Set 2 Answer Key

Chemistry (SRM Institute of Science and Technology)

SRM

DEPARTMENT OF CHEMISTRY
College of Engineering and Technology
SRM Institute of Science and Technology
Kattankulathur – 603203

Set-2

INTERNAL ASSESSMENT – II [CLA1 T2]

ANSWER KEY

Program: B.Tech	**Date: 13/10/2023**
Course Code & Title:21CYB101J & Chemistry	**Duration: 8.00-9.00AM**
Year &Sem: I Year & I Sem	**Max. Marks: 30 marks**

Part – A (10 x 1 = 10 Marks)
Answer ALL the Questions

1. (b) Electronegativity
2. (c) + 527 Kcal mol^{-1}
3. (c) Hard acid combines with Hard base
4. (c) Both LiF and AgI precipitate
5. (c) $-\Delta G^0 = RT \ln K_C$
6. (d) decrease of free energy
7. (a) 1.212 V
8. (c) = 0
9. (d) Fire hazards
10. (b) Temperature

Part – B (2 x 10 = 20 Marks)

11. (a) i. Explain with examples the variation of any three periodic properties along the period and down the group? (6 Marks)

Any three periodic properties **[3 x 2 = 6Marks]**

Periodic property	**Across the period**	**Down the group**
Atomic radius	Decreases	Increases
Ionization energy	Increases	Decreases
Electron affinity	Increases	Decreases
Electronegativity	Increases	Decreases

ii. Write a note on the applications and limitations of the HSAB principle. (4 Marks)

Any two applications **[2 Marks]**
Any two limitations **[2 Marks]**

Applications

- In hydrogen bonding
- Linkage of ambidentate ligands to metal atoms
- Symbiotic effect
- To predict the direction of Inorganic reactions
- Solubility in water
- Hard Soft interactions - Types of ores

Limitations of HSAB principle

Pearson's HSAB theory is in direct contradiction with Fajan's rules. For example, the later predicts the nature of Beryllium salts to be more covalent. But according to the HSAB principle, the Be2+ ion is a hard acid and is expected to show charge-controlled bonding that result in a more ionic nature for beryllium compounds. But this is not true.

Since hydrogen ion, H^+ is a hard acid and the hydride ion, H- is a soft base, according to HSAB principle the interactions between them must be polar covalent and H_2 must be unstable. Indeed H_2 is a stable molecule with pure covalent nature

(OR)

(b) Derive Gibbs-Helmholtz equation.

i. **Derive Gibbs-Helmholtz equation with steps to get $\Delta G = \Delta H + T\,[\partial \Delta G / \partial T]P$**
(6 Marks)

Arrange the compounds in order of increasing entropy (S) and justify your order.

ii. **(4 Marks)**

Arrange the compounds in order of increasing entropy **[2 Marks]**
Justification **[2 Marks]**

$CH_3OH(s)$, $CH_3OH(l)$, $CH_3OH(g)$, $CH_3CH_2OH(g)$

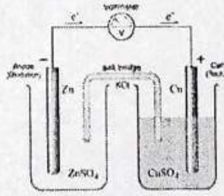
$CH_3\,OH(s) < CH_3\,OH\,(l) < CH_3\,OH(g) < CH_3\,CH_2\,OH(g)$

Gaseous phase and largeness of the compound reasons for greater entropy as there are more degrees of freedom.

12. (a) i. Construct an Electrochemical cell and give its representations. **(4 Marks)**

Any one example
Construction and Explanation **[3 Marks]**
Representation **[1 Mark]**

An electrochemical cell is a device that can generate electrical energy from the chemical reactions occurring in it, or use the electrical energy supplied to it to facilitate chemical reactions in it. These devices are capable of converting chemical energy into electrical energy, or vice versa



ii. The molar solubility of $PbBr_2$ is 2.17×10^{-3} mol/lit at a certain temperature. Calculate K_{sp} for $PbBr_2$ **(6 Marks)**

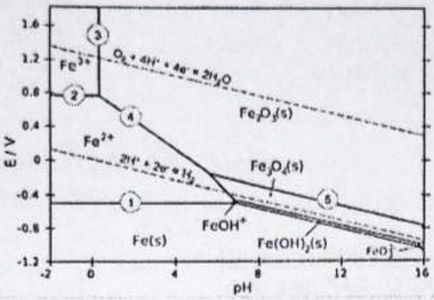
Expression **[2 Marks]**
Calculation **[4 Marks]**

For $PbBr_2$,the expression of solubility is $K_{sp} = [Pb^{2+}][Br^-]^2 = (S)(2S)^2 = 4S^3$ Substituting $S = 2.17 \times 10^{-3}$; $K_{sp} = 4S^3 = 4(2.17 \times 10^{-3})^3 = 4.1 \times 10^{-8}$

(OR)

(b) **With a neat sketch explain Pourbaix diagram for Iron.** **(10 Marks)**

Diagram [2 Marks]
Explanation [8 Marks]



Pourbaix Diagrams are the plot of electrochemical stability for different redox states of an element as a function of pH. These diagrams are essentially phase diagrams that plot the map the conditions of potential and pH (most typically inaqueous solutions) where different redox species are stable.

Examples of equilibria in the iron Pourbaix diagram (numbered on the plot):

i. Zones
ii. Lines:

$Fe^{2+} + 2e^- \longrightarrow Fe(s)$ (pure redox reaction - no pH dependence) - No 1
$Fe^{3+} + e^- \longrightarrow Fe^{2+}$ (pure redox reaction - no pH dependence) - No 2
$2Fe^{3+} + 3H_2O \rightarrow Fe_2O_3(s) + 6H^+$ (pure acid-base, no redox) - No 3
$2Fe^{2+} + 3H_2O \rightarrow Fe_2O_3(s) + 6H^+ + 2e^-$ (slope = -59.2 x 6/2 = -178 mV/pH) - No 4
$2Fe_3O_4(s) + H_2O \rightarrow 3Fe_2O_3(s) + 2H^+ + 2e^-$ (slope = -59.2 x 2/2 = -59.2 mV/pH) - No 5