TDC (CBCS) Even Semester Exam., 2022

CHEMISTRY

(4th Semester)

Course No. : CHMDSC/GEC–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. Which of the Fe^{2+} and Fe^{3+} has more unpaired electrons?

2. Write the general electronic configuration of transition elements.

3. Write the highest oxidation state exhibited by manganese ($z = 25$).

4. Sc^{3+} ion is colourless while Cr^{3+} ion is coloured. Explain.

5. What is the coordination number of iron in $K_3[Fe(C_2O_4)_3]$?

6. Write the name of a bidentate ligand.

7. Write the formula of tetraaquooxalato-iron (III).

8. Write one example of chelate compound.

9. Define mean free path.

10. Define compressibility factor.

11. State the law of corresponding states.

12. Write van der Waals' gas equation for an ideal gas.

13. Define critical temperature.

14. What is unit cell?

15. What are Miller indices of a plane?

16. Draw the structure of NaCl.

17. Name one zero-order reaction.

18. The rate constant for a first-order reaction is 0·0085 min^{-1}. Calculate its half-life period.

19. The rate constant of a reaction is 2×10^{-2} L mol^{-1} s^{-1}. What is the order of reaction?

20. Determine the order of reaction which has the rate expression, rate $= k[A]^{1/2}[B]^{3/2}$.

SECTION—B

Answer any *five* of the following questions : 2×5=10

21. Why do most transition metal ions exhibit paramagnetism?

22. Why do transition elements exhibit good catalytic properties?

23. What is isomerism? Write one example of linkage isomerism. 1+1=2

24. Write the IUPAC (2005) name of $[Cr(NH_3)_6][Co(CN)_6]$.

25. What are ideal and real gases? Why do real gases deviate from ideal behaviour?

26. Calculate the r.m.s. speed of CO_2 at the body temperature.

27. What are cohesion and adhesion forces?

28. How does viscosity of a liquid vary with temperature?

29. A first-order reaction is 75% complete in 60 minutes. Find the half-life of this reaction.

30. Define activation energy. What is the unit of activation energy? 1+1=2

SECTION—C

Answer any *five* of the following questions : 5×5=25

31. What are transition metals? In what way are the electronic configuration of transition elements differ from the representative elements? Calculate the theoretical magnetic moment of Ti^{3+} ion. 2+2+1=5

32. What is lanthanide contraction? Give two examples of lanthanide elements. What are the oxidation states exhibited by lanthanide elements? 2+2+1=5

33. Using VBT, predict the shape and magnetic property of $[Co(CO)_4]^-$ ion. 3+2=5

34. What is crystal field theory? How does it differ from the valence bond theory? Draw the sequence of energy levels of orbitals in square planar crystal field. 1+2+2=5

35. Define Boyle temperature. How is it related to van der Waals' constants *a* and *b*? Write the SI units of van der Waals' constants *a* and *b*. 1+2+2=5

36. Define collision diameter. How is it determined? What is the difference between collision number and collision frequency? 1+2+2=5

37. What are liquid crystals? Explain the difference among a liquid crystal, a solid and a liquid. Write two applications of liquid crystals. 1+2+2=5

38. Define the terms 'surface tension' and 'surface energy'. What are the effects of temperature on the surface tension of a liquid? Write two practical applications of surface tension. 2+1+2=5

(Continued)

39. Define order of a reaction. What is the difference between order and molecularity of a reaction? Cite one example of each.

2+2+1=5

40. A first-order reaction takes 100 minutes for completion of 60% of the reaction. Find the time when 90% of the reaction will be completed. How does activation energy vary with rise in temperature? 3+2=5

★★★