MANAVA BHARATI
INDIA INTERNATIONAL SCHOOL

CLASS XII: CHEMISTRY
MID TERM ASSESSMENT
SESSION:2024-25

Weightage: 70 marks.
Time Duration: 3 hours

General Instructions:

- There are 33 questions in this question paper with internal choice.
- SECTION A consists of 16 multiple -choice questions carrying 1 mark each.
- SECTION B consists of 5 short answer questions carrying 2 marks each.
- SECTION C consists of 7 short answer questions carrying 3 marks each.
- SECTION D consists of 2 case - based questions carrying 4 marks each.
- SECTION E consists of 3 long answer questions carrying 5 marks each.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

SECTION A (1 x 16 Marks)

1. In comparison to a 0.01 M solution of glucose, the depression in the freezing point of a 0.01 M $MgSO_4$ solution is

(a) The same (b) About twice (c) About three times (d) About six times

2. Vapour pressure of a pure liquid X is 2 atm at 300 K. It is lowered to 1 atm on dissolving 1 g of Y in 20 g of liquid X. If the molar mass of X is 200, what is the molar mass of Y? (1)

(a) 20 (b) 50 (c) 100 (d) 200

3. What is the expected value of the van't Hoff factor for $K_3[Fe(CN)_6]$ in dilute solutions? (1)

(a) 3 (b) 4 (c) 2 (d) 1

4.The oxidation state of nickel in $Ni(CO)_4$ (1)

(a) 1 (b) 4 (c) 2 (d) 0

5. In the cell notation, the double vertical line (‖) represents: (1)

(a) A salt bridge (b) A porous membrane (c) A conducting wire (d) An inert electrode

6. In a galvanic cell, oxidation occurs at the: (1)

(a) Cathode (b) Anode (c) Electrolyte (d) Salt bridge

7. The standard reduction potential for a half-reaction indicates: (1)

(a) The rate of the reaction (b) The equilibrium constant of the reaction
(c) The tendency of a species to be reduced (d) The energy change of the reaction

8. Half life period of first order reaction is 20 minutes. How long will it take to 75% completion? (1)

(a) 60 minutes (b) 80 minutes (c) 40 minutes (d) 30 minutes

$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{20} = 34.65$

$t = \frac{2.303}{34.65} \times 0.6020 = 0.693$

9. Which of the following is not an element of the first transition series.
(a) Iron (b) Chromium (c) Magnesium (d) Nical

10. A first-order reaction has a rate law expression of: (1)
(a) Rate = k[A]. (b) Rate = $k[A]^2$ (c) Rate = k. (d) Rate = k/[A]

11. As an electroplated protective covering, what metal is used? (1)
(a) Plutonium (b) Chromium (c) Nickel (d) Iron

12. Which transition metal is known for its various oxidation states, forming colorful compounds? (1)
(a) Cadmium (b) Copper (c) Zinc (d) Chromium

Q. no 13 to 16 are Assertion - Reasoning based questions.
These consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true and R is not the correct explanation of A
(c) A is true but R is false
(d) A is False but R is true

13. **Assertion:** $[FeF_6]^{3-}$ is paramagnetic.
Reason: F- is a weak field ligand, hence does not cause pairing of electrons. (1)

14. **Assertion:** Current stops flowing when $E_{cell} = 0$.
Reason: Equilibrium of the cell reaction is attained. (1)

15. **Assertion :** According to Kohlrausch law , molar conductivity of a strong Electrolyte at infinite dilution is the sum of molar conductivities of its ion.
Reason : The current carried by cation and anion is always equal. (1)

16. **Assertion :** Low spin tetrahedral complexes are not formed.
Reason : For tetrahedral complexes, CFSE is lower than pairing energy. (1)

SECTION B (2 x 5 marks)

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each

17. On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y? (2)

18. (i) Why is Cr^{2+} reducing and Mn^{3+} oxidising when both have d^4 configuration?
(ii) Name a member of the lanthanoid series which is well known to exhibit +4 oxidation state. (2)

19. Calculate the emf of the following cell at 298 K ?
Fe (s)| Fe^{2+}(0.001 M) || H^+(1M | H2 (g) (1 bar) , Pt (s) (Given: E°_{cell} = + 0.44 V) (2)

20. Express the rate of the following reaction in terms of the formation of ammonia.
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ (2)

21. Write down the name of the given compound: $K_3[Co(C_2O_4)_3]$. (2)

SECTION C (3x 7 marks)

This section contains 7 questions with internal choice in one question. The following questions are short answer types and carry 3 marks each.

22. 8 g of glucose, $C_6H_{12}O_6$ (Molar mass = 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil? (Kb for water = 0.52 K kg mol^{-1}, boiling point of pure water = 373.15 K) (3)

23. Explain variation of molar conductivity with Concentration (With strong & weak electrolyte) with diagram. (3)

24. What is lanthanoid contraction?. Write two consequences of lanthanoid contraction. (1+2)

25. For a reaction $2\ NH_3 \rightarrow N_2 + 3\ H_2$ in the presence of platinum catalyst rate=k. Write the order and molecularity of this reaction. Write the unit of k. (3)

26. Complete the following chemical equations :

(i) $MnO_4^-(aq) + S_2O_3^{2-}(aq) + H_2O(l) \rightarrow$

(ii) $Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) + H^+(aq) \rightarrow$ (1.5+ 1.5)

27. Define half-life period. The half-life for radioactive decay of ^{14}C is 5730 years. An archeological artifact containing wood had only 80% of the ^{14}C found in a living tree. Estimate the age of the sample. (Given, log 2 = 0.3010) (3)

28. $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain. (At. no. Fe = 26) (3)

SECTION D (4x 2 marks)

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+1+1) marks each. Read the passage carefully and answer the questions that follow.

29. The two series of inner transition elements, Lanthanoid and actinides constitute the f block of the periodic table. With the successive filling of inner orbitals, 4f, there is a gradual decrease in the atomic and ionic sizes of the metals along the series (Lanthanoid contraction). This contraction is similar to the observed in an ordinary transition series and it is attributed to the same cause, the imperfect shielding of electrons by another in this sub-shell due to shapes of these f- orbitals. The almost identical radii of Zr and Hf a consequence of the Lanthanoid contraction. The typical oxidation state of Lanthanoid is +3. The oxidation states of +2 and +4 are exhibited by some of the elements to acquire a stable electronic configuration of f0, f7 or f14.

1. Which of the following is the most common oxidation state among the lanthanoid?

(a) +3 (b) +4 (c) +2 (d) +5

2. IUPAC name of product formed by reaction of methyl amine with two moles of ethyl chloride

(a) N,N-Dimethylethanamine (b) N,N-Diethylmethanamine

(c) N-Methyl ethanamine (d) N-Ethyl - N-methylethanamine

3. The formula of the coordination compound Tetraammineaquachloridocobalt(III) chloride is

(a) $[Co(NH_3)_4(H_2O)Cl]Cl_2$ (b) $[Co(NH_3)_4(H_2O)Cl]Cl_3$

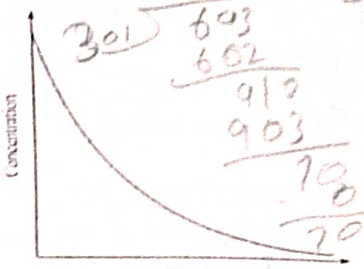
(c) $[Co(NH_3)_2(H_2O)Cl]Cl_2$ (d) $[Co(NH_3)_4(H_2O)Cl]Cl$

4. Which set of ions exhibit specific colours?
(Atomic number of Sc = 21, Ti = 22, V=23, Mn = 25, Fe = 26, Ni = 28 Cu = 29 and Zn =30)

(a) Sc^{3+}, Ti^{4+}, Mn^{3+} (b) Sc^{3+}, Zn^{2+}, Ni^{2+}

(c) V^{3+}, V^{2+}, Fe^{3+} (d) Ti^{3+}, Ti^{4+}, Ni^{2+} (1+1+1+1)

30. The half-life of a reaction is the time required for the concentration of reactant to decrease by half, i.e., $[A]_t = [A]/2$ For first order reaction,
$t_{1/2} = 0.693/k$ This means $t_{1/2}$ is independent of initial concentration.
Figure shows that typical variation of concentration of reactant exhibiting first order kinetics. It may be noted that though the major portion of the first order kinetics may be over in a finite time, the reaction will never cease as the concentration of reactant will be zero only at infinite time.



The following questions are multiple choice questions.
Choose the most appropriate answer:

(i) A first order reaction has a rate constant k=3.01 x 10-3 /s. How long will it take to decompose half of the reactant?

(a) 2.303 s (b) 23.03 s (c) 230.3 s (d) 2303 s

(ii) The rate constant for a first order reaction is 7.0 x 10-4 s-1. If initial concentration of reactant is 0.080 M, what is the half-life of reaction?

(a) 990 s (b)79.2 s (c)12375 s (d) 10.10 x 10-4 s

(iii) For the half-life period of a first order reaction, which one of the following statements is generally false?

(a) It is independent of initial concentration. (b) It is independent of temperature.

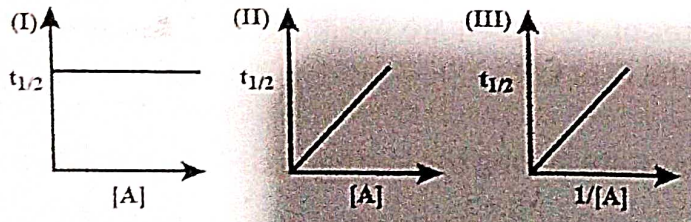
(c) It decreases with the introduction of a catalyst. (d) None of these.

(iv) The rate of a first order reaction is 0.04 mol L-1 s-1 at 10 minutes and 0.03 mol L-1 s-1 at 20 minutes after initiation. The half life of the reaction is

(a) 4.408 min (b) 44.086 min (c) 24.086 min (d)2.408 min

OR

(iv) The plot of $t_{1/2}$ vs initial concentration $[A]^0$ for a first order reaction is given by



(1+1+1+1)

SECTION E (5x 3 marks)

The following questions are long answer types and carry 5 marks each. All questions have an internal choice.

31. Answer the following questions: (2+3)

a. If a current of 0.5 ampere flows through a metallic wire for 2 hours, then how many electrons would flow through the wire?

b. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

OR

a. Calculate the emf of the cell in which the following reaction takes place:
$Ni(s)+2Ag^{+}$ (0.002 M) ----> Ni^{2+} (0.160 M)+2Ag(s)
Given that $E^{0}_{(cell)} = 1.05$ V. (Given log 2 = 0.3010)

b. What are fuel cells? Write the electrode (anode and cathode) reactions of $H_2 - O_2$ fuel cells.

(1+2+2)

32. Answer the following questions:

a. What are ambidentate ligands?

b. What is crystal field splitting energy? How does the magnitude of Δ_o decide the actual configuration of d-orbitals in a coordination entity?

c. Give the electronic configuration of the following complexes on the basis of Crystal Field Splitting theory. $[CoF_6]^{3-}$ and $[Fe(CN)_6]_4$.

33. a Out of 1 M glucose and 2 M glucose, which one has a higher boiling point and why?

b. A 10% solution (by mass) of sucrose in water has a freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water if the freezing point of pure water is 273.15 K.
Given: (Molar mass of sucrose = 342 g mol^{-1}) (Molar mass of glucose = 180 g mol^{-1})

(2+3)