FYUG Odd Semester Exam., 2023
(Held in 2024)

CHEMISTRY

(1st Semester)

Course No. : CHMDSM-101T

(Fundamentals of Chemistry—I)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer *ten* questions, selecting *two* from each Unit : 2×10=20

UNIT—I

1. Give two limitations of Bohr's atomic model.

2. What is Heisenberg's uncertainty principle? Give the mathematical expression of uncertainty principle explaining all the terms involved.

3. Write electronic configurations of the following :

$Mn^{2\oplus}$, Cr

UNIT—II

4. Explain why He_2 molecule does not exist but $He_2^{\oplus}$ molecule can exist.

5. Arrange the following in the increasing order of bond length :

$O_2^{\oplus}$, $O_2^{\ominus}$, O_2, $O_2^{2\ominus}$

6. Which of the following molecules is paramagnetic? Calculate the spin-only magnetic moment :

O_2, N_2

UNIT—III

7. Define collision number and mean free path.

8. Establish a relation amongst average velocity, most probable velocity and root mean square velocity.

9. Define ideal gas. Give two reasons for the deviation of real gases from ideality. 1+1=2

(Continued)

UNIT—IV

10. Small drops of liquids are always spherical whereas larger drops are not. Explain.

11. Differentiate between Schottky and Frenkel defects.

12. Calculate the number of atoms per unit cell in FCC lattice.

UNIT—V

13. Arrange the following in increasing order of acid strength :

CH_3COOH, $CH_2ClCOOH$, $\overset{F}{\overset{|}{C}}H_2—CH_2COOH$

14. Arrange the following in the increasing order of stability :

$Ph—\overset{Ph}{\overset{|}{\underset{Ph}{\overset{|}{C^+}}}}$, $CH_3—CH_2—\overset{\oplus}{C}H_2$, $H_3C—\overset{CH_3}{\overset{|}{\underset{CH_3}{\overset{|}{C^{\oplus}}}}}$

15. Arrange the following in increasing order of stability :

(Turn Over)

SECTION—B

Answer *five* questions, selecting *one* from each Unit : 10×5=50

UNIT—I

16. *(a)* What is de Broglie's hypothesis? Derive the following expression where the symbols have their usual meanings : 2+3=5

$$\lambda = \frac{h}{\sqrt{2mE}}$$

λ = Wavelength of matter wave
h = Planck's constant
m = Mass of microscopic particle
E = Kinetic energy of microscopic particle

(b) In which region of electromagnetic spectrum the Lyman series lie? Calculate the shortest and longest wavelengths in the hydrogen spectrum of Lyman series. 1+4=5

17. *(a)* What are quantum numbers? Discuss the significance of each quantum number. 1+4=5

(b) What is Pauli exclusion principle? Explain why 2*p*-orbital is filled earlier than 3*s*. 1+2=3

(Continued)

(c) Explain why half-filled and completely-filled orbitals are more stable than any other electronic configuration. 2

UNIT—II

18. *(a)* Using VSEPR theory, find out the shape of the following : 2×3=6

BF_3, SF_4, XeF_2

(b) Draw the MO diagram of NO molecule and comment on its magnetic property. 4

19. *(a)* Using VSEPR theory, draw the shape of the following : 2×3=6

$I_3^{\ominus}$, $XeOF_4$, ClF_3

(b) Draw the resonating structures of NO_3^- and C_6H_5OH. 2+2=4

UNIT—III

20. *(a)* From kinetic theory of gases, derive the relation

$$PV = \frac{1}{3} MC^2$$

where the symbols have their usual meanings. 5

(Turn Over)

(b) What is RMS velocity? At what temperature the RMS velocity of CO_2 gas is same as that of Cl_2 gas at 298 K? 5

21. (a) What is van der Waals' equation of state for real gases? Explain all the terms involved in it. Also state the units and significances of a and b. 1+1+3=5

(b) What is compressibility factor? What is the value of compressibility factor for ideal gases? Using van der Waals' equation of state, explain why $z > 1$ for H_2 and He. 1+1+3=5

UNIT—IV

22. (a) What is surface tension? How does temperature affect surface tension? Explain the principle behind measurement of surface tension using drop number method. 1+1+3=5

(b) What is Bravis lattice? A compound of X and Y crystallizes in the cubic structure in which Y-atoms are at the corners and X-atoms are at the alternate faces of the cube. Find the formula of the compound. 1+4=5

(Continued)

23. (a) What is coefficient of viscosity? How do temperature and pressure affect coefficient of viscosity? Describe the principle behind the measurement of η using Ostwald viscometer. 1+(½+½)+3=5

(b) What are surface active agents? Give examples. Describe the cleansing action of soap. 1+1+3=5

UNIT—V

24. (a) What is hyperconjugation effect? Explain the stability of carbocations using H-effect. 1+3=4

(b) What are carbanions? Discuss the shape and stability of carbanions. 1+3=4

(c) Differentiate between inductive effect and electromeric effect. 2

25. (a) What is resonance effect? Explain why phenol is acidic in nature. 1+3=4

(b) Explain Hückel's rule of aromaticity taking a suitable example. 3

(c) Write one reaction each for the formation of a carbocation, carbanion and free radical. 3

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