

5/CHE-300 Syllabus-2023

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(Nov-Dec)

FYUP : 5th Semester Examination

MAJOR

CHEMISTRY

(Chemistry-IV)

CHE-300

Marks : 75

Time : 3 hours

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

PART—A

(Inorganic)

(Marks : 37)

1. (a) With the help of a suitable example,
explain 'equivalent configuration' and
'equivalent atoms'.

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(Turn Over)

- (b) Assign point groups to the following molecules : $1\frac{1}{2} \times 4 = 6$
- (i) XeOF_4
 - (ii) Ferrocene (staggered)
 - (iii) $\text{Trans-[PtCl}_2(\text{NH}_3)_2]$
 - (iv) Borazole
- (c) List down all the symmetry elements and symmetry operations of Cr(CO)_6 . $2+2=4$
- (d) With the help of a suitable example, explain centre of inversion, proper axis and rotation-reflection axis. $1+1+2=4$
- (e) Draw the flowchart for assigning point groups to different molecules. 3

OR

2. (a) Assign point groups to the following molecules : $1\frac{1}{2} \times 4 = 6$
- (i) SbF_5
 - (ii) $\text{Cis-N}_2\text{F}_2$
 - (iii) $\text{MnO}_4^\ominus$
 - (iv) $\text{H}_2\text{C}=\text{C}=\text{CH}_2$

(3)

- (b) Using a suitable example, define what is meant by 'symmetry element' and 'symmetry operation'. $2+2=4$.
- (c) Clearly depict and identify the symmetry planes present in PtCl_4^{2-} . 2
- (d) What is meant by product of symmetry? Explain using a suitable example. 2
- (e) What symmetry elements are present in the following molecular point groups? 3
- (i) C_s
 - (ii) $C_{\infty v}$
 - (iii) T_d
- (f) How many symmetry operations can be generated from an S_5 improper axis of rotation? 2
3. (a) How do metals occur in nature? Write down the steps involved in the extraction of metals from their ores. $1+2=3$
- (b) Explain the following terms : $\frac{1}{2} \times 4 = 2$
- (i) Minerals
 - (ii) Ores
 - (iii) Gangue
 - (iv) Flux

(4)

(c) What kind of ores do the following metals exist as in nature? $\frac{1}{2} \times 4 = 2$

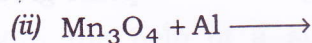
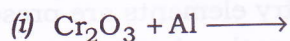
(i) Mercury

(ii) Aluminium

(iii) Zinc

(iv) Iron

(d) Predict the products and balance the following reactions : $1+1=2$



(e) Explain how aluminium is extracted from bauxite ore. 3

(f) Mention two general properties of inorganic polymers. Give three points of difference between inorganic and organic polymers. $1+1=2$

(g) What are homo-atomic and hetero-atomic polymers? Give one example of each type. 2

(h) What are silicones? How are they obtained and why are they considered valuable? Mention one important use of silicones. $\frac{1}{2} \times 4 = 2$

(6)

PART—B

(Physical)

(Marks : 38)

5. (a) Write the frequency equation for a diatomic molecule assuming it behaves as a simple harmonic oscillator. Obtain the vibrational energy levels for such a molecule and define zero point energy. 2+3+1=6
- (b) Which of the following molecules will be microwave active? 2
 H_2, Cl_2, HCl, H_2O
- (c) Explain the following in short : 2+2=4
(i) Additive properties
(ii) Constitutive properties
- (d) Write the Clausius-Mosotti equation for a non-polar molecule and explain the meaning of the terms involved. 2+1=3
- (e) The microwave spectrum of HBr molecule shows equidistant lines separated by 16.94 cm^{-1} . Calculate the bond length of the molecule if atomic masses of H and Br are 1.008 and 80 a.m.u. respectively. 4

(7)

OR

6. (a) Define surface tension. Describe the capillary rise method for determining the surface tension of a liquid. 1+3=4
- (b) Explain the following : 3+3=6
- (i) Anharmonicity
- (ii) Induced polarization
- (c) Describe the different types of spectroscopy involved in the different regions of the electromagnetic spectrum. 5
- (d) What are degrees of freedom? Calculate the total degrees of freedom present in the following : $1+1\frac{1}{2}+1\frac{1}{2}=4$
- (i) CO_2
- (ii) H_2O
7. (a) Differentiate between thermal and photochemical reactions. 4
- (b) Discuss the photodecomposition of hydrogen iodide molecule. 3
- (c) Derive the Michaelis-Menten equation for an enzyme-catalyzed reaction. 6

(8)

(d) Explain the following in short : $3+3=6$

(i) Opposite reaction

(ii) Parallel reaction

OR

8. (a) With the help of Jablonski diagram, explain the following phenomena : 5

(i) Fluorescence

(ii) Phosphorescence

(b) What are photosensitized reactions? Give example. 2

(c) What are consecutive reactions? Obtain the rate expression for such reactions. $2+4=6$

(d) Explain the following in short : $3+3=6$

(i) Transition state theory

(ii) Chain reaction of decomposition of acetaldehyde
