH_3COOH_{(aq)} + Na_2CO_{3(s)} \longrightarrow 2CH_3COONa_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

b) i) The catalyst speeds up the rate of reaction by lowering the activation energy, that is the minimum amount of energy required to start a reaction. Since the activation energy is lowered, the rate of reaction increases.

8 b) ii) The possible catalyst is MnO_2 (Manganese(IV) oxide)

iii) The possible catalyst used remains unchanged chemically as the amount of catalyst (MnO_2) before reaction is the same even at the end of reaction as per equation

$$2H_2O_{2(aq)} + MnO_{2(s)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + MnO_{2(s)}$$

Overall reaction: $2H_2O_{2(aq)} \xrightarrow{MnO_2} 2H_2O_{(l)} + O_{2(g)}$

Hence the catalyst remains unchanged.

6. (a) List two classes of oxides. Give one example in each case.

6(a) Classes of oxides include:

- Basic oxides

Example: Calcium oxide (CaO)

- Acidic oxides.

Example: Carbondioxide (CO_2)

(b) Tetrachloromethane = CCl_4.

The type of bond in CCl_4 is

- Covalent bond.

2017 – Q11

(b) The preparation of ammonia in the laboratory is done by heating any ammonium salt with an alkali.

(i) Write a balanced chemical equation for the preparation of ammonia gas.

(ii) State two uses of ammonia.

11. a, A mixture with equal boiling point cannot be separated by simple fractional distillation because both liquids will evaporate and condense at same temperature hence they will not be separated successfully.

b, i, $2NH_4Cl_{(aq)} + Ca(OH)_{2(aq)} \rightarrow CaCl_{2(aq)} + 2H_2O_{(l)} + 2NH_{3(g)}$

ii, Uses of Ammonia.

I. In production of nitrogenous fertilizers like urea

II. In manufacture of nitric acid

2016

(b) (i) Explain why sulphur and its compounds are removed from fuels before they are burned.

(ii) Describe how sulphur dioxide is changed into sulphur trioxide. Give the reaction conditions and the equation(s).

11. (a) State the meaning of the following and give one example in each case.

(i) Amphoteric oxide.

(ii) Acidic oxide.

2015

7. (a) Briefly explain what will happen when

(i) concentrated sulphuric acid is exposed to the atmosphere?

(ii) iron (II) sulphate is exposed to air for a long time?

(iii) a bottle containing $AgNO_3$ is left open?

7. a)i) When concentrated sulphuric acid is exposed to the atmosphere, will absorb water vapour from the atmosphere and become dilute. This is due to its hygroscopic property.

ii) When iron(II) sulphate is exposed to air, it turns from blue/green into brownish. This occur because of the oxidation of iron (II) to iron (III) by oxygen in air. That is $Fe^{2+} \longrightarrow Fe^{3+} + e^-$

iii) When a bottle containing $AgNO_3$ is left open, so whitish precipitate of silver will be formed and the volume of $AgNO_3$ will decrease. This is due to the decomposition of silver nitrate.

That is $AgNO_{3(aq)} \longrightarrow \underset{\text{Precipitates}}{Ag_{(s)}} + NO_{2(g)} + O_{2(g)}$

b) Application of neutralization in daily life

i) Treating/managing the soil pH in farms.

ii) In treating heartburns in which a person may take ashes to neutralize the acid.

iii) When stung by a bee a person may apply ashes to reduce pain.

2014 – Q5

(b) (i) Write the reaction equations involved in the industrial manufacturing of sulphuric acid starting with sulphur dioxide in the contact process.

(ii) Explain why sulphur trioxide is not dissolved directly in water to obtain sulphuric acid in contact process.

5 a) Name of the missing elements

i/ Carbon.

ii/ Nitrogen

iii/ Oxygen

iv/ Neon

v/ Sodium.

vi/ Magnesium.

b) i/ $2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$

$SO_{3(g)} + H_2SO_{4(l)} \longrightarrow H_2S_2O_{7(l)}$

$H_2S_2O_{7(l)} + H_2O_{(l)} \longrightarrow 2H_2SO_{4(aq)}$

5 b) ii/ Sulphur trioxide is not dissolved directly in water to obtain sulphuric acid in contact process because their would be formation of fumes of sulphuric acid since the reaction is exothermic therefore making it difficult to convert the acid.

2015 – Q8

(b) When a burning splint is introduced into a gas jar containing carbon dioxide, the flame goes out.
(i) What two properties of carbon dioxide does this experiment illustrate?
(ii) What type of equipment used widely in everyday life makes use of these two properties?

8 a)
i) R-OH = Alcohol
R-COOH = Carboxylic acids.
RCOOR' = Esters.

ii) R-OH = Hydroxyl group.
R-COOH = Carboxyl group.

8 bi) Carbondioxide does not support combustion.
Carbondioxide is denser than air
ii) Fire extinguisher.

2013

13 marks

13. The formation of oxides of non-metals can be both beneficial and harmful to man. Justify the statement focusing on the oxides of carbon, nitrogen and sulphur.

2012

3 marks

3. (a) With the help of chemical equation, what will be observed when ammonia reacts with
(i) Hydrogen chloride.
(ii) Copper (II) oxide.

2011

5. (a) Briefly explain why carbon dioxide is very important for making life on land and sea possible.

(b) List at least four uses of sulphur.

24. Organic Chemistry

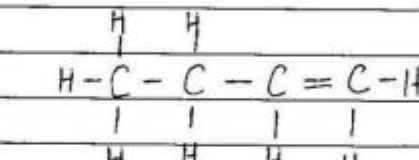
2018

10. (a) (i) Define isomerism.
(ii) Draw and name two structural formulae of the isomers of C_4H_8.

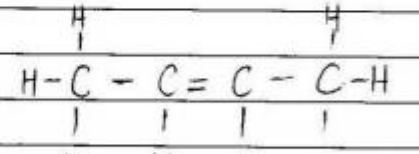
(b) Carbon dioxide can be prepared by adding an acid to calcium carbonate.
(i) Using a named acide, write a balanced chemical equation for the reaction.
(ii) Name all the products formed in (b) (i).

10 a) i) It the condition of organic compound to have the same molecular formula but different structural formulae.

ii) 1st isomer: $CH_3CH_2CHCH_2$ → Butene



2nd isomer: $CH_3CHCHCH_3$ → But-2-ene



10b) i) $CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(s)} + H_2O_{(l)} + CO_{2(g)}$

ii) calcium chloride, water and carbondioxide

2017

3 marks – Q6

(b) Write the chemical formula of tetrachloromethane and state the type of bond that exists.

6(a) Classes of oxides include:
- Basic oxides

Example: Calcium oxide (CaO)

- Acidic oxides.

Example: Carbondioxide (CO_2)

(b) Tetrachloromethane = CCl_4.

The type of bond in CCl_4 is
- Covalent bond.

8. (a) You are provided with CH_3CH_2OH, $CH_3CH_2CH_3$, CH_3COOH, and $CH_2=CH_2$.
   (i) Which compounds are gases at room temperature?
   (ii) How can you distinguish compound $CH_3CH_2CH_3$ and $CH_2=CH_2$?
   (iii) Which compound would react with sodium carbonate? Write the balanced chemical equation for the reaction.

8 a) i) Compounds which are gaseous at room temperature are $CH_2=CH_2$ and $CH_3CH_2CH_3$

ii) $CH_3CH_2CH_3$ can be distinguished from $CH_2=CH_2$ as $CH_2=CH_2$ decolorises Potassium permanganate solution forming CH_2OHCH_2OH whereas $CH_3CH_2CH_3$ can not decolorize the $KMnO_4$ solution

iii) A compound which will react with Na_2CO_3 is CH_3COOH as per equation

$$2CH_3COOH_{(aq)} + Na_2CO_{3(s)} \longrightarrow 2CH_3COONa_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

b) i) The catalyst speeds up the rate of reaction by lowering the activation energy, that is the minimum amount of energy required to start a reaction. Since the activation energy is lowered, the rate of reaction increases.

8 b) ii) The possible catalyst is MnO_2 (Manganese(IV) oxide)

iii) The possible catalyst used remains unchanged chemically as the amount of catalyst (MnO_2) before reaction is the same even at the end of reaction as per equation

$$2H_2O_{2(aq)} + MnO_{2(s)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + MnO_{2(s)}$$

Overall reaction: $2H_2O_{2(aq)} \xrightarrow{MnO_2} 2H_2O_{(l)} + O_{2(g)}$

Hence the catalyst remains unchanged.

2016

6. (a) Write the structural formula for the following compounds:
   (i) But-2-ene.
   (ii) Pent-2-yne.
   (iii) 1, 2 dichloroethane.
   (iv) 2, 4 dimethylhexane.

2015 – Q9

(b) Compound X contains 24.24% carbon, 4.04% hydrogen and 71.72% chlorine. Given that, the vapour density of X is 49.5.

(i) Calculate the molecular formula of the compound X.

(ii) Draw and name the displayed/open structure formula of the possible isomer(s) from the molecular formula determined.

9: a) i) The type of chemical bond found in fluorine molecule is covalent bond.

9: a)(ii) The other type of chemical bond is electrovalent bond.

Example; Potassium fluoride, formula is K_2F

b). i)

	C	H	CL
Mass	24.24	4.04	71.72
R.A.M	12	1	35.5
Mass / R.A.M	24.24 / 12	4.04 / 1	71.72 / 35.5
Divide small number by all	2.02 / 2.02	4.04 / 2.02	2.02 / 2.02
	1	2	1

∴ Empirical formula = $C_1H_2CL_1 = CH_2CL$

Molecular formula = n(Empirical formula).

But Molecular formula = Vapour density X2

= 49.5 X 2

= 99

Then from; Molecular formula = n(Empirical formula).

$99 = n(CH_2CL)$

Empirical formula = Relative Molecular Mass

$\Rightarrow CH_2CL = C + H_2 + CL$

$= 12 + 2(1) + 35.5$

$= 49.5$

To get n:

$99 = n(49.5)$

$n = 99/49.5$

$= 2.$

9: b) i) Then, Molecular Formula = n(CH2CL)

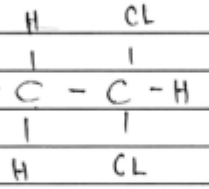
= 2(CH2CL)

= $C_2H_4Cl_2$.

∴ The molecular formula of the compound X is $C_2H_4Cl_2$.

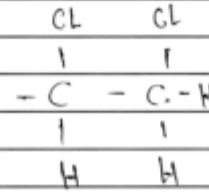
ii) The open structure isomers of $C_2H_4Cl_2$

a)



Name; 1,1-dichloroethane.

b)

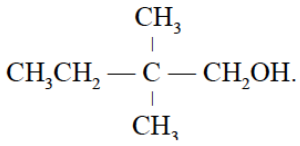


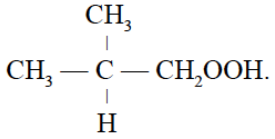
Name; 1,2-dichloroethane.

2015 – Q11

(b) Name the following compounds according to the IUPAC system.

(i) C_5H_{12}.

(ii) 

(iii) 

11. (a) Solution

Data given

Current, $I = 2A$

Metal, X^{2+}

time, $t = 9\ min\ (9 \times 60\ sec)$

Mass, $m = 0.3552\ g$, R.A.M of $X = ?$

11. (a) Then, from

1st Law of electrolysis

$m = ZIt$.

$\therefore Z = \frac{m}{It}$

$= \frac{0.3552\ g}{2A \times 540\ s}$

$Z = 3.3 \times 10^{-4}\ g/C$

But

$Z = \frac{RAM}{V \times F}$ $V = 2$, $F = 96500\ C$

$\therefore RAM = Z \times V \times F$

$= 3.3 \times 10^{-4}\ g/C \times 2 \times 96500\ C$

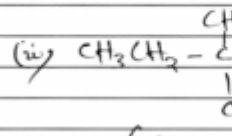
$= 3.3 \times 2 \times 9.65 \times 10^{-4} \times 10^{4}$

$= 63.69\ g/mol$

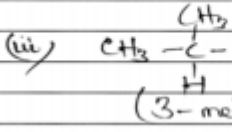
$\approx 64\ g/mol$

$\therefore$ The Molar mass of element X is approximately to be $64\ g/mol$.

(b) (i) C_5H_{12} – (Pentane)

(ii) 

(2,2 – dimethylbutan-1-ol)

(iii) 

(3-methylbutanoic acid)

2014

8. The following are the general structural formulae of certain organic compounds: R-OH, R-COOH, and RCOOR'.
   (a) Name the:
      (i) Homologous series represented by R-OH, R-COOH and RCOOR'.
      (ii) Functional groups represented by R-OH and R-COOH.

8 a)
i) R-OH = Alcohol
R-COOH = Carboxylic acids.
RCOOR' = Esters.

ii) R-OH = Hydroxyl group.
R-COOH = Carboxyl group.

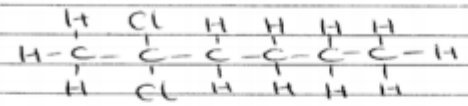
8 b i) Carbondioxide does not support combustion.
Carbondioxide is denser than air
ii) Fire extinguisher.

2013

6. (a) (i) State three characteristics of a homologous series.
   (ii) Draw the displayed/open structure formula of 2, 2-dichlorohexane.
   (iii) Giving two reasons, explain why 2, 2-dichloro-3-methylbutane is a structural isomer of 2, 2-dichloropentane.

6 (a) (i) - Have the same general formula
- Have similar chemical properties

(ii)



(iii) - It has the same molecular formula
- It has the same number and type of atoms

(b) (i). Forward reaction is exothermic
- Concentration of reactants and products remain constant.

(ii) - The forwad reaction is exothermic therefore when temperature is increased the backward reaction which is endothermic will be favoured and hence production of methanol will be decreased

2013 – Q7

(b) Write down the chemical equations of the reactions between the following:
   (i) Ethanol and sodium metal.
   (ii) Propanol warmed with excess acidified potassium permanganate.
   (iii) Propanol and acetic acid warmed together in the presence of concentrated sulphuric acid.

7(a) First step is purification of bauxite (Al_2O_3) in which the following process occur.

(i) bauxite react with sodium hydroxide.

$$Al_2O_3(s) + NaOH(aq) \rightarrow NaAlO_2(aq) + H_2O(aq)$$

(ii) then the steam of carbon is passed through

$$NaAlO_2(aq) + H_2O(l) + CO_2(g) \rightarrow Al(OH)_3(aq) + NaCO_3(aq)$$

(iii) Then $Al(OH)_3$ is calcinated

$$Al(OH)_3(aq) \rightarrow Al_2O_3(s) + H_2O(s)$$

7(c) The last step in electrolysis of purified Al_2O_3 The following reaction occur during electrolysis.

Ions present in Al_2O_3

cation; Al^{3+} and Anion O^{2-}

Reaction at anode.

$O^{2-} - 2e$

$2O^{2-} - 4e^- \rightarrow O_2$

(aq) (g)

Reaction at cathode.

$Al^{3+} + 3e^- \rightarrow Al$

(s)

Aluminium is taken from cathode electrode.

(b) (i) $Na + C_2H_5OH \rightarrow C_2H_5ONa + H_2$

(s) (aq) (aq) (g)

(ii) $C_3H_7OH \xrightarrow{KMnO_4} C_2H_5COOH$

(aq) (aq)

(iii) $C_3H_7OH + CH_3COOH \rightarrow CH_3COOC_3H_7 + H_2O$

(aq) (aq) (aq) (l)

2013 – Q9

(b) Explain the following reactions giving one example in each:

(i) Addition reaction.

(ii) Elimination reaction.

9. (a) Given:

Current = 0.5A

time = 30 min × 60 = 1800s

Mass = ?

Equivalent weight = ?

From $\text{Mass} = \frac{Ar \times It}{V \times F}$

$= \frac{108 \times 0.5 \times 1800s}{1 \times 96500}$

∴ Mass of silver liberated = 1g.

Equivalent weigh = $\frac{Ar}{V}$

$= \frac{108}{1}$

∴ Equivalent weight of silver = 108g.

(b) (i) Addition reaction.

Is the reaction of unsaturated hydrocarbon where by double or tripple bond are broken to form single bond.

Example $C_2H_{4g} + H_{2g} \xrightarrow{\text{nickel}} C_2H_6$

ethene methane.

2012

13 marks

12. Consider a four carbon hydrocarbon (C_4H_n), where n is an integer. Give the name of homologous series, molecular formula and structural formula for different isomers of the compound formed by each homologous. In each case indicate the causes of isomerism.

2011

4. (a) Organic chemistry deals with carbon element and its compounds. Name one carbon hydrogen compound and write the equation for its combustion.

(b) Write all the structural isomers of alcohols whose molecular formula is C_4H_9OH and give their IUPAC names.

25. Soil Chemistry

2018

13. In Tanzania, soil conservation is very important for Industrial Materials production. Explain six methods that are used to manage loss of plant nutrients from the soil.

13. Soil refers to an Organic matter that has been formed by disintegration of the parent rock due to weathering. Soil is formed due to various factors like parent rock, Climate, relief, organisms and time. Soil Conservation is the act of protecting and maintaining the soil nutrients from the loss of nutrients. They following are the methods of preventing the loss of soil nutrients.

Mulching is one of the method to prevent the loss of soil (plant) nutrients. Mulching refers to the process of covering the bare soil with the layers of organic matters like the rice husks, grasses. These organic matters maintain the soil moisture and also when they decompose they release important nutrients to the soil and also covering the bare soil will prevent the loss of soil nutrients (plant nutrients).

Addition of manure and fertilizer also is an important method of preventing the loss of soil or plant nutrients. When manure is added to the soil, it helps to release important nutrients that are required by the plants and to make the soil productive and thus when manure and fertilizer are added to the soil helps to prevent the loss of plant nutrients.

13. Intercropping is also one of the method of preventing the loss of plant nutrients. Since monocropping leads to loss of soil nutrients then intercropping should be encouraged. Monocropping makes the crops to use only the required plant nutrients and the rest are lost but when there is intercropping there will be no loss of plant nutrients.

Controlled grazing is also one of the method of preventing the loss of plant nutrients Whenever there is Overgrazing on one piece or tract of land the animals grazed tend to cause soil erosion into which the soil is removed and thus leading to loss of the soil nutrients of the particular area and thus whenever there is controlled grazing then the loss of plant nutrients will be prevented.

Avoiding burning of vegetation, is also one of the method of preventing the loss of the plant nutrients. When the vegetation are burnt, it leaves the soil bare and hence the soil becomes more prone to soil erosion and when the soil erosion occurs the valuable plant nutrients are washed away and thus leading to loss of plant nutrients, therefore avoiding burning vegetation will help in preventing the loss of soil nutrients.

13. Good harvesting methods also helps to manage loss of plant nutrients from the soil. poor harvesting methods leads to loss of important plant nutrients from the soil and hence when good harvesting methods are applied will help to prevent the loss of plant nutrients from the soil. Example the grass or rice husks are to be laid down in the soil insted of being slashed on burnt when they are laid down they will later decompose to provide the basic plant nutrients to the soil and hence prevent the loss of plant nutrients.

Therefore when these methods are applied to the soil it will help to make the soil more productive and hence make the soil to be able to allow plant growth and also burning of vegetation has to be avoided as it cause the loss of important plant nutrients from the soil and also leads to global warming due to emission of carbondioxide.

2018

8. (a) Distinguish manures from fertilizers. Give an example in each case.

(b) The following equation shows the reaction between hydrogen and iodine gas to form hydrogen iodide gas, $H_{2(g)} + I_{2(g)} \leftrightharpoons 2HI_{(g)}$; $\Delta H = -800kJ/mol$. Giving a reason, explain what would happen to the position of equilibrium if

(i) temperature is lowered.

(ii) hydrogen iodide gas is pumped into the system.

08 (a)

Manures	fertilizers
Are organic substances that can be applied in the soil to provide various nutrients improving fertility of the soil. eg. Animal dung	Are inorganic substances that can be easily applied in the soil to add specific nutrients in the soil eg. Calcium Ammonium Nitrate (CAN)

(b) i) The position of equilibrium will shift to the product side. Because the reaction is exothermic then low temperature will favour the production of hydrogen iodide gas according to Le chatelier principle

ii) The position of equilibrium will shift to the reactant side Because there will be alot of hydrogen iodide gas in the system and to balance the amount of each according le chatelier principle the equilibrium will shift to the reactant side

2017

3 marks

3. (a) Define the following terms:

(i) Soil.

(ii) Leaching.

(iii) Denitrification.

3(a) (iii) Denitrification is the process throught which nitrates and nitrogen compounds in the soil are converted into free nitrogen by denitrifying bacteria and released to the atmosphere.

(b) i) Temporary hard water is usually caused due to the presence of calcium hydrogen carbonate. When the water is heated the calcium hydrogen carbonate is decomposed into calcium carbonate which is insoluble. Calcium carbonate being insoluble is removed from the water leaving the water soft.

The equation:

$$2\,CaHCO_{3(aq)} \xrightarrow{\Delta} CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)}$$

ii) Permanent hardness of water is caused due to the presence of sulphates of calcium or magnesium. By taking an example of calcium sulphate ($CaSO_4$) the permanent hardness of water can be removed by adding chemicals such as sodium carbonate. Sodium carbonates react with the soluble sulphates to form insoluble salts which can be removed leaving the water soft.

The equation;

$$CaSO_{4(aq)} + Na_2CO_{3(aq)} \rightarrow CaCO_{3(s)} + Na_2SO_{4(aq)}$$

The calcium carbonate so formed is then removed since it is insoluble. Also incase of magnesium ions.

$$MgSO_{4(aq)} + NaCO_{3(aq)} \rightarrow MgCO_{3(s)} + Na_2SO_{4(aq)}$$

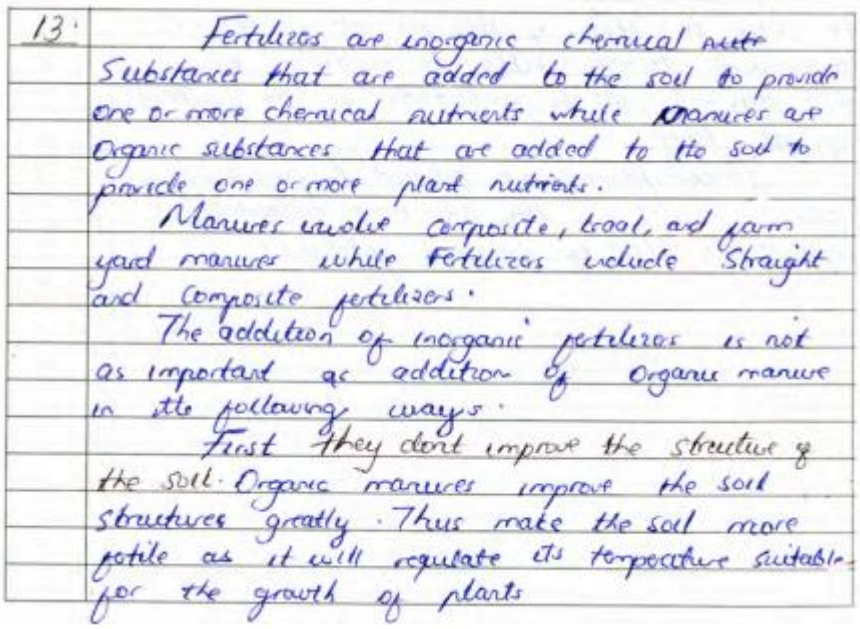
The magnesium carbonate is then removed leaving the water soft.

2016

3. (a) Give the meaning of the following terms:
   (i) Soil pH.
   (ii) Liming.

2015
13 marks

13. Addition of inorganic fertilizers in the farm is not as important as addition of organic manure. Discuss the correctness of this statement in four points.

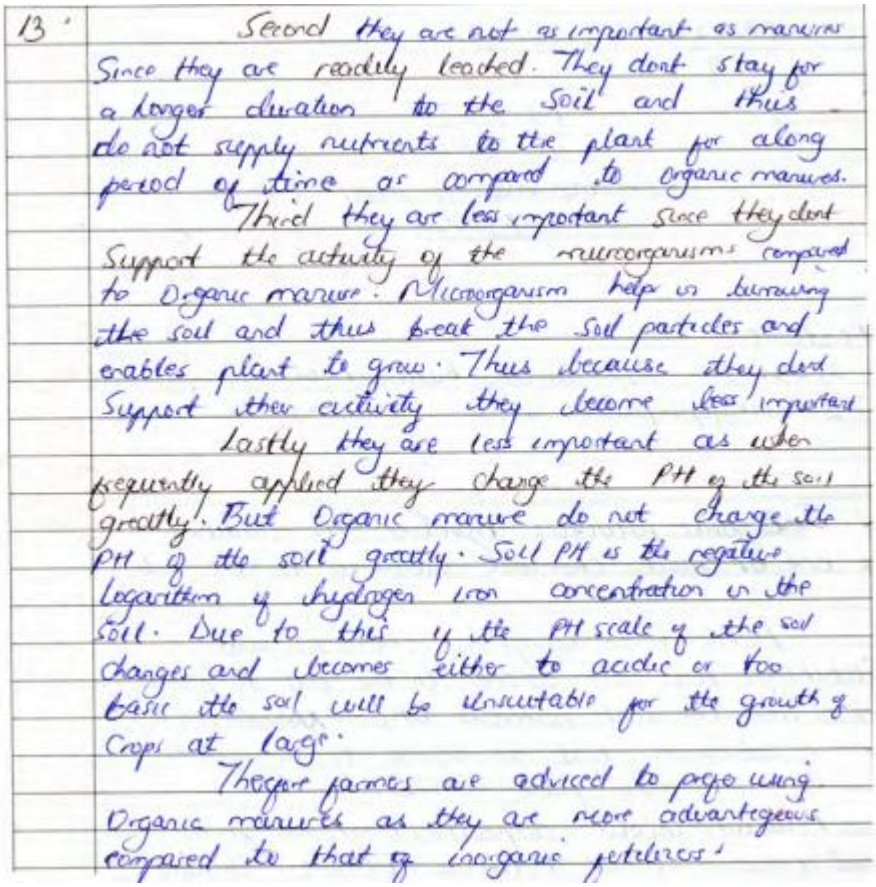


13. Fertilizers are inorganic chemical mate substances that are added to the soil to provide one or more chemical nutrients while Manures are Organic substances that are added to the soil to provide one or more plant nutrients.

Manures include composite, kraal, and farm yard manures while Fertilizers include Straight and Composite fertilizers.

The addition of inorganic fertilizers is not as important as addition of Organic manure in the following ways.

First they dont improve the structure of the soil. Organic manures improve the soil structures greatly. Thus make the soil more fetile as it will regulate its temperature suitable for the growth of plants



13. Second they are not as important as manures Since they are readily leached. They dont stay for a longer duration to the soil and thus do not supply nutrients to the plant for along period of time as compard to organic manures.

Third they are less important since they dont Support the activity of the microorganisms compared to Organic manure. Microorganism help in loosening the soil and thus break the soil particles and enables plant to grow. Thus because they dont Support their activity they become less important

Lastly they are less important as when frequently applied they change the PH of the soil greatly. But Organic manure do not change the PH of the soil greatly. Soil PH is the negative logarithm of hydrogen ion concentration in the soil. Due to this if the PH scale of the soil changes and becomes either to acidic or too basic the soil will be unsuitable for the growth of Crops at large.

Therefore farmers are advised to prefe using Organic manures as they are more advantageous compared to that of inorganic fertilizers.

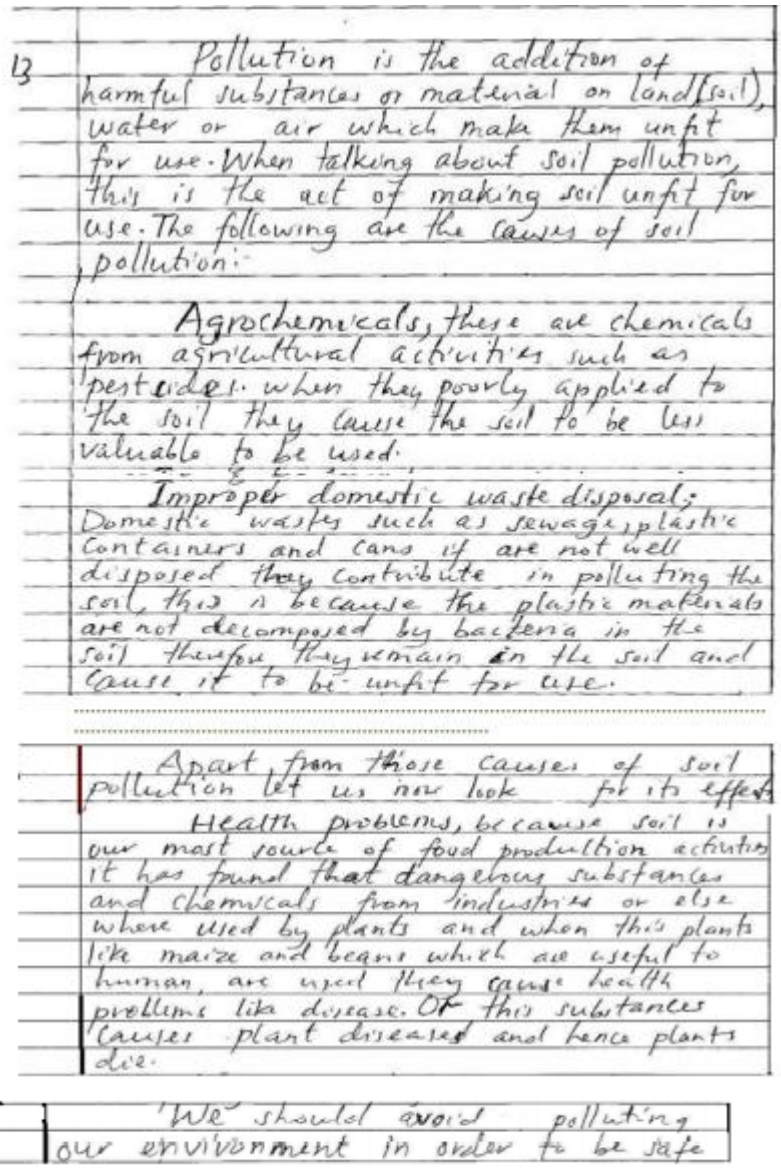
2014

3 marks

11. (a) (i) List four effects of excessive nitrogen to plants.
(ii) State two ways through which soil nitrogen can be lost.

13 marks

13. Describe five causes and effects of soil pollution.



13

Pollution is the addition of harmful substances or material on land(soil), water or air which make them unfit for use. When talking about soil pollution, this is the act of making soil unfit for use. The following are the causes of soil pollution:-

Agrochemicals, these are chemicals from agricultural activities such as pesticides. when they poorly applied to the soil they cause the soil to be less valuable to be used.

Improper domestic waste disposal; Domestic wastes such as sewage, plastic containers and cans if are not well disposed they contribute in polluting the soil, this is because the plastic materials are not decomposed by bacteria in the soil therefor they remain in the soil and cause it to be unfit for use.

Apart from those causes of soil pollution let us now look for its effects

Health problems, because soil is our most source of food production activities it has found that dangerous substances and chemicals from industries or else where used by plants and when this plants like maize and beans which are useful to human, are used they cause health problems like disease. Of this substances causes plant diseased and hence plants die.

We should avoid polluting our environment in order to be safe

2013

3 marks – Q4

(b) (i) What is soil erosion?
(ii) Explain four factors affecting soil erosion.

2013 – Q8

(b) Give the meaning of the following terms:
(i) Soil structure.
(ii) Acidic soil.
(iii) Liming.

2011

9. (a) Briefly explain how soil fertility can be maintained by adopting good farming methods.

26. Pollution

3 marks

(b) (i) Explain why sulphur and its compounds are removed from fuels before they are burned.

2016

8. (a) Identify and state the environmental problem caused by the gas which is released from the blast furnace in the extraction of iron from its oxide.

13 marks

12. Explain five methods to prevent terrestrial pollution.

2015

13 marks

12. Describe the cause, two effects and measures to be undertaken in order to prevent/reduce the amounts of acid rain.

12 The extraction of iron is mainly obtained from the ore called haematite (Fe_2O_3). The following are the stages involved in the extraction of iron

(i) Concentration of the ore

(ii) Roasting

(iii) Extraction of the iron by reduction using carbon

(iv) Refining of the crude (pig) iron.

(i) Concentration of the ore.

- The haematite ore is firstly concentrated to remove earth impurities and other non-magnetic impurities. The stage does not involve physical alteration of the ore

(ii) Roasting

In this stage, the ore is heated in the presence of oxygen (air) below its melting point. The following reactions take place during this stage

- The moisture present in the ore is removed by evaporation

$$Fe_2O_3 \cdot xH_2O_{(s)} \xrightarrow{\Delta} Fe_2O_{3(s)} + xH_2O_{(g)}$$

- Iron carbonate which might be probably present in the ore as impurity is decomposed into iron(II) oxide

$$FeCO_{3(s)} \xrightarrow{\Delta} FeO_{(s)} + CO_{2(g)}$$

- The ferrous oxide (FeO) formed by the decomposition of iron(II) carbonate is oxidized into iron(III) oxide. This reduces the chances for the iron to be lost since FeO react with sand to form slag.

$$4FeO_{(s)} + O_{2(g)} \longrightarrow 2Fe_2O_{3(s)}$$

- Non-metallic impurities such as antimony, arsenic and sulphur are oxidized into their respective oxides and escape as gases. For example

$$4As_{(s)} + 3O_{2(g)} \longrightarrow 2As_2O_{3(g)}$$

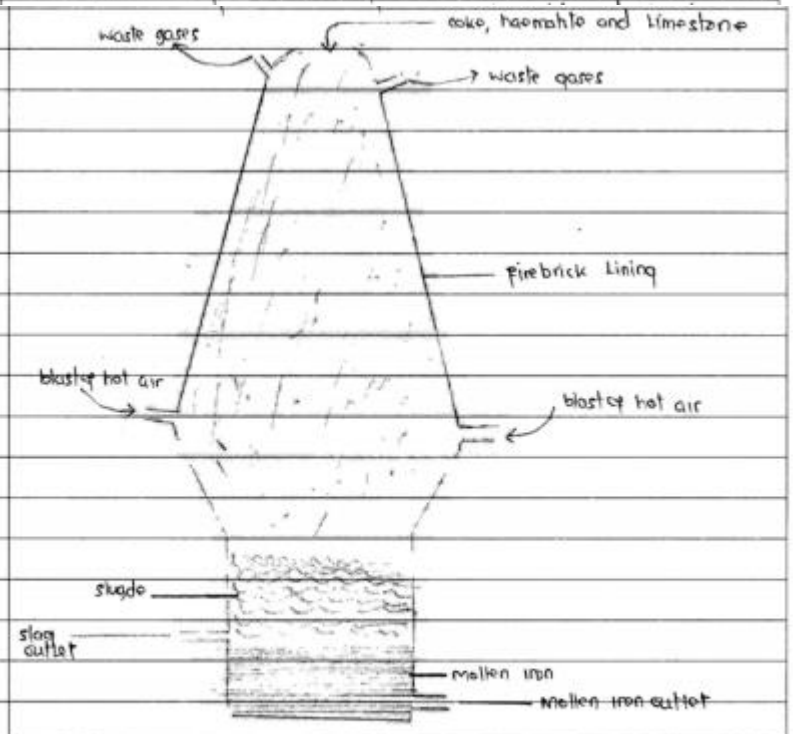
12 $4Sb_{(s)} + 5O_{2(g)} \longrightarrow 2Sb_2O_{5(s)}$

$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$

After that the remaining haematite is taken for smelting

(ii) Smelting of the ore to produce iron

The reduction process of haematite take place in the blast furnace. This is a tall structure which is about 30M tall and 15M in diameter. It has two pipes near the top for removing waste gases, a charging door at the top and two pipes at the bottom for the removal of molten pig iron and slag. The following is the structure of the blast furnace.



The coke, limestone and haematite are mixed together and put into the blast furnace through the charging door at the top

The blast furnace is divided into three main zones due to their

12 temperature differences. They include

(i) The upper zone of reduction

The temperature at this zone varies from 300°c – 800°c. The following reactions take place in the upper zone of reduction.

- The carbon (coke) reacts with oxygen to form carbon dioxide $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$
- The carbon dioxide formed react with coke to produce carbon monoxide

$$CO_{2(g)} + C_{(s)} \longrightarrow 2CO_{(g)}$$

- The haematite iron (III) oxide is reduced to iron by the carbon monoxide

$$Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 2Fe_{(l)} + 3CO_{2(g)}$$

- Some of the lime stone is decomposed at 800°c to form calcium oxide

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(l)} + CO_{2(g)}$$

- The carbon dioxide formed then react with coke to produce carbon monoxide

$$C_{(s)} + CO_{2(g)} \longrightarrow 2CO$$

(ii) Middle zone of reduction

The temperature in this zone is ranging from 900°c – 1200°c. The following reactions take place in this zone

- The limestone continue to decompose into calcium oxide

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(l)} + CO_{2(g)}$$

- The quicklime formed react with sand to form fusible slag. In this reaction, the quicklime acts as a flux.

$$CaO_{(l)} + SiO_{2(s)} \longrightarrow CaSiO_{3(l)}$$

12 The slag being less denser float over the molten iron

(iii) Lower zone of reduction

It is the hottest zone of the furnace with the temperature ranging from 1200°c to 1500°c. The following reactions take place in the lower zone of reduction.

- The spongy iron melts into molten iron.
- The iron (II) oxide is reduced to iron by carbon

$$FeO_{(s)} + C_{(s)} \longrightarrow Fe + CO_2$$

The iron obtained in this furnace is impure and hence it is called pig iron. The iron being more denser sinks at the bottom of the furnace and removed from the bottom pipe. It is prevented from being oxidized by a layer of fusible slag. The slag and the pig iron are then removed periodically.

(iv) Refining of the pig iron

The pig iron is then refined and purified by resmelting using another blast furnace. The iron obtained is called cast iron as it is relatively pure compared to the pig iron.

13. The formation of oxides of non-metals can be both beneficial and harmful to man. Justify the statement focusing on the oxides of carbon, nitrogen and sulphur.

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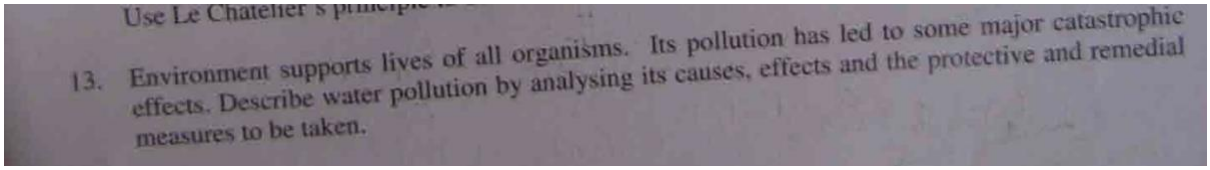
2012

10. (a) (i) Name three gases which should not be produced in order to prevent the destruction of ozone layer.
(ii) List and explain three effects of ozone layer depletion.

(b) Lack of safe water for domestic and industrial uses is a serious problem in most of Tanzanian towns. The major cause of this problem is pollution in the water sources. Slate three methods that could make water from a pond or a well be safe for drinking.

2011


Use Le Chatelier's principle

13. Environment supports lives of all organisms. Its pollution has led to some major catastrophic effects. Describe water pollution by analysing its causes, effects and the protective and remedial measures to be taken.

27. Qualitative Analysis

No questions 2011 to 2017