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ST. LAWRENCE HIGH SCHOOL

A JESUIT CHRISTIAN MINORITY INSTITUTION

FOR GOD AND COUNTRY

PRE-ANNUAL EXAMINATION– 2020

CLASS – XI

Sub: Chemistry **MODEL ANSWER** **Date: 14.01.2020**

SECTION-I
MULTIPLE CHOICE TYPE QUESTIONS

MARKS – 1X14=14

1. 1. In which medium (acidic, alkaline, neutral) $KMnO_4$ has the maximum equivalent weight?

a) Acidic b) Alkaline c) Neutral d) Equivalent

Ans. b) Alkaline

2. Maximum number of H-Bonds, a water molecule can form-

a) 3 b) 2 c) 4 d) 1

Ans. c) 4

3. Which ion has greater polarizing character?

a) Na^+ b) Mg^{2+} c) Al^{3+} d) Si^{4+}

Ans. d) Si^{4+}

4. The ratio among most probable velocity, mean velocity and root mean square velocity is given-

a) 1:2:3, b) $1:\sqrt{2}:\sqrt{3}$ c) $\sqrt{2}:\sqrt{3}:\sqrt{\frac{8}{\pi}}$, d) $\sqrt{2}:\sqrt{\frac{8}{\pi}}:\sqrt{3}$

Ans. d) $\sqrt{2}:\sqrt{\frac{8}{\pi}}:\sqrt{3}$

5. The values of ΔH and ΔS of a certain reaction are -400KJmol^{-1} and -20KJmol^{-1} respectively. The temperature below which the reaction is spontaneous is-

a) 100K, b) 20^0C, c) 20K, d) 120^0C

Ans. c) 20K

6. Among the following, intensive property is-

a) Enthalpy b) Temperature c) Volume d) Refractive index

Ans. b) Temperature Or d) Refractive index (Both options are correct)

7. When CO2 is passed through water, which of the following species will be present in water?

a) H_2CO_3, CO_2, CO_3^{2-}, HCO_3^- b) H_2CO_3, CO_3^{2-} c) CO_2, CO_3^{2-} d) H_2CO_3, CO_2

Ans. a) H_2CO_3, CO_2, CO_3^{2-}, HCO_3^-

8. Which one of the following has minimum value of cation/anion radius ratio?

a) NaCl b) KCl c) $MgCl_2$ d) CaF_2

Ans. d) CaF_2

9. Which one of the following has minimum value of cation/anion ratio?

a) NaCl b) KCl c) $MgCl_2$ d) CaF_2

Ans. d) 4

10. The chemical formulae of Sodium Nitroprusside-

a) $Na_2[Fe(CN)_5NOS]$ b) $Na_2[Fe(CN)_5NO]$ c) $Na_2[Fe(No_2)_5NOS]$ d) $Na_2[Fe(Cl)_5NOS]$

Ans. b) $Na_2[Fe(CN)_5NO]$

11. The normality of 30 Vol H_2O_2-

a) 2.678 N b) 5.336 N c) 8.034 N d) 6.685 N

Ans. b) 5.336 N

12. NO_x in the atmosphere due to-

a) Lightning b) Incomplete combustion of fuel c) Thermal plant d) Radioactive decay

Ans. a) Lightning

13. NO_x in the atmosphere due to-

a) Lightning b) Incomplete combustion of fuel c) Thermal plant d) Radioactive decay

Ans. a) Li/NH_3 Or b) $Pd/BaSO_4$ (Both options are correct)

14. Ethylene can be separated from acetylene by passing the mixture through-

a) Fuming H_2SO_4 b) Pyrogalol c) Ammoniacal Cu_2Cl_2 d) Charcoal powder

Ans. c) Ammoniacal Cu_2Cl_2

SECTION-II

GROUP-A

Answer the following questions. (Alternatives are to be noted) **MARKS: 1X4=4**

1. Find the number of neutrons present in $5X10^{-4}$ mole of ^{14}C isotope.

Ans. $2.4088X10^{21}$

2. Give an example of a process which is simultaneously isothermal and adiabatic.

Ans. Adiabatic free expansion of an ideal gas (or isothermal free expansion of an ideal gas)

OR

Write down the general electronic configuration of lanthanide elements.

Ans. $4f^{1-14}5d^{0-1}6s^2$

3. For the reaction, $2Br(g) \longrightarrow Br_2(g)$, what are the signs of ΔH and ΔS?

Ans. $\Delta H<0$ and $\Delta S<0$

OR

Calculate the double bond equivalent (DBE) of the compound having molecular formula, C_6H_8. Is the compound aromatic?

Ans. Three (3); the compound is not aromatic.

4. Why Los Angeles Smog is called photochemical smog?

Ans. Because, this type of smog is created from photochemical reactions (i.e. in presence of sunlight) among hydrocarbons, oxides of nitrogen (NO_2, NO) and oxygen.

GROUP-B

Answer the following questions. (Alternatives are to be noted) **MARKS: 2X5=10**

5. The oxide of metal "M" (equivalent mass = E) has the molecular formula M_xO_y. Show that the valency and atomic mass of M are **2y/x** and **2yE/x** respectively.

Ans. Hint: equivalent mass= (Atomic mass/ Valency); V= 2y/x and M= 2yE/x

OR

A balloon of 1000 L capacity is to be filled up with hydrogen gas at 30^0C and 750mm Hg pressure. What amount of iron will be required to generate the required volume of hydrogen?

Ans.-1662.65g of Fe.

6. Define the following terms:

a) Reaction Quotient, b) Active Mass

Ans. **a) Reaction Quotient**: At constant temperature, the reaction quotient of a reaction at any instant may be defined as the ratio of the product of active masses of the products to that of the reactants with each active mass term raised to the power which appears as stoichiometric coefficient of the substances in the balanced chemical equation.

b) Active Mass: It is generally denotes the molar concentration of the reactant(gram-mole per litre)

7. BCl_3 is trigonal planar while $AlCl_3$ is tetrahedral in dimeric state-Explain.

Ans. BCl_3 is trigonal planar, due to intramolecular back bond formation while $AlCl_3$ is tetrahedral in dimeric state, due to intermolecular back bond formation.

OR

Covalent bonds have definite directions but electrovalent bonds have no definite direction-explain.

Ans. In electrovalent compounds any charged ion remains equally surrounded from all direction by oppositely charged ions but in covalent bond the direction of electronic movement remains shifted towards the more electronegative element.

8. An alkane has a molecular mass of 72. Draw all its possible isomers and IUPAC names.

Ans. Three (3) isomers are possible.

n-pentane, iso-pentane (2-methylbutane), neo-pentane (2,2-dimethylpropane)

OR

Mention two drawbacks of Friedel-Crafts alkylation reaction.

Ans. a) Polyalkynation and b) Isomerization

9. Find the pH of the following: a) 10^{-8}M HCl, b) 0.02M Acetic acid (pK_a=4.74)

Ans. a) 10^{-8}M HCl: 6.97

b) 0.02M Acetic acid (pK_a=4.74): 3.21

GROUP-C

Answer the following questions. (Alternatives are to be noted) **MARKS: 3X9=27**

10. Determine the wavelength and frequency of the radiation having the longest wavelength in Lyman series of hydrogen atom. [R= 109618 cm^{-1}]

Ans. Wavelength= 1215.67 Angstrom and Frequency= $2.467X10^{15}$ S^{-1}

OR

Account for the following:

(i) Chromium has electronic configuration $3d^5\ 4s^1$ and not $3d^4\ 4s^2$

(ii) What is the maximum number of electrons present in an atom, for which (n+l) =3?

Ans. **(i) Half-filled orbital stability and Exchange energy.**

(ii) According to the given conditions,

a) If n=3, l=0: These two values of quantum numbers indicate 3s-sub-shell. It can hold maximum 2 electrons.

b) If n=2, l=1: These two values of quantum numbers denote 2p sub-shell. It may contain maximum 6 electrons.

Therefore, (2+6) =8 electrons will have (n+l) =3

11. Arrange the following as stated:

(i) Increasing order of basic property: PbO, ZnO, MgO

(ii) Increasing order of bond polarity: B-Cl, Ba-Cl, Br-Cl, Cl-Cl

(iii) Increasing order of electron affinity: I, F, Cl, Br **1+1+1=3**

Ans. (i) Increasing order of basic property: ZnO<PbO<MgO

(ii) Increasing order of bond polarity: Ba-Cl>B-Cl>Br-Cl>Cl-Cl

(iii) Increasing order of electron affinity: Cl>F> Br> I

12. Mention the hybridization state, geometry and shape of the given compounds.

$XeOF_4$, PCl_3F_2 and I_3^- **1+1+1=3**

Ans.

Molecules	Hybridization	Geometry	Shape
$XeOF_4$	sp^3d^2	Octahedral	Square-pyramidal
PCl_3F_2	sp^3d	TBP	TBP
I_3^-	sp^3d	TBP	Linear

OR

(i) Mention the electronic configuration of O_2 molecule from MOT.

(ii) Also mention the order of bond length, bond strength and magnetic property among the following species

O_2^+, O_2^-, $O_2^=$, O_2^{++} **1+2= 3**

Ans. Electronic configuration of O_2 molecule from MOT:

KK $(\sigma_{2S})^2(\sigma_{2S}^*)^2(\sigma_{2Pz})^2(\pi_{2Px})^2(\pi_{2Py})^2(\pi^*_{2Px})^1(\pi^*_{2Py})^1$

Order of bond length: $O_2^= > O_2^- > O_2^+ > O_2^{++}$

Bond strength: $O_2^= < O_2^- < O_2^+ < O_2^{++}$

Magnetic property:

O_2^+(Paramagnetic), O_2^-(paramagnetic), $O_2^=$(Diamagnetic), O_2^{++} (Diamagnetic)

13. At 27°C, a cylinder of 10L volume contains 0.4g He, 1.6g O_2 and 1.4g H_2. Determine the total pressure of the mentioned gas-mixture and the partial pressure of He.

Ans. Total pressure of the reaction mixture= 0.4926 atm

Partial pressure of He gas in mixture= 0.2463 atm

14. Balance the following redox reactions by ion electron method: **2x1.5=3**

i) $Zn + NaNO_3 + NaOH \longrightarrow Na_2ZnO_2 + NH_3 + H_2O$

ii) $Cr_2O_7^{-2} + Fe^{2+} + H^+ \longrightarrow Cr^{3+} + Fe^{3+} + H_2O$

Ans. i) $4Zn + 7NaNO_3 + NaOH = 4Na_2ZnO_2 + NH_3 + 2H_2O$

ii) $Cr_2O_7^{-2} + 6Fe^{2+} + 14H^+ = 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

15. 10 moles of an ideal gas expand isothermally and reversibly from a pressure of 5 atm to 1 atm at 300K. What is the largest mass that can be lifted through a height of 1m by this experiment?

Ans. W= -40149.8 J, mgh= W, m= 4096.9 kg

OR

At 25°C temperature, the heat of combustion of sucrose, carbon and hydrogen are -5644 $KJmol^{-1}$, -393.5 $KJmol^{-1}$ and -285.8 $KJmol^{-1}$ respectively. Determine the heat of formation of sucrose at 25°C

Ans. Heat of formation of sucrose at 25°C = -2221.8 $KJmol^{-1}$

16. (i) Calculate the volume strength of a 10% solution of H_2O_2. **1+1+1=3**

(ii) Complete the following chemical reactions:

1. $B_2H_6 + NH_3 \longrightarrow$

2. $SiCl_4 + H_2O \longrightarrow$

Ans. **(i) 10% solution of H_2O_2= 32.94 Volume**

(ii) 1. $3B_2H_6 + 6NH_3 \rightarrow 2B_3N_3H_6 + 12H_2$

2. $SiCl_4 + H_2O \longrightarrow Si(OH)_4$ (Silicic acid) + 4HCl

OR

Arrange the following:

(i) CaH_2, BeH_2 and TiH_2 in order of increasing electrical conductance

(ii) LiH, NaH and CsH in order of increasing ionic character

(iii) NaH, MgH_2 and H_20 in order of increasing reducing property **3X1=3**

Ans. (i) $BeH_2 < CaH_2 < TiH_2$, (ii) LiH <NaH <CsH , (iii) NaH> $MgH_2 > H_20$

17. (i) Lithium is the only alkali metal which forms nitrides directly-explain.

(ii) A freshly cut piece of sodium metal gives shine but its lustre soon gets tarnished when exposed to air-give reason.

(iii) Unlike diamond, graphite is a conductor of electricity-explain. **1+1+1=3**

Ans. i) The lattice energy of Lithium Nitride,which consists of a small cation Li^+ and a small anion N^{-3} is much higher and this energy compensates for the high bond dissociation energy of N_2. The larger alkali metal ions cannot compensate for these energy requirements.

ii) Sodium, being very reactive metal comes in contact with air i.e. oxygen and reacts spontaneously.

iii) Unlike diamond, graphite due to its typical multi layered structure having inter layer spaces can allow the passage of free electrons through them.

OR

Comment on each of the following statements: **2+1=3**

(i) The ionic mobilities of the alkali metal ions in aqueous solution are

$Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

(ii) Describe the shapes of BF_3 and $[BF_4]^-$. Assign the hybridization of Boron in each case.

Ans. (i) Smaller ions are more easily hydrated. As Li^+ is the smallest ion among the given ions, it is the most easily hydrated and has the least ionic mobility.

(ii)BF_3: sp^2 hybridized, planar geometry

$[BF_4]^-$: sp^3 hybridized, Tetrahedral geometry

18. (i) Which atoms in a Toluene molecule always remain in the same plane and why?

(ii) Write down the state of hybridisation of carbon atoms in the following compound:

$CH_2=C=C=CH-CH_3$

iii) Dipole moment of Vinyl chloride is less than ethyl chloride-explain. **1+1+1=3**

Ans. (i) Six atoms of the benzene ring and the adjacent carbon of the substituent methyl group all lie on the same plane along with six benzylic hydrogen atoms and one of the three H atom of the methyl substituent.

(ii) $CH_2=C=C=CH-CH_3$

sp^2 sp sp sp^2 sp^3

iii) For ethyl chloride the dipole moment is directed towards the more electronegative Cl atom, whereas for vinyl chloride, due to resonance the resultant moment becomes relatively weaker.

OR

Draw the structures of the following organic compounds:

a) 3-ethyl-4, 5-dimethylhex-1-yne-3-ol, b) N-ethyl-N-methylbutan-2-amine

How many alkyl groups are expected to be obtained from $CH_3\,CH_2\,CH_2\,CH\,(CH_3)\,CH_2\,CH_3$ by the removal of different non-equivalent H-atoms? **2+1=3**

Ans. a) 3-ethyl-4, 5-dimethylhex-1-yne-3-ol [CHCC(OH) $(C_2H_5)CH(CH_3)CH(CH_3)CH_3$]

b) N-ethyl-N-methylbutan-2-amine [$CH_3CH_2CH(CH_3)\,N\,(CH_3)\,(C_2H_5)$]

c) Seven (7) alkyl groups can be obtained.

GROUP- D

Answer the following questions. (Alternatives are to be noted) **MARKS: 5X3=15**

19. (i)A buffer solution contains 0.01mol of NH_3 and 0.02mol of NH_4Cl per litre. Determine the pH of the solution. Given: $K_b\,(NH_3) = 1.8X10^{-5}$

(ii) In a 0.01M acetic acid solution, degree of ionization of acetic acid is 4.2%. Determine the concentration of H_3O^+ ions in that solution.

(iii)Find the K_p /K_c for the following chemical reaction:

$CO\,(g) + ½\,O_2\,(g) = CO_2\,(g)$ **2+2+1=5**

Ans. a) pH= 8.96, b) $[H_3O^+]= 4.2X10^{-4}$ M, c) $K_p/K_c = 1/(RT)^{1/2}$

OR

(i)What is Buffer capacity? **1+1+1+2=5**

(ii)The entropy of the system decreases on condensation of a vapour, still the process occurs spontaneously. Explain with reasons.

(iii)What is meant by "Free Expansion"?

(iv)An ideal gas is compressed from 0.5L to 0.25L at 0.1atm. What amount of work is done?

Ans. i) Buffer capacity: It is defined as the number of gram-moles of strong base or acid required to change the pH of 1 litre of that buffer solution by 1 unit.

ii) The increase in entropy of the surrounding is greater than the decrease in entropy of the system. Hence, ΔS for the overall process is always positive.

iii) The work done by a system against zero external pressure is known as free expansion.

iv) 2.53 Joule

20. What happens when? **5x1=5**

(i) PbO_2 reacts with concentrated H_2SO_4

(ii) Borax is strongly heated

(iii) Aluminium is treated with caustic soda

Account for the following:

(i) Explain why $N\,(CH_3)_3$ is more basic than $N\,(SiH_3)_3$

(ii) $[SiF_6^{2-}]$ is known but $[SiCl_6^{2-}]$ is not known---Give reasons.

Ans. (i) PbO_2 reacts with concentrated H_2SO_4: $PbO_2 + H_2SO_4 = Pb\,(SO_4)_2 + H_2O$

(ii) Borax is strongly heated: $Na_2B_4O_7, 10H_2O \xrightarrow{Heat} Na_2B_4O_7 + 10H_2O \xrightarrow{Heat} 2NaBO_2 + B_2O_3$

(iii) Aluminium is treated with caustic soda: $2Al + 2NaOH + 2H_2O \longrightarrow 2NaAlO_2 + 3H_2$

Account for the following:

(i) N $(CH_3)_3$ experiences electronic pushing effect from three methyl groups and in N $(SiH_3)_3$, due to back bonding, the donation of lone pair electrons becomes difficult.

(ii) $[SiF_6^{2-}]$ is known but $[SiCl_6^{2-}]$ is not known because $[SiCl_6^{2-}]$ is further destabilsed due to steric crowding among the Cl atoms.

21. **(i)**How will you distinguish each of the following pairs of compounds chemically?

a) Benzene and cyclohexene

b) Propene and Propyne

(ii)How will you carry out the following conversions?

Methane ⟶ Ethylene

2-butene ⟶ 1-butene

(iii)Identify the structure of A and B:

B ⟵ (Cu-Tube, 600°C) Ethyne ⟶ (H_2/Lindler's catalyst) A **1+1+1+1+0.5+0.5=5**

Ans. a) Benzene and cyclohexene: 1-2% cold alkaline $KMnO_4$ solution reacts with cyclohexene and gets decolourised but benzene remains unreacted.

b) Propene and Propyne: Propyne reacts with Cu_2Cl_2, NH_4OH or $AgNO_3$, NH_4OH and forms red and white colored precipitate respectively but Propene doesn't react.

c) Methane to Ethylene

CH_4 $\xrightarrow{A}$ CH_3Cl $\xrightarrow{B}$ CH_3CH_3 $\xrightarrow{C}$ CH_3CH_2Cl $\xrightarrow{D}$ CH_2CH_2

A= Cl_2, UV-light, B= Na in dry ether, C= Cl_2, controlled sunlight, D= alc. KOH

2-butene ⟶ 1-butene

$CH_3CHCHCH_3$ $\xrightarrow{E}$ $CH_3CH(Br)CH_2CH_3$ $\xrightarrow{F}$ $CH_3CH_2CHCH_2$

E= HBr, F= alc. KOH

iii) A= Ethene, B= Benzene

OR

(i)Neither Vinyl chloride nor chlorobenzene can be used as alkylating agent in Friedel-Crafts reaction-Why?

(ii)Identify the structure of M and N:

CaC_2 $\xrightarrow{H_2O}$ M $\xrightarrow[2.\ 60^\circ C - 80^\circ C]{1.\ Hg^{2+},\ 20\%\ H_2SO_4}$ N

(iii)Boiling points of isomeric pentanes are 36.2°C, 28°C and 9.5°C respectively. Identify the compounds and give reason. **2+1+1+1=5**

Ans. i) For both the compounds the C-Cl bond gets partial double bond character.

ii) M= C_2H_2 N= CH_3CHO

iii) Boiling points of isomeric pentanes are 36.2°C: n- pentane, 28°C: iso-pentane, 9.5°C: neo-pentane [Factor: With decrease in surface area or area of contact the boiling point gradually decreases.]