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REGIONAL OFFICE- BHOPAL
TERM-1 EXAMINATION (2025-26)

CLASS – XI SUBJECT – CHEMISTRY (043)

Max. Marks : 70

MARKING SCHEME

Q. No.	Answer	Marks
1	(a) Molarity	1
2	(d) 2*s*-orbital	1
3	(b) One mole of a substance	1
4	(c) $1s^2\ 2s^2\ 2p^6\ 3s^1$	1
5	(c) Trigonal pyramidal	1
6	(a) CH_2O	1
7	(a) spherical	1
8	(a) $s>p>d>f$	1
9	(b) Negative	1
10	(c) Entropy	1
11	(a) increases	1
12	(c) Isobaric	1
13	(a) Both A and R are true, and R is the correct explanation of A.	1
14	(d) A is false but R is true	1
15	(b) Both A and R are true, and R is not the correct explanation of A.	1
16	(a) Both A and R are true, and R is the correct explanation of A.	1
17	(i) This measurement has 3 significant numbers since all nonzero digits are significant. (ii) The first three zeros are insignificant, but the zero between the sixes is, hence this number has 4 significant figures.	1 + 1
18	Water has a bond angle of 104.5° because of the two lone pairs of electrons on oxygen that repel the bonding pairs, reducing the bond angle. Methane has a tetrahedral bond angle of 109.5° with no lone pairs.	2
19	i) Balmer ii) n=3, l=0, m=0, s= +1/2	1 + 1
20	Intensive- Volume and Heat Capacity, Extensive - Density, Temperature OR The total enthalpy change for a chemical reaction is the same, regardless of whether the reaction occurs in one step or multiple steps, as long as the initial and final conditions are the same	1 + 1 2
21	$C-H < N-H < O-H < F-H$ Reason: The ionic character is greater in the molecules with the highest electronegativity difference because the electron pair shifts toward the more electronegative atom, increasing the ionic character.	1 + 1

22	Calculation of wavenumber λ =5800Å =5800 X 10^{-10} m wave no. =1/λ =1/5800x10^{-10} =1.724 m^{-1} Frequency = c/λ =3 x10^{-8}/5800 x10^{-10} = 5.1 x10^{-2} HZ	1.5 +1.5
23	(i) Ne, due to higher nuclear charge. (ii) F, due to small size (iii) Li, due to less nuclear charge.	1 1 1
24	(i) $\Delta G = \Delta H - T\Delta S$ (ii) To make ΔG negative TΔS > ΔH. (iii) ΔH and ΔS are negative	1 1 1
25	Given: Amount of NaOH = 4gm Amount of Water = 36gm Formula used: $\text{Mole Fraction (X)} = \frac{\text{number of moles of a component}}{\text{Total numbers of moles of all component}}$ No. of moles of H_2O = 36/18 = 2 moles No. of mole NaOH=4/40=0.1mole Total number of moles = 2+ 0.1 = 2.1 Mole fraction of H_2O = $\frac{\text{No.of moles of H2O}}{\text{Total number of moles}}$ = 2/2.1 = 0.952 Mole fraction of NaOH= $\frac{\text{No.of moles of NaOH}}{\text{Total number of moles}}$ = 0.1/2.1= 0.048	½ for formula , ½ for steps +1+1
26	(i) A hydrogen bond is defined as an attractive force acting between the hydrogen attached to an electronegative atom of one molecule and an electronegative atom of a different molecule (may be of the same kind). (ii) There are two types of H-bonds: (a) Intermolecular H-bond e.g., HF, H_2O etc. (b) Intramolecular H-bond e.g., o-nitrophenol (iii) Hydrogen bonds are stronger than Van der Walls forces since hydrogen bonds are regarded as an extreme form of dipole-dipole interaction.	1 ½ ½ 1
27	(i) Aufbau principle - The Aufbau Principle states that, in the ground state of an atom or ion, electrons fill atomic orbitals of the lowest available energy level before occupying higher-energy levels (ii) Heisenberg's uncertainty principle – It states that the position and the velocity of an object cannot both be measured exactly at the same time. (iii) No two electrons in an atom can have the same set of four quantum numbers (iv) [Ar] $3d^{10}$ $4s^1$	1 1 1 Any Three

28	(i) Isolated system – No exchange of energy or matter between the system and surrounding- eg. Thermos flask (ii) State function- Variable depends only state not on the path eg. P, V, T (iii) Adiabatic Process- No exchange of heat between the system and surrounding	1 1 1
29	(i) The possible values of l and m_l are : total = 9 (ii) 2, because all four quantum number can not be same for any two electrons. (iii) spherical , dumble shaped (iv) dx^2-y^2 , dz^2	1 1 1 1
30	(i) (a) Joule (ii) (a) First Law (iii) (b) W = P Δ V (iv) (a) Zero	1 1 1 1
31	(a) (i) $F_2 < Cl_2 < O_2 < N_2$ (ii) I < Br < F < Cl (iii) $N_2 < O_2 < F_2 < Cl_2$ (b) (i) Due to the general decrease in atom size and increase in nuclear charge, the electronegative of elements increases as one moves from left to right in the periodic table. (ii) The ionisation enthalpy of a group decreases from top to bottom due to the increase in atomic size caused by the addition of a new shel OR (i) Element V is likely to be the least reactive element. This is because it has the highest first ionization enthalpy (ΔiH_1) and a positive electron gain enthalpy (ΔegH). (ii) Element II is likely to be the most reactive metal as it has the lowest first ionization enthalpy (ΔiH1) and a low negative electron gain enthalpy (ΔegH). (iii) Element III is likely to be the most reactive non–metal as it has a high first ionization enthalpy (ΔiH1) and the highest negative electron gain enthalpy (ΔegH). (iv) Element V is likely to be the least reactive non–metal since it has a very high first ionization enthalpy (ΔiH_2) and a positive electron gain enthalpy (ΔegH). (v) Element VI has a low negative electron gain enthalpy (ΔegH). Thus, it is a metal. Further, it has the lowest second ionization enthalpy (ΔiH_2). Hence, it can form a stable binary halide of the formula MX_2(X=halogen).	1 1 1 1 1
32	(a) (i) According to the given reaction, 1 atom of A reacts with 1 molecule of B. 200 molecules of B will react with 200 atoms of A and 100 atoms of A will be left unreacted. Hence, B is the limiting reagent while A is the excess reagent. (ii) According to the given reaction, 1 mol of A reacts with 1 mol of B. 2 mol of A will react with 2 mol of B. Hence, A is the limiting reactant. (iii) No limiting reagent. (iv) 2.5 mol of B will react with 2.5 mol of A. Hence, B is the limiting reagent.	(a) ½ + ½ + ½ + ½

(b)

Element	Symbol	% by mass	Atomic mass	Moles of the element (Relative no. of moles)	Simplest molar ratio	Simplest whole number molar ratio
Iron	Fe	69.9	55.85	$\frac{69.9}{55.85} = 1.25$	$\frac{1.25}{1.25} = 1$	2
Oxygen	O	30.1	16.00	$\frac{30.1}{16.00} = 1.88$	$\frac{1.88}{1.25} = 1.5$	3

∴ Empirical formula = Fe_2O_3. (b) 3

OR

(a) Limiting Reagent: Limiting reagents are substances that are completely consumed in the completion of a chemical reaction. They are also referred to as limiting agents or limiting reactants. 1

(b) **$3H_2 + N_2 \rightarrow 2NH_3$**

In the reaction given above, 3 moles of Hydrogen gas are required to react with 1 mole of nitrogen gas to form 2 moles of ammonia. But what if, during the reaction, only 2 moles of hydrogen gas are available along with 1 mole of nitrogen. 4

In that case, the entire quantity of nitrogen cannot be used (because the entirety of nitrogen requires 3 moles of hydrogen gas to react). Hence, the hydrogen gas is limiting the reaction and is therefore called the limiting reagent for this reaction.

Calculation - N_2 + $3H_2$ ⟶ $2NH_3$

Mass 50kg 10kg

Moles 50/28 10/2

1.786 k moles 5 k moles

1 mole of N_2 reacts with 3 moles of H_2.

1.786 k moles of N_2 reacts with m moles of H_2.

∴ x = 3 × 50/28

= 5.357 k moles of H_2

However, we are given with only 5 k moles of H_2

∴ H_2 is the limiting reagent.

3 mole of H_2 gives 2 moles of NH_3

5 k mole of H_2 gives x moles of NH_3

⇒ x = 2 × 5k / 3 ⇒ 3.333 k moles of NH_3

Amount of NH_3 = 3.333 × 17 kg

= 56.667 kg

OR find it in NCERT textbook for class XI page No- 22

33	There are 16 electrons in a molecule of dioxygen, 8 from each oxygen atom. The electronic configuration of oxygen molecule can be written as: $[\sigma-(1s)]^2\left[\sigma^*(1s)\right]^2[\sigma(2s)]^2\left[\sigma(1p_z)\right]^2[\pi(2p_x)]^2\left[\pi(2p_y)\right]^2\left[\pi^*(2p_x)\right]^1\left[\pi^*(2p_y)\right]^1$ Since the 1s orbital of each oxygen atom is not involved in boding, the number of bonding electrons = 8 = Nb and the number of anti-bonding orbitals = 4 = Na. Bond order ½ (Nb - Na) ½ (8 - 4) = 2 -paramagnetic Similarly, the electronic configuration of O_2^+can be written as: $KK[\sigma(2s)]^2\left[\sigma^*(2s)\right]^2\left[\sigma(2p_z)\right]^2[\pi(2p_x)]^2\left[\pi(2p_y)\right]^2\left[\pi^*(2p_x)\right]^1$ Nb = 8 Na = 3 Bond order of O_2^+ = 1/2 (8 - 3) = 2.5 -paramagnetic Electronic configuration of O_2^-ion will be: $KK[\sigma(2s)]^2\left[\sigma^*(2s)\right]^2\left[\sigma(2p_z)\right]^2[\pi(2p_x)]^2\left[\pi(2p_y)\right]^2\left[\pi^*(2p_x)\right]^2\left[\pi^*(2p_y)\right]^1$ Nb = 8 Na = 5 Bond order of O_2^-= 1/2(8 -5) = 1.5 -paramagnetic Electronic configuration of O_2^{2-}ion will be: $KK[\sigma(2s)]^2\left[\sigma^*(2s)\right]^2\left[\sigma(2p_z)\right]^2[\pi(2p_x)]^2\left[\pi(2p_y)\right]^2\left[\pi^*(2p_x)\right]^2\left[\pi^*(2p_y)\right]^2$ Nb = 8 Na = 6 Bond order of O_2^{2-}= 1/2(8 - 6) = 1 -Diamagnetic	4
	Bond dissociation energy is directly proportional to bond order. Thus, the higher the bond order, the greater will be the stability. On this basis, the order of stability is $O_2^+ > O_2 > O_2^- > O_2^{2-}$.	1
	OR	
	(i) Hybridization is a concept used to describe the mixing of atomic orbitals to form new hybrid orbitals, which are degenerate (equal in energy) and used to form chemical bonds. This concept helps explain the molecular geometry and bonding properties of molecules.	1
	(ii) sp^3d^2 Hybridization : Involves the mixing of one s orbital, three p orbitals, and two d orbitals to form six sp^3d^2 hybrid orbitals, resulting in an octahedral geometry. Example: In sulfur hexafluoride (SF_6), the sulfur atom is sp^3d^2 hybridized.	2
	sp^3d Hybridization : Involves the mixing of one s orbital, three p orbitals, and one d orbital to form five sp^3d hybrid orbitals. This results in a trigonalbipyramidal geometry. Example: In phosphorus pentachloride (PCl_5), the phosphorus atom is sp^3d hybridized.	2