

Total No. of Questions: 6

Total No. of Printed Pages: 2

Enrollment No.....



Faculty of Science  
End Sem Examination May-2024

FS3EG04 Chemistry

Programme: B.Sc. (Hons.)

Branch/Specialisation: Forensic  
Science

Duration: 3 Hrs.

Maximum Marks: 60

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

- Q.1 i. Which of the following involves direct vaporization and condensation of solid without intermediate? **1**  
(a) Crystallisation (b) Sublimation  
(c) Differential Extraction (d) Chromatography
- ii. For electrical neutrality of an atom, the condition is: **1**  
(a) No. of protons = no. of neutrons  
(b) No. of electrons = no. of neutrons  
(c) No. of protons = no. of electrons  
(d) No. of protons > no. of electrons
- iii. Covalent bonds are formed between: **1**  
(a) Two non-metals (b) A metal and a non-metal  
(c) Two metals (d) Two ligands
- iv. Which of the following is an example of co-ordinate compound? **1**  
(a)  $\text{NH}_3\text{-BF}_3$  (b)  $\text{NaCl}$  (c)  $\text{O}_2$  (d)  $\text{CO}_2$
- v. Number of possible oxidation state for p-block elements: **1**  
(a) Increases across the period  
(b) Decreases across the period  
(c) Increases down the group  
(d) Decreases down the group
- vi. Which of the following has lowest melting point? **1**  
(a) Li (b) Na (c) K (d) Rb
- vii. Which of the following is not an example of Arrhenius acid? **1**  
(a)  $\text{HCl}$  (b)  $\text{HClO}_4$  (c)  $\text{H}_2\text{SO}_4$  (d)  $\text{AlCl}_3$
- viii. The conjugate base of  $\text{HSO}_4^-$  is: **1**  
(a)  $\text{SO}_4^{2-}$  (b)  $\text{H}_2\text{SO}_4$  (c)  $\text{HSO}_3^-$  (d)  $\text{SO}_3^-$

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- ix. Larger is the value of  $K_a$ : **1**  
(a) Stronger is the acid (b) Stronger is the base  
(c) Weaker is the acid (d) Weaker is the base
- x. The ionic product of water at  $25^\circ\text{C}$  is: **1**  
(a)  $1.0 \times 10^{-14}$  (b)  $1.0 \times 10^{-7}$  (c)  $1.0 \times 10^{+7}$  (d)  $1.0 \times 10^{+14}$
- Q.2 i. Define atomic mass with suitable example. **2**  
ii. The estimated average requirement for dietary calcium is 4.8 g. What is the estimated average requirement of calcium in moles? (Molar mass of  $\text{Ca} = 40.078\text{u}$ ). **3**
- iii. Define chromatography. Write its principle. Explain any one chromatographic technique. **5**
- OR iv. A compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molar mass is 98.96 g. Determine its empirical and molecular formula. **5**
- Q.3 i. Define bond length and bond order. **2**  
ii. Define ionic and covalent bond. Write their characteristics. Mention suitable examples of ionic and covalent compound. **8**
- OR iii. Write postulates of VSEPR theory. Explain the geometry of three different molecules based on VSEPR theory. **8**
- Q.4 i. Briefly explain biological importance of sodium. **3**  
ii. What are alkali metals? Explain their general characteristics. **7**
- OR iii. What are p-block elements? Write three characteristics of p-block elements. Explain anomalous properties of carbon. **7**
- Q.5 i. Define pH and  $\text{p}K_a$ . How are they calculated. **4**  
ii. Explain Bronsted-Lowry and Lewis concept of acids and bases. Write suitable examples of each. **6**
- OR iii. Calculate the solubility of  $\text{A}_2\text{X}_3$  in pure water. Given:  $K_{sp} = 1.1 \times 10^{-23}$ . **6**
- Q.6 Attempt any two: **5**  
i. Write two properties of water. Explain its structure. **5**  
ii. What is pH scale? Explain its importance. **5**  
iii. Explain common ion effect with suitable example. **5**

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P.T.O.

## Marking Scheme

### Chemistry (T) - FS3EG04 (T)

Q.1	i)	Which of the following involves direct vaporization and condensation of solid without intermediate: (b) Sublimation	1
	ii)	For electrical neutrality of an atom, the condition is: (c) no. of protons = no. of electrons	1
	iii)	Covalent bonds are formed between: (a) two non-metals	1
	iv)	Which of the following is an example of co-ordinate compound: (a) $\text{NH}_3\text{-BF}_3$	1
	v)	Number of possible oxidation state for p-block elements: (a) increases Down the group	1
	vi)	Which of the following has lowest melting point: (d) Rb	1
	vii)	Which of the following is not an example of Arrhenius acid: (d) $\text{AlCl}_3$	1
	viii)	The conjugate base of $\text{HSO}_4^-$ is: (a) $\text{SO}_4^{2-}$	1
	ix)	Larger is the value of $K_a$ : (a)	1
	x)	The ionic product of water at $25^\circ\text{C}$ is: (a) $1.0 \times 10^{-14}$	1
Q.2	i.	Define atomic mass with suitable example. Definition of atomic mass - 1 mark Example - 1 mark	2
	ii.	The estimated average requirement for dietary calcium is 4.8 g. What is the estimated average requirement of calcium in moles? (Molar mass of Ca = 40.078u) Solution: Number of moles = Given weight of substance / Molar mass - 1 mark Number of moles = $4.8 / 40.078$ - 1 mark Number of moles = 0.12 M - 1 mark Therefore, average requirement of Ca in moles is 0.12 M	3
	iii.	Define chromatography. Write its principle. Explain any one chromatographic technique. Definition of chromatography - 1 mark Principle - 1 mark	5

OR	iv.	Any one technique - 3 marks A compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molar mass is 98.96 g. Determine its empirical and molecular formula?	5
		Solution: Step 1: Conversion of mass percent to grams - 1 mark Assuming 100 gm of compound, Hydrogen = 4.07 g Carbon = 24.27 g Chlorine = 71.65 g	
		Step 2: Calculation of number of moles of each element - 1 mark Moles of hydrogen = $4.07/1.008 = 4.04$ Moles of carbon = $24.27/12.01 = 2.021$ Moles of chlorine = $71.65/35.453 = 2.021$	
		Step 3: Calculate ratio of elements - 1 mark $\text{H} = 4.04/2.021 = 2$ , $\text{C} = 2.021/2.021 = 1$ , $\text{Cl} = 2.021/2.021 = 1$ , it gives a ratio of 2:1:1 for H:C:Cl	
		Step 4: Deducing the empirical formula - 1 mark empirical formula = $\text{CH}_2\text{Cl}$	
		Step 5: Determining molecular weight - 1 mark Empirical weight of $\text{CH}_2\text{Cl} = 12.01 + 2 \times 1.008 + 35.453 = 49.48 \text{ g}$ $n = \text{molar mass/empirical weight} = 98.96/49.48 = 2$	
		Molecular formula = (empirical formula) <sub>n</sub> = $(\text{CH}_2\text{Cl})_2 = \text{C}_2\text{H}_4\text{Cl}_2$	
Q.3	i.	Define bond length and bond order. Definition of bond length - 1 mark Definition of bond order - 1 mark	2
	ii.	Define ionic and covalent bond. Write their characteristics. Mention suitable examples of ionic and covalent compound. Definition of ionic bond - 1 mark Definition of covalent bond - 1 mark Characteristics of ionic bond - 2 marks Characteristics of covalent bond - 2 marks	8

		Example of ionic compound	- 1 mark			Two properties	- 2 marks	
		Example of covalent compound	- 1 mark			Structure and its explanation	- 3 marks	
OR	iii.	Write postulates of VSEPR theory. Explain the geometry of three different molecules based on VSEPR theory.		<b>8</b>		ii.	What is pH scale? Explain its importance.	<b>5</b>
		Postulates of VSEPR	- 5 marks				pH scale	- 3 marks
		Three examples	- 3 marks				Importance	- 2 marks
						iii.	Explain common ion effect with suitable example.	<b>5</b>
Q.4	i.	Briefly explain biological importance of sodium.		<b>3</b>			Common ion effect	- 3 marks
		Biological importance	- 3 marks				Example	- 2 marks
	ii.	What are alkali metals? Explain their general characteristics.		<b>7</b>				
		What are alkali metals	- 2 marks					
		Characteristics	- 5 marks					
OR	iii.	What are p-block elements? Write three characteristics of p-block elements. Explain anomalous properties of carbon.		<b>7</b>				
		What are p-block elements	- 1 mark					
		Three characteristics	- 3 marks					
		Anomalous properties of carbon	- 3 marks					
Q.5	i.	Define pH and pK <sub>a</sub> . How are they calculated?		<b>4</b>				
		Definition of pH	- 1 mark					
		Formula of pH calculation	- 1 mark					
		Definition of pK <sub>a</sub>	- 1 mark					
		Formula of pK <sub>a</sub> calculation	- 1 mark					
	ii.	Explain Bronsted-Lowry and Lewis concept of acids and bases. Write suitable examples of each.		<b>6</b>				
		Bronsted-Lowry acid	- 1 mark					
		Bronsted-Lowry base	- 1 mark					
		Bronsted-Lowry acid and base example	- 1 mark					
		Lewis acid	- 1 mark					
		Lewis base	- 1 mark					
		Lewis acid and base example	- 1 mark					
OR	iii.	Calculate the solubility of A <sub>2</sub> X <sub>3</sub> in pure water. Given: K <sub>sp</sub> = 1.1 x 10 <sup>-23</sup> . Solution:		<b>6</b>				
		Solubility equation for A <sub>2</sub> S <sub>3</sub>	- 1 mark					
		K <sub>sp</sub> = [A <sup>3+</sup> ] <sup>2</sup> [X <sup>2-</sup> ] <sup>3</sup> = 1.1 x 10 <sup>-23</sup>	- 1 mark					
		K <sub>sp</sub> = (2S) <sup>2</sup> (3S) <sup>3</sup> = 108S <sup>5</sup>	- 2 marks					
		S <sup>5</sup> = 1 x 10 <sup>-25</sup>	- 1 mark					
		S = 1.0 x 10 <sup>-5</sup> mol/L	- 1 mark					
Q.6		Attempt any two:						
	i.	Write two properties of water. Explain its structure.		<b>5</b>				