**2023/TDC(CBCS)/EVEN/SEM/
CHMDSC/GE–401T/337**

TDC (CBCS) Even Semester Exam., 2023

CHEMISTRY

(4th Semester)

Course No. : CHMDSC/GE–401T

**(Transition Metals, Coordination Chemistry,
States of Matter and Chemical Kinetics)**

Full Marks : 50

Pass Marks : 20

Time : 3 hours

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

SECTION—A

Answer any *fifteen* of the following questions :

1×15=15

1. Write the general electronic configuration of the first transition series.

2. Name the only synthetic radioactive element in lanthanoids.

3. The +3 oxidation states of lanthanum ($Z = 57$) and gadolinium ($Z = 64$) are especially stable. Why?

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(2)

4. Among Co^{2+} and Ni^{2+}, who has lower magnetic moment?

5. Give an example of unsymmetrical bidentate ligand.

6. Write two drawbacks of valence bond theory.

7. State Jahn-Teller theorem.

8. Write two postulates of crystal field theory.

9. What is Boyle temperature?

10. What is the significance of compressibility factor?

11. Write the kinetic gas equation and explain the terms involved.

12. Write the significance of van der Waals' constant, a.

13. Define liquid crystal and give example.

14. What is the effect of temperature on surface tension?

15. What is vacancy defect?

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16. Write Bragg's law.

17. Give an example of zero-order reaction.

18. What is threshold energy?

19. What is the unit of rate constant for a second-order reaction?

20. What do you mean by instantaneous rate of reaction?

SECTION—B

Answer any *five* of the following questions :

$$2 \times 5 = 10$$

21. Write various features of a Latimer diagram.

22. Explain why transition elements act as catalyst.

23. Explain ligand isomerism with suitable example.

24. Draw different geometrical isomers of $[PtClBrPy(NH_3)]$.

25. Define collision number and mean free path.

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26. Explain the effect of temperature and pressure on coefficient of viscosity of gases.

27. Write the rules for identification of lattice plane.

28. Explain F-centre with an example.

29. Show that the half-life period of a zero-order reaction is directly proportional to initial concentration.

30. Explain various factors affecting the rate of a reaction.

SECTION—C

Answer any *five* of the following questions :

5×5=25

31. *(a)* Write the difference between lanthanoids and actinoids. 2

(b) Draw Latimer diagram for the following reduction half-reaction and calculate the value of $E°$ for reduction of Cu^{2+} to Cu : 1+2=3

$$Cu^{2+} + e^{\ominus} \longrightarrow Cu^{+}, \quad E° = 0·15\upsilon$$

$$Cu^{+} + e^{\ominus} \longrightarrow Cu, \quad E° = 0·50\upsilon$$

(5)

32. *(a)* What is lanthanide contraction? Give reason. 2

(b) Explain how lanthanides are separated by ion-exchange method. 3

33. *(a)* Using VBT, explain the formation of $[Fe(H_2O)_6]^{2+}$. Comment on its magnetic character. 2½+½=3

(b) Give the IUPAC names of the following : 2

   (i) $[(NH_3)_5Cr-OH-Cr(NH_3)_5]Cl_3$

   (ii) $[Ni(dmg)_2]$

34. *(a)* Which of the complex will show strong Jahn-Teller distortion? 2

   $[Co(en)_3]^{2+}$ and $[Fe(CN)_6]^{4-}$

(b) Calculate the CFSE for $[Co(en)_3]^{2+}$ and $[Fe(CN)_6]^{4-}$. 3

35. *(a)* Derive the kinetic gas equation in terms of density. 3

(b) Explain the cause of deviation of real gas from ideal behaviour. 2

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36. *(a)* Draw and explain the Andrews isotherm of CO_2. 3

(b) Show that the ratio of most probable velocity, average velocity and root-mean-square velocity is $1 : 1 \cdot 128 : 1 \cdot 224$. 2

37. *(a)* Explain in detail different types of symmetry elements of a cube. Also mention the total number of symmetry elements. 2½+½=3

(b) What is the number of Na-atoms and Cl-atoms present in the unit cell of NaCl? 2

38. *(a)* Draw different unit cells for $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$. 2

(b) Explain the process of determination of surface using stalagmometer. 3

39. *(a)* For a reaction, $2A + B \rightarrow 3C$, the rate of appearance of C is $1 \cdot 3 \times 10^{-4} \, \text{mol L}^{-1} \, \text{s}^{-1}$. Calculate the

(i) rate of reaction;

(ii) rate of disappearance of A. 2

(b) Deduce the integrated rate equation for a second-order reaction when both the reactants are same. 3

(7)

40. *(a)* The rate constants of a reaction at 500 K and 700 K are $0 \cdot 02 \, \text{s}^{-1}$ and $0 \cdot 07 \, \text{s}^{-1}$ respectively. Calculate the value of Ea and A. 3

(b) Explain the criteria of effective collision in the light of collision theory of reaction rate. 2

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