MALAPPURAM DISTRICT HIGHER SECONDARY

CHEMISTRY TEACHERS ASSOCIATION

OXY CHEMISTRY 3.0

FIRST YEAR CHEMISTRY MODEL EXAMINATION 3.3

BASED ON FOCUS AREA 2021

ANSWER KEY

Time : 2 Hours *Cool Off Time : 20 Minutes* *Maximum Score : 60*

Answer any 6 questions from 1 to 12. Each carries 2 scores. ***(6 X 2 = 12)***

1. calculate the mass of SO_3 produced when 500 gram of SO_2 reacts with 200 gram of oxygen according to the equation. $2SO_2 + O_2 \rightleftharpoons 2SO_3$ (2)

Ans . $2SO_2$ + O_2 ⇌ $2SO_3$

128g 32g 160g

ie , 128g SO_2 → 160g SO_3

1g SO_2 = 160/ 128 = 1.25g SO_3

Therefore , 500g SO_2 = 1.25 x 500 = 625 g of SO_3

2. a) What is photoelectric effect? (1)

b) Write any two observations of photoelectric effect (1)

Ans .

a) Certain metals eject electrons when light of certain frequency falls on it . This is photoelectric effect .

b) There is minimum frequency called threshold frequency for metals to eject electrons .

The number of electrons ejected is proportional to intensity of light .

3. Account for the following

a) Electron gain enthalpy of noble gases is positive (1)

b) Chlorine has the highest electron gain enthalpy (1)

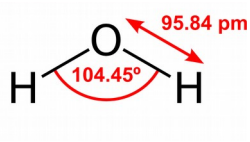
Ans .

a) Noble gases have completely filled valence orbitals . The electron added has to enter the nest higher principal quantum number . This leads to unstable electronic configuration.

b) In chlorine , the electron enters n=3 quantum level . Here , electron-electron repulsion is less because the energy level is large .

4. Explain the structure of water based on VSEPR theory. (2)

Ans .



Water has 2 bond pairs and 2 lone pairs of electrons . Expected geometry is tetrahedral . Due to lp-lp and lp-bp repulsions the actual geometry is bent . The bond angle reduces to 104.5 degrees .

5. Write 4 differences between sigma and pi bonds (2)

SIGMA	PI
1) Formed by axial overlap	1) Formed by side wise overlapping
2) Strong bond	2) Weak bond
3) Extent of overlapping large	3) Extent of overlapping small
4) Free rotation possible	4) Free rotation not possible

6. What is compressibility factor? (2)

Ans . The deviation from ideal behaviour is measured in terms of compressibility factor Z . $Z = PV/nRT$.

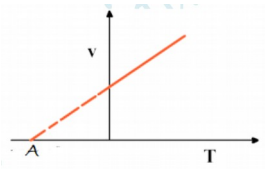
For ideal gases Z=1

At high pressure , for all gases Z> 1

At intermediate pressure , most gases have Z< 1

At low pressure Z is approximately 1

7. Name the law represented by the following graph. Give the significance of point marked "A" (2)



Ans: Charles' law, Zero Kelvin (Absolute Zero), at this temperature the gas is supposed to occupied zero volume

8. What is meant by "dead burnt plaster"? Why is it called so? (2)

Ans . Plaster of Paris is chemically $CaSO_4 ½ H_2O$. It is manufactured from gypsum

$CaSO_4 2H_2O \xrightarrow{393\ K} CaSO4\ 1/2\ H_2O + 3H_2O$

Half a molecule of water is necessary for setting of Plaster of Paris. When heated above 393K It becomes anhydrous CaSO4. It is called dead burnt plaster It is not suitable for the uses of Plaster of Paris

9. What is allotropy? What are the chief allotropes of carbon? (2)

Ans . The phenomenon by which an element can exist in one or more physical states is called allotropy. The allotropes of C are diamond graphite & fullerene

Diamond is the hardest material sp^3 hybridised, rigid 3 dimensional network

Graphite Soft layered structure sp^2 hybridised, conducting

Fullerene spheroidal carbon cage molecules prepared by heating graphite

10. What is metamerism? Write the metamers of $C_4H_{10}O$ (2)

Ans . Isomers which differ in alkyl groups on either sides of the functional groups are called metamers and the phenomenon is called metamerism .

$C_4H_{10}O$

$CH_3 - CH_2 - CH_2 - O - CH_3$ and $CH_3 - CH_2 - O - CH_2CH_3$

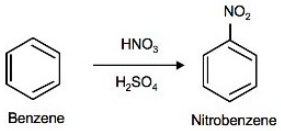
11. Write the chemical equation and name the following reactions.

a) Benzene to toluene (1)

b) Benzene to nitrobenzene (1)

Ans.a) **b)**

Friedal – Crafts alkylation reaction



Nitration reaction

12. Hydrogen combines with oxygen to form water(H_2O) and hydrogen peroxide(H_2O_2)

(a) Which law is illustrated here? (1)

(b) State the law. (1)

Ans; (a) Law of Multiple proportions

(b) " when two elements combine to form more than one compound, the mass of one element that combines with a fixed mass of the other element, are in the simple whole number ratio".

Answer any 8 questions from 13-28 carries 3 scores each. ***(8 X 3 = 24)***

13. (a) Define limiting reagent. (1)

(b) How can you detect the presence of carbon and Hydrogen in an organic compound? (2)

Ans. (a) The reactant which is completely consumed in a reaction.

(b) Given compound is heated with CuO the gas thus produced here is passed through lime water, If it turns milky it indicate the presence of carbon. The gas produced here is CO_2.

Given compound is heated with CuO the gas thus produced here is passed through anhydrous $CuSO_4$., If it turns to blue it indicate the presence of hydrogen. The gas produced here is H_2O.

14. (a) What are the important observations and conclusions made by Rutherford from his alpha ray scattering experiment? (2)

(b) Give any two limitations of Rutherford nuclear model of atom. (1)

Ans. (a) The important observations are

1) Most of the alpha particles passed through the gold foil without any deviation.
2) A small fraction of the alpha particles was deflected by small angles.
3) A very few alpha particles bounced back.

Conclusions.

1) Most space in the atom is empty.
2) The positive charge of the atom is concentrated in a very small volume at the center called nucleus.
3) The volume occupied by the nucleus is negligibly small as compared to the total volume of the atom.

(b) Limitations.

1) It cannot explain the stability of the atom.

2) It cannot explain the electronic structure of atom.

15. (a) State Heisenberg's Uncertainty Principle. (1)

(b) calculate the uncertainty in the velocity of a cricket ball of mass 130g, if the uncertainty in its position is of the order of 1.2 A^0. (2)

Ans. (a) "It is not possible to determine the exact position and momentum of microscopic particles simultaneously".

(b)$\Delta x.m.\Delta v = h/4\prod$

Here, m = 130g = $130x10^{-3}$kg, $\Delta x = 1.2A^0 = 1.2x10^{-10}$

$\Delta v = 6.626x10^{-34} \div [4x3.14x130x10^{-3}x1.2x10^{-10}] = 3.382x10^{-24}$

16. (a) State modern periodic law. (1)

(b) what are isoelectronic species? (2)

Ans.(a) "The physical and chemical properties of elements are the periodic function of their atomic numbers".

(b) The species having same number of electrons.

17. (a) What do you meant by ionization enthalpy? (1)

(b) why the ionization enthalpy of nitrogen is higher than oxygen? (2)

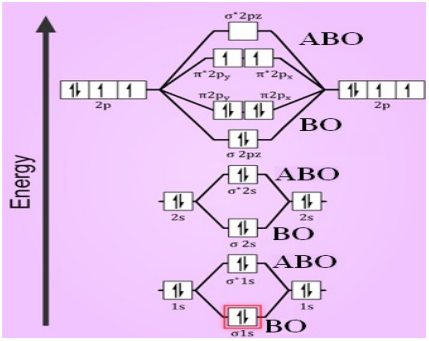
Ans.(a) It is the amount of energy required to remove valence electron from an isolated gaseous atom.

(b) Due to the stable half filled electronic configuration of nitrogen.

18. (a) Draw the molecular orbital diagram for O_2. (2)

(b) calculate the bond order of O_2. (1)

Ans.a)



(b) Bond order = ½[N_b-N_a] = ½[10-6] = 2

19. What are the causes for the deviation of real gases from ideal behavior? (3)

Ans. This is due to the two wrong postulates of Kinetic molecular theory of gases, that are

1) There is no force of attractions between the gas molecules
2) The actual volume of the gas molecule is negligible small as compared to the total volume of the container.

20. For the reaction of $4Fe(s) + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$ the entropy change is -549$JK^{-}mol^{-1}$ at 298K.

In spite of the negative entropy change, why the reaction is spontaneous? (3)

(Given enthalpy change of the reaction is -1648KJ/mol.)

Ans. ΔH = -1648KJ/mol = -1648000J/mol , ΔS = -549$JK^{-}mol^{-}$, T= 298K

$\Delta G = \Delta H - T\Delta S$

ΔG = -1648000-[298X-549] = -1484398Jmol- = -1484.398$KJmol^{-}$.

Here ΔG is negative, so the process is spontaneous.

21. For the equilibrium, $2NOCl_{(g)} \rightleftharpoons 2N0_{(g)} + Cl_{2(g)}$, the value of equilibrium constant Kp is 1.8×10^{-2} bar at 500K.Calculate Kc for the reaction at the same temperature. (R = 0.083 litre bar K^{-1} mol^{-1}.) (3)

Ans. $K_p = 1.8x10^{-2}$ bar , T = 500K , R = 0.083Lbar$mol^{-}K^{-}$,

$\Delta n = 3-2 = 1$

$K_p = K_c(RT)^{\Delta n}$

$1.8x10^{-2} = K_c[0.083x500]1$

$K_c = 1.8x10^{-2} \div [0.083x500] = 4.33x10^{-4}$

22. Explain the disproportionation reaction with suitable example. (3)

Ans. In this an element in one oxidation state is simultaneously oxidized and reduzed.

Eg: $2H_2^{+1}O_2^{-1} \rightarrow 2H_2^{+1}O^{-2} + O_2^{0}$

Here oxygen undergoes oxidation and reduction.

Oxidation state, -1 decreases to -2[reduction] and -1 increases to 0[oxidation].

23. Briefly explain the different types of hydrides. (3)

Ans. Hydrides are the binary compounds of hydrogen.

There are three types

1) Ionic or saline hydrides; hydrogen with S- block elements Eg: NaH, CaH_2
2) Covalent or molecular hydrides: hydrogen with P-block elements. It is further sub divided in to three,
   A) Electron deficient hydride : hydrogen with 13 th group elements, these are Lewis acids, eg; B_2H_6
   B) Electron precise hydrides: hydrogen with 14 th group elements. eg: CH_4
   C) Electron rich hydrides: hydrogen with 15 to 17 th group elements, these are Lewis bases. eg: NH_3, H_2O, HCl
3) Metallic or non-stoichiometric hydrides: hydrogen with D and F block elements.eg: $LaH_{2.87}$

24. Briefly explain the following

(a) Syn gas (1)

(b) producer gas (1)

(c) coal gasification (1)

Ans.(a) syn gas: mixture of CO and H_2

(b) producer gas : mixture of CO and N_2

(c) coal gasification : it is the conversion of coal in to water gas, $C + H_2O_{(g)} \rightarrow CO + H_2$

25. Match the following

1.$CaSO_4.1/2H_2O$	A)Limestone
2. $CaCO_3$	B) Quick lime
3. $Na_2CO_3 .10H_2O$	C) Slaked lime
4. $NaHCO_3$	D) Washing soda
5. CaO	E) Baking soda
6. $Ca(OH)_2$	F) Plaster of paris

(3)

Ans.1---- F, 2----- A, 3------- D, 4-------- E, 5--------- B, 6---------- C

26. (a) What are silicones? (1)

(b) CO_2 is a gas but SiO_2 is a solid, explain. (2)

Ans.(a) These are the organic polymer of silicon, having (R_2SiO) repeating units.

(b) In CO_2 carbon is the central atom ,its hybridization is SP and shape is linear so it is a gas. But in SiO2, silicon is the central atom and its hybridization is SP^3. Here each silicon is surrounded by four oxygen atoms and each oxygen is surrounded by two silicon atoms, so it exist as solid.

27. Briefly explain the following

(a) Green house effect

(b) Acid rain

(c) BOD (3)

Ans.(a) when the concentration of CO_2 increases in the atmosphere, it absorbs more infra- red radiations from the solar energy and hence the temperature of the earth's atmosphere increases. This is known as Green house effect. It results Global warming.

(b) When the pH of rain water falls below 5.6, it is called acid rain.

(c) The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water is called BOD.

28. Write the general formula of the following homologous series.

1) Alkene 2) Alcohol 3) Chloroalkane (3)

Ans. 1) Alkene = C_nH_{2n} 2) Alcohol = $C_nH_{2n+1}OH$ 3) Chloroalkanes = $C_nH_{2n+1}Cl$

Answer any 6 questions from 29 to 40 carries 4 scores each. ***(6X 4 = 24)***

29. a) You are given an organic compound containing nitrogen. Explain how you will proceed to determine the presence of nitrogen. (3)

b) $2CH_3Br + 2Na \xrightarrow{\text{Dry ether}} \ldots\ldots\ldots\ldots\ldots$ (1)

Ans: a) Nitrogen present in an organic compound is detected by "Lassaigne's test". Here the organic compound is fused with metallic sodium in a fusion tube. It is then plunged into distilled water taken in a china dish. The solution is boiled and filtered. The filtrate is known as sodium fusion extract. To one part of sodium fusion extract add freshly prepared ferrous sulphate ($FeSO_4$) solution. It is heated to boiling, cooled and acidified with dil. H_2SO_4. If Blue or green colouration or precipitate observed, the compound contains Nitrogen .

b) CH_3- CH_3 + 2NaBr

30. a) i) Write the electronic configuration of copper (z = 29) (1)

ii) Find the number of electrons in the subshell with azimuthal quantum number l =2. (1)

b) Give the shrodingers wave equation and explain the terms involved. (2)

Ans: a) (i) $_{29}Cu$: [Ar] $3d^{10}4s^1$ OR 1s2 2s2 2p6 3s2 3p6 4s1 3d10

(ii) l = 2 denotes d sub shell, which can accommodate a maximum of 10 electrons.

b)

$$\hat{H}\Psi = E\Psi$$

$\hat{H}$ = hamiltonian operator
Ψ = wave function
E = energy

31. The geometry of the molecule is decided by the type of hybridization.

a) Discuss the shape of PCl_5 molecule using hybridization. (2)

b) Give the reason for the high reactivity of PCl_5. (2)

Ans: a) In PCl_5, the central atom is in sp_3d hydridisation.

The five sp^3d hybrid orbitals formed are directed to the five corners of a regular trigonal bipyramid with bond angles 120 and 90 degrees.

The shape of the molecule is trigonal bipyramidal

b) PCl_5 contains two types of P – Cl bonds - 3 equatorial bonds and 2 axial bonds. The axial bond pairs suffer more repulsion from the equatorial bond pairs. So the axial bond length is greater than the equatorial bond length. So PCl_5 is highly unstable and is very reactive.

32. a) What are buffer solutions? Give an example for a buffer solution. (2)

b) The concentration of H^+ ion in a sample of soft drink is 3.8×10^{-3}M. Determine its pH. (2)

Ans; a)The solutions whose pH do not change even if some amount of acid or base is added to it (1)

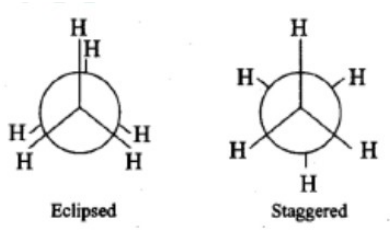
Example. CH_3COOH/CH_3COONa buffer OR NH_4OH/NH_4Cl buffer (1)

b). $PH = -\log(H^+)$ (1) $PH = -\log(3.8 \times 10^{-3}) = 2.4$ (1)

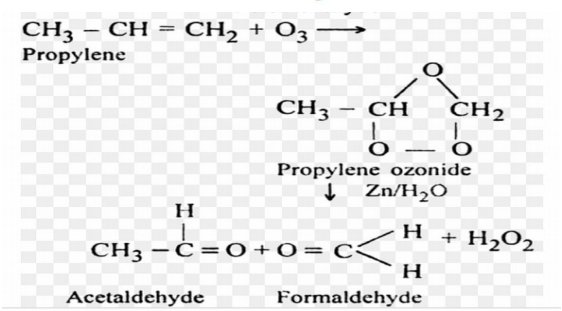
33. a)Draw the Newman Projections of the eclipsed and staggered conformations of ethane molecule. (2)

b)Give the chemical equations for the steps involved in the ozonolysis of propene. (2)

Ans; a) (2)



b)



34. a) Give the structural formula of functional group isomers of the compound C_3H_6O (2)

b) Give the IUPAC name of the above isomers (2)

Ans: a) CH_3-CH_2-CHO (1) CH_3-CO-CH_3 (1)

b) CH_3-CH_2-CHO -- propan-2-al (1) CH_3-CO-CH_3 -- propanone (1)

35. Lithium and Magnesium show diagonal relationship.

a) Give any two similarities between Li and Mg. (2)

b) What happens when Na is treated with i) water and ii) Liquid NH_3? (2)

Ans: a)

- Both Li and Mg are harder but lighter than other elements of the respective group.
- They do not form superoxides.
- Their carbonates decompose easily on heating to form oxides and CO2.
- Their bicarbonates are stable only in solution. Any two points 1x2=2

b) i) $Na + H_2O \rightarrow NaOH + H_2$ (1)

ii) solution turns deep blue due to the presence of ammoniated electrons.

or $Na + (x+y)\ NH_3 \rightarrow [Na(NH_3)_x]^+ + [e(NH_3)_y]^-$ (1)

36.a)What are the products obtained when HBr is added to propene (2)

b)which is the major product and name the principle behind it (2)

Ans; a) CH_3-CHBr-CH_3 and CH_3-CH_2-CH_2-Br (1+1)

b) CH_3-CHBr-CH_3 (1) Markonikovs rule (1)

37. a) The oxidation number of sulphur in SO_4^{2-} is …… (1)

b) Balance the following equation using half reaction method.

$Cr_2O_7^{2-} + SO_3^{2-} \rightarrow Cr^{3+} + SO_4^{2-}$ [In acidic medium] (3)

Ans; a) +6 (1)

b) $Cr_2O_7^{2-} + 3SO_3^{2-} + 8H^+ \rightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$ (each step carries ½ score)

38.a) Le-Chatlier's principle helps to explain the effect of change in conditions on equilibrium.

Discuss the effect of pressure in the following equilibrium on the basis of Le-Chatlier's principle:

$$CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_2O_{(g)}$$ (2)

b) What are conjugate acid – base pairs? Illustrate using a suitable example. (2)

Ans;a) As pressure increases, forward reaction increases (1)

As the product side contains lesser number of moles (1)

b) these are species formed by the interchange of an H^+ ion (1)

example (½ x 2=1)

39. When BF_3 is treated with LiH at 450K, a hydride of boron is formed..

a) Identify the hydride of boron formed in the above reaction. (1)

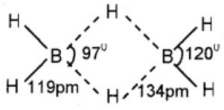
b) Briefly explain the structure of the above mentioned hydride. (2)

c) Boron compounds behave as Lewis acids. Why? (1)

Ans: a) B_2H_6 or Diborane (1)

b)structure of diborane , boron sp^3 hybradized, two bridge B-H-B bonds which are 3 centered 2 electron bonds or banana bonds (2)

c)The central atom Boron is electron deficient (1)



40. a) Give the criteria for spontaneity of a process in terms of free energy change (ΔG). (1)

b) State the first law of thermodynamics. (1)

c) Find the temperature above which the reaction $MgO_{(s)} + C_{(s)} \rightarrow Mg_{(s)} + CO_{(g)}$.

becomes spontaneous. (Given $\Delta_r H^0 = 490$ kJ mol^{-1} and $\Delta_r S^0 = 198$ J K mol^{-1}). (2)

Ans: a) If ΔG is negative ,spontaneous or If ΔG is positive ,non spontaneous (1)

b)It states that energy can neither be created nor be destroyed or It states that the energy of isolated system is constant (1)

c) $\Delta G=\Delta H -T\Delta S$ (1)

$\Delta H=490$ kJ mol^{-1} $= 490000$ J mol^{-1}

Assuming $\Delta G= 0$

$0 =490000 - T \times 198$

$T=490000/198 =2474$ K (1)