

3/CHE-200 Syllabus-2023

2 0 2 4

(December)

FYUP : 3rd Semester Examination

MAJOR

CHEMISTRY

(Chemistry—III)

CHE-200

Marks : 75

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

PART—A

(Inorganic)

(Marks : 38)

1. (a) Explain the anomalous behaviour of lithium from other member of its group. 2
- (b) Why are Be and Mg show similar physical and chemical properties? Explain giving reason for your answer. 2

(2)

- (c) Write down one method of preparation and one use of the following compounds each : 2×2=4
- (i) Lithium aluminium hydride
- (ii) Aluminium chloride
- (d) Define ionization enthalpy. What are the factors on which ionization enthalpy depends? 2
- (e) What is catenation? Bond energies of catenated elements are as follows :
 $\text{C—C } 348 \text{ kJ mole}^{-1}$, $\text{Si—Si } 222 \text{ kJ mole}^{-1}$
and $\text{Ge—Ge } 167 \text{ kJ mole}^{-1}$
Which elements would you expect to show maximum catenation and why? 2
- (f) What are pseudohalogens? Give an example. 2
- (g) Explain why interhalogen compounds are more reactive than the halogens. Give example of interhalogen compounds. 3
- (h) Draw the structures of BrF_3 and IF_7 . 1+1=2

(3)

OR

2. (a) How is boric acid prepared? Mention one use of boric acid. 1+1=2
- (b) Giving balance equation, write what happens, when—
- (i) I_2 solution reacts with sodium thiosulphate;
- (ii) hydrazine reacts with AuCl_3 ;
- (iii) hydrazoic acid is reacted with $(\text{CN})_2$. 1+1+1=3
- (c) What is meant by inert pair effect? Explain taking suitable examples. 2
- (d) What are the different oxidation states exhibited by group 17 elements of the periodic table? Explain the variation. 3
- (e) The dissociation energy of F_2 molecule is lesser than the dissociation energy of Cl_2 molecule. Explain. 2
- (f) Taking suitable examples comment on the reactivity of polyhalides and pseudohalides. 2

(4)

- (g) Write one method of preparation of BrF_5 and draw its structure. $1+1=2$
- (h) What happens when mercuric cyanide is thermally decomposed? Write the reactions. 1
- (i) Give two similarities between halogens and pseudohalogens. 2
3. (a) Explain, giving reason for your answer, why most of the *d*-block elements can act as a catalyst. 2
- (b) Write the electronic configurations of chromium and copper.
(At. Nos. : Cr = 24, Cu = 29) 1
- (c) Fe is most stable in its +3 oxidation state than its +2 oxidation state, while Mn is stable in its +2 oxidation state rather than its +3 oxidation state. Explain. (At. Nos. : Fe = 26, Mn = 25) 2
- (d) What is lanthanide contraction? Explain the causes and consequences of lanthanide contraction. 3

(5)

- (e) Describe the preparation and uses of the following : $1\frac{1}{2}\times 2=3$
- (i) Nessler's reagent
- (ii) Potassium permanganate
- (f) Draw the structure of nickel tetracarbonyl. 1
- (g) Draw the MOT energy level diagram. Calculate the bond order and mention the magnetic properties of N_2^+ molecule and N_2^{2-} molecule. 3
- (h) Write the main postulate of molecular orbital theory of covalent bonding. 2
- (i) Draw the pi-bonding and anti-bonding molecular orbitals. Obtain by linear combination of p_x - p_x orbitals. 2

OR

4. (a) Write one method of preparation of sodium cobaltinitrite and draw its structure. 2
- (b) What are transition elements? Giving their valence shell electronic configuration, justify why Zn and Hg are not usually considered as transition element. 2

(6)

- (c) Write the general electronic configuration of lanthanides and actinides. 2
- (d) Discuss the variation in oxidation state for the first, second and third row transition metals. 2
- (e) Give reason for the following observations : 3
- (i) Compounds of transition elements are coloured
 - (ii) Transition elements are good catalyst
- (f) Mention one method of preparation of UF_6 . 1
- (g) Write down the molecular orbital configurations of O_2^+ , O_2 , O_2^- , O_2^{2-} . 2
- (h) Draw the molecular orbital energy level diagram for Cl_2 molecule. 2
- (i) What happens to the bond length when an electron is removed from— 3
- (i) N_2 molecule;
 - (ii) O_2 molecule;
 - (iii) Cl_2 molecule.

(7)

PART—B

(Physical)

(Marks : 37)

5. (a) Which of the following are polynomials? In case of a polynomial, write down its degree and leading coefficient : 3
- $f(x) = 4x^2 + 2$
- $f(x) = 3x^2 - 2x + \sqrt{x}$
- $f(x) = 12 - 4x^5 + 3x^2$
- (b) Draw the graph of the function $3y = -3x + 12$ and find the intercept and slope of the line. 3
- (c) Find the derivatives of the following : $1\frac{1}{2} \times 2 = 3$
- (i) $x^3 + 2x$
 - (ii) $e^{x^2} + 5$
- (d) A card is drawn from a well-shuffled pack of 52 cards. What is the probability of getting a king of heart or a queen of club? 3

- (e) Find the roots of the following quadratic equations : 4

(i) $x^2 - 5 = 4x$

(ii) $4x^2 + 9 = 12x$

- (f) Use Stirling approximation to estimate $\ln 10!$. 2

OR

6. (a) Calculate the maximum value for the following function at $x = 1$: 3

$$y = x^3 - x$$

- (b) Integrate the following : $2 \times 2 = 4$

(i) x^3 (within the limit $x = 2$ to $x = 4$)

(ii) $\frac{1}{5^x}$ (within the limit $x = 0$ to $x = 5$)

- (c) Convert the following exponential equation into its linear form : 2

$$A = B \cdot e^{-E/RT}$$

- (d) Given 3 distinguishable particles and 2 compartments, calculate ${}^n P_r$ and ${}^n C_r$. $3\frac{1}{2}$

- (e) If

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{bmatrix} \text{ and } B = \begin{bmatrix} 3 & -1 & 3 \\ -1 & 0 & 2 \end{bmatrix}$$

then find $2A - B$. $3\frac{1}{2}$

- (f) Find out the magnitude of the vector $6\hat{i} + 2\hat{j} + 3\hat{k}$. 2

7. (a) Derive the mathematical relationship between the equilibrium constants K_p and K_c for a gaseous reaction. Explain the significance of Δ_n . 5

- (b) What is Le-Chatelier's principle? Explain giving examples. 4

- (c) Calculate the degree of hydrolysis of 0.10 molar solution of sodium acetate at 25 °C. $K_a = 1.8 \times 10^{-5}$ and $K_w = 1 \times 10^{-14}$. 4

- (d) Explain solubility product of a salt in an aqueous medium. 2

(10)

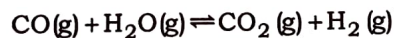
- (e) What is hydrolysis? Derive an expression for the hydrolysis of a salt of a weak acid and strong base in terms of dissociation constant of weak acid and ionic product of water. 4

OR

8. (a) Deduce van't Hoff equation for temperature dependence of equilibrium constant in terms of K_p and K_c . 4

- (b) State and explain the law of mass action. 2

- (c) The value of K_p for the water-gas reaction



is 1.06×10^5 at 25°C . Calculate ΔG° for this reaction. ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$) 3

- (d) Derive Henderson's equation for the determination of pH of a buffer solution. 4

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- (e) Calculate the pH of the following : $2 \times 2 = 4$

(i) 10^{-8} (N) aqueous solution of HCl

(ii) 10^{-7} (N) aqueous solution of NaOH

- (f) Why is CuSO_4 acidic when dissolved in water and that of NaCl is neutral? 2
