TABLE OF CONTENT

CHAPTER FIFTEEN

CHAPTER SIXTEEN

CHAPTER ONE

SEPARATION OF MIXTURES AND PURIFICATION OF CHEMICAL SUBSTANCES

ELEMENTS, COMPOUNDS AND MIXTURES

1. A mixture is different from a compound because

A. the properties of a compound are those of its constituents, while those of a mixture differ from its constituents
B. a mixture is always homogeneous while a compound is not
C. the constituent of a compound is chemically bound together while those of a mixture are not
D. a mixture can be represented by a chemical formula while a compound cannot
UTME, 2014

2. Which of the following substances is not a homogeneous mixture?

A. filtered sea water
B. soft drinks
C. flood water
D. writing ink
UTME, 2020

3. Which one of the following is not a mixture?

A. Air
B. Mercury
C. Milk
D. Cement
UTME, 2021

PHYSICAL AND CHEMICAL CHANGES

4. Which of the following is a physical change?

A. Exposing white phosphorus to air
B. Burning kerosene
C. Dissolving calcium in water
D. Freezing ice cream
UTME, 2019

5. Which of the following are chemical changes?

I. cooking of food
II. digestion of food
III. freezing of water
IV. water is heated up

A. I and II
B. I, II, and III
C. III and IV
D. all of the above
UTME, 2021

SEPARATION PROCESSES

6. A sample of any of the following substances disappears after some time when exposed to air like camphor, naphthalene, or dry ice. What is this phenomenon called?

A. Sublimation
B. Evaporation
C. Diffusion
D. Radiation
UTME, 2021

ANSWER AND EXPLANATIONS

1. Answer: **Option C**

Explanation: Mixtures are physical bonds and can be easily separated by physical means, e.g., Air, while compounds are chemically bonded together; hence, they can't be separated by physical means, e.g., NaCl.

2. Answer: **Option A**

Explanation: A heterogeneous mixture is one in which the composition is not uniform. It consists of two or more phases. Examples are soda (water plus carbon dioxide), aerosol, smog, oil and water, sand and water, flood water, writing ink, soft drink, etc. Filtered sea water is not a heterogeneous mixture.

3. Answer: **Option B**

Explanation: A mixture is a material made up of two or more different chemical substances which are not chemically combined. Mercury is a chemical element with the symbol Hg and atomic number 80.

4. Answer: **Option D**

Explanation: Because ice cream is a physical change, so ice cream is easily reversed after melt

5. Answer: **Option A**

Explanation: Food digestion is considered a chemical change because enzymes in the stomach and intestines break down large macromolecules into simpler molecules. Cooking food is a chemical change as it involves a change in the

composition of the food. After cooking, the raw ingredients of the vegetables cannot be regained.

6. Answer: **Option A**

Explanation: Sublimation is the transition of a substance directly from the solid to the gas state without passing through the liquid state. Familiar substances that sublime readily include iodine, dry ice, menthol, and camphor.

CHAPTER TWO

CHEMICAL COMBINATION
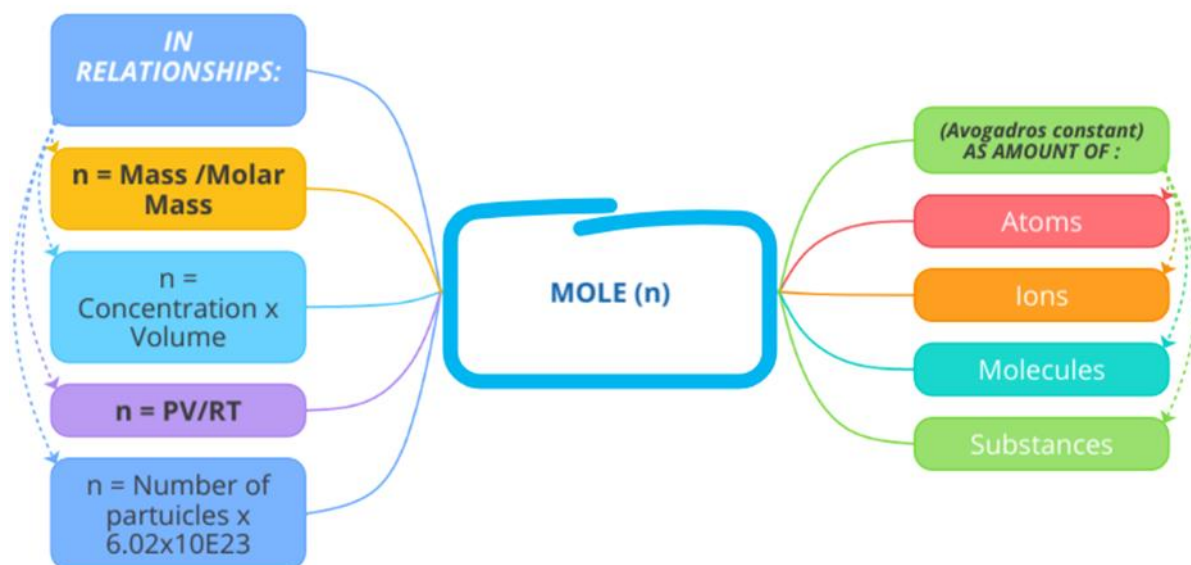
Stoichiometry, laws of definite and multiple proportions, the law of conservation of matter, Gay Loussac's law of combining volumes, Avogadro's law; chemical symbols, formulae, equations and their uses, relative atomic mass based on 12C=12, the mole concept and Avogadro's number.

7. Calculate the percentage composition of oxygen in calcium trioxocarbonate (IV) [Ca=40, C=12, O=16]

A. 16

B. 48

C. 40

D. 12

UTME, 2018

8. What volume of carbon (II) oxide is produced by reacting excess carbon with 10 dm3 of oxygen?

A. 5dm3

B 20dm3

C. 15dm3

D. 10dm3

UTME, 2019

9. Which of the following gasses contains the least number of atoms at s.t.p?

A. 1 mole of butane

B. 4 moles of chlorine

C. 3 moles of ozone

D. 7 moles of argon

UTME, 2019

10. 220g of carbon dioxide contains ----- moles

A. 5
B. 6
C. 3
D. 4
UTME, 2021

ANSWERS AND EXPLANATION

7. Answer: **Option B**

Explanation: Calcium trioxocarbonate (IV) = $CaCO_3$
Percentage of Oxygen = $(3×16)/ (40+12+48)$ x 100%
%Oxygen = 48/100 x 100%
%Oxygen = 48%

8. Answer: **Option B**

Explanation: using the below equation for the reaction
$2CO + O_2 \rightarrow 2CO_2$
$22.4dm^3$ of O2 yield $44.8dm^3$ of $2CO_2$
10dm3 of O2 yield   xdm3
Cross multiplies x= 10 x 44.8/22.4
=$20dm^3$
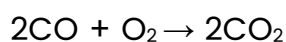
9. Answer: **Option D**

Explanation: Argon is a monatomic noble gas with the least number of atoms.

10. Answer: **Option A**

Explanation: One mole of carbon dioxide molecules has a mass of 44.01 g,
5 moles of carbon dioxide molecules have a mass of 220g, i.e., 5x 44.01 = 220g

CHAPTER THREE

KINETIC THEORY OF MATTER AND GAS LAWS
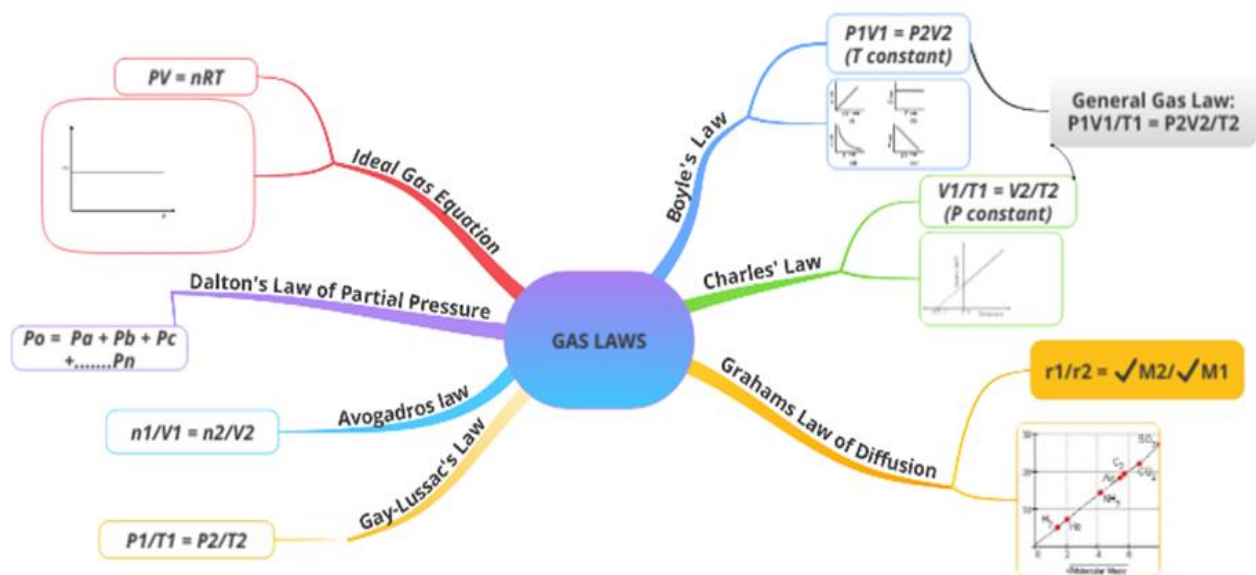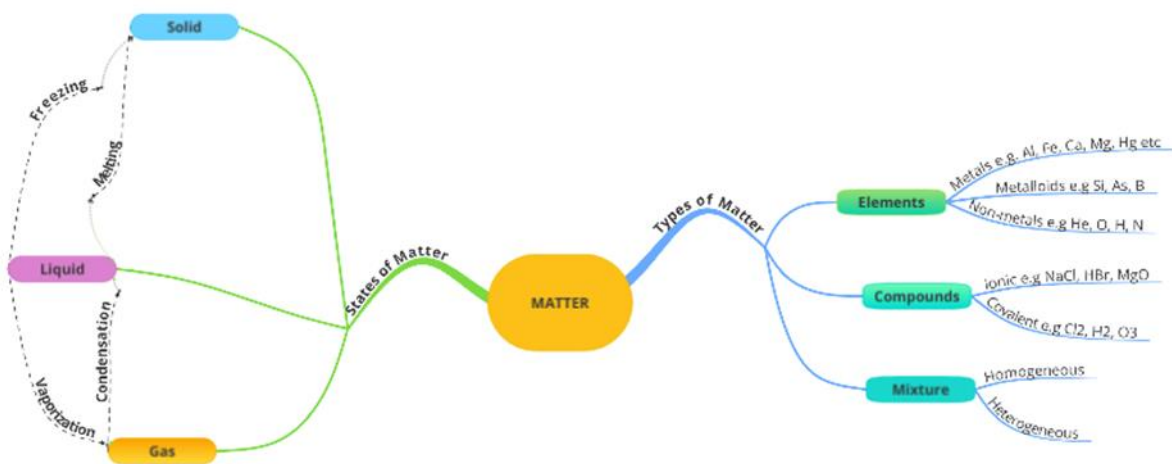
AN OUTLINE OF THE KINETIC THEORY OF MATTER;

11. Which of the following properties is not peculiar to matter?

A. Kinetic energy of particles increases from solid to gas
B. Random motion of particles increases from gas to solid
C. Orderliness of particles increases from gas to liquid
D. Random motion of particles increases from liquid to gas
UTME, 2016

12.   The scientist who stated that matter can be converted into energy is?

A. Boyle
B. Lavoisier
C. Avogadro
D. Einstein
UTME,2021

BOILING

13. The boiling points of water, ethanol, toluene and butan-2-ol are 373.0k, 351.3k, 383.6k and 372.5k, respectively, which liquid has the highest vapour pressure at 323.0k

A. water
B. toluene
C. ethanol
D. butan-2-ol
UTME,2020

The laws of Boyle, Charles, Graham and Dalton (law of partial pressure); combined gas law, molar volume and atomicity of gases.

BOYLE'S LAW

14. 30 cm³ of oxygen at 10 atmospheric pressure is placed in a 20cm³ container. Calculate the new pressure if the temperature is kept constant.

A. 6.7atm
B. 15.0atm
C. 6.0atm
D. 66.0atm
UTME, 2020

CHARLES'S LAW

15. According to Charles's law, the volume of a gas becomes zero at

A. -100°c
B. -273°c
C. -373°c
D. 0°c
UTME, 2017

16. A fixed mass of gas is a volume of 92cm3 at 3°C. What will be its volume at 18oC if the pressure remains constant?

A. 15.3cm3
B. 87.3cm3
C. 2.0cm3
D. 97.0cm3
UTME, 2018

17. To what temperature must a gas at 273k be heated to double its volume and pressure?

A. 298K

B. 546K

C. 819K

D. 1092K

UTME, 2019

GRAHAM'S LAW

18. The densities of two gases, X and Y, are 0.5g^{dm-3} and 2.0^{gdm-3}. What is the rate of diffusion of X relative to Y?

A. 0.1

B. 0.5

C. 2.0

D. 4.0

UTME, 2017

COMBINED GAS LAW, MOLAR VOLUME

19. A certain volume of gas at 298k is heated such that its volume and pressure are now four times the original values. What is the new temperature?

A. 18.6K

B. 100.0K

C. 298.0K

D. 4768.0K

UTME, 2020

THE IDEAL GAS EQUATION (PV = NRT).

20. The ideal gas laws and equations are true for all gases at

A. low pressures and lower temperatures
B. low temperatures and high pressures
C. high pressures and high temperatures
D. low pressure and high temperatures
UTME, 2017

21. Sample of gas exerts a pressure of 8.2atm when confined in a 2.93dm³ container at 20c. The number of moles of gas in the sample is

A. 1. 00
B. 2.00
C. 3.00
D. 4.00
UTME, 2020
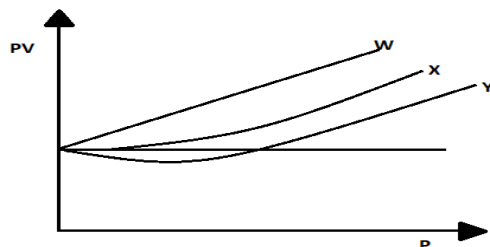
22. From the diagram above, an ideal gas can be represented by

A. K

B. M

C. L

D. N

UTME, 2016

The relationship between vapor density of gases and the relative molecular mass

23. If the molecular mass of tetraoxosulphate (VI) acid is 98, calculate its vapor density.

A. 196

B. 49

C. 106

D. 82

UTME, 2018

ANSWERS AND EXPLANATION

11. Answer: **Option B**

Explanation: Molecules in the solid phase have the least amount of energy, while gas particles have the greatest amount of energy; therefore, the random motion of particles from gas to solid will decrease while from solid to gas will increase

12. Answer: **Option D**

Explanation: The principle described by the physicist Albert Einstein's famous formula: $E = mc^2$, involves mass-energy equivalence. I.e., the relationship between mass and energy.

13. Answer: **Option C**

Explanation: Ethanol has the highest vapor pressure. Due to its smaller size,

14. Answer: **Option B**

Explanation: The above question is under Boyle's law which can be represented mathematically as $P_1V_1 = P_2V_2$

P1=10 atm   P2= unknown X   V1= 30 cm3   V2= 20 cm3
Solving for P2
P2 = 10×30/20 = 15 atm.

15. Answer: **Option B**

Explanation: At zero Kelvin, the volume of a gas becomes zero -273°c = OK
i.e. -273°c + 273 = OK

16. Answer: **Option D**

Explanation: The above question is under Charles's Law which can be represented mathematically as $V_1/T_1 = V_2/T_2$

V1 = 92   V2 = unknown   T1 = 3+273 = 276K   T2 = 18 + 273 = 291K
$(V_1/T_1) = (V_2/T_2)$
T1 = 276K
$\therefore (92/276) = (V_2/291)$
V2 $(92 * 291)/276$
= 97.0 cm3

17. Answer: Option D

Explanation: The above question is under General gas law, which can be represented mathematically as

$P_1V_1/T_1 = P_2V_2/T_2$
P1 = p   V1 =v   T1= 273k   P2 =2p V2 = 2v T2 = unknown x
Substituting the above data in the above formula
$P*V/273 = 2P*2V/T_2$
$PV/273 = 4PV/T_2$
Cross multiply
T2PV= 273*4PV
T2= 273*4PV/PV
PV will cancel PV
T2= 273*4 =1092k

18. Answer: **Option C**

Explanation: The rate of the dimension of a gas is inversely proportional to the square root of its molecular mass or its density, which is Graham's Law of diffusion of a gas.

$D_x = 0.5gdm{-}3$, $D_y = 2gdm{-}3$
$R_x / R_y = \sqrt{D_y} / \sqrt{D_x}$
$= \sqrt{2} / \sqrt{0.5}$
$= 2.0$
$P_1V_1 / T_1 = P_2V_2 / T_2$

19. Answer: **Option D**

Explanation: $P_1V_1 / T_1 = P_2V_2 / T_2$
$P_1V_1 / T_1 = 4P_1 \times 4V_1 / T_2$
i.e., $P_1V_1 / 298 = 4P_1 \times 4V_1 / T_2$
$T_2 = 298 \times 4P_1 \times 4V_1 / P_1V_1$
The P_1V_1 in the numerator will cancel out the P_1V_1 at the denominator leaving 4*4
=16
$= 298 * 16 = 4768.^0K$

20. Answer: **Option D**

Explanation: Generally, a gas behaves more like an ideal gas at higher temperature and lower pressure.

21. Answer: **Option A**

Explanation: An ideal gas PV = nRT

PV = nRT
2.93 x 8.2 = 0.082 x 293 x n
∴ n = (2.93 x8.2) / (0.082 x 293)
n = 1

22. Answer: **Option D**

Explanation: The straight horizontal line in the PV versus p graph is for an ideal gas, while the other lines are those of some real gases. The ideal gas law states that PV = nRT,

23. Answer: **Option D**

Explanation: Molecular mass = Vapor Density x 2
Vapor Density = Molecular Mass / 2
Molecular mass = 98g/mol

Vapor Density = 98 / 2   Vapor Density = 49g/mol

CHAPTER FOUR

ATOMIC STRUCTURE AND BONDING

THE CONCEPT OF ATOMS, MOLECULES, AND IONS,
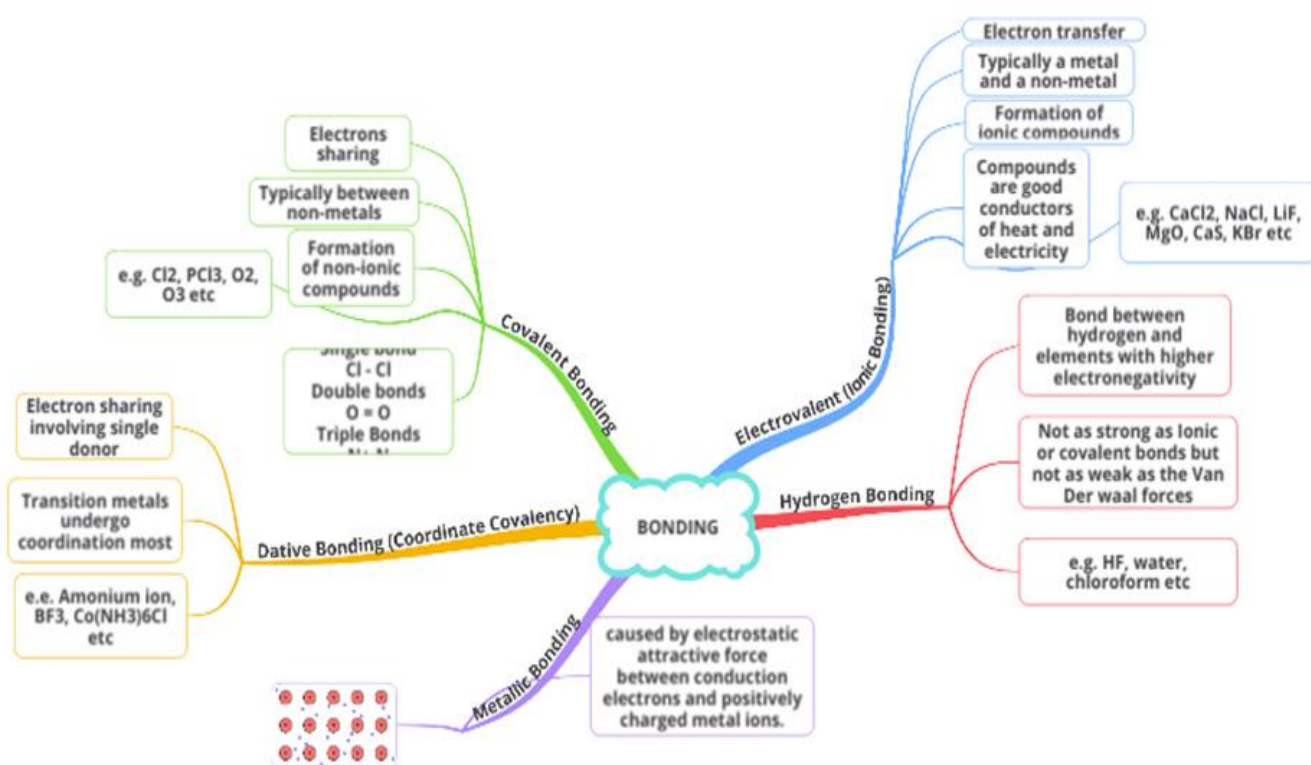
24. Neutrons were discovered by?

A. James Chadwick
B. Ernest Rutherford
C. J.J Thompson
D. John Dalton
UTME,2021

ATOMIC STRUCTURE, ELECTRON CONFIGURATION,

25. How many protons, neutrons, and electrons are present in the element 60/27 Co, respectively?

A. 27, 33 and 33
B. 33, 27 and 27
C. 27, 33, and 27
D. 60, 33 and 60
UTME, 2014

26. Atomicity of ozone is

A. 1
B. 2
C. 3
D. 4
UTME, 2015

27. An isotope has an atomic number of 15 and a mass number of 31. How many protons does it contain?

A. 16
B. 15
C. 31
D. 46
UTME, 2016

28. A particle that contains protons, 10 neutrons, and 10 electrons is

A. positive ion
B. neutral atom of a metal
C. neutral atom of a non-metal
D. negative ion
UTME, 2017

29. The maximum electron in the N shell is?

A. 2
B. 8
C. 18
D. 32
UTME, 2021

The periodic table and periodicity of elements, presentation of the periodic table to recognise families of elements

30. An element X has electron configuration 1s22s22p63s23p5. Which of the following statements is correct about the element?

A. It has a completely filled p-orbital

B. It has 5 electrons in its outermost shell.

C. It belongs to group II on the periodic table

D. It is a halogen

UTME, 2014

31. Which of the noble gases has the greatest ionisation energy?

A. He

B. Xe

C. Ar

D. Rr

UTME, 2015

32. Electronic configuration of an elements 13x in the subsidiary energy level is

A. $1s^2 2s^2 2p^6 3s^2 3p^1$

B. $1s^2 2s^2 2p^4 3p^1 3s^1$

C. $1s^2 2s^2 2p^6 3s^2 3p^3$

D. $1s^1 2s^2 2p^6 3s^2 3p^4$

UTME, 2015

33. Which of the following statements is correct about the periodic table?

A. Elements in the same period have the same number of valence electrons

B. The valence electrons of the elements in the same period increase progressively across the period

C. Elements in the same group have the same number of electron shells

D. The non-metallic Properties of the elements tend to decrease across each period

UTME, 2015

34. The number of electronic shells contained in an atom with electron configuration $1s^22s^22p^63s^23p^64s^2$ is

A. 3

B. 2

C. 4

D. 5

UTME, 2016

35. The shape of the S-orbital is

A. elliptical

B. spiral

C. circular

D. spherical

UTME, 2017

36. In electro valency, the oxidation number of the participating metal is always

A. decreasing
B. increasing
C. constant
D. neutral
UTME, 2018

37. Beryllium and Aluminium have similar properties because they:

A. are both metals
B. belongs to the same group
C. belongs to the same period
D. are positioned diagonally to each other
UTME, 2018

38. Elements in the periodic table are arranged in the order of their

A. atomic numbers
B. metallic character
C. mass number
D. relative atomic mass
UTME, 2019

39. Which of the following properties increases from left to right along the period but decreases down the group in the Periodic Table?

i. Atomic Number
ii. Ionization energy
 iii. Metallic character
 iv. Electron affinity

A. ii and iii only
B. ii and iv only
C. iii and iv only
D. i and ii only
UTME, 2019

Chemical bonding. Electrovalency and covalency, the electron configuration of elements and their tendency to attain the noble gas structure. Hydrogen and metallic bonds are special electrovalency and covalency bonds, respectively. A coordinate bond is a type of covalent bond as illustrated by complexes like $[Fe\,(CN)_6]^{3-}$, $[Fe\,(CN)_6]^{4-}$, $[Cu\,(NH_3)_4]^{2+}$ and $[Ag\,(NH_3)_2]^+$; van der Waals' forces should be mentioned as a special type of bonding forces.

40. The weakest attractive force that can be observed between two molecules is

A. ionic
B. covalent
C. co-ordinate covalent
D. VanderWaals
UTME, 2015

41. Elements P, Q, R, S have 6, 11, 15, 17 electrons, respectively, therefore,

A. P will form an electrovalent bond with R
B. Q will form a covalent bond with S
C. R will form an electrovalent bond with S
D. Q will form an electrovalent bond with S
UTME, 2018

42. The type of bonding in $[Cu(NH_3)_4]^{2+}$ is

A. coordinate
B. electrovalent
C. metallic
D. covalent
UTME, 2018

43. Elements X and Y have electronic configurations $1s^22s^22p^4$ and $1s^22s^22p^63s^23p^1$ respectively. When they combine, the formula of the compound formed is
A. XY
B. X2Y
C. Y2X3
D. X2Y3
UTME, 2019

44. Which of the following represents the type of bond present in ammonium chloride?

A. ionic only
B. covalent only
C. ionic and dative covalent
D. dative covalent
UTME, 2019

45. The nucleus of a hydrogen atom consists of

A. 1 proton only
B. 1 proton, 2 neutrons
C. 1 neutron only
D. 1 electron only
UTME,2021

Shapes of simple molecules: linear ((H_2, O_2, Cl_2, HCl, and CO_2), non-linear (H_2O), and tetrahedral; (CH_4) and pyramidal (NH_3).

46. The molecular shape and bond angle of water are respectively
A. linear, 180°
B. bent, 109.5°
C. tetrahedral, 109.5°
D. bent, 105°
UTME, 2019

47. What is the shape of a molecule of CCl_4?

A. Pyramid
B. tetrahedral
C. Trigonal planar
D. linear
UTME, 2020

RADIOACTIVITY – TYPES AND PROPERTIES OF RADIATIONS

48. All these are electromagnetic waves except

A. White light
B. Photon
C. X-ray
D. Infrared
UTME, 2015

49. The radioisotope used in industrial radiography for the rapid checking of faults in welds and casting is

A. Phosphorus-32
B. Cobalt-60
C. Carbon-14
D. Iodine-131
UTME, 2016

50. The arrangement of particles in crystal lattices can be studied using

A. X-rays
B. β-rays
C. α-rays
D. γ-ray
UTME, 2016

NUCLEAR REACTIONS. SIMPLE EQUATIONS; USES AND APPLICATIONS OF NATURAL AND ARTIFICIAL RADIOACTIVITY.

51. $^{226}_{88}Ra \rightarrow ^{x}_{86}Rn$ + Alpha Particle

A. 226

B. 220

C. 227

D. 222

UTME, 2017

52. A radioactive nucleus has a half-life of 20 years, starting with 100,000 particles. How many particles will be left at the end of 40 years

A. 75,000 particles

B. 35,000 particles

C. 25,000 particles

D. 50,000 particles

UTME, 2019

ANSWERS AND EXPLANATION

24. Answer: **Option A**

Explanation: Sir James Chadwick was a British physicist awarded the 1935 Nobel Prize in Physics for his discovery of the neutron in 1932. - Ernest Rutherford discovered alpha and beta rays, Sir Joseph John Thomson was credited with the discovery of the electron, John Dalton was best known for introducing the atomic theory into chemistry

25. Answer: **Option C**

Explanation: The number of electrons in an electrically-neutral atom is the same as the number of protons in the nucleus
.

26. Answer: **Option C**

Explanation: Ozone has a chemical formula O_3 which means it has a total of 3 atoms of oxygen, so its atomicity is 3

27. Answer: **Option B**

Explanation: The answer is 15 because the number of protons equals the atomic number since there is no charge.

28. Answer: **Option D**

Explanation: It means that the atom has gained an electron, making it a negative ion.

29. Answer: **Option D**

Explanation: The N shell is the fourth orbit with 32 max number of electrons using 2n2

30. Answer: **Option D**

Explanation: The element has 7 valence electrons in its outermost shell. Therefore, it can be found in group 7. All group 7 elements are halogens.

31. Answer: **Option A**

Explanation: Among noble gases, Helium has the highest first ionisation energy. The smaller the size, the greater the force of attraction and thus required. More energy will be required to remove an electron from the atom and vice versa.

32. Answer: **Option A**

Explanation: Since the element is 13x, this indicates that the element is aluminium; therefore, $1s^2 2s^2 2p^6 3s^2 3p^1$ is the electronic configuration representing aluminium.

33. Answer: **Option B**

Explanation: Periods are also known as horizontal rows and anything horizontal moves from left to right. So as the elements in the same period move horizontally, i.e., from left to right, they increase, and an atom is added.

34. Answer: **Option C**

Explanation: The electronic configuration indicates that the element's atomic number is 20, so the number of electronic shells is 4. The first shell accommodates two electrons; the second can carry eight, the third accommodates eight, and the fourth shell accommodates two electrons.

35. Answer: **Option D**

Explanation: The S orbital is a spherical shape. The p orbital is a dumbbell shape.

36. Answer: **Option D**

Explanation: In electro-valency, the oxidation number of the participating metal remains constant.

37. Answer: **Option D**

Explanation: from the periodic table, beryllium is present in the second period, and aluminium is present in the third period of the periodic table, and both elements are metal. Hence, both aluminium and beryllium have a diagonal

relationship. Both the elements even act as Lewis's acids, in which they can behave either as acid or base when reacting with certain compounds.

38. Answer: **Option A**

Explanation: In the modern periodic table, the elements are listed in order of increasing atomic number.

39. Answer: **Option B**

Explanation: Ionization energy and electron affinity increase across a period and decrease down a group.

40. Answer: **Option D**

Explanation: Vander Waals are the weakest attractive forces between two molecules. Options A, B, C are not weak forces because the force attraction that exists between their molecules is very strong.

41. Answer: **Option D**

Explanation: P = $(2, 4)$, Q = $(2, 8, 1)$, R= $(2, 8, 5)$, S= $(2, 8, 7)$.
Given the above is the electronic arrangement of PQRS elements, Q will form an electrovalent bond with S.

42. Answer: **Option A**

Explanation: Most complex ions, especially those involving ammonia, manage to bond up themselves with coordinate covalent bonds.

43. Answer: **Option C**

Explanation: Element X $1s^22s^22p^4$ Valency of X is 2 Element Y $1s^22s^22p^63s^23P^1$ valency of Y is 3. There is an exchange of valency when a compound is being formed. Hence, we have Y2X3.

44. Answer: **Option C**

Explanation: The Ammonium molecule was formed due to the dative covalent bond between hydrogen and nitrogen. The ammonium ion is now acting as a metal that forms an ionic or covalent bond with chlorine in the same manner as sodium would have.

45. Answer: **Option A**

Explanation: The hydrogen atom is the simplest of all atoms: it consists of a single proton and a single electron.

46. Answer: **Option D**

Explanation: The shape of the water molecule = Bent/ V-shaped and the bond angle of water = 104.5°/ 105°, and that of Carbon dioxide's molecular shape is linear.

47. Answer: **Option B**

Explanation: CCl_4 has a tetrahedral geometry with bond angles of 109.5 °. And that ammonia molecule has a trigonal pyramidal shape as predicted by the valence shell electron pair repulsion theory (VSEPR theory).

48. Answer: **Option B**

Explanation: Photon is a unit of energy that carries light and has zero mass. Hence, photons are not an electromagnetic wave.

49. Answer: **Option B**

Explanation: Cobalt alloys are corrosion-resistant, heat-resistant, and wear-resistant. This makes cobalt-based alloy castings useful in numerous industries, including medical, aerospace, automotive, military, and other applications.

50. Answer: **Option A**

Explanation: Rays are a type of radiation called electromagnetic waves. X-ray imaging creates pictures of the inside of your body. X-rays can also be used to study crystal lattices.

51. Answer: **Option D**

Explanation: When a nucleus of Ra (radium) decays, it emits an alpha particle is ^4_2He and becomes an Rn (radon) nucleus. Therefore, x will be $^{226}_{88}Ra$ ......$^{222}_{86}Rn$ + ^4_2He

52. Answer: **Option C**

Explanation: After the first 20 years, half of the substance $(1/2×100,000=50,000)$ will have decayed. Hence, we have 100,000 – 50,000 = 50,000 particles left. After the second 20 years (being 40 years in all), half of the remaining substance $(1/2×50,000=25,000)$ will have decayed remaining particles after 40 years = 50,000 – 25,000 = 25,000 particles.

CHAPTER FIVE

AIR

The natural gaseous constituents and their proportion in the air. - nitrogen, oxygen, water vapour, carbon (IV) oxide, and noble gases (argon and neon).
53. The constituent of air that acts as a diluent is

A. nitrogen
B. carbon (IV) oxide
C. noble gases
D. oxygen
UTME, 2013

54. Which of the following does not support the fact that air is a mixture?

A. the constituents of air are in a fixed proportion by mass
B. it cannot be represented with a chemical formula
C. the constituents of air can be separated by physical-by-physical means
D. none of the above
UTME, 2019

ANSWERS AND EXPLANATIONS

53. Answer: **Option A**

Explanation: Nitrogen is used to prevent oxidation or other deterioration of a product, as an inert diluent of a reactive gas, as a carrier to remove heat or chemicals, and as an inhibitor of fire or explosions.

54. Answer: **Option D**

Explanation: Air as it is a mixture of many compounds. The major components would be Nitrogen (N_2), Oxygen (O_2), Carbon Dioxide (CO_2), Water (H_2O), and many others in minute amounts. Also, there is no chemical formula for air.

CHAPTER SIX

WATER

HARD AND SOFT WATER: TEMPORARY AND PERMANENT HARDNESS AND METHODS OF SOFTENING HARD WATER.

55. Water is said to be temporarily hard when it contains

A. $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$ salts
B. $Ca(HCO_3)_2$ and $CaCO_3$ SALTS
C. $Mg(HCO3)_2$ and $CaSO_4$ salts
D. $CaSO_4$ and $Ca(HCO3)_2$ salts
UTME, 2014

56. The furring of kettles is caused by the presence of water in

A. calcium hydrogentrioxocarbonate (IV)
B. calcium trioxocarbonate (IV)
C. calcium tetraoxosulphate (VI)
D. calcium hydroxide
UTME, 2017

57. Water for town supply is chlorinated to make it free from

A. bad colour
B. bacteria
C. temporary hardness
D. permanent hardness
UTME, 2017

SOLUBILITY
Unsaturated, saturated and supersaturated solutions. Solubility curves and simple deductions from them (solubility defined in terms of a mole per dm3) and simple calculations.

58. If 24.4 g of lead (II) trioxonitrate (V) was dissolved in 42 g of distilled water at 20oC; calculate the solubility of the solute in gdm-3.

A. 581.000.
B. 0.581
C. 5.810
D. 58.100
UTME, 2013

59. At 27°C, 58.5g of sodium chloride is present in 250cm3 of a solution. The solubility of sodium chloride at this temperature is?
(Molar mass of sodium chloride = 111.0gmol-1)

A. 2.0 moldm-3
B. 0.25 moldm-3
C. 1.0 moldm-3
D. 0.5 moldm-3
UTME, 2019

Solvents for fats, oil, and paints and the use of such solvents to remove stains.

60. An example of a solid emulsion is

A. Butter
B. Hair cream
C. Milk
D. Cod-liver oil
UTME, 2016

61. The boiling of fat and aqueous caustic soda is referred to as

A. hydrolysis
B. esterification
C. acidification
D. saponification
UTME, 2018

62. Which of the following roles does sodium chloride play in preparation? It

A. reacts with glycerol

B. purifies the soap, accelerates the decomposition of fat and oil

C. separates soap from glycerol

D. converts the fatty acid to its sodium salt

UTME, 2020

ANSWERS AND EXPLANATION

55. Answer: **Option A**

Explanation: Temporary hardness is due to the presence of calcium hydrogen carbonate Ca $(HCO_3)_2$ and magnesium hydrogen carbonate Mg $(HCO_3)_2$. Both calcium hydrogencarbonate and magnesium hydrogen carbonate decompose when heated.

56. Answer: **Option B**

Explanation: Temporary hardness in water is caused by calcium and magnesium trioxocarbonate (IV) $CaCO_3$ causes the furring of kettles
Permanent hardness in water= Mg & Ca Sulphate. Temporary hardness in water= Mg & Ca Carbonate.

57. Answer: **Option B**

Explanation: Chlorination of water kills harmful microorganisms such as bacteria.

58. Answer: **Option A**

Explanation: n g/dm^3=amount×1000/volume of water
24.4×1000/42=581g/dm^3

59. Answer: **Option A**

Explanation: Given the Mass of the salt = 58.5g
Volume = 250 cm3 = 0.25 dm3
Mass concentration = Mass/Volume
= 58.5/0.25 = 234 gdm-3
Solubility (in moldm-3 = 234/111   = 2.11 moldm-3   ≅ 2.0 moldm-3

60. Answer: **Option A**

Explanation: Butter is an example of a class of colloids called emulsions. An emulsion is a colloidal dispersion of a liquid in either a liquid or a solid. A stable emulsion requires an emulsifying agent to be present.

61. Answer: **Option D**

Explanation: When oil or fat is heated together with caustic soda (NaOH), soap will be formed. This process is called saponification.

62. Answer: **Option C**

Explanation: It is mainly added for precipitation to separate it from the aqueous solution. Salt is also used to separate glycerol from the water.

CHAPTER SEVEN

ENVIRONMENTAL POLLUTION

SOURCES AND EFFECTS OF POLLUTANTS.

63. The gas which causes global warming is?

 A. O2
 B. CO2
 C. N2
 D. He
UTME,2021

Air pollution: Examples of air pollutants such as H2S, CO, SO2, oxides of nitrogen, chlorofluorocarbons and dust.

64. A major source of oxide of nitrogen is gotten from the burning of

A. coal
B. wood
C. fuel
D. chlorofluorocarbons
UTME, 2015

65. Which of the following results in the fall of acid rain?

A. oxide of lead
B. particulate matter
C. oxides of sulphur
D. gaseous hydrocarbon
UTME, 2015

66. Which of the following pollutants will lead to the depletion of the ozone layer?
A. chlorofluorocarbon
B. carbon (ii) oxide
C. hydrogen sulphide
D. sulphur (iv) oxide
UTME, 2019

Water pollution, Sewage, and oil pollution should be known.

67. In a water body, too much sewage leads to

A. a decrease in the temperature of the water which causes the death of aquatic animals
B. an increase in the number of aquatic animals in the water
C. an increase in the bacterial population which reduces the level of oxygen in the water
D. a decrease in the bacterial population which increases the level of oxygen in the water
UTME, 2013

ANSWERS AND EXPLANATION

63. Answer: **Option B**

Explanation: Global warming occurs when carbon dioxide (CO_2) and other air pollutants collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface.

64. Answer **Option A**

Explanation: The troposphere is the first and lowest layer of the atmosphere of the Earth. Gases mix at this layer, Weather occurs here, a Region where plants and animals breathe and live, Tropospheric pollution is caused by the presence of unwanted gaseous or solid components in the air.

65. Answer: **Option C**

Explanation: Acid rain results when sulfur dioxide (SO_2) and nitrogen oxides (NOX) are emitted into the atmosphere and transported by wind and air currents.

66. Answer: **Option A**

Explanation: Chlorofluorocarbons ($CFCs$), hydrochlorofluorocarbons ($HCFCs$) and halons destroy the earth's protective ozone layer, which shields the earth from harmful ultraviolet ($UV-B$) rays generated from the sun.

67. Answer: **Option C**

Explanation: There will be an increase in the population of microorganisms such as bacteria. As such, the level of oxygen in the water will reduce.

CHAPTER EIGHT

ACIDS, BASES AND SALTS

GENERAL CHARACTERISTICS AND PROPERTIES OF ACIDS, BASES AND SALTS.
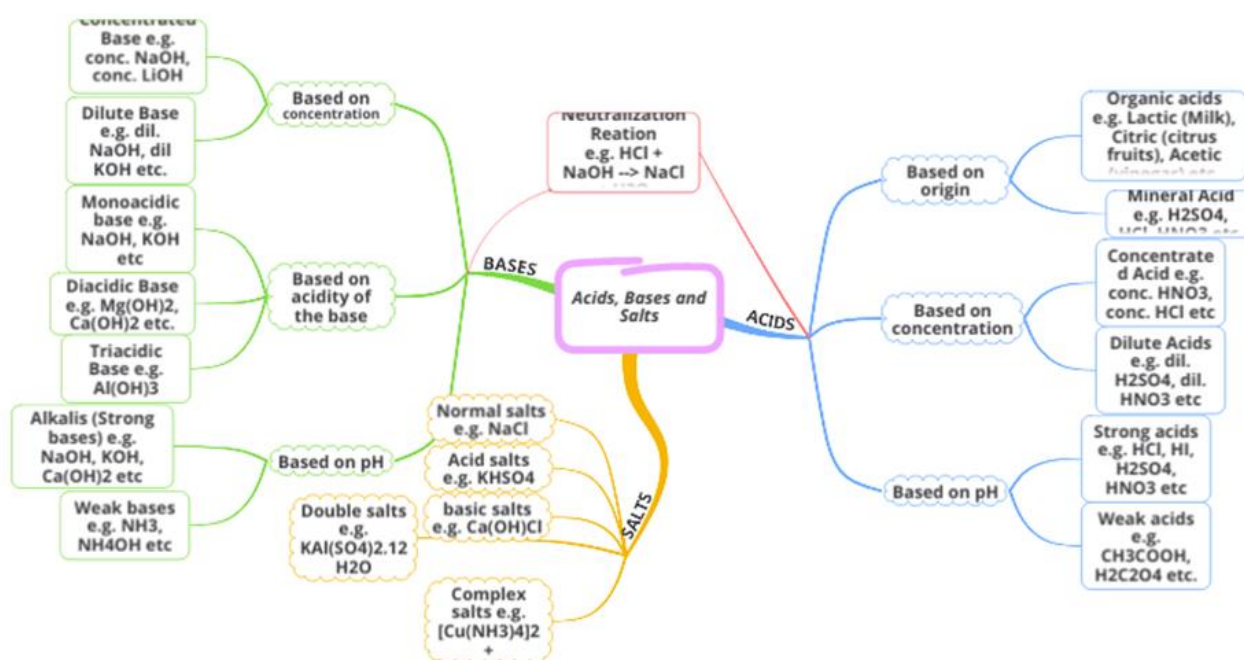
68. A suitable reagent for distinguishing between ethanoic and ethanol is

A. bromine water
B. Fehling's solution
C. sodium hydrogen trioxocarbonate (iv)
D. Ammoniacal silver trioxonitrate(V)
UTME, 2015

69. Tartaric acid is used industrially to

A. make baking powder
B. make fruit juice
C. remove rust
D. dry substance
UTME, 2015

70. Which of the following describes the chemical property of acids?

A. None of the above
B. Acid + XCO_3 → Salt + H_2O + NH_3
C. Acid + $NaOH$ → Normal salt + CO_2
D. Acid + $XnCO_3$ → Salt + H_2O + CO_2
UTME, 2019

71. A 'breath test' used by traffic police to check drunken driving uses?

A. Tumeric on filter paper
B. Silica gel coated with saliva nitrate
C. Potassium permanganate-sulphuric acid
D. Potassium dichromatic-sulphuric acid
UTME,2021

BASES

72. The basicity of CH3COOH is

A. 4
B. 1
C. 2
D. 3
UTME, 2014

73. The drying agent suitable for drying ammonia is

A. Calcium Chloride
B. Calcium Oxide
C. Phosphorus (V) Oxide
D. Concentrated H2SO4
UTME, 2016

74. Aluminium hydroxide is used in the dyeing industry as a

A. dye
B. dispersant
C. salt
D. mordant
UTME, 2017

75. Copper (II) tetraoxosulphate (IV) is widely used as

A. fertilizer
B. fungicide
C. Disinfectant
D. purifier
UTME, 2020

SALT

76. Steam changes the colour of anhydrous cobalt (II) chloride from

A. white to red
B. blue to white
C. blue to pink
D. white to blue
UTME, 2013

77. An example of a hygroscopic substance is

A. $CuO(s)$.
B. $MgCl_2(s)$.
C. $CaCl_2(s)$.
D. $NaOH(s)$.
UTME, 2013

78. When salt loses its water of crystallization to the atmosphere on exposure, the process is said to be

A. efflorescence
B. deliquescence
C. effervescence
D. fluorescence
UTME, 2015

79. The salt that reacts with dilute hydrochloric acid to produce a pungent smelling gas which decolourises acidified purple potassium tetraoxomanganate (VII) solution is

A. Na_2SO_4
B. Na_2SO_3
C. Na_2S
D. Na_2CO_3
UTME, 2018

80. One of the active components of baking powder is

A. $MgSO_4$
B. $NaHCO_3$
C. $CaSO_4$
D. $NaCl$
UTME, 2020

OXIDE

81. Which of the following is a set of neutral oxides?

A. N_2O, H_2O, CO
B. N_2O, SO_2, CO
C. N_2O, Na_2O, ZnO
D. N_2O, SO_3, NO
UTME, 2019

82. Which of the following pairs of substances will react further with oxygen to form a higher oxide?

A. CO_2 and H_2O
B. NO and H_2O
C. CO and CO_2
D. SO_2 and NO
UTME, 2018

PH AND POH SCALE; SIMPLE CALCULATIONS

83. Three drops of a 1.0 mol dm-3 solution of HCl were added to 20cm3 of a solution of pH 6.4. The pH of the resulting solution will be

A. close to that of pure water
B. less than 6.4
C. greater than 6.4
D. unaltered
UTME, 2013

84. What is the PH of 0.001moldm3 solution of the sodium hydroxide

A. 14

B. 13

C. 12

D. 11

UTME, 2018
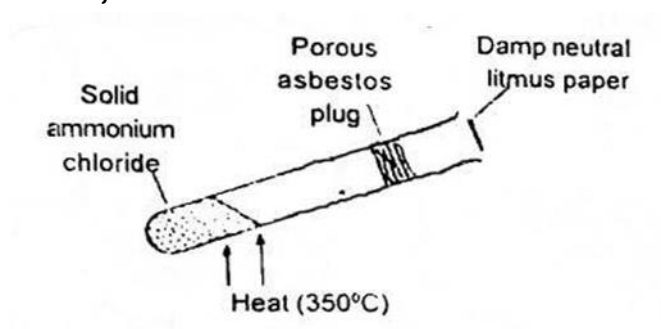
85. A sample of orange juice is found to have a pH of 3.80. What is the concentration of the hydroxide ion in the juice?

A. 1.6 × 10-4

B. 6.3 × 10-11

C. 6.3 × 10-4

D. 1.6 × 10-11

UTME, 2017

86. In the shown experiment (Fig. 1) the litmus paper will initially

A. be bleached

B. turns green

C. turns red

D. turns blue

UTME, 2018

87. The indicator most suitable for this reaction should have a pH equal to

A. 5

B. 7

C. 3

D. 9

UTME, 2019

ACID BASE TITRATION

88. What volume of 0.5M H2SO4 will exactly neutralize 20cm3 of 0.1M NaOH Solution?

A. 2.0cm3

B. 5.0cm3

C. 6.8cm3

D. 8.3cm3

UTME, 2016

89. What is the concentration of a solution containing 2g of NaOH in 100cm3 of solution?

[Na=23, O=16, H=1]

A. 0.05 moldm-3

B. 0.30 moldm-3

C. 0.50 moldm-3

D. 0.40 moldm-3

UTME, 2016
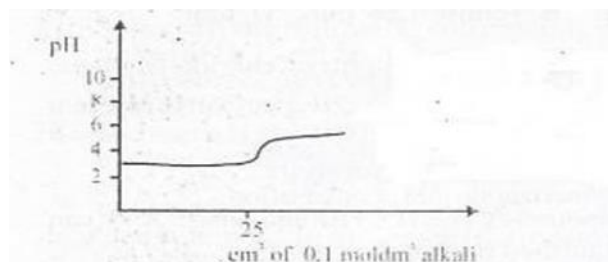
90. The curve depicts titration between

A. Strong acid and strong base
B. Strong acid and weak base
C. Weak acid and weak base
D. Weak acid and strong base
UTME, 2016

91. In the reaction between sodium hydroxide and tetraoxosulphate (VI) solutions, what volume of 0.5molar sodium hydroxide would exactly neutralize 10cm3 of 1.25molar tetraoxosulphate (vi) acid?

A. 25cm3
B. 10cm3
C. 20cm3
D. 50cm3
UTME, 2019

92. The process by which salt and water reacted in a limited way to form an acid or a base is?

A. Neutral process
B. Basic acidic process
C. Hydrolysis
D. Sublimation
UTME,2021

ANSWERS AND EXPLANATION

68. Answer: **Option C**

Explanation: Sodium hydrogen trionocarbonate iv is the only distinguishing reagent between ethanoic and ethanol. Option A, B, D are not conspicuous in distinguishing between ethanoic and ethanol.

69. Answer: **Option A**

Explanation: Tartaric acid is commonly mixed with sodium bicarbonate which is sold as the baking powder used as a leavening agent in food preparation.

70. Answer: **Option D**

Explanation: Acid reacts with a base to formed salt and water so option D best describes the above statement.

71. Answer: **Option D**

Explanation: The earliest developed breathalyser was based on the reaction of alcohol is present in the exhaled air with a cocktail of chemicals containing sulfuric acid, potassium dichromate, silver nitrate, and water. Silver nitrate catalyzes the reaction between alcohol and potassium dichromate in an acidic medium.

72. Answer: **Option B**

Explanation: Since CH_3COOH can donate 1 proton (H^+) to form CH_3COO^- & H^+ so the basicity of ethanoic acid is 1. (Monobasic acid). NB the basicity of an acid depends on the total amount of proton (positive ions) it can donate.

73. Answer: **Option B**

Explanation: For drying Ammonia gas (basic in nature), we need a basic substance because if it is an acidic substance, Ammonia will react with it and form a salt. So, only CaO can be used for drying Ammonia.

74. Answer: **Option D**

Explanation: Aluminium hydroxide is also used as a mordant in dyeing.

75. Answer: **Option B**

Explanation: Copper sulphate is an inorganic compound that combines sulphur with copper. It can kill bacteria, algae, roots, plants, snails, and fungi. The toxicity of copper sulphate depends on the copper content.

76. Answer: **Option C**

Explanation: The cobalt chloride changes colour because the salt in the solution dissociates into ions. Cobalt ions are hydrated in the solution and have a pink colour. Adding concentrated hydrochloric acid to the solution changes the colour of the solution to bluish-purple.

77. Answer: **Option A**

Explanation: $CaCl_2$, $MgCl_2$ and NaOH are all deliquescence substances, they form new solutions when they absorb water but CuO doesn't, it absorbs water and still remains the same,

78. Answer: **Option A**

Explanation: Efflorescence, is the spontaneous loss of water by a hydrated salt, which occurs when the aqueous vapour pressure of the hydrate is greater than the partial pressure of the water vapour in the air.

79. Answer: **Option B**

Explanation: Na_2SO_3 is the salt that reacts with dilute hydrochloric acid to produce a pungent-smelling gas that decolourizes acidified purple potassium tetraoxonanganate (VII) solution, this gas is SO_2.

80. Answer: **Option B**

Explanation: All baking powders contain sodium bicarbonate (just like baking soda). But baking powder also contains two acids. One of these acids is called monocalcium phosphate.

81. Answer: **Option A**

Explanation: Neutral oxides are oxides that are neither acidic nor basic. examples of neutral oxides are nitrous oxide (N_2O), nitric oxide (NO), carbon monoxide (CO) water (H_2O) while an acidic oxide reacts with water and produces an acid. Usually, it is the oxide of non-metals. Examples include SO_2, CO_2, and SO_3.

82. Answer: **Option D**

Explanation: SO_2 and NO, this is because The SO_2 will form SO_3 and NO will form NO_2

83. Answer: **Option B**

Explanation: Because the three drops of 1.0mol dm3 of HCL will increase the acidity of the resulting solution and therefore the pH will be less that it original pH

84.   Answer: **Option D**

Explanation:

$[H+] [OH-] = 10-14$
$[H+] = 10-14/[OH-] = 10-14/ (1 * 10-3) = 10-11$
$pH = -Log10[H+]$
$= - Log10[10-11] = - 1 * -11 Log10[10-11] = 1 = -1 * -11 * 1 = 11$

85. Answer: **Option B**

Explanation: Pk10=PH+POH
14=3.8+POH
POH=10.2
BUT -LOG[OH-]=POH
LOG[OH-]=-10.2
$[OH-]=LOG^-1 -10.2$ = $6.3X10^-11$

86. Answer: **Option D**

Explanation: The scale of PH is 1 to 14, 1 to about 6.3 (indicating acidity) when the litmus turns red, it reads from about 6.4 to about 8.5 (indicating Neutrality) when the litmus turns purple, and it reads from about 8.6 to 14.0 (indicating Alkalinity) when the litmus turns blue. Hence the colour of litmus in a neutral medium is purple.

87. Answer: **Option C**

Explanation: Refer to the explanation above

88. Answer: **Option A**

Explanation: $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ from the above equation ratio of acid / ratio of base is 1:2
$CaVa \div CbVb = 1/2$ and $Ca = 0.5$ mldm3 $Cb = 0.1$ moldm3 $Va = ?$ $Vb = 20cm3$
substituting the value
$0.5Va \div (0.1 \times 20) = 1/2$
Cross multiply $= 0.5Va \times 2 = 0.1 \times 20 \times 1$
$Va = 2.0cm3$

89. Answer: **Option C**

Explanation: Concentration = no of moles/volume.
No of moles = Mass given /Molar mass=   mass given is 2g and the molar mass of NaOH IS 40g
$2/40 = 0.05$ mole
Note that the volume 100cm3 was converted to dm3 100/1000= 0.1dm
Concentration = no of moles/volume= 0.05/0.1 = 0.5mol.dm3

90. Answer: **Option B**

Explanation: In a weak base-strong acid titration, the acid and base will react to form an acidic solution. A conjugate acid will be produced during the titration, which then reacts with water to form hydronium ions. This results in a solution with a pH lower than 7.

91. Answer: **Option D**

Explanation: 2NaOH+H2SO4=Na2SO4+2H2O from the above equation

CaVa ÷ CbVb =1/2 and Ca = 1.25 molar   Cb =0.5molor Va=10cm3 Vb=? substituting the value
1.25×10 ÷ (0.5 × Vb) = 1/2
Cross multiply =1.25×10 × 2 = 0.5 × Vb× 1
25= 0.5Vb   divide both side by 0.5
Vb =50cm3

92. Answer: **Option C**

Explanation: Salt hydrolysis is a reaction in which one of the ions from a salt reacts with water, forming either an acidic or basic solution While Hydrolysis is any chemical reaction in which a molecule of water breaks one or more chemical bonds.

CHAPTER NINE

OXIDATION AND REDUCTION

25 / 0

Single-Replacement
A + BC --> AC + B

Double-Replacement
AB + CD --> AD + CB

X + O2 --> oxides + water + heat

AB --> A + B

A + B <--> C + D

A + B --catalyst--> CD

A + B --> AB   Combination Reaction

Replacement Reaction

Combustion Reaction

Decomposition Reaction

Reversible Reactions

Catalytic Reaction

TYPES OF REACTIONS

REDOX Reaction

Oxidation
- addition of oxygen
- removal of hydrogen
- loss of electron
- increase in oxidation number

Reduction
- addition of hydrogen
- removal of oxygen
- gain of electron
- decrease in oxidation number

oxidation in terms of the addition of oxygen or removal of hydrogen.

93. Which of the following reactions is an oxidation process?

A. $2H + 2e^- \rightarrow H_2$
B. $2O_2^- + 4e^- \rightarrow O_2$
C. $OCl^- + H_2O + 2e^- \rightarrow 2OH^- + Cl^-$
D. $Cl + e^- \rightarrow Cl^-$
UTME, 2019

94. A chemical process in which there is a gain of electrons is known as?

A. Sublimation
 B. Reduction
C. Oxidation
D. Distillation
UTME,2021

95. The reactions involving simultaneous oxidation and reduction?

A. Automatic reactions
B. Alternate reactions
C. Reduction agency
D. Redox reactions
UTME,2021

Use of oxidation numbers. Oxidation and reduction treated as change in oxidation number and use of oxidation numbers balancing simple calculation

$Cr_2O_7^{2-}(aq) + H_2O(l) \rightleftharpoons 2CrO_4^{2-}(aq) + 2H^+(aq)$
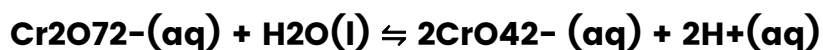
96. The oxidizing agent in the reaction above is

A. $CO(g)$
B. $C(s)$
C. $H_2O(g)$
D. $H_2(g)$
UTME, 2014

97. What happens to the reaction above when the hydrogen ion concentration is increased?

A. more of the products will be formed
B. the reaction will not proceed
C. the equilibrium position will shift to the right
D. the equilibrium position will shift to the left
UTME, 2014

98. An oxidation state of Cr in K2CrO7

A. 7
B. 6
C. 5
D. 4
UTME, 2015

99. MnO4(aq) + Y + 5Fe2+ (aq) ↦Mn2+ (aq) + 5Fe2+ (aq) + 4H2O(l)

In the equation above, Y is

A. $10H^+(aq)$

B. $5H^+(aq)$

C. $8H^+(aq)$

D. $4H^+(aq)$

UTME, 2016

100. Consider the equation below:

Cr2O2−7 + 6Fe2+ + 14H+ → 2Cr3+ + 6Fe3+ + 7H2O.
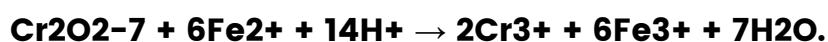
The oxidation number of chromium changes from

A. +5 to +3

B. +6 to +3

C. −2 to +3

D. +7 to +3

UTME, 2019

Tests for oxidizing and reducing agents.

101. Zn(s) + CuSO4(aq) → ZnSO4(aq) + Cu(s)
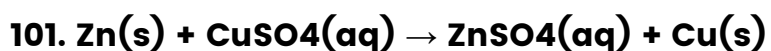
In the reaction above, the oxidizing agent is

A. $CuSO_4(aq)$

B. $ZnSO_4(aq)$

C. $Cu(s)$

D. $Zn(s)$

UTME, 2013

102. Which of the following will act as both oxidizing agents and reducing agents?

A. H2S
B. NH3
C. Cl2
D. SO2
UTME, 2020

ANSWERS AND EXPLANATION

93. Answer: **Option B**

Explanation: oxidation has to do with the addition of oxygen and removal of hydrogen

94. Answer: **Option B**

Explanation: Reduction, is any of a class of chemical reactions in which the number of electrons associated with an atom or a group of atoms is increased

95. Answer: **Option D**

Explanation: Redox (reduction/oxidation) describes all chemical reactions in which atoms have an increase or decrease in oxidation number (oxidation state).

96. Answer: **Option D**

Explanation: oxidizing agent, also known as an oxidant or oxidizer, is a substance that has the ability to oxidize other substances Common oxidizing agents are oxygen, hydrogen peroxide and halogens.

97. Answer: **Option D**

Explanation: It will shift to the left because for the reaction to move forward it must have the following conditions: increase in concentration, increase in pressure and decrease in temperature. Therefore, dis reaction is an exothermic reaction.

98. Answer: **Option D**

Explanation: The oxidation state of K2Cr2O7 is +6. K= 1 Cr = x O= -2

2x1+2x+ (-2x7)   2+2x+(-14) =0   2x -14+2   2x=12   x=+6

99. Answer: **Option B**

Explanation: the balance of the chemical equation is therefore Y is MnO4^- +5Fe2+ +8H+ --> Mn2+ + 5Fe3+ + 4H2O (8H+(aq)

100. Answer: **Option D**

Explanation: First we find the oxidation num of Cr2O7

X+2+(-2×7)   2x+14   2x/14=7

From the other side of the equation, chromium is 2Cr3+ is which is +3 so chromium changes are   +7 to +3

101. Answer: **Option A**

Explanation: CuSO4(aq) because it is the compound that is reduced. It oxidizes Zinc (i.e., it gives Zn oxygen). Remember: addition of oxygen=oxidation; giver of the oxygen is the oxidizing agent

102. Answer: **Option D**

Explanation: SO2 can act as both oxidizing as well as reducing agent since it has +4 oxidation state which is exactly between its highest oxidation state +6 and lowest oxidation state +2, Thus it can change its oxidation number either from +4 to-2(reduction) and +4 to+6 (oxidation).

CHAPTER TEN

ELECTROLYSIS

ELECTROLYTES AND NON-ELECTROLYTES. FARADAY'S LAWS OF ELECTROLYSIS.

103. Calculate the quantity of electricity in coulombs required to liberate 10g of copper from a copper compound
[Cu=64, F = 96500 Cmol-1]

A. 32395.5
B. 30156.3
C. 60784.5
D. 15196.5
UTME, 2014

104. Calculate the volume in cm3 of oxygen evolved at s.t.p when a current of 5A is passed through acidified water for 193s?
[F = 96500Cmol-1. Molar volume of a gas at s.t.p = 22.4dm3]

A. 0.056dm3
B. 0.224dm3
C. 224.000dm3
D. 56.000dm3
UTME, 2016

105. A quantity of electricity liberates 3.6g of Silver from its salt. What mass of aluminum will be liberated from its salt by the same quantity of electricity? [Al = 27, Ag = 108].

A 2.7g

B 1.2g

C 0.9g

D 0.3g

UTME, 2018

106. What mass of magnesium would be obtained by passing a current of 2 amperes for 2 hours 30 mins, through molten magnesium chloride?

[1 faraday = 96500C, Mg = 24]

A. 1.12g

B. 4.48g

C. 1.80g

D. 2.00g

UTME, 2019

Electrochemical cells: Redox series (K, Ca, Na, Mg, Al, Zn, Fe, Sn, Pb, H, Cu, Hg, Ag, Au,) half-cell reactions and electrode potentials. (Simple calculations only).

107. Copper is displaced from the solution of its salts by most metals because it

A. is a transition element

B. is at the bottom of the activity series

C. is very reactive

D. has completely filled 3d-orbitals

UTME, 2013

108. In an electrochemical cell, polarization is caused by

A. Oxygen
B. Hydrogen
C. Tetraoxosulphate(IV) acid
D. Chlorine
UTME, 2016

Electrolysis of dilute H2SO4, aqueous CuSO4, CuC12 solution, dilute and concentrated NaC1 and fused solution of sodium chloride

109. The acid in the electrolysis of water is dilute by

A. HNO3
B. CH3COOH
C. H2SO4
D. HCl
UTME, 2015

Corrosion as an electrolytic process, cathodic protection of metals, painting, electroplating and coating with grease or oil as ways of preventing iron from corrosion

110. In the electrolytic extraction of calcium from calcium chloride, the cathode is

A. zinc
B. graphite
C platinum
D. Iron
UTME, 2014

111. The constituent of air necessary in the rusting process are

A. O_2 and H_2O
B. Ar and CO_2
C. CO_2 and H_2O
D. O_2 and CO_2
UTME, 2017

112. H_2SO_4 is used to remove rust on the surface of iron (picking) before electroplating. The type of reaction involved is

A. redox reaction
B. Neutralization
C. Double decomposition
D. Hydrolysis
UTME, 2020

ANSWERS AND EXPLANATION

103. Answer: **Option B**

Explanation: $Cu \rightarrow Cu^{2+} + 2e$
64g Cu requires 2 x 96500 coulombs
10g Cu requires x coulombs   then cross multiply
x = 10x2x96500/64 =30156.3

104. Answer: **Option A**

Explanation: Q=IT
Q = 193 x 5 = 965C
$4OH \mapsto 2H_2O + O_2 + 4e$
4 x 96500C = 22.4dm3
965C = x
x = 22.4×965/4×96500 = 0.056dm3

105. Answer: **Option D**

Explanation: 96500C liberates 108g of Ag
xC will liberate 3.6g of Ag cross multiply
x= 96500*3.6/108 =3216.6C
3F =27
96500 x 3C 27g
3216.6C... Xg cross multiply
3216.6×27÷3×96500
0.3g

106. Answer: **Option D**

Explanation: Q=IT I= 2 T =2hrs & 30mins = $(120 + 30)$ mins = 150mins
50mins to Seconds = 150 x60 = 9,000s   Q= 2 x 9000   = 18000
2 x 96500 will discharge 24g of Mg
18,000 will discharge Xg of Mg cross multiply
24×18,000= 193000x divide both side by 193000
≈ 2.00g

107. Answer: **Option B**

Explanation: Because it is at the bottom of the activity series. copper being a transition element does not have anything to do with its displacement.

108. Answer: **Option B**

Explanation: Hydrogen bubbles which cause back E.M.F stick to the electrode, such is removed by means of depolarizer like manganese(iv) oxide

109. Answer: **Option C**

Explanation: H2SO4 is the acid used in the electrolysis of water. Options A, B, and D are concentrated acids and they will react with the water.

110. Answer: **Option D**

Explanation: Iron is the cathode while Graphite is the anode.

111. Answer: **Option A**

Explanation: The Necessary conditions for corrosion are: - Presence of moisture i.e., air and water.

112. Answer: **Option B**

Explanation: Rust is a base that is neutralized by H2SO4, hence the removal of rust is a neutralization reaction

CHAPTER ELEVEN

ENERGY CHANGE

Energy changes ΔH accompanying physical and chemical changes: dissolution of substances in/or reaction with water e.g., Na, NaOH, K, NH4Cl. Endothermic +ΔH and exothermic -ΔH reactions.
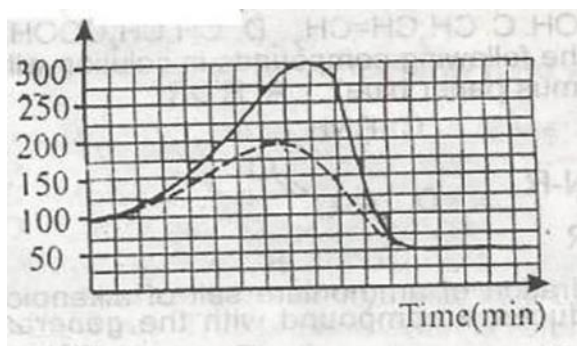
113. In the graph above, the activation energy of the catalyzed reaction is

A. 100KJ
B. 300KJ
C. 250KJ
D. 200KJ
UTME, 2013

114. In the reaction above, the concentration of 2SO3(g) can be increased by

A. decreasing the pressure
B. decreasing the temperature
C. the addition of catalyst
D. increasing the temperature
UTME, 2013
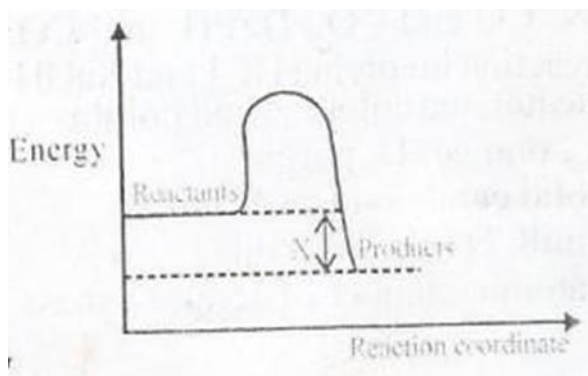
115. In the diagram above, X is the

A. Enthalpy
B. Activated complex
C. Activation energy
D. Enthalpy change
UTME, 2016

116. Which the hydration energy is greater than the lattice energy is referred to as

A. A reversible reaction
B. A spontaneous reaction
C. An endothermic reaction
D. An exothermic reaction
UTME, 2016
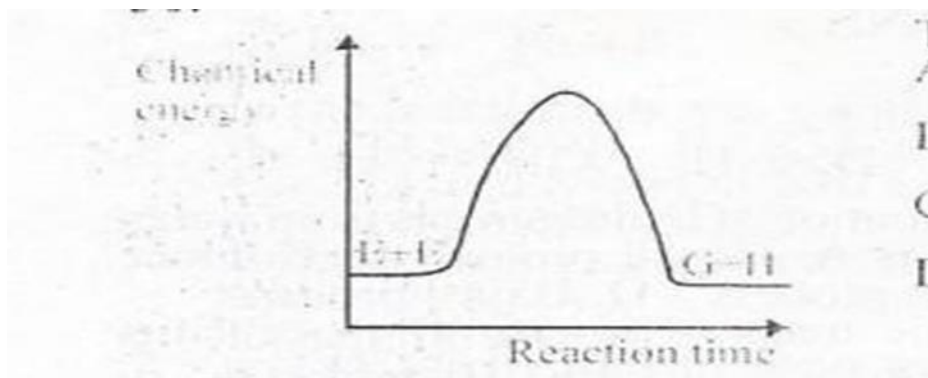
117. The diagram above represents

A. A spontaneous reaction

B. An exothermic reaction

C. Nonspontaneous reaction

D. An endothermic reaction

UTME, 2016

118. When ΔH is negative, a reaction is said to be

A. endothermic

B. exothermic

C. reversible

D. ionic

UTME, 2017

119. X(g) + 3Y(g) → 2z(g) H = +ve. If the reaction above takes place at room temperature, the G   will be

A. negative

B. zero

C. positive

D. indeterminate

UTME, 2017

120. The heat of formation of ethene, C2H4 is 50 kJmol-1, and that of ethane, C2H6 is -82kJmol-1. Calculate the heat evolved in the process:

C2H4 + H2 → C2H6

A. -122kJ

B. -132kJ

C. -88kJ

D. -60kJ

UTME, 2019

121. The heat required to raise the temperature of the body by 1k is called?

A. Specific heat

B. Thermal capacity

C. Water equivalent

D. None of the above

UTME,2021

122. The molar enthalpy change accompanying the removal of an electron from a gas phase atom or ion in its ground state is called?

A. Electron gain enthalpy
B. Ionization enthalpy
C. Enthalpy change
D. Enthalpic gas removal
UTME,2021

Entropy as an order-disorder phenomenon: simple illustrations like mixing of gases and dissolution of salt

123. $NH_3(g) + HCl(s) \rightarrow NH_4Cl(s)$
The entropy change in the system above is

A. positive
B. zero
C. negative
D. intermediate
UTME, 2015

ANSWERS AND EXPLANATION

113. Answer: **Option D**

Explanation: Activation energy can be calculated as follows 300kj-100kj=200kj

114. Answer: **Option B**

Explanation: The reaction is exothermic and in an exothermic reaction decrease in temperature favors the forward reaction and vice versa

115. Answer: **Option D**

Explanation: Enthalpy change is the name given to the amount of heat evolved or absorbed in a reaction carried out at constant pressure.

116. Answer: **Option D**

Explanation: When the hydration energy is greater than the lattice energy, then it is exothermic

117. Answer: **Option C**

Explanation: A nonspontaneous reaction is a reaction that does not favor the formation of products at the given set of conditions.

118. Answer: **Option B**

Explanation: When ΔH is negative, heat is liberated to the surrounding and that is an exothermic reaction. When ΔH is positive, heat is absorbed from the surrounding and that is an exothermic reaction.

119. Answer: **Option A**

Explanation: $\Delta G = \Delta H - T\Delta S$.
For ΔG which is Gibbs free Energy to be positive or negative, the value of ΔH (change in enthalpy) and ΔS (change in entropy) and also the value of temperature must be given. The table below summaries the condition.

Enthalpy Change [ΔH)	Entropy Change [ΔS)	Gibbs free Energy (ΔG)
Positive	Positive	It depends on the temperature it might be negative or positive
Negative	Positive	Always negative
Negative	Negative	Depend on the temperature it may be positive or negative
Positive	Negative	Always positive

120. Answer: **Option B**

Explanation: $\Delta H = \Delta P - \Delta R$ $\Delta P = -82$ kJmol- $\Delta R = 60$ kJmol-
$\Delta H = -82 - 50 = -132$ kj/mol

121. Answer: **Option B**

Explanation: Heat capacity or thermal capacity: The amount of heat to be supplied to an object to produce a unit change in its temperature(1k).

122. Answer: **Option B**

Explanation: Ionization enthalpy is the minimum amount of energy required to detach from an isolated gaseous atom the most loosely bound electron and turn it into a gaseous cation.

123. Answer: **Option C**

Explanation: Entropy is the degree of disorderliness, now we should expect a decrease in the entropy of the reaction in the question, since there is a decrease in the number of gases as the reactions proceed. So, the entropy of the system is negative

CHAPTER TWELVE

RATES OF CHEMICAL REACTION

Elementary treatment of the following factors which can change the rate of a chemical reaction:
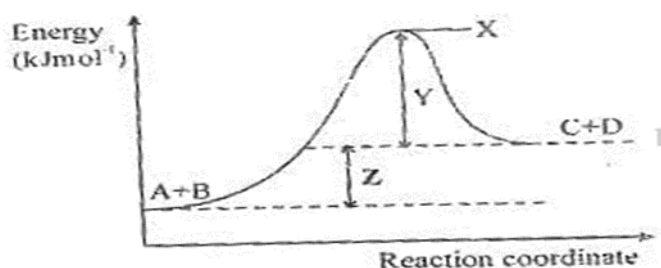
124. The minimum amount of energy required for a reaction to take place is

A. lattice energy
B. ionization energy
C. activation energy
D. kinetic energy
UTME, 2013

125. Z in the diagram above represents

A heat of reaction
B activation energy
C free energy
D entropy of reaction
UTME, 2014

126. PCl5(g)→ PCl3(g) + Cl2(g)
In the reaction above, a decrease in pressure will

A. Decelerate the reaction

B. Increase yield of PCl3

C. Increase the yield of PCl5

D. Accurate the reaction

UTME, 2015
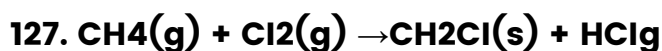
127. CH4(g) + Cl2(g) →CH2Cl(s) + HClg
The major factor that influences the rate of the reaction above is

A. Concentration

B. Catalyst

C. Temperature

D. Light

UTME, 2016

128. Consider the reaction
A(s) + 2B(g) → 2C(aq) + D(g)
What will be the effect of a decrease in pressure on the reaction?
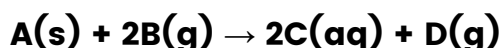
A. the equilibrium will shift

B. rate of forward reaction will increase

C. rate of backward reaction will increase

D. rates of forward and backward reaction are not affected

UTME, 2019

Catalyst e.g., the decomposition of H2O2 or KClO3 in the presence or absence of MnO2

129. Which of the following statements about catalysts is false?

A. biological catalysts are called enzymes

B. catalysts do not appear in the balanced equation

C. catalysts reduce the activation energy for a reaction

D. catalysts do not alter the mechanism of the reaction and never appear in the rate low

UTME, 2019

ANSWERS AND EXPLANATION

124. Answer: **Option C**

Explanation: Activation energy, in chemistry, is the minimum amount of energy that is required to activate atoms or molecules to a condition in which they can undergo chemical transformation.

125. Answer: **Option A**

Explanation The Heat of Reaction (also known as Enthalpy of Reaction) is the change in the enthalpy of a chemical reaction that occurs at a constant pressure.

126. Answer: **Option B**

Explanation: decrease in pressure favors the side with larger volume. from the equation, the products have 2 volumes of PCl3 and Cl2 compared to the reactant with 1volume of PCl3 therefore, there will be increase in the yield of PCl3.

127. Answer: **Option D**

Explanation: The greater the intensity of light (visible or ultra-violet) the more reactant molecules is likely to gain the required energy (activation energy) and react, so the reaction speed increases.

128. Answer: **Option B**

Explanation: When there is a decrease in pressure, the equilibrium will shift towards the side of the reaction with more moles of gas.

129. Answer: **Option D**

Explanation: Catalyst, in chemistry, any substance that increases the rate of a reaction without itself being consumed. Enzymes are naturally occurring catalysts responsible for many essential biochemical reactions.

CHAPTER THIRTEEN

EQUILIBRIUM

130. In an equilibrium reaction, which of the following conditions indicates that the maximum yield of the product will be obtained?

A. Equilibrium constant is very large
B. $\Delta H - T\Delta S = O$
C. $\Delta H > T \Delta S$
D. Equilibrium constant is less than zero
UTME, 2014

131. For the general equation of the nature
xP + yQ $\rightleftharpoons$ mR + nS, the expression for the equilibrium constant is for the general equation of the nature

A. $k[P]x[Q]y$

B. $\dfrac{m[R][S]}{x[P]y[Q]}$

C. $\dfrac{[R]m[S]n}{[P]x[Q]y}$

D. $\dfrac{[P]x[Q]y}{[R]m[S]n}$

UTME, 2019

ANSWERS AND EXPLANATION

130. Answer: **Option A**

Explanation: A large equilibrium constant means that the reaction proceeds in the forward direction, from reactants to products, until almost all the reactants have been converted to products, which is also applicable to the reaction above

131. Answer: **Option C**

Explanation: equilibrium constant is A mathematical ratio that shows the concentrations of the products divided by the concentrations of the reactants.
k = concentration of product /concentration of reactant Let us assume they are all in aqueous solution
$k = ([R]m[S]n)/([P]x[Q]y)$

CHAPTER FOURTEEN

NON-METALS AND THEIR COMPOUNDS

22 / 0
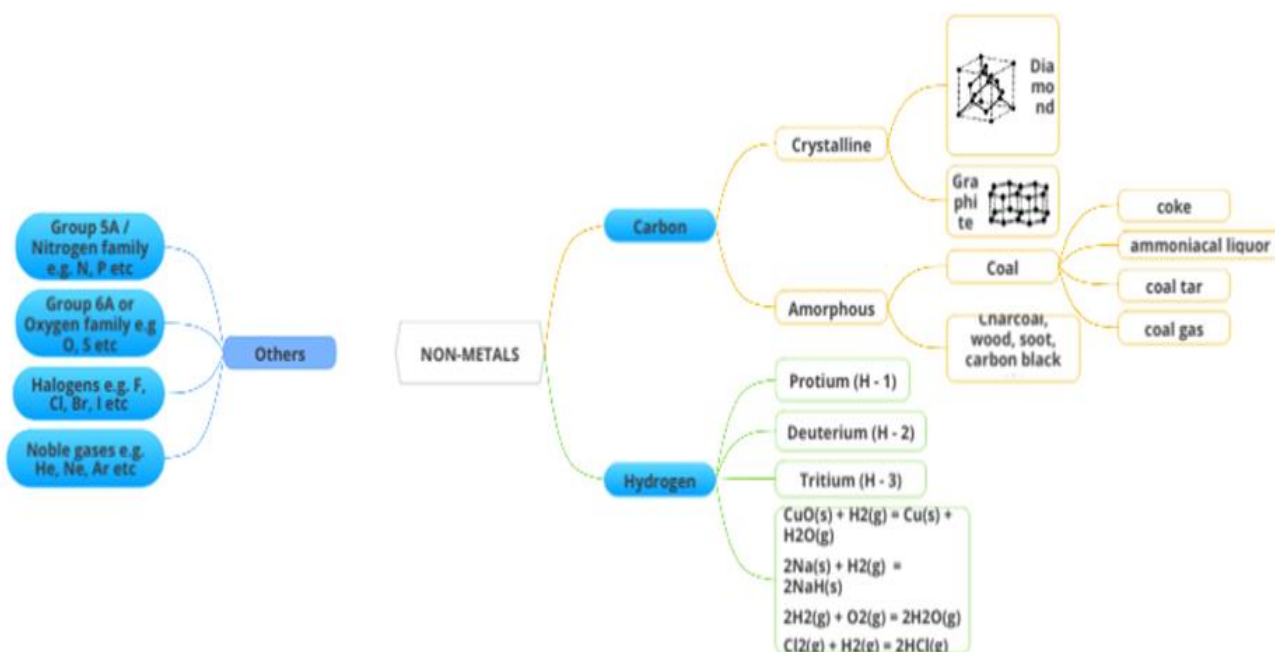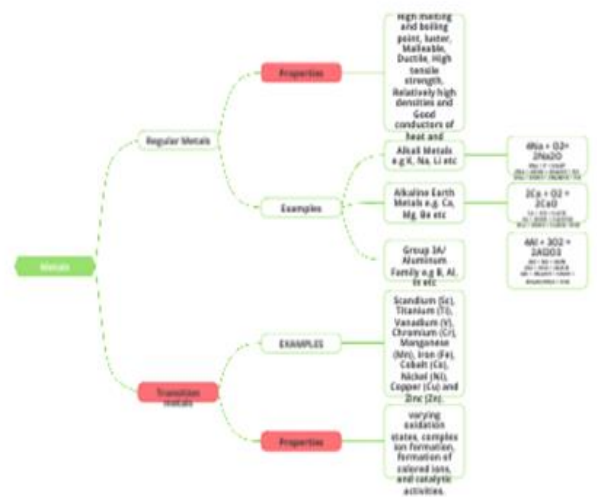
Hydrogen: commercial production from water gas and cracking of petroleum fractions, laboratory preparation, properties, uses and test for hydrogen

132. The industrial preparation of hydrogen gas from water gas is referred to as

 A. Bosch process
 B. Contact process
 C. Haber process
 D. Bayer Process
  UTME, 2016

Halogens: Chlorine as a representative element of the halogen. Laboratory preparation, industrial preparation by electrolysis, properties and uses, e.g. water sterilization, bleaching, manufacture of HCl, plastics and insecticides. Hydrogen chloride and Hydrochloric acid: Preparation and properties. Chlorides and test for chlorides.

133. Rare gases are suitable because they

A. are monoatomic
B. form ions easily
C. have duplet or octet electronic configuration in the outermost shells in their atoms
D. are volatile gases
UTME, 2015

134. Which process(es) is/are involved in the turning of starch iodide paper blue-black by chlorine gas?

A. chlorine attacks the starch to give the blue-black color
B. chlorine attacks the iodide ion to give the blue-black color
C. chlorine oxidizes the iodide ion to produce iodine which attacks the starch to give the blue-black color
D. iodine attacks the starch to give the blue-black color
UTME, 2019

135. Which of the following is a non-metal that remains liquid at room temperature?

A. Chlorine
B. Phosphorus
C. Bromine
D. Helium
UTME, 2021

136. The reactivity of fluorine is due to?

A. its high electro negativity
B. small size of fluorine atom
C. availability of D-orbitals
D. strong f-f bond
UTME, 2021

137. The most abundant rare gas in the atmosphere is?

A. He

B. Ne

C. Ar

D. Xe

UTME, 2021

Oxygen and Sulphur

138. Which of these gases is used as an anesthesia?

A. N_2O

B. NO_2

C. NH_3

D. NO

UTME, 2013

139. Ca $(OH)_2$(s) + 2NH4Cl(g) → CaCl2 (s) + 2H2O2 (l) + X.
In the reaction above, X is

A. NO_2

B. NH_3

C. N_2O

D. NO_2

UTME, 2017

140. The gas that is most useful in protecting humans against solar marathon is

A. chlorine
B. ozone
C. carbon IV oxide
D. hydrogen Sulphur
UTME, 2015.

141. An element used in the production of matches is

A. nitrogen
B. aluminum
C. copper
D. Sulphur
UTME, 2018

142. Sulphur exists in six forms in the solid state. This property is known as

A. Isomerism
B. Allotropy
C. Isotopy
D. Isomorphism
UTME, 2019

143. Burning magnesium ribbon in air removes which of the following

(i) oxygen
(ii) nitrogen
(iii) argon and
(iv) carbon(iv)oxide

A. i and iv only
B. i, ii, iii and iv only
C. i only
D. i and ii only
UTME, 2019

144. Which important nitrogen-containing compound is produced in Haber's process?

A. NH_3
B. NO_2
C. NO
D. HNO_3
UTME, 2019

145. The function of sulphury during the vulcanization of rubber is to

A. act as a catalyst for the polymerization of rubber molecules
B. convert rubber from thermosetting to thermoplastic polymer
C. form chains which bind rubber molecules together
D. break down rubber polymer molecules
UTME, 2020

146. Oxygen is absent in which of the following?

A. Kerosene
B. Soil
C. Glass
D. Cement
UTME,2021

147. A binary compound of oxygen with another element is referred to as?

A. Oxide
B. Element
C. Carbon
D. Nitrogen
UTME,2021

CARBON

ALLOTROPES: USES AND PROPERTIES

148. Diamond cannot be used

A. In making bicycle chains
B. As abrasives
C. In cutting glass and metals
D. As dies for drawing wires
UTME, 2016

149. Which of the following conducts electricity?

A. Sulphur
B. Graphite
C. Diamond
D. Red phosphorous
UTME, 2020

CARBON (IV) OXIDE

150. The gas that can be collected by downward displacement of air is

A. chlorine
B. Sulphur (IV) oxide
C. carbon (IV) oxide
D. ammonia
UTME, 2017

ANSWERS AND EXPLANATION

132. Answer: **Option A**

Explanation: Haber-Bosch process, also called Haber ammonia process, or synthetic ammonia process, method of directly synthesizing ammonia from hydrogen and nitrogen, developed by the German physical chemist Fritz Haber.

133. **Answer: Option C**

Explanation: Rare gases are stable because they have duplet or octet electronic configurations in the outermost shells of their atoms. As a result, they don't go into solution easily.

134. Answer: **Option C**

Explanation: It passed through H2SO4 because when chlorine is liberated in the mixture, little amount of HCl is also liberated and both are passed through H2SO4 so as to eliminate HCl because it can't react with it, then chlorine gas is liberated and passed through water to attain pure chlorine.

135. Answer: **Option C**

Explanation: Bromine is a chemical element with the symbol Br and atomic number 35. It is the third-lightest halogen and is a volatile red-brown liquid at room temperature that evaporates readily to form a similarly colored vapor.

136. Answer: **Option A**

Explanation: Fluorine (F), most reactive chemical element and the lightest member of the halogen elements. As the most electronegative element, it is extremely reactive.

137. Answer: **Option C**

Explanation: The most abundant naturally occurring gas is Nitrogen $(N2)$, Argon is the most abundant rare gas in the atmosphere. It is represented by the symbol Ar. The atomic number of Ar is 18.

138. Answer: **Option A**

Explanation: Nitrous oxide is an N-methyl-d-aspartate receptor antagonist and may reduce the incidence of chronic post-surgical pain.

139. Answer: **Option B**

Explanation: Balancing the chemical equation. Ca $[OH]2$ + 2NH4Cl → CaCl2 + 2H2O + 2NH3
X = NH3

140. Answer: **Option B**

Explanation: The ozone layer acts as a filter for the shorter wavelength and highly hazardous ultraviolet radiation (UVR) from the sun, protecting life on Earth from its potentially harmful effects.

141. Answer: **Option D**

Explanation: Sulphur is the major ingredient for making fire starting matches while phosphorus sulphide is used in coating striking surface on the side of the matches.

142. Answer: **Option B**

Explanation: Allotropes of Sulphur · (i) Rhombic Sulphur or α-Sulphur · (ii) Monoclinic Sulphur or β-Sulphur · (iii) Plastic Sulphur or δ-Sulphur. The allotropes

of Sulphur are the allotropy is only used for elements and not for chemical compounds.

143. Answer: **Option C**

Explanation: magnesium ribbon will remove oxygen from air, but not only oxygen.

144. Answer: **Option A**

Explanation: Haber-Bosch process, also called Haber ammonia process, or synthetic ammonia process, method of directly synthesizing ammonia from hydrogen and nitrogen,

145. Answer: **Option C**

Explanation: The most common vulcanization agent is sulfur. It forms bridges between individual polymer molecules when heated with rubber.

146. Answer: **Option A**

Explanation: Kerosene contains hydrocarbon with twelve to eighteen carbon atoms per molecule I.e C12H26-C15H32 is the formula of kerosene.

 147. Answer: **Option A**

Explanation: An oxide is a chemical compound that contains at least one oxygen atom and one other element in its chemical formula.

148. Answer: **Option A**

Explanation: Diamond is very strong to be used as dyes in drawing of wires, cutting of glass and metals and as well used as abrasives, because of it octagonal arrangement of the tetrahedral structure of its crystals and also due to the fact that it has a very high melting and boiling point.

149. Answer: **Option B**

Explanation: In a graphite molecule, one valence electron of each carbon atom remains free, thus making graphite a good conductor of electricity.

150. Answer: **Option D**

Explanation: Since ammonia gas is lighter than air, it is collected by downward displacement of air.

CHAPTER FIFTEEN

METALS AND THEIR COMPOUNDS

16 / 0

A mind map diagram showing:

METALS branching into **Transition metals** and **Regular Metals**

Transition metals:
- EXAMPLES: Scandium (Sc), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu) and Zinc (Zn)
- Properties: varying oxidation states, complex ion formation, formation of colored ions, and catalytic activities.

Regular Metals:
- Properties: High melting and boiling point, luster, Malleable, Ductile, High tensile strength, Relatively high densities and Good conductors of heat and electricity.
- Examples:
  - Alkali Metals e.g K, Na, Li etc
    - $4Na + O_2 = 2Na_2O$
    - $3Na + P = Na_3P$
    - $2Na + 2H_2O = 2NaOH + H_2$
    - $2Na + 2NH_3 = 2NaNH_2 + H_2$
  - Alkaline Earth Metals e.g. Ca, Mg, Be etc
    - $2Ca + O_2 = 2CaO$
    - $Ca + Cl_2 = CaCl_2$
    - $Ca + 2H_2O = Ca(OH)_2$
    - $3Ca + 2NH_3 = Ca_3N_2 + 3H_2$
  - Group 3A/ Aluminum Family e.g B, Al, In etc
    - $4Al + 3O_2 = 2Al_2O_3$
    - $2Al + N_2 = 2AlN$
    - $2Al + 3Cl_2 = 2AlCl_3$
    - $2Al + 2NaOH + 6H_2O = 2NaAl(OH)_4 + 3H_2$

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GENERAL PROPERTIES OF METALS

151. There is a large temperature interval between the melting point and the boiling point of metal because:

A. metals have a very high melting point
B. metals conduct heat very rapidly
C. melting does not break the metallic bond but boiling does
D. the crystal lattice of metal is easily broken
UTME, 2020

152. Which of the following compound is NOT the correct formed compound when the parent metal is heated in air?

A. Calcium oxide
B. Sodium oxide $(Na2O)$
C. Copper (II) oxide (CuO)
D. tri-iron tetra oxide $(Fe2O)$
UTME,2020

Alkali metals e.g., sodium

153. Due to the high reactivity of sodium, it is usually stored under

A. water
B. mercury
C. paraffin
D. phenol
UTME, 2017

SODIUM HYDROXIDE

154. An aqueous solution of a metal salt, M. gives a white precipitate with NaOH which dissolves in excess NaOH. With aqueous ammonia, the solution of M also gives a white precipitate which dissolves in excess ammonia Therefore the cation in M is

A. Zn
B. Ca
C. Al
D. Po
UTME, 2018

ALKALINE-EARTH METALS, E.G., CALCIUM

155. A compound that gives a brick-red color to a non-luminous flame is likely to contain

A. copper ions
B sodium ions
C calcium ions
D aluminum ions
UTME, 2014

156. Which of the following metals cannot replace hydrogen from water or steam?

A. Sodium
B. Magnesium
C. Copper
D. Calcium
UTME, 2018

157. Which of the following alkaline metals react more quickly spontaneously with water?

A. Calcium
B. Beryllium
C. Magnesium
D. Strontium
UTME, 2019

158. Which of the following is a form of calcium carbonate?

I. limestone
II. marble
III. chalk
Iv. egg-shells

A. I only
B. I, II and IV
C. I and II only
D. I, II, III, and IV
UTME, 2021

Aluminum Purification of bauxite, electrolytic extraction, properties and uses of aluminum

159. aluminum containers are frequently used to transport trioxonitrate (v) acid because aluminums

A. has a silvery-white appearance
B. has a low density
C. does not react with the acid
D. does not corrode
UTME, 2013

160. Which of the following does NOT contain aluminum as a component?

A. Over-head cables
B. Duralumin
C. Container for caustic soda
D. Container for trioxonitrate (v) acid
UTME, 2020

METALS OF THE FIRST TRANSITION SERIES. CHARACTERISTIC PROPERTIES

161. The colored nature of transition metal ions are associated with their partially filled

A. f- orbital
B. s- orbital
C. p-orbital
D. d-orbital
UTME, 2013

Iron Extraction from sulphide and oxide ores

162. Iron is often galvanized in order to

A. Make it more malleable
B. Remove the impurities unit
C. Protect it against corrosion
D. Render it passive

UTME, 2016

163. The reddish–brown rust on ion roofing sheets consists of

A. $Fe^{3+}(H_2O)_6$
B. $FeO.H_2O$
C. $Fe_2O_3.3H_2O$
D. $Fe_3O_4.2H_2O$

UTME, 2017

164. The removal of rust from iron by treatment with tetraoxosulphate (vi) acid is based on the

A. Hydrolysis of the iron
B. Reaction of acid with base
C. Oxidation of the rust
D. Dehydration of the iron

UTME, 2020

Alloy Steel

165. The constituent common to duralumin and alnico is

A. Co
B. Mn
C. Al
D. Mg
UTME, 2017

166. Which of these alloys contains copper?

A. solder
B. steel
C. permalloy
D. bronze
UTME, 2018

Tin Extraction from its ores. Properties and uses.

167. Tin is unaffected by air at ordinary temperature due to its

A. Low melting point
B. Weak electropositive character
C. High boiling point
D. White lustrous appearance
UTME,2017

Copper Extraction from sulphide

168. Which of the following will precipitate in dil. HCl

A. ZnS
B. Na2S
C. FeS
D. CuS
UTME, 2020

169. The metal used to recover copper from a solution of copper sulphate is?

A. Na
B. Ag
C. Hg
D. Fe
UTME, 2021

170. The only metal that is anti-bacterial is?

A. Iron
B. Sodium
C. Aluminum
D. Copper
UTME,2021

ANSWERS AND EXPLANATION

151. Answer: **Option C**

Explanation: Metallic bonds are strong and require a great deal of energy to break, and therefore metals have high melting and boiling points. The stronger the bonding in a metal, the higher its melting and boiling points will be.

152. Answer: **Option D**

Explanation: metal reacts in moist air by oxidation to give a hydrated iron oxide. This does not protect the iron surface to further reaction since it flakes off, exposing more iron metal to oxidation. This process is called rusting

153. Answer: **Option C**

Explanation: Sodium, (Na) is kept under kerosene (paraffin) to avoid reactivity with air. Paraffin is also known as Kerosene. Na(sodium) is kept in kerosene to prevent it from coming in contact with oxygen and moisture.

154. Answer: **Option A**

Explanation: It is Zinc Because Zn^{2+} Al^{3+} Pb^{2+} gives a white gelatinuos ppt soluble in excess $NaOH(aq)$ solution. While only Zn^{2+} is soluble in excess $NH_3(aq)$ solution and gives white ppt too.

155. Answer: **Option C**

Explanation: Calcium is the only metal that burn with brick red flame. Option A, C, D will not burn with brick red flame rather burn with brick blue flame

156. Answer: **Option C**

Explanation: Metals above hydrogen in the activity series can displace or replace hydrogen present in water $(H2O)$ example of such metals are Ca, K, Na etc while below hydrogen cannot replace it such as copper is below and so it cannot displace hydrogen

157. Answer: **Option A**

Explanation: After a second or so, the calcium metal begins to bubble vigorously as it reacts with the water, producing hydrogen gas, and a cloudy white precipitate of calcium hydroxide.

158. Answer: **Option D**

Explanation: Calcium trioxocarbonate (IV) occurs abundantly in earth's crust as limestone, chalk and marble, Eggshell is made almost entirely of calcium carbonate $(CaCO3)$ crystals.

159. Answer: **Option C**

Explanation: Aluminium doesn't react with either dilute or concentrated trioxonitrate (V) acid because an insoluble oxide is formed on its surface which renders it passive.

160. Answer: **Option C**

Explanation: Sodium Hydroxide reacts with metals, such as Aluminium, Lead, Tin and Zinc, to form flammable and explosive Hydrogen gas. Hence, Aluminium cannot be used as a component for storing caustic soda

161. Answer: **Option D**

Explanation: D block elements are also referred to as transition elements or transition metals. because they have unfilled or either half-filled d orbitals.

162. Answer: **Option C**

Explanation: iron is galvanized with zinc covering to protect it against corrosion. Option A, B, D are the main reasons iron is galvanized

163. Answer: **Option C**

Explanation: Iron [Fe] reacts with H_2 in the presence of oxygen to form a rust. Which is represented by the formular $(Fe_2O_3.3H_2O$.

164. Answer: **Option D**

Explanation: Dehydration of the iron is the process that involves removal of rust from iron by treatment with tetraoxosulphate (vi) acid (H_2SO_4).

165. Answer: **Option C**

Explanation: constituents of duralumin are: Al, Cu, Mg, Mn. Alnico is an acronym referring to a family of iron alloys which in addition to iron are composed primarily of Al, Ni and Co.

166. Answer: **Option D**

Explanation: bronze, alloy traditionally composed of copper and tin.

167. Answer: **Option A**

Explanation: Tin is relatively unaffected by both water and oxygen at room temperature due to its low melting point.

168. Answer: **Option D**

Explanation: Usually CuS does not react with HCl but In qualitative analysis, Cu^{2+} ions react with H_2S to produce a dark precipitate of CuS.

169. Answer: **Option D**

Explanation: Zinc, Aluminium, Iron is relatively inexpensive and being unreactive on exposure to water.

170. **Answer Option D**

Explanation: Copper demonstrated the greatest antimicrobial activity. The silver coatings demonstrated the second most antimicrobial surface.

CHAPTER SIXTEEN

ORGANIC COMPOUNDS
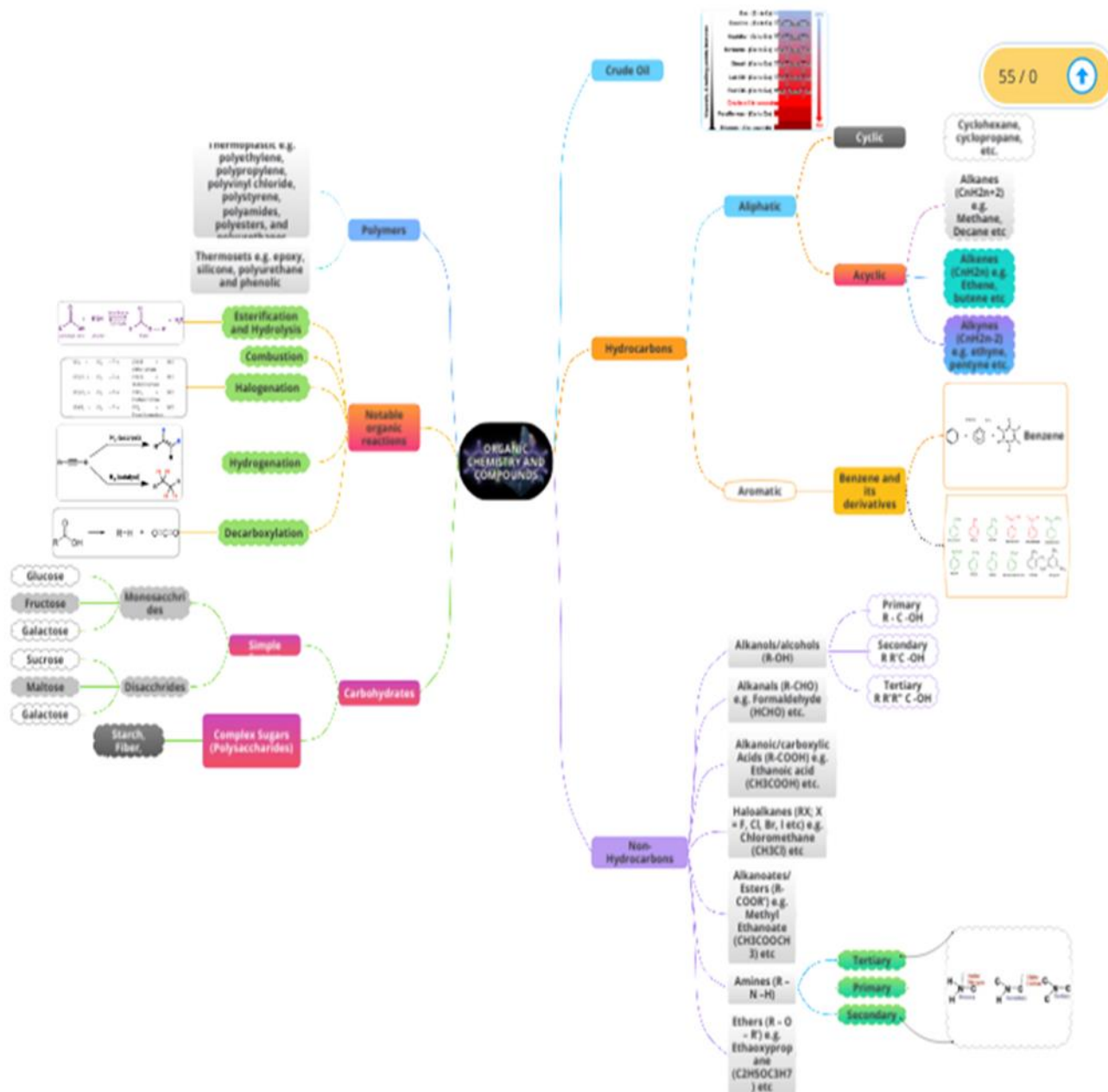
An introduction to the tetravalency of carbon, the general formula, IUPAC nomenclature and the determination of the empirical formula of each class of the organic compounds mentioned below.

171. The ability of carbon to form long chains is referred to as

A. Alkylation
B. Acylation
C. Carbonation
D. Catenation
UTME, 2016

172. The IUPAC nomenclature of the compound H3C-CH(CH3)-CH(CH3)-CH2-CH3

A. 3,4- dimethylhexane
B. 2,3- dimethyl pentane
C. 2- ethyl hexane
D. 2,3- dimethylhexane
UTME,2019

173. The IUPAC name for CICH2-CH2-CH2-OH is

A. 1-chloropropan-3-ol
B. 3-chloropropan-1-ol
C. 1 cholorpropano
D. 3-chloropropanol
UTME, 2020

174. Give the common name for the following compound $(CH_3)_2$ CH CH$_2$ –Br

A. Isobutyl bromide
B. Methyl bromide
C. propyl bromide
D. Butyl bromide
UTME, 2021

175. What is the IUPAC name for the following compound? HC≡CCH$_3$

A. Acetylene
B. Methyl acetylene
C. Butanol
D. Decanoic acid
UTME, 2021

176. A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen. If the molar mass of the compound is 180, Find the molecular formula [H = 1, C = 12, O = 16)

A. CH$_2$O
B. C$_3$H$_6$O$_3$
C. C$_6$H$_{12}$O$_6$
D. C$_6$H$_{12}$O$_3$
UTME, 2015

177. A certain hydrocarbon on complete combustion at s.t.p produced 89.6dm3 of CO2 and 54g of water. The hydrocarbon should be

A. C6H6

B. C4H10

C. C5H10

D. C4H6

UTME, 2019

Aliphatic hydrocarbon (alkane alkene and alkyne)

hydrocarbons

178.The compounds made up of only carbon and hydrogen are called?

A. Carbon compounds

B. Hydrocarbons

C. Atoms

D. Carbon hydrolysis

UTME, 2021

Alkane

179. The reaction of halogens in the presence of sunlight is an example of

A. oxidation reaction

B. addition reaction

C. hydrogenation reaction

D. substitution reaction

UTME, 2017

180. An isomer of C5H12 is

A. 2−ethyl butane
B. butane
C. 2−methyl butane
D. 2−methyl propane
UTME, 2017

181. When large hydrocarbon molecules are heated at high temperature in the presence of a catalyst to give smaller molecules, the process is known as

A. disintegration
B. polymerization
C. cracking
D. degradation
UTME, 2018

Alkene and Alkyne

182. An organic compound decolorized acidified KMnO4 solution but failed to react with ammoniacal AgNO3 solution. The organic compound is likely?

A. a carboxylic acid
B. Alkane
C. Alkene
D. Alkyne
UTME, 2020

183. Complete dehydrogenation of ethyne yields

A. benzene

B. methane

C. ethane

D. propane

UTME, 2020

Aromatic hydrocarbons e.g., benzene – structure, properties and uses.

184. The derivative of benzene that can be used in making explosives is

A. aniline

B. xylene

C. phenol

D. toluene

UTME, 2018

185. which of these compounds exhibits resonance

A. benzene

B. ethanol

C. propene

D. butyne

UTME, 2020

Alkanols

186. Alkanols have the general molecular formula

A. C_1H_{2n-2}
B. $C_1H_{2n-1}CHO$
C. $C_1H_{2n-2}OH$
D. $C_2H_{2n+1}OH$
UTME, 2016

187. A certain liquid has a high boiling point. It is viscous, non-toxic, and miscible with water to be hygroscopic; this liquid most likely to be

A. $CH_3CH_2CH_2CH_2OH$
B. $CH_3CH_2CHOH_3$
C. $CH_3CH_2CH_2CH_2OH_3$
D. $CH_3OHCHOH_2OH$
UTME, 2020

188. Which of the following statement is TRUE of the complete hydrolysis of a glyceride by sodium hydroxide?

A. 3 moles of NaOH are required for each mole of glyceride
B. 3 moles of glycerol are produced
C. only one mole of soap is formed
D. concentrated H_2SO_4 is essential for the completion of the reaction.
UTME, 2020

Alkanals and alkanones

189. The general formula of alkanones is

A. RCHO
B. R2CO
C. RCOOH
D. RCOOR
UTME, 2018

190. The compounds CH3CH2CHO and CH3COCH3 can be distinguished from each other using

A. Dilute ammonia
B. Benedict's solution
C. Tollen's reagent
D. Sodium hydroxide solution
UTME, 2016

Alkanoic acids

191. The alkanoic acid found in human sweat is

A. CH3-COOH
B. CH3—CH2—COOH
C. H-COOH
D. CH3
UTME, 2018

A. $R-C\overset{O}{\underset{OR}{\diagdown}}$

B. $R-C\overset{O}{\underset{NH_2}{\diagdown}}$

C. $R-NH_2$

D. $R-C\overset{O}{\underset{R}{\diagdown}}$
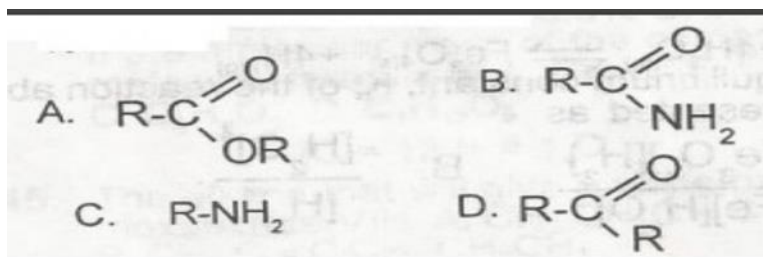
192. Use the above option to answer this question. The dehydration of ammonium salt of alkanoic acids produces a compound with the general formula

A. A
B. B
C. C
D. D
UTME, 2013

Alkanoate

193. Soaps clean surfaces on the principle based on?

A. viscosity
B. floatation
C. elasticity
D. surface tension
UTME, 2021

Amines (Alkanamines) Primary, Secondary, and tertiary

194. A primary amide is generally represented by the formula

A. RCOOR
B. RCONH2
C. RCONHR
D. RCONR2
UTME, 2013

Carbohydrates

195. The process of converting starch to ethanol is

A. cracking
B. distillation
C. fermentation
D. oxidation
UTME, 2014

$$CH_3 - \underset{\underset{OH}{|}}{\overset{\overset{H}{|}}{C}} - COOH$$
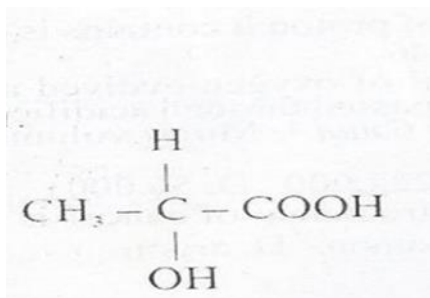
$$n \text{ monosaccharide} \underset{Q}{\overset{P}{\rightleftharpoons}} \text{polysaccharide } -n$$

water.

196. The compound above exhibits

A. Geometric isomerism

B. Positional isomerism

C. Structural isomerism

D. Optical isomerism

UTME, 2016

197. In the process above, P and Q respectively represent

A. Condensation and hydrolysis

B. Fermentation and condensation

C. Polymerization and hydrolysis

D. Polymerization and condensation

UTME, 2016

198. One of the following is not a physical property of monosaccharides?

A. Monosaccharides get charred when heated

B. Monosaccharides are water-soluble, sweet substances

C. They are highly vital to the exploration of metals

D. They can be reduced to sugar alcohol

UTME,2021

Proteins: Primary structures, hydrolysis and tests (Ninhydrin, Biuret, Millon's and xanthoproteic)

199. The inherited traits of an organism are controlled by?

A. RNA molecules

B. Nucleotides

C. DNA molecules

D. Enzymes

UTME, 2021

Polymers

200. The monomer of nylon is

A. Hydroxybenzene

B. Hexanedioic acid

C. Benzene -1, -4-dicarboxylic acid

D. Ethane-1,2-diol

UTME, 2016

ANSWERS AND EXPLANATION

171. Answer: **Option D**

Explanation: Catenation is the ability of carbon to form long chains. In fact, carbon atoms are unique because of catenation—they are unique among all of the other atoms found in nature.

172. Answer: **Option B**

Explanation: The parent's name is pentane at carbon number 2 the substituent is methyl, at carbon number 3 the substituent is methyl therefore the name of The IUPAC Name B. 2,3- dimethyl pentane

173. Answer: **Option D**

Explanation: The parent's name is propanol due to the presence of alcohol functional group at carbon number 1 the substituent is choro, at carbon number 1. The IUPAC Name is 3-chloropropanols

174. Answer: **Option B**

Explanation: Propyne (methylacetylene) is an alkyne with the chemical formula HC≡CCH3 3.

175. Answer: **Option B**

Explanation: IUPAC name is the name given to a compound after chemistry rules for naming a compound is been applied therefore for HC≡CCH3 the IUPAC is Methylacetylene, while the common name is (propyne) which is an alkyne.

176. Answer: **Option C**

Explanation: The element are CARBON, HYDROGEN, AND OXYGEN Divide them by their relative atomic mass   C = C – 40%; 40/12 = 3.33   H= – 6.7%; 6.7/1 = 6.7 O = O – 53.3%; 53.3/16 = 3.33 divide them by 3.33 which is the least   C C = 3.33/3.33 = 1 H= H = 6.7/3.33 = 2 O = O = 3.33/3.33 = therefore the empirical formular is. CH_2O to calculate the molecular formula (CH_2O) n = 180 $(12 + 2 + 16)$ ~n = 180   30n = 180 divided both side by 30   n = 6 MOLECULAR FORMULAR IS = $C_6H_{12}O_6$

177. Answer: **Option D**

Explanation: $C_xH_y + O_2 = xCO_2 + y/2 H_2O$, if we burn 1 mol of certain hydrocarbon, we would get x mol of CO_2 and y/2 mol of H_2O. During combustion, we received 54/18 = 3 mol of water and 89.6/22.4 = 4 mol CO_2. Note that one mole of a compound has $22.4dm^3$

178. Answer: **Option A**

Explanation: A hydrocarbon is any of a class of organic chemicals made up of only the elements carbon (C) and hydrogen (H hydrocarbon are of two classes Aliphatic (Alkane Alkene, and Alkyne) and Aromatic Hydrocarbons. (Benzene and its derivatives).

179. Answer: **Option D**

Explanation: Reaction of halogen with alkane in the presence of sunlight (ultraviolet) is termed halogenation. Halogenation is an example of substitution reaction.

180. Answer: **Option C**

Explanation: isomers are molecules of the same formula but having a different arrangement the isomers of the organic compound (C5H12) which is pentane is 2-methyl butane

181. Answer: **Option C**

Explanation: Cracking, in petroleum refining, the process by which heavy hydrocarbon molecules are broken up into lighter molecules by means of heat and usually pressure and sometimes catalysts.

182. Answer: **Option C**

Explanation: Alkenes which are unsaturated hydrocarbon react with potassium manganate (VII) solution in the cold and decolorized it and the color change depends on whether the potassium manganate (VII) is used under acidic or alkaline conditions and alkene do not react with Ammoniacal AgNO3 solution.

183. Answer: **Option C**

Explanation: Hydrogenation is a reaction in which hydrogen is added to reduce unsaturation

184. Answer: **Option D**

Explanation: Toluene which is the derivative of benzene, toluene is attached to methyl group as substituent is used in making explosive

185. Answer: **Option B**

Explanation: Benzene exhibit resonance because of the overlap of orbitals, double bond is made up of pi bond

186. Answer: **Option D**

Explanation: Alkanols possess a Hydroxide (OH) as functional group therefore C2H2n+1OH general molecular formula

187. Answer: **Option D**

Explanation: Ethanol is soluble in water primarily because of the presence of - OH group (Hydroxyl group) that allows or enables it to form hydrogen bonds with water molecules, and also it is a polar solvent.

188. Answer: **Option A**

Explanation: In saponification 1 mole triglycerol requires 3mole of NaOH

189. Answer: **Option B**

Explanation: Alkanones also known as ketones have the general formula R2CO Alkanones are organic molecules containing only carbon (C), hydrogen (H) and oxygen (O) atoms. Alkanones belong to the group of organic compounds known as ketones.

190. Answer: **Option C**

Explanation: Tollen's reagent is a chemical reagent used to distinguish between aldehyde and ketone functional group along with some alpha hydroxyl ketone which can be tautomerized

191. Answer: **Option B**

Explanation: Bacteria of the genus Propionibacterium produce propanoic acid as the end product of their analogic metabolism

192. Answer: **Option B**

Explanation: The dehydration of alkanoic which is also known as carboxylic acid will yield Amide and the general formula for amide correspond to option B

193. Answer: **Option D**

Explanation: Since the surface tension forces become smaller as the distance between water molecules increases, the intervening soap molecules decrease the surface tension.

194. Answer: **Option B**

Explanation: Primary amines arise when one of three hydrogen atoms in ammonia is replaced by an alkyl or aromatic group.

195. Answer: **Option C**

Explanation: fermentation, chemical process by which molecules such as glucose are broken down anaerobically.

196. Answer: **Option D**

Explanation: Optical isomerism have a chiral carbon atom at the center, and chiral carbon is a carbon with four different kinds of atoms attached to it.

197. Answer: **Option A**

Explanation: Condensation involves the formation of a new chemical bond while hydrolysis involves the breakdown of a chemical bond. condensation and hydrolysis is that condensation produces a smaller molecule as a byproduct whereas hydrolysis does not produce a byproduct.

198. Answer: **Option C**

Explanation: Monosaccharides are reducing sugars. Pure monosaccharides are water-soluble, white, crystalline solids. Form a black residue of carbon when dehydrated They taste sweet.

199. Answer: **Option C**

Explanation: DNA now has three distinct functions—genetics, immunological, and structural—that are widely disparate and variously dependent on the sugar-phosphate backbone and the bases.

200. Answer: **Option B**

Explanation: Nylon-6,6 is made from two monomers each of which contains 6 carbon atoms - hence its name. One of the monomers is a 6-carbon acid with a -COOH group at each end - hexanedioic acid.

CHEMISTRY MIND MAP

BONDING

- Dative Bonding
- Ionic Bonding
- Metallic Bonding
- Hydrogen Bonding
- Covalent Bonding

MATTER

States of Matter
- Solid
- Liquid
- Gas
  - Freezing
  - Melting
  - Condensation
  - Vaporization

Types of Matter
- Elements
  - Metals e.g. Al, Fe, Ca, Mg, Hg etc
  - Metalloids e.g Si, As, B
  - Non-metals e.g He, O, H, N
- Compounds
  - ionic e.g NaCl, HBr, MgO
  - Covalent e.g Cl2, H2, O3
- Mixture
  - Homogeneous
  - Heterogeneous

IN RELATIONSHIPS:

n = Mass /Molar Mass

n = Concentration x Volume

n = PV/RT

n = Number of partuicles x 6.02x10E23

MOLE (n)

(Avogadros constant) AS AMOUNT OF :

Atoms

Ions

Molecules

Substances

Mind map: **GAS LAWS**

- **Ideal Gas Equation**
  - $PV = nRT$

- **Boyle's Law**
  - $P_1V_1 = P_2V_2$ (T constant)

- **General Gas Law:** $P_1V_1/T_1 = P_2V_2/T_2$

- **Charles' Law**
  - $V_1/T_1 = V_2/T_2$ (P constant)

- **Grahams Law of Diffusion**
  - $r_1/r_2 = \sqrt{M_2}/\sqrt{M_1}$

- **Gay-Lussac's Law**
  - $P_1/T_1 = P_2/T_2$

- **Avogadros law**
  - $n_1/V_1 = n_2/V_2$

- **Dalton's Law of Partial Pressure**
  - $P_o = P_a + P_b + P_c + \ldots P_n$

ATOMIC MODELS

Atom

Nucleus

Proton
- Mass: 1.672×10^{-27} kg
- Charge: $+1.6 \times 10^{-19}$ C

Neutron

Electrons
- Mass: 9.1×10^{-31} kg
- Charge: -1.6×10^{-19} C

Atomic energy levels
- $1/\lambda^2 = -1/n^2 R$
  - no electron quantum number
  - R= constant

Atomic Models

Electron Cloud Model
- Visualises a central nucleus with a cloud of negative charges or electron charges

Bohr's Model
- Proposed an atomic model in which electron found in atom can only occupy orbits for which angular momentum is quantized
  - L=n (h/2π)
    - n is called quantum number. h = planck's constant = 6.626 × 10^-34

Rutherford Model
- Atom consist of positively charged heavy core cared nucleus around which negatively charged electrons circle on orbit

Developed to

Thompson's Model
- Ratio of charge to mass e/m
- Visualises electron and a homogeneous sphere of positive charge inside of which are negatively charged electrons

Plum pudding

BONDING

Dative Bonding (Coordinate Covalency)
- Electron sharing involving single donor
- Transition metals undergo coordination most
- e.e. Amonium ion, BF3, Co(NH3)6Cl etc

Covalent Bonding
- Electrons sharing
- Typically between non-metals
- Formation of non-ionic compounds
- e.g. Cl2, PCl3, O2, O3 etc
- Single bond
  - Cl - Cl
  - Double bonds
  - O = O
  - Triple Bonds

Metallic Bonding
- caused by electrostatic attractive force between conduction electrons and positively charged metal ions.

Electrovalent (Ionic Bonding)
- Electron transfer
- Typically a metal and a non-metal
- Formation of ionic compounds
- Compounds are good conductors of heat and electricity
- e.g. CaCl2, NaCl, LiF, MgO, CaS, KBr etc

Hydrogen Bonding
- Bond between hydrogen and elements with higher electronegativity
- Not as strong as Ionic or covalent bonds but not as weak as the Van Der waal forces
- e.g. HF, water, chloroform etc

Acids, Bases and Salts

BASES

Based on concentration
- Concentrated Base e.g. conc. NaOH, conc. LiOH etc.
- Dilute Base e.g. dil. NaOH, dil KOH etc.

Based on acidity of the base
- Monoacidic base e.g. NaOH, KOH etc
- Diacidic Base e.g. $Mg(OH)_2$, $Ca(OH)_2$ etc.
- Triacidic Base e.g. $Al(OH)_3$

Based on pH
- Alkalis (Strong bases) e.g. NaOH, KOH, $Ca(OH)_2$ etc
- Weak bases e.g. NH_3, NH_4OH etc

Neutralization Reation
e.g. HCl + NaOH --> NaCl + H2O

ACIDS

Based on origin
- Organic acids e.g. Lactic (Milk), Citric (citrus fruits), Acetic (vinegar) etc.
- Mineral Acid e.g. H_2SO_4, HCl, HNO_3 etc.

Based on concentration
- Concentrated Acid e.g. conc. HNO_3, conc. HCl etc
- Dilute Acids e.g. dil. H_2SO_4, dil. HNO_3 etc

Based on pH
- Strong acids e.g. HCl, HI, H_2SO_4, HNO_3 etc
- Weak acids e.g. CH_3COOH, $H_2C_2O_4$ etc.

SALTS
- Normal salts e.g. NaCl
- Acid salts e.g. $KHSO_4$
- basic salts e.g. Ca(OH)Cl
- Double salts e.g. $KAl(SO_4)_2.12H_2O$
- Complex salts e.g. $[Cu(NH_3)_4]^{2+}$

TYPES OF REACTIONS

Single-Replacement
A + BC --> AC + B

Double-Replacement
AB + CD --> AD + CB

X + O2 --> oxides + water + heat

AB --> A + B

A + B <--> C + D

A + B --catalyst--> CD

A + B --> AB — Combination Reaction

Replacement Reaction

Combustion Reaction

Decomposition Reaction

Reversible Reactions

Catalytic Reaction

REDOX Reaction

Oxidation
- addition of oxygen
- removal of hydrogen
- loss of electron
- increase in oxidation number

Reduction
- addition of hydrogen
- removal of oxygen
- gain of electron
- decrease in oxidation number

NON-METALS

Others
- Group 5A / Nitrogen family e.g. N, P etc
- Group 6A or Oxygen family e.g O, S etc
- Halogens e.g. F, Cl, Br, I etc
- Noble gases e.g. He, Ne, Ar etc

Carbon

Crystalline
- Diamond
- Graphite

Amorphous
- Coal
  - coke
  - ammoniacal liquor
  - coal tar
  - coal gas
- Charcoal, wood, soot, carbon black

Hydrogen
- Protium (H - 1)
- Deuterium (H - 2)
- Tritium (H - 3)

$CuO(s) + H2(g) = Cu(s) + H2O(g)$

$2Na(s) + H2(g) = 2NaH(s)$

$2H2(g) + O2(g) = 2H2O(g)$

$Cl2(g) + H2(g) = 2HCl(g)$

Chemical Industry mind map:

- Soaps and Detergents
- Heavy Chemicals
- Glass
- Paints
- Fertilizers
- Pharmaceuticals

CHEMICAL INDUSTRY

- Metals from Ore
- Cement
- Fine Chemicals
- Ceramics
- Plastics
- Food and Drinks

METALS

Transition metals

EXAMPLES
Scandium (Sc), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu) and Zinc (Zn)

Properties
varying oxidation states, complex ion formation, formation of colored ions, and catalytic activities.

Regular Metals

Properties
High melting and boiling point, luster, Malleable, Ductile, High tensile strength, Relatively high densities and Good conductors of heat and electricity.

Examples

Alkali Metals e.g K, Na, Li etc
$4Na + O_2 = 2Na_2O$
$3Na + P = Na_3P$
$2Na + 2H_2O = 2NaOH + H_2$
$2Na + 2NH_3 = 2NaNH_2 + H_2$

Alkaline Earth Metals e.g. Ca, Mg, Be etc
$2Ca + O_2 = 2CaO$
$Ca + Cl_2 = CaCl_2$
$Ca + 2H_2O = Ca(OH)_2$
$3Ca + 2NH_3 = Ca_3N_2 + 3H_2$

Group 3A/ Aluminum Family e.g B, Al, In etc
$4Al + 3O_2 = 2Al_2O_3$
$2Al + N_2 = 2AlN$
$2Al + 3Cl_2 = 2AlCl_3$
$2Al + 2NaOH + 6H_2O = 2NaAl(OH)_4 + 3H_2$

Organic Chemistry and Compounds — concept map

ORGANIC CHEMISTRY AND COMPOUNDS

Carbohydrates
- Complex Sugars (Polysaccharides) — Starch, Fiber, glucogen etc.
- Simple Sugars
  - Disacchrides — Maltose, Sucrose
  - Monosacchrides — Galactose, Fructose, Glucose

Notable organic reactions
- Decarboxylation
- Hydrogenation
- Halogenation
- Combustion
- Esterification and Hydrolysis

Polymers
- Thermoplastic e.g. polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyamides, polyesters, and polyurethane
- Thermosets e.g. epoxy, silicone, polyurethane and phenolic

Non-Hydrocarbons
- Ethers (R – O – R') e.g. Ethaoxyprop ane (C2H5OC3H7) etc
- Amines (R – N–H)
  - Secondary
  - Primary
  - Tertiary
- Alkanoates/ Esters (R– COOR') e.g. Methyl Ethanoate (CH3COOCH 3) etc
- Alkanoic/carboxylic Acids (R-COOH) e.g. Ethanoic acid (CH3COOH) etc
- Haloalkanes (RX; X = F, Cl, Br, I etc) e.g. Chloromethane (CH3Cl) etc
- Alkanals (R-CHO) e.g. Formaldehyde (HCHO) etc
- Alkanols/alcohols (R-OH)
  - Tertiary R R'R''C-OH
  - Secondary R R'C-OH
  - Primary R-C-OH

Hydrocarbons
- Aromatic
  - Benzene and its derivatives
- Aliphatic
  - Acyclic
    - Alkynes (CnH2n-2) e.g. ethyne, pentyne etc
    - Alkenes (CnH2n) e.g. Ethene, butene etc
    - Alkanes (CnH2n+2) e.g. Methane, Decane etc
  - Cyclic — Cyclohexane, cyclopropane etc.

Crude Oil
- Viscosity & boiling points increase