



Study Material Based on the
Latest **CBSE** Syllabus and **NCERT** Textbooks

Together with[®]

OBJECTIVE TYPE QUESTIONS (CHEMISTRY)

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CLASS
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Part-I

[Multiple Choice Questions, Assertion-Reason Questions and Case-based Questions]

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ELECTROCHEMISTRY

Multiple Choice Questions

1. Which of the following expression is correct for ' K_a ' in terms of Λ° and Λ , where ' C ' is molarity.

$$(a) K_a = \frac{C\Lambda_m^\circ}{\Lambda_m(\Lambda_m^\circ - \Lambda)}$$

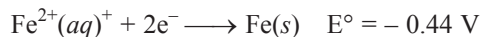
$$(b) K_a = \frac{C\Lambda_m^2}{\Lambda_m^\circ(\Lambda_m^\circ - \Lambda_m)}$$

$$(c) K_a = \frac{C\Lambda_m^2}{\Lambda_m^\circ}$$

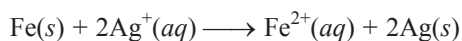
$$(d) K_a = \frac{C\Lambda_m^2}{(\Lambda_m^\circ - \Lambda_m)}$$

Ans. (b)

2. $\text{Ag}^+(aq) + e^- \longrightarrow \text{Ag}(s)$ $E^\circ = +0.80 \text{ V}$



What is *emf* of



(a) 1.16 V

(b) 1.24 V

(c) 2.04 V

(d) -1.16 V

Ans. (b)

3. $\text{X}(s) + 2\text{Y}^+(aq) \rightleftharpoons \text{X}^{2+}(aq) + 2\text{Y}(s)$; ($E^\circ_{\text{cell}} = 0.059 \text{ V}$)

What is the value of ' K ' for above reaction?

(a) 1×10^8

(b) 1×10^2

(c) 4×10^3

(d) 3×10^4

Ans. (b)

4. Which of the following statement is correct?

(a) E_{Cell} and $\Delta_r G$ of cell reaction both are extensive properties.

(b) E_{Cell} and $\Delta_r G$ of cell reaction both are intensive properties.

(c) E_{Cell} is an intensive property while $\Delta_r G$ of cell reaction is an extensive property.

(d) E_{Cell} is an extensive property while $\Delta_r G$ of cell reaction is an intensive property.

Ans. (c)

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5. $\Lambda_m = \Lambda_m^\circ - A\sqrt{C}$, At what concentration $\Lambda_m = \Lambda_m^\circ$?

- (a) $C \rightarrow \infty$ (b) $C \rightarrow 1$ (c) $C \rightarrow 0$ (d) $C \rightarrow 10$

Ans. (c)

6. The products of electrolysis of dil. H_2SO_4 are

- (a) H_2 at cathode, SO_2 at anode (b) H_2 at cathode, O_2 at anode
(c) O_2 at cathode, H_2 at anode (d) SO_2 at cathode, O_2 at anode

Ans. (b)

7. Kohlrausch given the following relation for strong electrolytes:

[CBSE 2020]

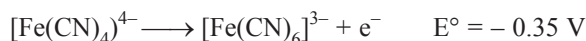
$$\Lambda = \Lambda_0 - A\sqrt{C}$$

Which of the following equality holds?

- (a) $\Lambda = \Lambda_0$ as $C \longrightarrow \sqrt{A}$ (b) $\Lambda = \Lambda_0$ as $C \longrightarrow \infty$
(c) $\Lambda = \Lambda_0$ as $C \longrightarrow 0$ (d) $\Lambda = \Lambda_0$ as $C \longrightarrow 1$

Ans. (c)

8. On the basis of following E° values, the strongest oxidising agent is



- (a) Fe^{2+} (b) Fe^{3+} (c) $[Fe(CN)_6]^{3-}$ (d) $[Fe(CN)_6]^{4-}$

Ans. (b)

9. Match the terms given in Column I with the units given in Column II.

Column I

Column II

(A) Λ_m

(i) $S \text{ cm}^{-1}$

(B) E_{Cell}

(ii) m^{-1}

(C) κ

(iii) $S \text{ cm}^2 \text{ mol}^{-1}$

(D) G^*

(iv) V

(a) A – (i), B – (iii), C – (ii), D – (iv),

(b) A – (iii), B – (iv), C – (i), D – (ii),

(c) A – (ii), B – (i), C – (iii), D – (iv),

(d) A – (i), B – (iii), C – (iv), D – (ii),

Ans. (b)

10. The relationship between specific conductance (κ) and resistivity (ρ) is

- (a) $\kappa = \frac{1}{\rho}$ (b) $\kappa \times \rho = R$ (c) $\kappa \times \frac{1}{R} = \rho$ (d) $\kappa = \frac{1}{R} \times \rho$

Ans. (a)

11. Λ_m° for NaCl, HCl and CH_3COONa are 126.0, 426. $100 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. If the conductance of 0.001 m CH_3COOH is $5 \times 10^{-5} \text{ S cm}^{-1}$, the degree of dissociation of CH_3COOH is:

- (a) 10% (b) 12.5% (c) 15% (d) 10.5%

Ans. (b)

12. In $\Lambda = \Lambda^\circ - A\sqrt{C}$ is equation of straight line, slope and intercept respectively equal to

- (a) $-\Lambda, \Lambda^\circ$ (b) $+\Lambda, \Lambda^\circ$ (c) $\Lambda^\circ, -A$ (d) $\Lambda^\circ, +A$

Ans. (a)

13. $2\text{Fe}^{3+}(\text{aq}) + 2\text{I}^{-}(\text{aq}) \longrightarrow 2\text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{s})$ has $E_{\text{cell}}^\circ = 0.236 \text{ V}$ at 298 K.

The value of ΔG° is equal to

- (a) $-45.54 \text{ kJ mol}^{-1}$ (b) $+45.54 \text{ kJ mol}^{-1}$
(c) $-45.54 \text{ J mol}^{-1}$ (d) $-455.4 \text{ kJ mol}^{-1}$

Ans. (a)

14. For an electrochemical cell $\text{Mg}(\text{s}) + 2\text{Ag}^{+} \longrightarrow 2\text{Ag}(\text{s}) + \text{Mg}^{2+}(\text{aq})$

The cell representation is:

- (a) $\text{Mg}^{2+} | \text{Mg} || \text{Ag}^{+}(\text{aq}) | \text{Ag}$ (b) $\text{Mg} | \text{Mg}^{2+}(\text{aq}) || \text{Ag}^{+}(\text{aq}) | \text{Ag}(\text{s})$
(c) $\text{Ag} | \text{Ag}^{+} || \text{Mg}^{2+}(\text{aq}) | \text{Mg}$ (d) $\text{Mg}^{2+} | \text{Mg}(\text{s}) || \text{Ag}(\text{s}) | \text{Ag}^{+}$

Ans. (b)

15. Li is best reducing agent because:

- (a) It has lowest reduction potential (b) It has highest reduction potential
(c) It has lowest oxidation potential (d) It has lowest ionisation enthalpy

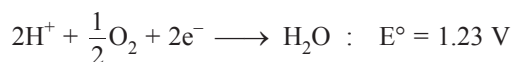
Ans. (a)

16. Which of the following is best reducing agent?

- (a) K (b) Ag (c) Mg (d) Hg

Ans. (a)

17. The half cell reactions for the rusting of iron are:



ΔG° (in kJ mol^{-1}) for the overall reaction $\text{Fe} + \frac{1}{2}\text{O}_2 + 2\text{H}^{+} \longrightarrow \text{Fe}^{2+} + \text{H}_2\text{O}$, is

- (a) -76 (b) -322 (c) -122 (d) -176

Ans. (b)

18. $E_{\text{cell}} - E_{\text{cell}}^\circ = 0.0591 \text{ V}$, the ratio of C_1/C_2 at 298 K is:

- (a) 2 (b) 100 (c) 10 (d) 1000

Ans. (b)

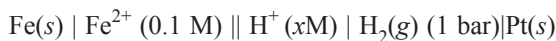
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19. If $\text{Cu}^+ + \text{e}^- \longrightarrow \text{Cu}$, $E^\circ = x_1 \text{V}$, $\text{Cu}^{2+} + 2\text{e}^- \longrightarrow \text{Cu}$, $E^\circ = x_2 \text{V}$, then $\text{Cu}^{2+} + \text{e}^- \longrightarrow \text{Cu}^+$, E° in volt will be:

- (a) $x_1 - 2x_2$ (b) $x_1 + 2x_2$
 (c) $x_1 - x_2$ (d) $2x_2 - x_1$

Ans. (d)

20. The emf of the following cell at 298 K is 0.1745 V. [Given: $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{V}$]



Calculate the H^+ ions concentration of the solution at the electrode where hydrogen is being produced.

- (a) 10^{-3}M (b) 10^{-4}M
 (c) 10^{-5}M (d) 10^{-6}M

Ans. (c)

21. An electrochemical cell behaves like an electrolytic cell when:

- (a) $E_{\text{cell}} = E_{\text{external}}$ (b) $E_{\text{cell}} = 0$
 (c) $E_{\text{external}} > E_{\text{cell}}$ (d) $E_{\text{external}} < E_{\text{cell}}$

Ans. (c)

23. Which of the following is correct for spontaneity of the cell?

- (a) $\Delta G = -\text{ve}$, $E^\circ = +\text{ve}$ (b) $\Delta G = +\text{ve}$, $E^\circ = 0$
 (c) $\Delta G = -\text{ve}$, $E^\circ = 0$ (d) $\Delta G = +\text{ve}$, $E^\circ = -\text{ve}$

Ans. (a)

24. The potential of hydrogen electrode in contact with a solution whose pH is 10.

[($\log 10^{10} = 10.0000$) Given: $E^\circ_{\text{H}^+/\text{H}_2} = 0$]

- (a) +0.591 V (b) +0.0591 V
 (c) -0.591 V (d) -1.18 V

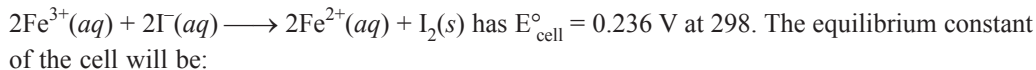
Ans. (c)

25. Which of the following can oxidise Fe^{2+} under suitable conditions?

- (a) MnO_4^- in acidic medium (b) $\text{Cr}_2\text{O}_7^{2-}$ in acidic medium
 (c) H_2O_2 in acidic medium (d) all of these

Ans. (d)

26. The cell in which the following reaction occurs:



[$\log 10^8 = 8.000$ Given]

- (a) 10^6 (b) 10^4 (c) 10^3 (d) 10^8

Ans. (d)

27. For an electrochemical cell, $F_2(g) + 2I^-(aq) \longrightarrow 2F^-(aq) + I_2(s)$

The correct cell representation and Nernst equation respectively are:

(a) $Pt(s) | F_2(g) | F^-(aq) || I^-(aq) | I_2(s) | Pt(s)$, $E_{cell} = E_{cell}^\circ - \frac{0.0591}{2} \log \frac{[I^-]^2}{[F^-]^2}$

(b) $Pt(s) | I_2(s) | I^-(aq) || F^-(aq) | F_2(g) | Pt$, $E_{cell} = E_{cell}^\circ - \frac{0.0591}{2} \log \frac{[F^-]^2}{[I^-]^2}$

(c) $F_2(g) | F^-(aq) || I^-(aq) | I_2(s)$, $E_{cell} = E_{cell}^\circ - 0.0591 \log \frac{[I^-]}{[F^-]}$

(d) $I_2(s) | I^-(aq) || F^-(aq) | F_2(g)$, $E_{cell} = E_{cell}^\circ - \frac{0.0591}{2} \log \frac{[I_2]}{[F_2]}$

Ans. (b)

28. If the standard electrode potential of an electrode is greater than zero, then we can infer that its:

(a) reduced form is more stable compared to hydrogen gas.

(b) oxidised form is more stable compared to hydrogen gas.

(c) reduced and oxidised forms are equally stable.

(d) reduced form is less stable than hydrogen gas.

Ans. (a)

29. The e.m.f of cell: $Zn(s) | Zn^{2+} (0.1 M) || Ag^+ (0.01 M) | Ag(s)$

$$E_{Zn^{2+}/Zn}^\circ = -0.76 \text{ V}, E_{Ag^+/Ag}^\circ = +0.80 \text{ V}$$

[Given: $\log 10 = 1$]

(a) 1.56 V

(b) 1.47 V

(c) 1.37 V

(d) 1.60 V

Ans. (b)

30. The e.m.f of cell $Pt(s) | Sn^{2+} (0.01 M) | Sn^{4+} (0.01 M) || Fe^{3+} (0.1 M) | Fe^{2+} (0.01 M) | Pt$ if

$$E_{cell}^\circ = 0.62 \text{ V is:}$$

(a) 0.59 V

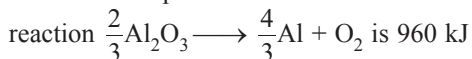
(b) 0.62 V

(c) 0.68 V

(d) 0.76 V

Ans. (c)

31. The minimum potential difference needed to reduce Al_2O_3 at 773 K, the ΔG° for the decomposition



(a) +2.48 V

(b) -2.48 V

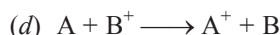
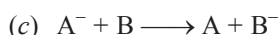
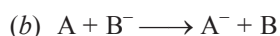
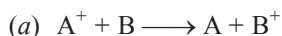
(c) 1.24 V

(d) -1.24 V

Ans. (b)

32. The electrochemical cell $A(s) | A^+(aq) (1 M) || B^+(aq) (1 M) | B(s)$ has $E^\circ = 0.30 \text{ V}$

Which of the following is correct cell reaction?



Ans. (d)

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33. Among the following, the strongest reducing agent is:

[Given: $E_{\text{Cl}_2/\text{Cl}^-}^\circ = +1.36 \text{ V}$, $E_{\text{Cr}^{3+}/\text{Cr}}^\circ = -0.74 \text{ V}$, $E_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}}^\circ = +1.33 \text{ V}$, $E_{\text{MnO}_4^-/\text{Mn}^{2+}}^\circ = 1.51 \text{ V}$.]

- (a) Mn^{2+} (b) Cr^{3+} (c) Cl^- (d) Cr

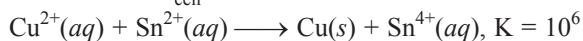
Ans. (d)

34. Which of the following is best reducing agent?

- (a) F^- (b) Cl^- (c) Br^- (d) I^-

Ans. (d)

35. The value of E_{cell}° for the reaction:



[Given: $\log 10 = 1$]

- (a) 0.1773 V (b) 0.01773 V (c) 0.02153 V (d) 1.773 V

Ans. (a)

36. $\text{M} + \text{H}_2\text{O} \longrightarrow \text{Oxide or hydroxide} + \text{H}_2$

Which metal out of Fe, Na, Hg, Ag do not give above reactions?

- (a) Fe and Hg (b) Na and Hg (c) Hg and Ag (d) Na and Ag

Ans. (c)

37. Among the following, which will be best conductor of electricity?

- (a) 1 M CH_3COOH (b) 1 M Oxalic acid (c) 1 M H_2SO_4 (d) 1 M Boric acid

Ans. (c)

38. Conductance of which of the following decrease with increase in temperature?

- (a) Electrolyte (b) Semiconductors (c) Insulators (d) Metals

Ans. (d)

39. Resistivity is equal to:

- (a) $R \times \frac{l}{a}$ (b) $\frac{l}{R} \times \frac{l}{a}$ (c) $R \times \frac{a}{l}$ (d) $\frac{l}{R} \times \frac{a}{l}$

Ans. (c)

40. S.I. units of specific conductance (electrolytic conductivity) is:

- (a) $\Omega^{-1} \text{ m}^{-1}$ (b) S m^{-1} (c) mho m^{-1} (d) all of these

Ans. (d)

Assertion-Reason Questions

Directions: In the following question, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

- (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
- (b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.

(c) Assertion is true but the Reason is false.

(d) The statement of the Assertion is false but the Reason is true.

41. Assertion: Conductivity of electrolyte increases with decrease in concentration.

Reason: Number of ions per unit volume decreases on dilution.

Ans. (d)

42. Assertion: On dilution, the equivalent as well as molar conductivity increases.

Reason: With dilution, the number of current carrying particles per cm^3 increases.

Ans. (c)

43. Assertion: ZnSO_4 can be stored in copper container.

Reason: Cu is more reactive than zinc.

Ans. (c)

44. Assertion: The ion which has lower reduction potential will be oxidised first at anode.

Reason: It will lose electrons easily.

Ans. (a)

45. Assertion: H^+ ions are reduced first at cathode instead of Na^+ .

Reason: H^+ have lower reduction potential than Na^+ .

Ans. (c)

Case-based Questions

46. Read the given passage and answer the questions based on passage and related studied concepts.

Metallic conductance involves movement of electrons where as electrolytic conductance involves movement of ions. Specific conductance increases with increase in concentration where as Λ_m (molar conductivity) decreases with increase in concentration. Electrochemical cell converts chemical energy of redox reaction into electricity. Electrochemical series is arrangement of elements and ions in increasing order of their reduction potential. Electrolytic cell converts electrical energy into chemical energy which is used in electrolysis. Kohlrausch law helps to determine limiting molar conductivity of weak electrolyte, their degree of ionisation (α) and their dissociation constants.

(i) Which of the following solution of KCl will have highest specific conductance?

- (a) 0.5 M (b) 0.01 M (c) 0.1 M (d) 1.0 M

(ii) The product formed at cathode in electrolysis of aq. NaCl is

[CBSE 2020]

- (a) H_2 (b) O_2 (c) Cl_2 (d) All of these

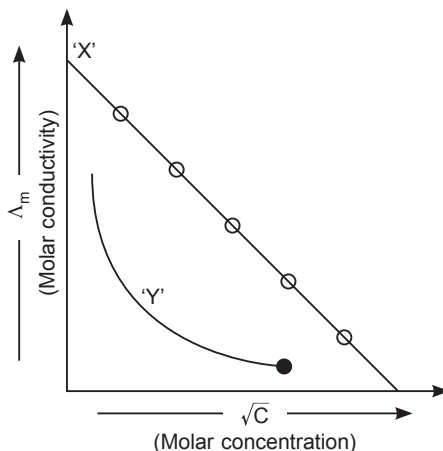
(iii) Which will have highest conductance?

- (a) Ag at 30°C (b) Ag at 60°C (c) Cu at 30°C (d) Cu at 60°C

Ans. (i) (d) (ii) (a) (iii) (a)

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47. Observe the graph shown in figure between Λ_m (molar conductivity) Vs \sqrt{C} (Molar concentration) and answer the questions based on graph.



- (i) The curve 'Y' is for:
 (a) KCl (b) CH_3COOH (c) NaCl (d) None of these
- (ii) What is intercept on Λ_m axis for 'X' equal to:
 (a) molar conductivity (b) limiting molar conductivity
 (c) resistivity (d) none of these
- (iii) Slope is equal to
 (a) $-A$ (b) $+A$ (c) $\frac{A}{2}$ (d) none of these

Ans. (i) (b) (ii) (b) (iii) (a)

4

CHEMICAL KINETICS

Multiple Choice Questions

1. The half life period of first order reaction is 1386 seconds. The specific rate constant of the reaction is

- (a) $0.5 \times 10^{-2} \text{ s}^{-1}$ (b) $0.5 \times 10^{-3} \text{ s}^{-1}$
(c) $5.0 \times 10^{-2} \text{ s}^{-1}$ (d) $5.0 \times 10^{-3} \text{ s}^{-1}$

Ans. (b)

2. The rate constant of a reaction $A \longrightarrow B$ is $0.6 \times 10^{-3} \text{ Ms}^{-1}$. If the concentration of [A] is 5 M, then what will be concentration of [B] after 20 minutes?

- (a) 0.36 M (b) 0.72 M (c) 1.08 M (d) 3.60 M

Ans. (b)

3. A first order reaction has specific reaction rate 10^{-2} s^{-1} . How much time it will take for 20g of reactant to reduce to 5g?

- (a) 138.6 s (b) 346.5 s (c) 693.0 s (d) 238.6 s

Ans. (a)

4. Mechanism of a hypothetical reaction $X_2 + Y_2 \longrightarrow 2XY$ is given below:

- (a) $X_2 \rightleftharpoons X + X$ (fast)
(b) $X + Y_2 \longrightarrow XY + Y$ (slow)
(c) $X + Y \longrightarrow XY$ (fast)

The overall order of reaction is

- (a) 2 (b) 0 (c) 1.5 (d) 1

Ans. (c)

5. If the initial concentration of reactant is doubled, $t_{1/2}$ is also doubled, the order of reaction is

- (a) zero (b) 1 (c) 2 (d) 3

Ans. (a)

6. If conc. of reactant 'A' is increased 10 times and rate of reaction becomes 100 times. What is order with respect to 'A'?

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

Ans. (b)

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7. In the first order reaction the concentration of reactant decreases from 0.6 M to 0.3 M in 30 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M:

- (a) 60 min (b) 30 min (c) 15 min (d) 50 min

Ans. (a)

8. In a chemical reaction $X \longrightarrow Y$, it is found that the rate of reaction doubles when the concentration of X is increased four times. The order of the reaction with respect to X is [CBSE 2020]

- (a) 1 (b) 0 (c) 2 (d) 1/2

Ans. (d)

9. The unit of rate constant depends upon the [CBSE 2020]

- (a) molecularity of the reaction. (b) activation energy of the reaction.
(c) order of the reaction. (d) temperature of the reaction.

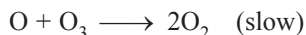
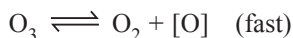
Ans. (c)

10. $t_{1/2}$ for a chemical reaction is 30 min. The time taken for 90% reaction to be complete will be

- (a) 100 min (b) 200 min (c) 300 min (d) 400 min

Ans. (a)

11. The chemical reaction, $2O_3 \longrightarrow 3O_2$ proceeds as follows:



The rate law expression should be

- (a) $r = k[O_3]^2$ (b) $r = k[O_3]^2 [O_2]^{-1}$ (c) $r = k[O_3] [O_2]$ (d) $r = k \frac{[O_3]}{[O_2]}$

Ans. (b)

12. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it take for 100% completion? [KVS][NCERT Exemplar Problem]

- (a) 1.26×10^{15} s (b) 2.52×10^{14} s (c) 2.52×10^{28} s (d) infinite

Ans. (d)

13. Rate law cannot be determined from balanced chemical equation if _____.

- (a) reverse reaction is involved. (b) it is a sequence of elementary reactions.
(c) any of the reactants is in excess. (d) all of these

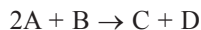
Ans. (d)

14. Which of the following statements are applicable to a balanced chemical equation of an elementary reaction?

- (a) Order is same as molecularity. (b) Molecularity can never be zero
(c) Both (a) and (b) (d) None of these

Ans. (c)

15. The non-stoichiometric reaction:



Initial conc. (A)	Initial conc. of (B)	Initial rate (Mol L ⁻¹)
0.1 M	0.1 M	1.2×10^{-3}
0.1 M	0.2 M	1.2×10^{-3}
0.2 M	0.1 M	2.4×10^{-3}

The rate law for formation of C is

(a) $\frac{dc}{dt} = k[A]$

(b) $\frac{dc}{dt} = k[A][B]$

(c) $\frac{dc}{dt} = k[A]^2[B]^1$

(d) $\frac{dc}{dt} = k[A][B]^2$

Ans. (a)

16. A first order reaction is 50% complete in 69.3 minutes. Time required for 99.9% completion of this reaction is [NCERT Exemplar Problem]

(a) 693 min

(b) 6.93 min

(c) 0.693 min

(d) 6930 min

Ans. (a)

17. For the first order reaction half life is 14 seconds, the time required for the initial concentration to reduce $\frac{1}{8}$ th of its initial value is

(a) $(14)^3$ seconds

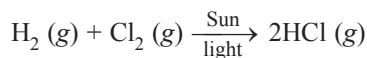
(b) 28 seconds

(c) 42 seconds

(d) 56 seconds

Ans. (c)

18. The order of reaction



(a) Zero

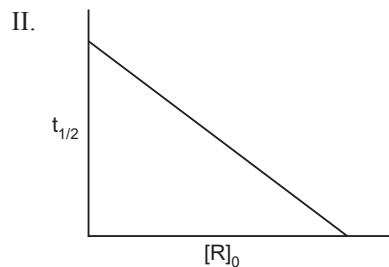
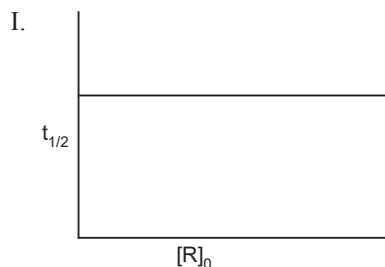
(b) 1

(c) 2

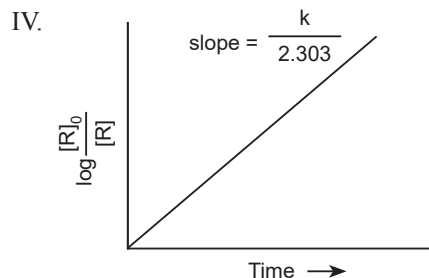
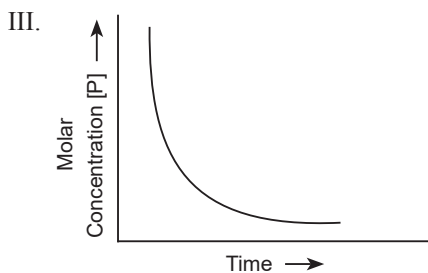
(d) 3

Ans. (a)

19. Which of the following graphs is correct for a first order reaction? [NCERT Exemplar Problem]



14 Objective Type Questions—12



(a) I and II

(b) II and III

(c) III and IV

(d) I and IV

Ans. (d)

20. The rates of reactions are studied under

(a) Thermodynamics

(b) Equilibrium

(c) Chemical kinetics

(d) Redox reaction

Ans. (c)

21. Which one of the following reactions is fast?

(a) Hydrolysis of starch

(b) $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \longrightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$

(c) Rusting of iron

(d) Hydrolysis of canesugar

Ans. (b)

22. The change in conc. of reactant or product per unit time is

(a) Rate constant

(b) Velocity constant

(c) Rate of reaction

(d) All of these

Ans. (c)

23. Rate of disappearance of reactant is represented by

(a) $\frac{-\Delta[\text{R}]}{\Delta t}$

(b) $\frac{+\Delta[\text{R}]}{\Delta t}$

(c) $-\frac{\Delta[\text{P}]}{\Delta t}$

(d) $+\frac{\Delta[\text{P}]}{\Delta t}$

Ans. (a)

24. Rate of appearance of product is represented by

(a) $\frac{-\Delta[\text{P}]}{\Delta t}$

(b) $\frac{+\Delta[\text{P}]}{\Delta t}$

(c) $\frac{\pm\Delta[\text{P}]}{\Delta t}$

(d) All of these

Ans. (b)

25. The conc. of reactants decreases and product increase with time is shown by

(a) +, -

(b) -, +

(c) \pm

(d) None of these

Ans. (b)

26. When change in conc. is measured over bigger interval of time, it is called
 (a) Instantaneous rate (b) Average rate (c) Both (a) and (b) (d) None of these

Ans. (b)

27. Which of the following are correct units of rate of reaction?
 (a) $\text{mol L}^{-1} \text{s}^{-1}$ (b) atm s^{-1} (c) mol L^{-1} (d) Both (a) and (b)

Ans. (d)

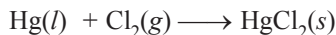
28. Average rate of reaction
 (a) increases with time
 (b) decreases with time as conc. of reactants decreases
 (c) remains same
 (d) cannot be predicted

Ans. (b)

29. Average rate becomes equal to instantaneous rate when
 (a) time interval is smallest (dt) (b) $\Delta t \longrightarrow 0$
 (c) Both (a) and (b) (d) time interval is bigger

Ans. (c)

30. Which of the following represents rate of reaction of the following reaction:



- (a) $-\frac{\Delta[\text{Hg}]}{\Delta t}$ (b) $-\frac{\Delta[\text{Cl}_2]}{\Delta t}$ (c) $+\frac{\Delta[\text{HgCl}_2]}{\Delta t}$ (d) All of these

Ans. (d)

31. Which of the following represents rate of reaction $2\text{HI}(g) \longrightarrow \text{H}_2(g) + \text{I}_2(g)$ correctly?

- (a) $-\frac{\Delta[\text{HI}]}{2\Delta t}$ (b) $-\frac{\Delta[\text{H}_2]}{2\Delta t}$ (c) $-\frac{\Delta[\text{I}_2]}{2\Delta t}$ (d) $+\frac{1}{2} \frac{\Delta[\text{H}_2]}{2\Delta t}$

Ans. (a)

32. If initial conc. of N_2O_5 is 2.33 mol L^{-1} and after 184 min, it is reduced to 2.08 mol L^{-1} , the average rate of reaction, $2\text{N}_2\text{O}_5(g) \longrightarrow 4\text{NO}_2(g) + \text{O}_2(g)$ will be

- (a) $1.13 \times 10^{-5} \text{ mol L}^{-1} \text{s}^{-1}$ (b) $6.79 \times 10^{-4} \text{ mol L}^{-1} \text{s}^{-1}$
 (c) $4.07 \times 10^{-2} \text{ mol L}^{-1} \text{s}^{-1}$ (d) $6.79 \times 10^{-4} \text{ mol L}^{-1} \text{hr}^{-1}$

Ans. (a)

33. In a reaction $2\text{A} \longrightarrow \text{Products}$, the concentration of 'A' decreases from 0.5 M to 0.4 M in 10 min, the rate during this interval is

- (a) $1 \times 10^{-2} \text{ mol L}^{-1} \text{min}^{-1}$ (b) $5 \times 10^{-3} \text{ mol L}^{-1} \text{min}^{-1}$
 (c) $1 \times 10^{-2} \text{ mol L}^{-1} \text{s}^{-1}$ (d) $5 \times 10^{-3} \text{ mol L}^{-1} \text{s}^{-1}$

Ans. (b)

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34. The rate of reaction represented in terms of conc. of reactants is called

- (a) Molecularity of reaction (b) Order of reaction
(c) Rate law or rate equation (d) Rate constant

Ans. (c)

35. For reaction $aA + bB \longrightarrow cC + dD$, rate law is

- (a) $\frac{-d[R]}{dt} = k[A]^a[B]^b$ (b) $\frac{-d[R]}{dt} = k[A]^x[B]^y$
(c) $\frac{-d[R]}{dt} = k[A][B]$ (d) $\frac{-d[R]}{dt} = k[C][D]$

Ans. (b)

36. Rate constant is equal to rate of reaction when molar conc. of reactants is equal to

- (a) 1 (b) 0
(c) ∞ (d) 10

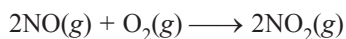
Ans. (a)

37. When order w.r.t [A] is 2, what will happen to rate if [A] is doubled—

- (a) doubled (b) four times
(c) $\frac{1}{2}$ (d) remains same

Ans. (b)

38. Initial rate of formation of NO_2 is given



	Initial [NO]	Initial [O ₂]	Initial rate of [NO ₂] formation in mol L ⁻¹ s ⁻¹
I.	0.30 M	0.30 M	0.096
II.	0.60 M	0.30 M	0.384
III.	0.30 M	0.60 M	0.192
IV.	0.60 M	0.60 M	0.768

The rate law is

- (a) $r = k[\text{NO}]^1 [\text{O}_2]^1$ (b) $r = k[\text{NO}]^2 [\text{O}_2]^1$
(c) $r = k[\text{NO}]^1 [\text{O}_2]^2$ (d) $r = k[\text{NO}]^2 [\text{O}_2]^0$

Ans. (b)

39. Which of the following is/are correct about the order of reaction

- (a) $x + y$ if rate = $k[A]^x [B]^y$ (b) determined experimentally
(c) can be zero or in fraction (d) All of these

Ans. (d)

Assertion-Reason Questions

Directions: In the following question, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

- (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
- (b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.
- (c) Assertion is true but the Reason is false.
- (d) The statement of the Assertion is false but the Reason is true.

40. Assertion: The molecularity of the reaction $\text{H}_2 + \text{Br}_2 \longrightarrow 2\text{HBr}$ appears to be 2.

Reason: Two molecules of the reactants are involved in elementary reaction.

Ans. (a)

41. Assertion: Acidic hydrolysis of an ester follows first order kinetics.

Reason: Conc. of H_2O remains nearly constant during the course of reaction.

Ans. (a)

42. Assertion: For a complex reaction, molecularity and order are not same.

Reason: Order of reaction may be zero.

Ans. (b)

43. Assertion: $\text{H}_2 + \text{Cl}_2 \xrightarrow{h\nu} 2\text{HCl}$ is photochemical reaction, its molecularity is 2.

Reason: The order of reaction is zero.

Ans. (b)

44. Assertion: Basic hydrolysis of ester is second order reaction.

Reason: The rate of reaction depends upon conc. of ester and $[\text{OH}^-]$

Ans. (a)

Case-based Questions

45. Observe the table given showing volume of CO_2 obtained by reaction of CaCO_3 and dilute HCl after every minute. Answer the questions that follow:

Table showing volume of CO_2 at one minute interval by reaction of CaCO_3 with dilute HCl.

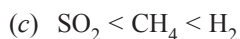
Time/(min)	Volume of CO_2/cm^3
0	0
1	24 cm^3
2	34 cm^3
3	38 cm^3
4	40 cm^3
5	40 cm^3
6	40 cm^3

5

SURFACE CHEMISTRY

Multiple Choice Questions

1. The correct ascending order of adsorption of the following gases on the same mass of charcoal at same temperature and pressure is



Ans. (b)

2. The formation of micelles takes place only above

(a) Inversion temperature

(b) Boyle's temperature

(c) Critical temperature

(d) Kraft temperature

Ans. (d)

3. Colloidion is 4% solution of which one of the following in alcohol-ether mixture.

(a) Nitroglycerin

(b) Cellulose acetate

(c) Glycol dinitrate

(d) Nitrocellulose

Ans. (d)

4. If 'x' is amount of adsorbate and 'm' is amount of adsorbent, which of the following is not related to adsorption process?

(a) $\frac{x}{m} = f(P)$ at constant T

(b) $\frac{x}{m} = f(T)$ at constant 'P'

(c) $P = f(T)$ at constant $\frac{x}{m}$

(d) $\frac{m}{x} = P \times T$

Ans. (d)

5. A plot of $\log \frac{x}{m}$ vs $\log p$ for adsorption of gas on a solid gives in straight line with slope equal to

(a) n

(b) $\frac{1}{n}$

(c) $\log k$

(d) $-\log k$ [KVS]

Ans. (b)

6. The protective power of lyophilic colloidal sol is expressed in terms of

(a) coagulation value

(b) gold number

(c) CMC (Critical Micelle Concentration)

(d) oxidation numbers [KVS]

Ans. (b)

20 Objective Type Questions—12

7. The coagulation values in millimoles per litre of the electrolyte for the coagulation of As_2S_3 sol are given

I. NaCl (52)

II. BaCl_2 (0.69)

III. MgSO_4 (0.22)

The correct order of coagulating power is

(a) $\text{I} > \text{II} > \text{III}$

(b) $\text{II} > \text{I} > \text{III}$

(c) $\text{III} > \text{II} > \text{I}$

(d) $\text{III} > \text{I} > \text{II}$

Ans. (c)

8. According to Freundlich adsorption isotherm, which of the following is correct?

(a) $\frac{x}{m} \propto p^1$

(b) $\frac{x}{m} \propto p^{1/n}$

(c) $\frac{x}{m} \propto p^0$

(d) All are correct for different ranges of pressure

Ans. (d)

9. 3g of activated charcoal was added to 50 ml of acetic acid solution (0.06 M) in a flask. After an hour it was filtered and the strength of filtrate was found to be 0.042 M. The amount of acetic acid adsorbed per gram of charcoal is

(a) 42 mg

(b) 54 mg

(c) 18 mg

(d) 36 mg

Ans. (b)

10. During the adsorption of gas on the surface of solid, which of the following is true?

(a) $\Delta G < 0$, $\Delta H > 0$, $\Delta S < 0$

(b) $\Delta G > 0$, $\Delta H < 0$, $\Delta S < 0$

(c) $\Delta G < 0$, $\Delta H < 0$, $\Delta S < 0$

(d) $\Delta G < 0$, $\Delta H < 0$, $\Delta S > 0$

Ans. (c)

11. The best coagulant for the precipitation of $\text{Fe}(\text{OH})_3$ sol is

(a) Na_2HPO_3

(b) NaNO_3

(c) Na_3PO_4

(d) Na_2SO_4

Ans. (c)

12. Which is favourable for physical adsorption?

(a) High T and high P

(b) High T and low P

(c) Low T and high P

(d) T and P do not affect

Ans. (c)

13. Identify the positively charged colloid.

(a) Haemoglobin

(b) As_2S_3

(c) Clay

(d) Gold sol

Ans. (a)

14. The stability of lyophobic sols is due to
- (a) adsorption of covalent molecules on the colloid
 - (b) the size of the particles
 - (c) the charge on particles
 - (d) Tyndall effect.

Ans. (c)

15. Gold sol can be prepared by
- (a) Hydrolysis of AuCl_3
 - (b) Oxidation of Gold by aqua-regia
 - (c) Peptization
 - (d) Reduction of AuCl_3 with HCHO solution.

Ans. (d)

16. Equal volumes each of two sols AgI one obtained by adding AgNO_3 to slight excess of KI and another obtained by adding KI to slight excess of AgNO_3 , are mixed together, then
- (a) the two sols will stabilize more electric charge
 - (b) the sol particles will acquire more electric charge
 - (c) mutual coagulation will take place
 - (d) A true solution will be obtained.

Ans. (c)

17. The gold numbers of four protective colloids X, Y, Z, W are 0.004, 0.01, 0.4, 0.2 respectively. The decreasing order of protective power is
- (a) X, Y, W, Z
 - (b) X, Y, Z, W
 - (c) W, X, Y, Z
 - (d) Z, X, Y, W

Ans. (a)

18. Which of the following statement is not correct?
- (a) The colour of colloidal solution depends upon size, nature of colloidal particles and wavelength of light scattered by particles.
 - (b) Mixture of milk and water appears blue in reflected light and red in transmitted light.
 - (c) Finest gold sol is red, as size increases it appears purple, then blue and finally golden.
 - (d) There is no change in colour of colloidal solution with increase in size of particles.

Ans. (d)

19. Identify the correct statement.
- (a) Argyrol is used in eye lotion
 - (b) Colloidal antimony is used for treatment of Kala-azar
 - (c) Colloidal gold is used for intramuscular injection
 - (d) All of these.

Ans. (d)

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20. In Freundlich Adsorption isotherm, the value of $1/n$ is [KVS]
(a) 1 in case of physical adsorption (b) 1 in case of chemisorption
(c) Between 0 and 1 in all cases (d) Between 2 and 4 in all cases

Ans. (c)

21. Which of the following forms micells in aq. solution above CMC? [KVS]
(a) Sodium stearate (b) Glucose
(c) Urea (d) Pyridinium chloride

Ans. (a)

22. Among the electrolytes Na_2SO_4 , CaCl_2 , $\text{Al}_2(\text{SO}_4)_3$ and NH_4Cl , the most effective coagulating agent for Sb_2S_3 sol is [KVS]
(a) Na_2SO_4 (b) CaCl_2 (c) $\text{Al}_2(\text{SO}_4)_3$ (d) NH_4Cl

Ans. (c)

23. The colour of sky is blue due to [KVS]
(a) Adsorption of light by atmospheric gases (b) Wavelength of scattered light
(c) Transmission of scattered light (d) All of these

Ans. (b)

24. The term 'sorption' stands for _____. [NCERT Exemplar Problem]
(a) absorption (b) adsorption
(c) both absorption and adsorption (d) desorption

Ans. (c)

25. Extent of adsorption of adsorbate from solution phase increases with _____. [NCERT Exemplar Problem]
(a) increase in amount of adsorbate in solution.
(b) decrease in surface area of adsorbent.
(c) increase in temperature of solution.
(d) decrease in amount of adsorbate in solution.

Ans. (a)

26. Physical adsorption of a gaseous species may change to chemical adsorption with _____. [NCERT Exemplar Problem]
(a) decrease in temperature
(b) increase in temperature
(c) increase in surface area of adsorbent
(d) decrease in surface area of adsorbent

Ans. (b)

27. On the basis of data given below predict which of the following gases shows least adsorption on a definite amount of charcoal? [NCERT Exemplar Problem]

Gas	CO ₂	SO ₂	CH ₄	H ₂
Critical temp./K	304	630	190	33

- (a) CO₂ (b) SO₂ (c) CH₄ (d) H₂

Ans. (b)

28. Freundlich adsorption isotherm is given by the expression $\frac{x}{m} = k p^{1/n}$ which of the following conclusions can be drawn from this expression.

- I. When $\frac{1}{n} = 0$, the adsorption is independent of pressure.
 II. When $\frac{1}{n} = 0$, the adsorption is directly proportional to pressure.
 III. When $n = 0$, $\frac{x}{m}$ vs p graph is a line parallel to x -axis.
 IV. When $n = 0$, plot of $\frac{x}{m}$ vs p is a curve.

- (a) I and II (b) I and III (c) III and IV (d) II and III

Ans. (b)

29. H₂ gas is adsorbed on activated charcoal to a very little extent in comparison to easily liquefiable gases due to _____.

- I. very strong van der Waal's interaction.
 II. very weak van der Waals forces.
 III. very low critical temperature.
 IV. very high critical temperature.

- (a) I and II (b) II and III (c) III and IV (d) I and III

Ans. (b)

30. Method of formation of solution is given in Column I. Match it with the type of solution given in Column II.

Column I	Column II
(A) Sulphur vapours passed through cold water	(i) Normal electrolyte solution
(B) Soap mixed with water above critical micelle concentration	(ii) Multi molecular colloids
(C) White of egg whipped with water	(iii) Associated colloid
(D) Soap mixed with water below critical micelle concentration	(iv) Macro molecular colloids

24 Objective Type Questions—12

(a) A (ii), B (iii), C (iv), D (i)

(b) A (iii), B (i), C (ii), D (iv)

(c) A (ii), B (iv), C (iii), D (i)

(d) A (iii), B (ii), C (i), D (iv)

Ans. (a)

31. Freshly prepared precipitate sometimes gets converted to colloidal solution by _____.

(a) coagulation

(b) electrolysis

(c) diffusion

(d) peptisation

Ans. (d)

32. The values of colligative properties of colloidal solution are of small order in comparison to those shown by true solutions of same concentration because of colloidal particles _____.

(a) exhibit enormous surface area.

(b) remain suspended in the dispersion medium.

(c) form lyophilic colloids.

(d) are comparatively less in number.

Ans. (d)

33. Which of the following electrolyte will have maximum flocculation value for $\text{Fe}(\text{OH})_3$ sol? [KVS]

(a) Na_2S

(b) $(\text{NH}_4)_3\text{PO}_4$

(c) K_2SO_4

(d) NaCl

Ans. (d)

34. Which one of the following forms micelles in aqueous solution above certain concentration? [KVS]

(a) Dodecyl trimethyl ammonium chloride

(b) Glucose

(c) Urea

(d) Pyridinium chloride

Ans. (a)

35. At high concentration of soap in water, soap behaves as _____.

[NCERT Exemplar Problem]

(a) molecular colloid

(b) associated colloid

(c) macromolecular colloid

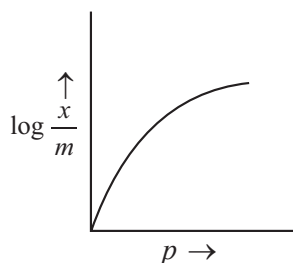
(d) lyophilic colloid

Ans. (b)

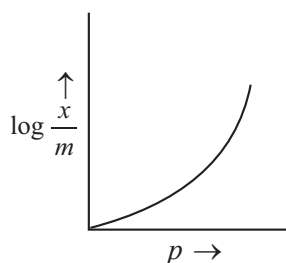
36. Which of the following curves is in accordance with Freundlich adsorption isotherm?

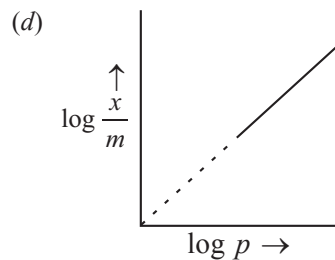
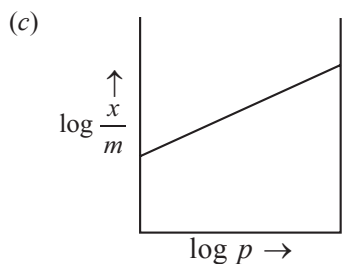
[NCERT Exemplar Problem]

(a)



(b)





Ans. (c)

37. Which of the following process is not responsible for the presence of electric charge on the sol particles? **[NCERT Exemplar Problem]**

- (a) Electron capture by sol particles.
- (b) Adsorption of ionic species from solution.
- (c) Formation of Helmholtz electrical double layer.
- (d) Absorption of ionic species from solution.

Ans. (d)

38. Which of the following statements are correct? **[NCERT Exemplar Problem]**

- I. Mixing two oppositely charged sols neutralises their charges and stabilises the colloid.
- II. Presence of equal and similar charges on colloidal particles provides stability to the colloids.
- III. Any amount of dispersed liquid can be added to emulsion without destabilising it.
- IV. Brownian movement stabilises sols.

- (a) I and II
- (b) II and III
- (c) III and IV
- (d) II and IV

Ans. (d)

39. What happens when a lyophilic sol is added to a lyophobic sol?

- I. Lyophobic sol is protected.
- II. Lyophilic sol is protected.
- III. Film of lyophilic sol is formed over lyophobic sol.
- IV. Film of lyophobic sol is formed over lyophilic sol.

- (a) I and II
- (b) I and III
- (c) II and IV
- (d) I and IV

Ans. (b)

40. Which phenomenon occurs when an electric field is applied to a colloidal solution and electrophoresis is prevented?

- I. Reverse osmosis takes place.
- II. Electro-osmosis takes place.
- III. Dispersion medium begins to move.
- IV. Dispersion medium becomes stationary.

- (a) I and II
- (b) II and III
- (c) III and IV
- (d) II and IV

Ans. (b)

Assertion-Reason Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Assertion (A) and Reason (R) are true but R is the correct explanation of Assertion (A)
- (b) Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
- (c) Assertion (A) is true but Reason (R) is false
- (d) Assertion (A) is false but Reason (R) is true.

41. Assertion: NH_3 gas is adsorbed on the surface of charcoal to maximum extent out of H_2 , N_2 , CO , NH_3 .

Reason: NH_3 has higher critical temperature, more intermolecular forces of attraction and H-bonding.

Ans. (a)

42. Assertion: In corrosion of iron, at anode



Reason: At cathode, reduction of H^+ take place in presence of O_2 to form H_2O in corrosion of iron.

Ans. (b)

43. Assertion: When O_2 is adsorbed on metallic surface, heat is released.

Reason: Bond length of O_2 is decreased and π^*2p orbital of oxygen is occupied.

Ans. (c)

44. Assertion: Aqueous solution of raw sugar is passed over activated charcoal, becomes colourless.

Reason: Colouring material gets adsorbed on the surface of charcoal.

Ans. (a)

45. Assertion: Detergents with low CMC are more economical to use.

Reason: Cleansing action of detergents involves the formation of micelles. These are formed when the concentration of detergents becomes equal to CMC. [NCERT Exemplar Problem]

Ans. (a)

Case-based Questions

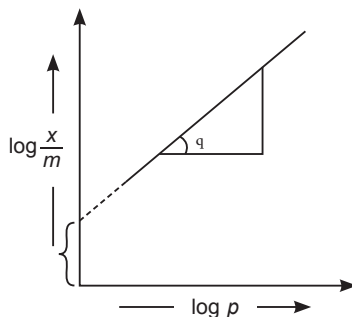
46. Read given passage and answer the questions that follow:

Glucose forms true solution in water given to patients. Suspension is heterogeneous, particles can be separated by filtration. Medicines are more effective in colloidal form. Lyophilic sols are more stable than lyophobic sols which need protective colloids like starch, gelatin. Sky is blue in colour due to Tyndall effect. Brownian movement is responsible for stability of colloids. Electric chimney in kitchen and industries is based on electrophoresis. Change in pH and heating leads to coagulation of lyophilic sols. Lyophobic sols are coagulated by electrolyte. Greater the charge on ion, more effective it will be for coagulation, is Hardy Schulze Rule.

- (i) Which of the following is most effective to coagulate AgI/Ag^+ sol?
 (a) MgCl_2 (b) K_2SO_4
 (c) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (d) none of these
- (ii) Which of the following is charge on colloidal solution of haemoglobin?
 (a) positive (b) negative
 (c) neutral (d) none of these
- (iii) The protective colloid used in ice-cream is
 (a) starch (b) gelatin
 (c) AS_2S_3 (iv) muddy water

Ans. (i) (c) (ii) (a) (iii) (b)

47. Observe the graph between $\log \frac{x}{m}$ (extent of adsorption) Vs $\log p$ (pressure) at constant temperature and answer the questions that follow:



- (i) The graph shows
 (a) extent of adsorption of gases $\left(\log \frac{x}{m}\right)$ on solids is directly proportional to pressure ($\log p$).
 (b) extent of adsorption is inversely proportional to pressure.
 (c) Extent of adsorption is independent of pressure.
 (d) None of these
- (ii) The slope of line is equal to
 (a) n (b) $\frac{1}{n}$
 (c) n^2 (d) $\log \frac{1}{n}$
- (iii) The intercept of line represents
 (a) k (b) $\ln k$
 (c) $\log k$ (iv) $2.303 \ln k$

Ans. (i) (a) (ii) (b) (iii) (c)

8

THE *d*- AND *f*-BLOCK ELEMENTS

Multiple Choice Questions

1. In which of the following pairs, both the ions are coloured in aqueous solutions?

[Atomic no of Sc = 21, Ti = 22, Ni = 28, Co = 27, Cu = 29]

- (a) Sc^{3+} , Ti (b) Sc^{3+} , Co^{2+} (c) Ni^{2+} , Cu^+ (d) Ni^{2+} , Ti^{3+}

Ans. (d)

2. Which of the following is most stable in aqueous solution?

- (a) Mn^{2+} (b) Cr^{3+} (c) V^{3+} (d) Ti^{3+}

Ans. (b)

3. The correct order of decreasing second ionisation enthalpy of Ti(22), V(23), Cr(24) Mn(25)

- (a) $\text{V} > \text{Mn} > \text{Cr} > \text{Ti}$ (b) $\text{Mn} > \text{Cr} > \text{Ti} > \text{V}$
 (c) $\text{Ti} > \text{V} > \text{Cr} > \text{Mn}$ (d) $\text{Cr} > \text{Mn} > \text{V} > \text{Ti}$

Ans. (d)

4. Which of the following pairs has the same ionic size?

- (a) Zr^{4+} , Hf^{4+} (b) Zn^{2+} , Hf^{4+} (c) Fe^{2+} , Ni^{2+} (d) Zr^{4+} , Ti^{4+}

Ans. (a)

5. The stability of Mn^{2+} , Fe^{2+} , Cr^{2+} , Co^{2+} is in order of

(At No. of Mn = 25, Fe = 26, Cr = 24, Co = 27)

- (a) $\text{Mn}^{2+} > \text{Fe}^{2+} > \text{Cr}^{2+} > \text{Co}^{2+}$ (b) $\text{Fe}^{2+} > \text{Mn}^{2+} > \text{Co}^{2+} > \text{Cr}^{2+}$
 (c) $\text{Co}^{2+} > \text{Mn}^{2+} > \text{Fe}^{2+} > \text{Cr}^{2+}$ (d) $\text{Cr}^{2+} > \text{Mn}^{2+} > \text{Co}^{2+} > \text{Fe}^{2+}$

Ans. (a)

6. Which of the following lanthanoid ion is diamagnetic?

(At No. of Ce = 58, Sm = 62, Eu = 63, Yb = 70)

- (a) Eu^{2+} (b) Yb^{2+} (c) Ce^{2+} (d) Sm^{2+}

Ans. (b)

7. Magnetic moment of 2.83 BM is given by which of the following ion?

- (a) Ti^{3+} (b) Ni^{2+}
 (c) Cr^{3+} (d) Mn^{2+}

Ans. (b)

8. Out of Mn_2O_7 , V_2O_3 , V_2O_5 , CrO , Cr_2O_3 , the basic oxides are
- (a) Mn_2O_7 , V_2O_3 (b) V_2O_3 , V_2O_5
 (c) V_2O_5 , CrO (d) V_2O_3 and CrO

Ans. (d)

9. The electronic configuration of Cu(II) is $3d^9$ whereas that of Cu(I) is $3d^{10}$. Which of the following is correct? [NCERT Exemplar Problem]

- (a) Cu(II) is more stable
 (b) Cu(II) is less stable
 (c) Cu(I) and Cu(II) are equally stable
 (d) Stability of Cu(I) and Cu(II) depends on nature of copper salts

Ans. (a)

10. Metallic radii of some transition elements are given below. Which of these elements will have highest density? [NCERT Exemplar Problem]

Element	Fe	Co	Ni	Cu
Metallic radii/pm	126	125	125	128

- (a) Fe (b) Ni (c) Co (d) Cu

Ans. (d)

11. Generally transition elements form coloured salts due to the presence of unpaired electrons. Which of the following compounds will be coloured in solid state? [NCERT Exemplar Problem]

- (a) Ag_2SO_4 (b) CuF_2
 (c) ZnF_2 (d) Cu_2Cl_2

Ans. (b)

12. Which of the following reactions are disproportionation reactions?

- (i) $\text{Cu}^+ \longrightarrow \text{Cu}^{2+} + \text{Cu}$
 (ii) $3\text{MnO}_4^- + 4\text{H}^+ \longrightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$
 (iii) $2\text{KMnO}_4 \longrightarrow \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$
 (iv) $2\text{MnO}_4^- + 3\text{Mn}^{2+} + 2\text{H}_2\text{O} \longrightarrow 5\text{MnO}_2 + 4\text{H}^+$

[NCERT Exemplar Problem]

- (a) (i) and (ii) (b) (i), (ii) and (iii)
 (c) (ii), (iii) and (iv) (d) (i) and (iv)

Ans. (b)

13. Which of the following lanthanoids show +2 oxidation state besides the characteristic oxidation state +3 of lanthanoids?

- I. Ce II. Eu III. Yb IV. Ho
 (a) I and II (b) II and III (c) I and IV (d) II and IV

Ans. (b)

30 Objective Type Questions—12

14. Match the Catalysts given in Column I with the processes given in Column II and select the correct option.

Column I (Catalyst)	Column II (Process)
(A) Ni in the presence of hydrogen	(i) Haber's Process
(B) Cu_2Cl_2	(ii) Contact Process
(C) V_2O_5	(iii) Vegetable oil to ghee
(D) Finely divided iron	(iv) Sandmeyer reaction
(a) A – (iii), B – (iv), C – (ii), D – (i)	
(b) A – (iv), B – (i), C – (iii), D – (ii)	
(c) A – (iii), B – (iv), C – (i), D – (ii)	
(d) A – (iv), B – (iii), C – (ii), D – (i)	

Ans. (a)

15. Match the compounds/elements given in Column I with uses given in Column II and select the correct option.

Column I (Compound/Element)	Column II (Use)
(A) Lanthanoid oxide	(i) Bullets
(B) Lanthanoid	(ii) Television Screen
(C) Mixed oxides of lanthanoids are employed	(iii) Petroleum cracking
(D) Magnesium based alloy is constituent of	(iv) Production of iron alloy
(a) A – (iii), B – (ii), C – (iv), D – (i)	
(b) A – (iv), B – (i), C – (iii), D – (ii)	
(c) A – (ii), B – (iv), C – (iii), D – (i)	
(d) A – (iii), B – (i), C – (iv), D – (ii)	

Ans. (c)

16. Match the properties given in Column I with the metals given in Column II and select the correct option. [NCERT Exemplar Problem]

Column I (Property)	Column II (Metal)
(A) An element which can show +8 oxidation state	(i) Mn
(B) $3d$ block element that can show upto +7 oxidation state	(ii) Cr
(C) $3d$ block element with highest melting point	(iii) Os
	(iv) Fe

- (a) A – (iii), B – (i), C – (ii)
 (b) A – (iv), B – (iii), C – (ii)
 (c) A – (i), B – (iii), C – (iv)
 (d) A – (iv), B – (ii), C – (i)

Ans. (a)

17. Match the statements given in column I with the oxidation states given in column II and select the correct option.

Column I	Column II
(A) Oxidation state of Mn in MnO_2 is	(i) +2
(B) Most stable oxidation state of Mn is	(ii) +3
(C) Most stable oxidation state of Mn in oxides is	(iii) +4
(D) Characteristic oxidation state of lanthanoids is	(iv) +5
	(v) +7

- (a) A – (iii), B – (ii), C – (v), D – (ii)
 (b) A – (iv), B – (i), C – (iii), D – (ii)
 (c) A – (iv), B – (ii), C – (i), D – (iii)
 (d) A – (iii), B – (i), C – (v), D – (ii)

Ans. (d)

18. Match the solutions given in column I and the colours given in column II and select the correct option.

Column I (Aqueous solution of salt)	Column II (Colour)
(A) $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	(i) Green
(B) $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$	(ii) Light pink
(C) $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$	(iii) Pale green
(D) Cu_2Cl_2	(iv) Colourless

- (a) A – (iv), B – (i), C – (iii), D – (ii)
 (b) A – (iii), B – (ii), C – (i), D – (iv)
 (c) A – (iv), B – (ii), C – (iii), D – (i)
 (d) A – (iii), B – (i), C – (ii), D – (iv)

Ans. (d)

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19. Match the property given in Column I with the element given in Column II and select the correct option.

Column I (Property)	Column II (Element)
(A) Lanthanoid which shows +4 oxidation state	(i) Gd
(B) Lanthanoid which can show +2 oxidation state	(ii) Pm
(C) Radioactive lanthanoid	(iii) Ce
(D) Lanthanoid which has $4f^7$ electronic configuration in +3 oxidation state	(iv) Eu
(a) A – (iii), B – (iv), C – (ii), D – (i)	
(b) A – (ii), B – (iii), C – (iv), D – (i)	
(c) A – (iv), B – (ii), C – (iii), D – (i)	
(d) A – (i), B – (iii), C – (iv), D – (ii)	

Ans. (a)

20. Match the property given in column I with the metals given in column II and select the correct option.

Column I (Property)	Column II (Metal)
(A) Element with highest second ionisation enthalpy	(i) Co
(B) Element with highest third ionisation enthalpy	(ii) Cr
(C) M in $M(CO)_6$ is	(iii) Cu
(D) Element with highest heat of atomisation	(iv) Zn
	(v) Ni
(a) A – (iv), B – (i), C – (v), D – (iii)	
(b) A – (iii), B – (ii), C – (iv), D – (i)	
(c) A – (v), B – (iii), C – (ii), D – (i)	
(d) A – (iii), B – (iv), C – (ii), D – (i)	

Ans. (d)

21. Which of the following ions show higher spin only magnetic moment value?

I. Ti^{3+}	II. Mn^{2+}	III. Fe^{2+}	IV. Co^{3+}
(a) I and II	(b) II and III	(c) I and IV	(d) I and III

Ans. (b)

22. Transition elements form binary compounds with halogens. Which of the following elements will form MF_3 type compounds?

I. Cr	II. Co	III. Cu	IV. Ni
(a) I and II	(b) II and IV	(c) II and III	(d) I and IV

Ans. (a)

23. Which of the following will not act as oxidising agents?

- I. CrO_3 II. MoO_3 III. WO_3 IV. CrO_4^{2-}
 (a) I and II (b) II and III (c) I and IV (d) II and III

Ans. (b)

24. Although +3 is the characteristic oxidation state for lanthanoids but cerium also shows +4 oxidation state because _____.

- I. it has variable ionisation enthalpy
 II. it has a tendency to attain noble gas configuration
 III. it has a tendency to attain f^0 configuration
 IV. it resembles Pb^{4+}
 (a) I and II (b) II and IV (c) II and III (d) I and IV

Ans. (c)

25. The electronic configuration of Gd (64) is

- (a) $[\text{Xe}] 4f^7 5d^1 6s^2$ (b) $[\text{Xe}] 4f^6 5d^2 6s^2$ (c) $[\text{Xe}] 4f^8 6s^2$ (d) $[\text{Xe}] 4f^9 5s^1$

Ans. (a)

26. Which of the following statements related to lanthanoids is incorrect?

- (a) Eu shows + 2 oxidation state (b) $\text{Pr}(\text{OH})_3$ to $\text{Lu}(\text{OH})_3$, basicity decreases
 (c) All lanthanoids more reactive than Al (d) Ce^{4+} is used as oxidising agent

Ans. (c)

27. The correct order of ionic radii Y^{3+} , La^{3+} , Eu^{3+} and Lu^{3+} is

- (a) $\text{Y}^{3+} < \text{La}^{3+} < \text{Eu}^{3+} < \text{Lu}^{3+}$ (b) $\text{Lu}^{3+} < \text{Eu}^{3+} < \text{La}^{3+} < \text{Y}^{3+}$
 (c) $\text{La}^{3+} < \text{Eu}^{3+} < \text{Lu}^{3+} < \text{Y}^{3+}$ (d) $\text{Y}^{3+} < \text{Lu}^{3+} < \text{Eu}^{3+} < \text{La}^{3+}$

Ans. (d)

28. In the following reactions, ZnO is respectively acting as a/an

- (i) $\text{ZnO} + \text{Na}_2\text{O} \longrightarrow \text{Na}_2\text{ZnO}_2$
 (ii) $\text{ZnO} + \text{CO}_2 \longrightarrow \text{ZnCO}_3$
 (a) acid and acid (b) acid and base
 (c) base and acid (d) base and base

Ans. (b)

29. Interstitial compounds are formed when small atoms are trapped inside the crystal lattice of metals. Which of the following is not the characteristic property of interstitial compounds?

[NCERT Exemplar Problem]

- (a) They have high melting points in comparison to pure metals.
 (b) They are very hard.
 (c) They retain metallic conductivity.
 (d) They are chemically very reactive.

Ans. (d)

34 Objective Type Questions—12

30. Which of the following statements is not correct? [NCERT Exemplar Problem]

- (a) Copper liberates hydrogen from acids.
- (b) In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine.
- (c) Mn^{3+} and Co^{3+} are oxidising agents in aqueous solution.
- (d) Ti^{2+} and Cr^{2+} are reducing agents in aqueous solution.

Ans. (a)

31. Highest oxidation state of manganese in fluoride is +4 (MnF_4) but highest oxidation state in oxides is +7 (Mn_2O_7) because _____ [NCERT Exemplar Problem]

- (a) fluorine is more electronegative than oxygen.
- (b) fluorine does not possess *d*-orbitals.
- (c) fluorine stabilises lower oxidation state.
- (d) in covalent compounds fluorine can form single bond only while oxygen forms double bond.

Ans. (d)

32. The magnetic moment of a divalent ion (atomic number = 25) in its aqueous solution will be:

- (a) 4.9 B.M.
- (b) 5.9 B.M.
- (c) 6.8 B.M.
- (d) 5.2 B.M.

Ans. (b)

33. The heaviest transition metal is:

- (a) Sc
- (b) Zn
- (c) Ni
- (d) Os

Ans. (d)

Assertion-Reason Questions

Directions: In the following question, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

- (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
- (b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.
- (c) Assertion is true but the Reason is false.
- (d) The statement of the Assertion is false but the Reason is true.

34. **Assertion:** Cu^{2+} iodide is not known.

Reason: Cu^{2+} oxidises I^- to iodine.

Ans. (a)

35. Assertion: Sc^{3+} is a coloured ion.

Reason: Colour of d -block elements is due to d - d transition.

[KVS]

Ans. (d)

36. Assertion: Transition metals have high melting points.

Reason: Transition metals have completely filled d -orbitals.

Ans. (c)

37. Assertion: Co(IV) is known but Ni(IV) is not known.

Reason: Ni(IV) is less stable than Pt(IV) but Ni(II) is more stable than Pt(II).

Ans. (d)

38. Assertion: The correct order of oxidising power is $\text{VO}_2^+ < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$.

Reason: The oxidation state of Mn is +7 in MnO_4^- .

Ans. (b)

Case-based Questions

39. Read the following passage and answer the questions that follow:

The group 14 elements after La(57) are called lanthanoids. Lanthanoids and Actinoids belong to f -block elements with general electronic configuration $(n-2)f^{1 \text{ to } 14} (n-1)d^{0-1} ns^2$. They show different oxidation states depending upon stability of f^0, f^7 and f^{14} configuration. There is regular decrease in atomic and ionic size among lanthanoids due to which basic character of oxides and hydroxides decreases.

(i) Which of the following shows +4 oxidation state?

- (a) La (b) Ce (c) Eu (d) Yb

(ii) Zirconium resembles with

- (a) Nb (b) Hf (c) Hg (d) Mo

(iii) The first and second ionisation energies of lanthanoids is

- (a) 200, 400 kJ mol^{-1} (b) 300, 600 kJ mol^{-1}
 (c) 600, 1200 kJ mol^{-1} (d) 800, 1600 kJ mol^{-1}

Ans. (i) (b) (ii) (b) (iii) (c)

40. Read the following passage and answer the questions as follow:

The d -block of the periodic table contains the elements of the groups 3 to 12 and are known as *transition elements*. In general, the electronic configuration of these elements is $(n-1)d^{1-10} ns^{1-2}$. The d -orbitals of the penultimate energy level in their atoms receive electrons giving rise to the three rows of the transition metals i.e. $3d, 4d$ and $5d$ series. However Zn, Cd and Hg are not regarded as transition elements. Transition elements exhibit certain characteristic properties like variable oxidation states, complex formation, formation of coloured ions, alloys, catalytic activity etc. Transition metals are hard (except Zn, Cd and Hg) and have a high melting points.

(i) Zn, Cd, Hg are:

- (a) Transition elements (b) Non-transition elements
 (c) Lanthanoids (d) None of these

36 Objective Type Questions—12

(ii) Which of the following pair of transition metal of 3d series do not show variable oxidation state?

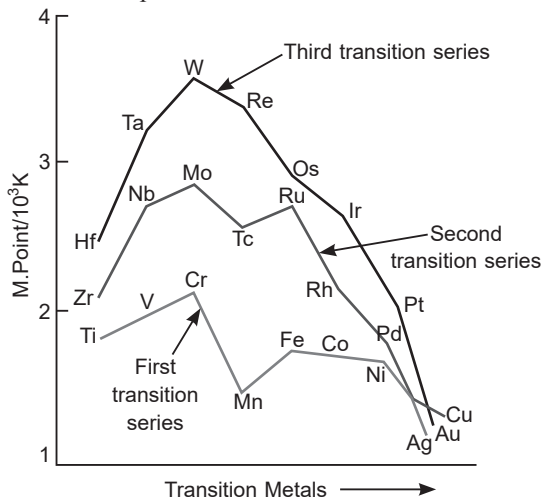
- (a) Sc and Zn (b) Ti and V (c) Mn and Cr (d) Fe and Ni

(iii) The colour of Mn^{2+} ions in aqueous solution is:

- (a) blue (b) green (c) yellow (d) pink

Ans. (i) (b) (ii) (a) (iii) (d)

41. Observe the graph of transition metal and their melting points and answer the questions based on the graph and related concepts.



(i) Which of the following has highest melting point in third transition series(5d series)?

- (a) W (b) Re (c) Pt (d) Cu

(ii) Which of the following has lowest enthalpy of atomisation in 3d series?

- (a) Sc (b) Ti (c) Mn (d) Zn

(iii) Which of the following has highest density in 3d series?

- (a) Cu (b) V (c) Ti (d) Sc

Ans. (i) (a) (ii) (d) (iii) (a)

9

COORDINATION COMPOUNDS

Multiple Choice Questions

1. The name of complex $[\text{Fe}(\text{CN})_6]^{3-}$ is [CBSE 2020]
- (a) Tricyanido ferrate (III) ion (b) Hexacyanido ferrate (III) ion
(c) Hexacyanido iron (III) (d) Hexacyanido ferrate (II) ion

Ans. (b)

2. The sum of coordination number of oxidation number of the metal M in the complex $[\text{M}(\text{en})_2 \text{C}_2\text{O}_4] \text{Cl}$ are
- (a) 7 (b) 8 (c) 9 (d) 6

Ans. (c)

3. Which of the following will not give test for Cl^- with $\text{AgNO}_3(\text{aq})$ at 25°C ?
- (a) $\text{CoCl}_3 \cdot 5\text{NH}_3$ (b) $\text{CoCl}_3 \cdot 6\text{NH}_3$
(c) $\text{CoCl}_3 \cdot 3\text{NH}_3$ (d) $\text{CoCl}_3 \cdot 4\text{NH}_3$

Ans. (c)

4. Which of these statements about $[\text{Co}(\text{CN})_6]^{3-}$ is true?
- (a) It has 4 unpaired electron, high spin (b) No unpaired electron, high spin
(c) No unpaired electron, low spin (d) 4 unpaired electron, low spin

Ans. (c)

5. The correct order of the stoichiometries of AgCl formed when AgNO_3 in excess is treated with complexes: $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$ respectively is
- (a) 3AgCl, 1AgCl, 2AgCl (b) 3AgCl, 2AgCl, 1AgCl
(c) 2AgCl, 3AgCl, 2AgCl (d) 1AgCl, 3AgCl, 2AgCl

Ans. (b)

6. Correct increasing order of wavelength of absorption in visible region for complex of Co^{3+} is
- (a) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$
(b) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$
(c) $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
(d) $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$

Ans. (d)

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7. Pick out the correct statement with respect to $[\text{Mn}(\text{CN})_6]^{2-}$

- (a) It is sp^2d^2 hybridised, tetrahedral
- (b) It is d^2sp^3 hybridised, octahedral
- (c) It is dsp^2 hybridised, square planar
- (d) It is sp^3d^2 hybridised octahedral

Ans. (b)

8. Which one has highest molar conductivity?

- (a) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- (b) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
- (c) $\text{K}_4[\text{Fe}(\text{CN})_6]$
- (d) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$

Ans. (c)

9. The pair having the same magnetic moment is [At No. Cr = 24, Mn = 25, Fe = 26, Co = 27]

- (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{CoCl}_4]^{2-}$
- (b) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- (c) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$
- (d) $[\text{CoCl}_4]^{2-}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

Ans. (b)

10. On treatment of 100 mL of 0.1 M $\text{CoCl}_3 \cdot 6\text{H}_2\text{O}$ with excess of AgNO_3 , 1.2×10^{22} ions are precipitated. The complex is [HOTS]

- (a) $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
- (b) $[\text{Co}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$
- (c) $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$
- (d) $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$

Ans. (d)

11. Among the ligands NH_3 , en, CN^- and CO, the correct order of field strength is

- (a) $\text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$
- (b) $\text{CN}^- < \text{NH}_3 < \text{CO} < \text{en}$
- (c) $\text{en} < \text{CN}^- < \text{NH}_3 < \text{CO}$
- (d) $\text{CO} < \text{NH}_3 < \text{en} < \text{CN}^-$

Ans. (a)

12. The oxidation state of Ni in $[\text{Ni}(\text{CO})_4]$ is

[CBSE 2020]

- (a) 0
- (b) 2
- (c) 3
- (d) 4

Ans. (a)

13. Which of the following will give a white precipitate upon reacting with AgNO_3 ?

[CBSE 2020]

- (a) $\text{K}_2[\text{Pt}(\text{en})_2\text{Cl}_2]$
- (b) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
- (c) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$
- (d) $[\text{Fe}(\text{H}_2\text{O})_3\text{Cl}_3]$

Ans. (c)

14. The formula of the complex triamminetri (nitrito-O) Cobalt (III) is

[CBSE 2020]

- (a) $[\text{Co}(\text{ONO})_3(\text{NH}_3)_3]$
- (b) $[\text{Co}(\text{NO}_2)_3(\text{NH}_3)_3]$
- (c) $[\text{Co}(\text{ONO}_2)_3(\text{NH}_3)_3]$
- (d) $[\text{Co}(\text{NO}_2)(\text{NH}_3)_3]$

Ans. (a)

15. The complex $[\text{Pt}(\text{NH}_3)_4]^{2+}$ has structure :

[KVS]

- (a) square planar (b) tetrahedral
(c) pyramidal (d) pentagonal

Ans. (a)

16. Which of the following is correct order of stability?

- (a) $[\text{Cu}(\text{NH}_3)_4]^{2+} < [\text{Cu}(\text{CN})_4]^{2-} < [\text{Cu}(\text{en})_2]^{2+} < [\text{Cu}(\text{H}_2\text{O})_4]^{2+}$
(b) $[\text{Cu}(\text{H}_2\text{O})_4]^{2+} < [\text{Cu}(\text{NH}_3)_4]^{2+} < [\text{Cu}(\text{en})_2]^{2+} < [\text{Cu}(\text{CN})_4]^{2-}$
(c) $[\text{Cu}(\text{NH}_3)_4]^{2+} < [\text{Cu}(\text{H}_2\text{O})_4]^{2+} < [\text{Cu}(\text{en})_2]^{2+} < [\text{Cu}(\text{CN})_4]^{2-}$
(d) $[\text{Cu}(\text{CN})_4]^{2-} < [\text{Cu}(\text{NH}_3)_4]^{2+} < [\text{Cu}(\text{H}_2\text{O})_4]^{2+} < [\text{Cu}(\text{en})_2]^{2+}$

Ans. (b)

17. Which of the following complexes formed by Cu^{2+} ions is most stable?

[NCERT Exemplar Problem]

- (a) $\text{Cu}^{2+} + 4\text{NH}_3 \rightleftharpoons [\text{Cu}(\text{NH}_3)_4]^{2+}$, $\log K = 11.6$
(b) $\text{Cu}^{2+} + 4\text{CN}^- \rightleftharpoons [\text{Cu}(\text{CN})_4]^{2-}$, $\log K = 27.3$
(c) $\text{Cu}^{2+} + 2\text{en} \rightleftharpoons [\text{Cu}(\text{en})_2]^{2+}$, $\log K = 15.4$
(d) $\text{Cu}^{2+} + 4\text{H}_2\text{O} \rightleftharpoons [\text{Cu}(\text{H}_2\text{O})_4]^{2+}$, $\log K = 8.9$

Ans. (b)

18. The stabilisation of coordination compounds due to chelation is called the chelate effect. Which of the following is the most stable complex species?

[NCERT Exemplar Problem]

- (a) $[\text{Fe}(\text{CO})_5]$ (b) $[\text{Fe}(\text{CN})_6]^{3-}$
(c) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ (d) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

Ans. (c)

19. The CFSE for octahedral $[\text{CoCl}_6]^{4-}$ is $18,000 \text{ cm}^{-1}$. The CFSE for tetrahedral $[\text{CoCl}_4]^{2-}$ will be

[NCERT Exemplar Problem]

- (a) $18,000 \text{ cm}^{-1}$ (b) $16,000 \text{ cm}^{-1}$
(c) $8,000 \text{ cm}^{-1}$ (d) $20,000 \text{ cm}^{-1}$

Ans. (c)

20. A chelating agent has two or more than two donor atoms to bind to a single metal ion. Which of the following is not a chelating agent?

[NCERT Exemplar Problem]

- (a) thiosulphato (b) oxalato
(c) glycinato (d) ethane-1, 2-diamine

Ans. (a)

- Code:** (a) A (1) B (2) C (4) D (5)
 (b) A (4) B (3) C (2) D (1)
 (c) A (3) B (2) C (4) D (1)
 (d) A (4) B (1) C (2) D (3)

Ans. (d)

- 26.** Match the complex ions given in Column I with the hybridisation and number of unpaired electrons given in Column II and assign the correct code: **[NCERT Exemplar Problem]**

Column I (Complex ion)	Column II (Hybridisation, number of unpaired electrons)
(A) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$	(1) dsp^2 , 1
(B) $[\text{Co}(\text{CN})_4]^{2-}$	(2) sp^3d^2 , 5
(C) $[\text{Ni}(\text{NH}_3)_6]^{2+}$	(3) d^2sp^3 , 3
(D) $[\text{MnF}_6]^{4-}$	(4) sp^3 , 4
	(5) sp^3d^2 , 2

- Code:** (a) A (3) B (1) C (5) D (2)
 (b) A (4) B (3) C (2) D (1)
 (c) A (3) B (2) C (4) D (1)
 (d) A (4) B (1) C (2) D (3)

Ans. (a)

- 27.** The complex ion having minimum magnitude of Δ_o (CFSE) is
 (a) $[\text{Co}(\text{NH}_3)_6]^{3+}$ (b) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
 (c) $[\text{Cr}(\text{CN})_6]^{3-}$ (d) $[\text{CoCl}_6]^{3-}$

Ans. (d)

- 28.** About $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$, which of the following statements are false.

- I. Both are octahedral
 II. $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$ is diamagnetic,
 $[\text{CoF}_6]^{3-}$ is paramagnetic
 III. Both are outer orbital complex
 IV. In both Co is +3.

- (a) II and III (b) II, III, IV
 (c) III only (d) III and IV

Ans. (c)

42 Objective Type Questions—12

29. The IUPAC name of $[\text{Co}(\text{en})_2(\text{ONO})\text{Cl}]\text{Cl}$ is
- (a) Chlorido bis (ethane 1, 2-diamine) nitrito-o-cobalt (III) chloride
 - (b) Chloro bis (ethylene diamine) nitrito cobalt (III) chloride
 - (c) Chlorido bis (ethylene diamine) nitro cobalt (III) chloride
 - (d) Chloro ethylene diamine nitro-o-cobalt (III) chloride

Ans. (a)

30. The shapes of $[\text{Cu}(\text{NH}_3)_4]^{2+}$ and $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ are
- (a) square planar, tetrahedral
 - (b) tetrahedral, square planar
 - (c) square planar, square planar
 - (d) tetrahedral, tetrahedral

Ans. (c)

31. The geometries of ammonia complexes with Ni^{2+} , Pt^{2+} and Zn^{2+} respectively are
- (a) octahedral, square planar, tetrahedral
 - (b) square planar, octahedral, tetrahedral
 - (c) tetrahedral, square planar, octahedral
 - (d) octahedral, tetrahedral, square planar

Ans. (a)

32. According to crystal field theory the M–L bond in complex is
- (a) Purely ionic
 - (b) Purely covalent
 - (c) Purely coordinate
 - (d) partially covalent

Ans. (a)

33. Amongst the following, the most stable complex is
- (a) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
 - (b) $[\text{Fe}(\text{NH}_3)_6]^{3-}$
 - (c) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$
 - (d) $[\text{FeCl}_6]^{3-}$

Ans. (c)

34. Which of the following species is **not** expected to be a ligand? [NCERT Exemplar Problem]
- (a) NO
 - (b) NH_4^+
 - (c) $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$
 - (d) CO

Ans. (b)

35. IUPAC name of $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$ is: [NCERT Exemplar Problem]
- (a) Platinum diaminechloronitrite
 - (b) Chloronitrito-N-ammineplatinum (II)
 - (c) Diamminechloridonitrito-N-platinum (II)
 - (d) Diamminechloronitrito-N-platinate (II)

Ans. (c)

36. Xe is a _____ ligand
- (a) ambidentate
 - (b) bidentate
 - (c) unidentate
 - (d) hexadentate

Ans. (c)

37. Identify the correct statements for the behaviour of ethane-1, 2-diamine as a ligand.

[NCERT Exemplar Problem]

- I. It is a neutral ligand.
- II. It is a didentate ligand.
- III. It is a chelating ligand.
- IV. It is a unidentate ligand.

(a) I and II

(b) I, II and III

(c) I and III

(d) I, II, III and IV

Ans. (b)

38. Match the compounds given in Column I with the oxidation state of cobalt present in it (given in Column II) and assign the correct code.

[NCERT Exemplar Problem]

Column I (Compound)

Column II (Oxidation state of Co)

(A) $[\text{Co}(\text{NCS})(\text{NH}_3)_5](\text{SO}_3)$

(1) + 4

(B) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{SO}_4$

(2) 0

(C) $\text{Na}_4[\text{Co}(\text{S}_2\text{O}_3)_3]$

(3) + 1

(D) $[\text{Co}_2(\text{CO})_8]$

(4) + 2

(5) + 3

Code: (a) A (1) B (2) C (4) D (5)

(b) A (4) B (3) C (2) D (1)

(c) A (5) B (1) C (4) D (2)

(d) A (4) B (1) C (2) D (3)

Ans. (c)

Assertion-Reason Questions

Directions: In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.

39. **Assertion (A):** $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_2$ and $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_2$ are reducing in nature.

[NCERT Exemplar Problem]

Reason (R): Unpaired electrons are present in their *d*-orbitals.

Ans. (b)

45. Read the given passage and answer the questions that follow:

In spite of the predictions of stable noble gas compounds since at least 1902, unsuccessful attempts at their synthesis gave rise to the widely held opinion that noble gases are not only noble but also inert. It was not until 1962 that this dogma was shattered when Bartlett in Canada published the first stable noble gas compound XePtF_6 . This discovery triggered a worldwide frenzy in this area, and within a short time span many new xenon, radon, and krypton compounds were prepared and characterized. The recent discoveries show the ability of xenon to act as a ligand. The discovery by Seppelt's group that more than one xenon atom can attach itself to a metal center which in the case of gold leads to surprisingly stable Au-Xe bonds. The bonding in $[\text{AuXe}_4]^{2+}$ involves 4 Xe ligands attached by relatively strong bonds to a single Au(II) center in a square planar arrangement with a Xe-Au bond length of about 274 pm. This discovery provides not only the first example of multiple xenon ligands but also represents the first strong metal - xenon bond.

[CBSE Question Bank]

(Source: Christie, K. O. (2001). *A renaissance in noble gas chemistry. Angewandte Chemie International Edition*, 40(8), 1419-1421.)

(i) In the complex ion $[\text{AuXe}_4]^{2+}$, Xe acts as:

- (a) central atom (b) ligand
(c) chelating agent (d) electrophile

(ii) Hybridisation shown by Au in $[\text{AuXe}_4]^{2+}$ is :

- (a) sp^3 (b) sp^3d (c) sp^3d^2 (d) sp^2

(iii) Xe is _____ ligand.

- (a) ambidentate (b) bidentate (c) unidentate (d) hexadentate

Ans. (i) (b) (ii) (a) (iii) (c)

46. Observe the table related to stability constant of some complex compounds. Answer the questions based on the table and related concepts.

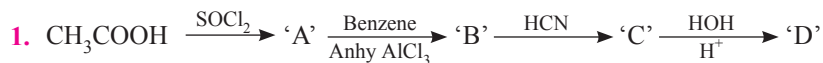
Stability Constants of Some Complexes

Complex	Stability Constant (β)
1. $[\text{Cu}(\text{NH}_3)_4]^{2+}$	4.5×10^{11}
2. $[\text{Cu}(\text{CN})_4]^{2-}$	2.0×10^{27}
3. $[\text{Ag}(\text{NH}_3)_2]^+$	1.6×10^7
4. $[\text{Co}(\text{NH}_3)_6]^{3+}$	5.0×10^{33}
5. $[\text{Ag}(\text{CN})_2]^\ominus$	5.4×10^{18}
6. $[\text{Ni}(\text{NH}_3)_6]^{2+}$	6.1×10^{18}
7. $[\text{Ni}(\text{en})_3]^{2+}$	4.6×10^{18}
8. $[\text{Fe}(\text{CN})_6]^{3-}$	1.2×10^{31}
9. $[\text{Fe}(\text{CN})_6]^{4-}$	1.8×10^6
10. $[\text{Cd}(\text{NH}_3)_4]^{2+}$	1.0×10^7

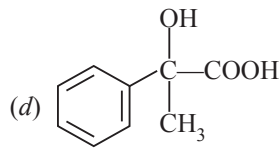
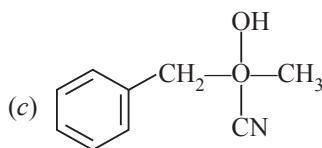
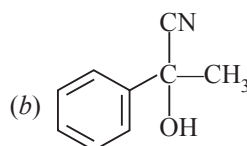
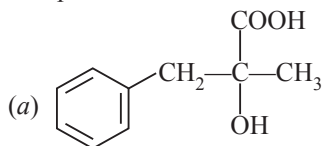
12

ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

Multiple Choice Questions



The product 'D' is:



Ans. (d)

2. Reduction of aldehydes and ketones into hydrocarbons using zinc amalgam and conc. HCl is called:

(a) Cope reduction

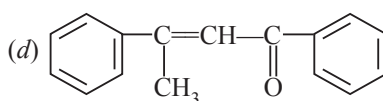
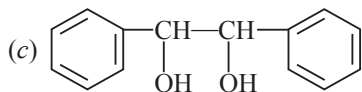
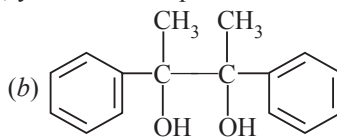
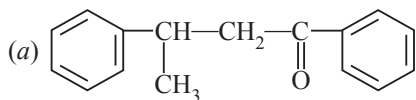
(b) Dow reduction

(c) Wolff Kishner reduction

(d) Clemensen reduction

Ans. (d)

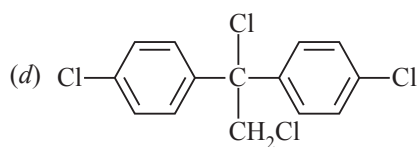
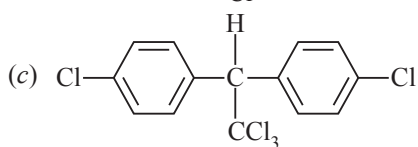
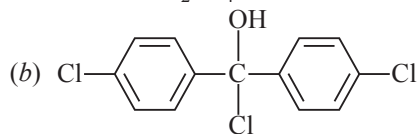
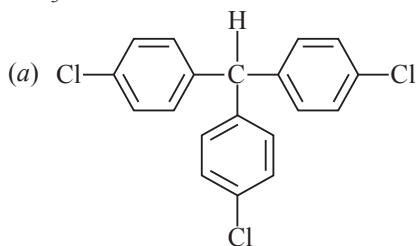
3. Acetophenone when reacted with base $\text{C}_2\text{H}_5\text{ONa}$, yields a stable product:



Ans. (d)

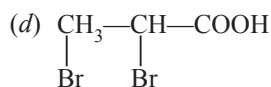
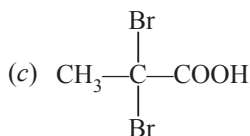
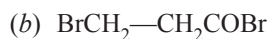
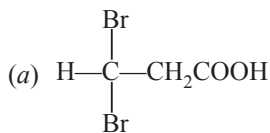
48 Objective Type Questions—12

4. $\text{CCl}_3\text{—C}(=\text{O})\text{—H}$ reacts with chlorobenzene in presence of conc. H_2SO_4 produces [KVS]



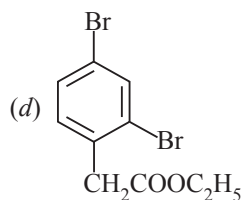
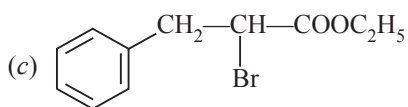
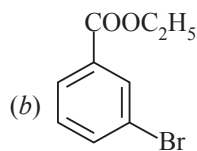
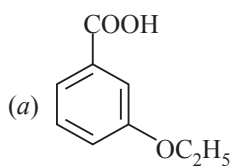
Ans. (c)

5. Propanoic acid with Br_2/P_4 yields a dibromo product. The structure will be



Ans. (c)

6. $\xrightarrow[\text{KOH}]{\text{KMnO}_4}$ 'B' $\xrightarrow[\text{FeCl}_3]{\text{Br}_2}$ 'C' $\xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{H}^+}$ 'D', 'D' is



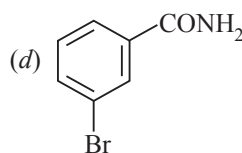
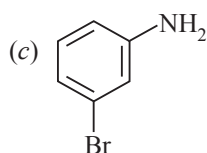
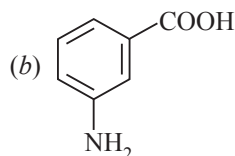
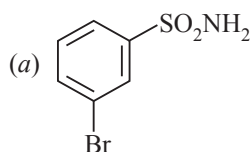
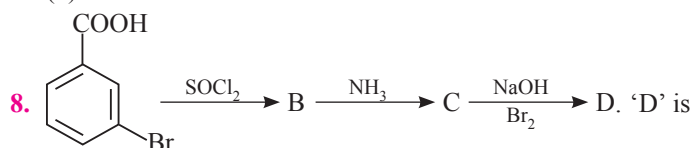
Ans. (b)

7. CH_3CHO and $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$ can be distinguished chemically by

[KVS]

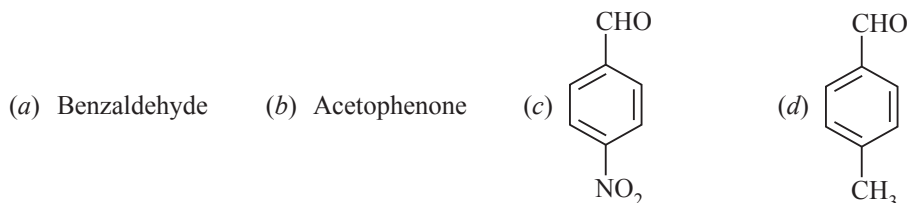
- (a) Benedict's test
 (b) Iodoform test
 (c) Tollen's reagent test
 (d) Fehling's solution test

Ans. (b)



Ans. (c)

9. Which is most reactive towards Nucleophilic substitution reaction?



Ans. (c)

10. Which of the following is not soluble in NaHCO_3 ?

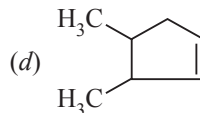
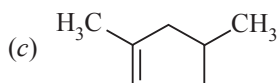
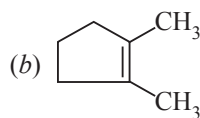
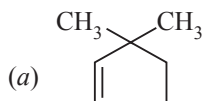
[KVS]

- (a) 2, 4, 6-Trinitrophenol (b) Benzoic acid
 (c) *o*-Nitrophenol (d) Benzene sulphonic acid

Ans. (c)

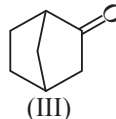
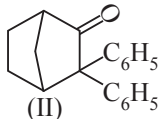
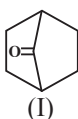
11. A single compound of the structure $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$ is obtained from ozonolysis of which of the following compound?

50 Objective Type Questions—12



Ans. (c)

12. Which among the given molecules can exhibit tautomerism?



(a) III only

(b) Both I and III

(c) Both I and II

(d) Both II and III

Ans. (a)

13. The product formed by the reaction of an aldehyde with a primary amine is

[KVS]

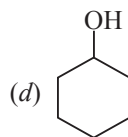
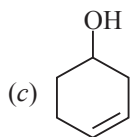
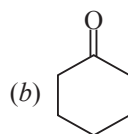
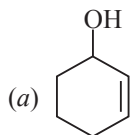
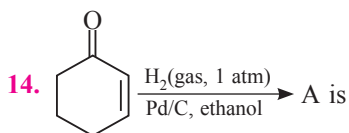
(a) Carboxylic acid

(b) Aromatic acid

(c) Schiff's base

(d) Ketone

Ans. (c)



Ans. (b)

15. The product obtained by condensation of Acetophenone in presence of NaOH

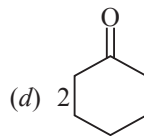
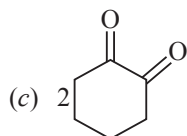
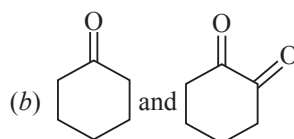
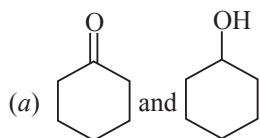
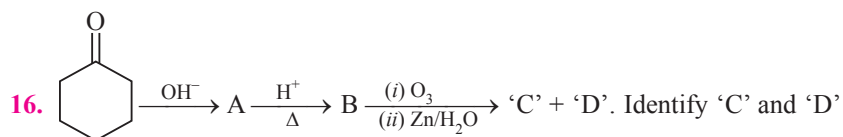
(a) 3-hydroxy-3-methyl-1, 3 diphenyl propanone

(b) 3-hydroxy-3-phenyl acetophenone

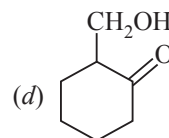
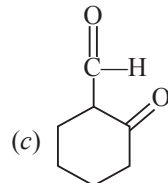
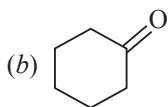
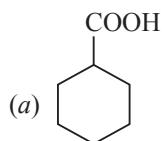
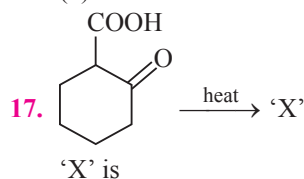
(c) Phorone

(d) Mesityl oxide

Ans. (a)

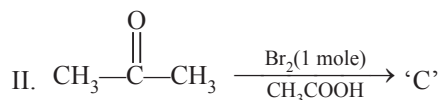
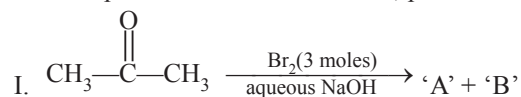


Ans. (b)

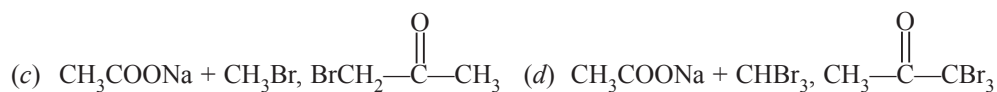
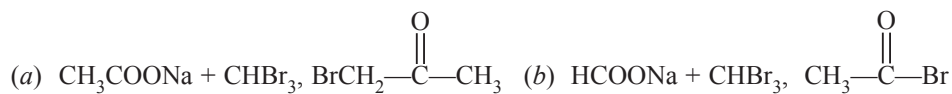


Ans. (b)

18. After completion of reaction I and II, products are

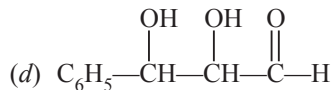
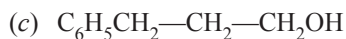
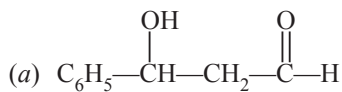
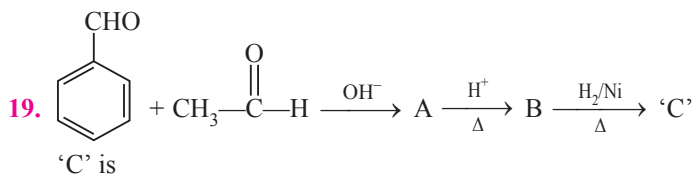


A + B and C are



Ans. (a)

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Ans. (c)

20. The correct order of increasing acidic strength is _____.

[NCERT Exemplar Problem]

(a) Phenol < Ethanol < Chloroacetic acid < Acetic acid

(b) Ethanol < Phenol < Chloroacetic acid < Acetic acid

(c) Ethanol < Phenol < Acetic acid < Chloroacetic acid

(d) Chloroacetic acid < Acetic acid < Phenol < Ethanol

Ans. (c)

21. Compound $\text{Ph}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Ph}$ can be prepared by the reaction of _____.

[NCERT Exemplar Problem]

(a) Phenol and benzoic acid in the presence of NaOH

(b) Phenol and benzoyl chloride in the presence of pyridine

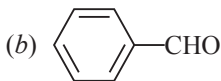
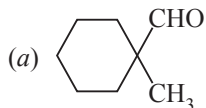
(c) Phenol and benzoyl chloride in the presence of ZnCl_2

(d) Phenol and benzaldehyde in the presence of palladium

Ans. (b)

22. Cannizzaro's reaction is not given by _____.

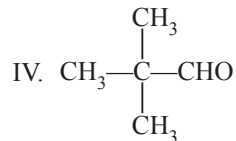
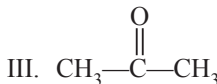
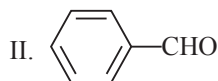
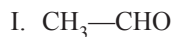
[KVS] [NCERT Exemplar Problem]



Ans. (d)

23. Which of the following compounds do not undergo aldol condensation?

[NCERT Exemplar Problem]



(a) I and II

(b) II and III

(c) II and IV

(d) I and IV

Ans. (c)

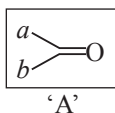
24. Treatment of compound $\text{Ph}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Ph}$ with NaOH solution yields
- I. Phenol
II. Sodium phenoxide
III. Sodium benzoate
IV. Benzophenone
- (a) I and II
(b) I and III
(c) I and IV
(d) II and IV

Ans. (b)

25. Benzophenone can be obtained by _____.
- I. Benzoyl chloride + Benzene + AlCl_3
II. Benzoyl chloride + Diphenyl cadmium
III. Benzoyl chloride + Phenyl magnesium chloride
IV. Benzene + Carbon monoxide + ZnCl_2
- (a) I and II
(b) I and III
(c) II and IV
(d) II and IV

Ans. (a)

26. Which of the following is the correct representation for intermediate of nucleophilic addition reaction to the given carbonyl compound (A):



- (a) I and IV
(b) I and III
(c) I and II
(d) II and IV

Ans. (c)

27. Match the common names given in Column I with the IUPAC names given in Column II.

Column I (Common names)

- (A) Cinnamaldehyde
(B) Acetophenone
(C) Valeraldehyde
(D) Acrolein

Column II (IUPAC names)

- (i) Pentanal
(ii) Prop-2-enal
(iii) 3-Phenylprop-2-enal
(iv) 1-Phenylethanone
(v) 4-Methyl pent-3-en-2-one

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- (a) A – (iv), B – (i), C – (ii), D – (iii)
 (b) A – (iii), B – (i), C – (iv), D – (ii)
 (c) A – (ii), B – (iv), C – (iii), D – (i)
 (d) A – (iii), B – (iv), C – (i), D – (ii)

Ans. (d)

28. Match the acids given in Column I with their correct IUPAC names given in Column II.

Column I (Acids)	Column II (IUPAC names)
(A) Phthalic acid	(i) Hexane-1,6-dioic acid
(B) Oxalic acid	(ii) Benzene-1,2-dicarboxylic acid
(C) Succinic acid	(iii) Pentane-1,5-dioic acid
(D) Adipic acid	(iv) Butane-1,4-dioic acid
(E) Glutaric acid	(v) Ethane-1,2-dioic acid

(a) A – (ii), B – (i), C – (iv), D – (iii), E – (v)
 (b) A – (ii), B – (v), C – (iv), D – (i), E – (iii)
 (c) A – (iii), B – (v), C – (ii), D – (i), E – (iv)
 (d) A – (iv), B – (ii), C – (i), D – (iii), E – (v)

Ans. (b)

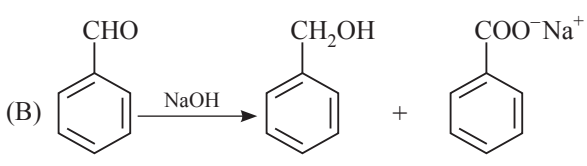
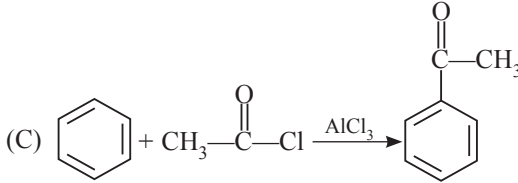
29. Match the reactions given in Column I with the suitable reagents given in Column II.

Column I (Reactions)	Column II (Reagents)
(A) Benzophenone → Diphenylmethane	(i) LiAlH_4
(B) Benzaldehyde → 1-Phenylethanol	(ii) DIBAL—H
(C) Cyclohexanone → Cyclohexanol	(iii) Zn(Hg)/Conc. HCl
(D) Phenyl benzoate → Benzaldehyde	(iv) $\text{CH}_3\text{MgBr, H}_2\text{O/H}^+$

(a) A – (iii), B – (iv), C – (i), D – (ii)
 (b) A – (iv), B – (iii), C – (ii), D – (i)
 (c) A – (iii), B – (i), C – (iv), D – (ii)
 (d) A – (iv), B – (ii), C – (iii), D – (i)

Ans. (a)

30. Match the example given in Column I with the name of the reaction in Column II.

Column I (Example)	Column II (Reaction)
(A) $\text{CH}_3\text{—}\overset{\text{O}}{\parallel}{\text{C}}\text{—Cl} + \text{H}_2 \xrightarrow{\text{Pd-C/BaSO}_4} \text{CH}_3\text{—}\overset{\text{O}}{\parallel}{\text{C}}\text{—H}$	(i) Friedel Crafts acylation
(B) 	(ii) HVZ reaction
(C) 	(iii) Aldol condensation
(D) $\text{R—CH}_2\text{—COOH} \xrightarrow{\text{Br}_2/\text{Red P}} \text{R—}\underset{\text{Br}}{\text{CH}}\text{—COOH}$	(iv) Cannizaro's reaction
(E) $\text{CH}_3\text{—CN} \xrightarrow[\text{(ii) H}_2\text{O/H}^+]{\text{(i) SnCl}_2/\text{HCl}} \text{CH}_3\text{CHO}$	(v) Rosenmund's reduction
(F) $2\text{CH}_3\text{CHO} \xrightarrow{\text{NaOH}} \text{CH}_3\text{—CH=CHCHO}$	(vi) Stephen's reaction
(a) A – (vi), B – (iii), C – (v), D – (i), E – (ii), F – (iv)	
(b) A – (iv), B – (v), C – (iii), D – (ii), E – (i), F – (vi)	
(c) A – (v), B – (iv), C – (i), D – (ii), E – (vi), F – (iii)	
(d) A – (vi), B – (v), C – (iii), D – (ii), E – (i), F – (iv)	

Ans. (c)

31. Which of the following conduct electricity in aqueous solution?

- (a) Acetic acid (b) Ethanol (c) Acetone (d) Methanol

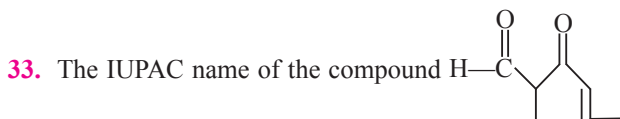
Ans. (a)

32. Ethanal (acetaldehyde) and acetone can be distinguished by

- (a) Iodoform test (b) Tollen's reagent test
(c) 2, 4-DNP test (d) All of these

Ans. (b)

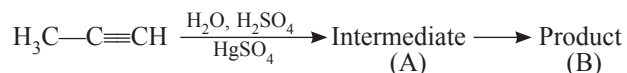
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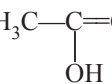
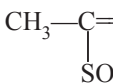
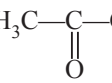
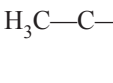
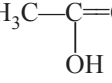
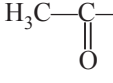
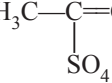
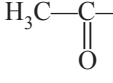


- (a) 2-Formyl hex-2-en-3-one
 (b) 5-methyl-4-oxo hex-2-en-5al
 (c) 3-keto-2-methyl hex-5en-al
 (d) 3-keto-2-methyl hex-4-en-1-al

Ans. (d)

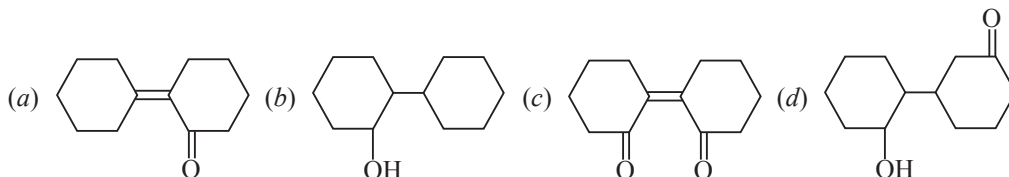
34. Predict the correct intermediate and the product in the following reaction:



- (a) 'A' , 'B' 
 (b) 'A' , 'B' 
 (c) 'A' , 'B' 
 (d) 'A' , 'B' 

Ans. (c)

35. Of the following which is the product formed when cyclohexanone undergoes aldol condensation followed by heating?



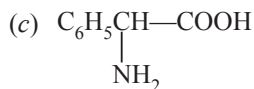
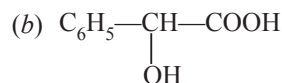
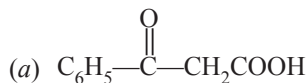
Ans. (a)

36. Arrange the following in order of increasing acidity.

- A. *o*-nitrobenzoic acid B. *p*-nitrobenzoic acid
 C. *p*-hydroxybenzoic acid D. benzoic acid
 (a) A < B < C < D (b) B < C < A < D
 (c) C < B < D < A (d) C < D < B < A

Ans. (d)

37. Which of the following carboxylic acid can undergo decarboxylation easily?



Ans. (a)

38. The increasing order of the rate of HCN addition to compound A to D is



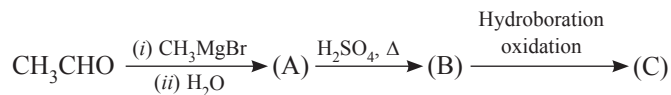
(where Ph is phenyl group)

(a) $\text{D} < \text{B} < \text{C} < \text{A}$ (b) $\text{D} < \text{C} < \text{B} < \text{A}$ (c) $\text{C} < \text{D} < \text{B} < \text{A}$ (d) $\text{A} < \text{B} < \text{C} < \text{D}$

Ans. (b)

39. Compounds A and C in the following reaction are _____.

[NCERT Exemplar Problem]



(a) identical

(b) positional isomers

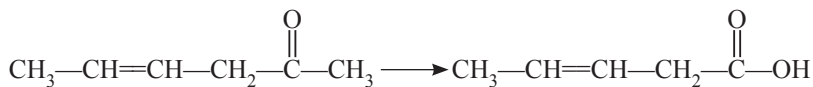
(c) functional isomers

(d) optical isomers

Ans. (b)

40. Which is the most suitable reagent for the following conversion?

[NCERT Exemplar Problem]



(a) Tollen's reagent

(b) Benzoyl peroxide

(c) I_2 and NaOH solution

(d) Sn and NaOH solution

Ans. (c)

41. Which of the following conversions can be carried out by Clemmensen Reduction?

I. Benzaldehyde into benzyl alcohol

II. Cyclohexanone into cyclohexane

III. Benzoyl chloride into benzaldehyde

IV. Benzophenone into diphenyl methane

(a) I and II

(b) II and III

(c) III and IV

(d) II and IV

Ans. (d)

Assertion-Reason Questions

Directions: In the following question, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

- (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
 (b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.
 (c) Assertion is true but the Reason is false.
 (d) The statement of the Assertion is false but the Reason is true.

42. Assertion: Formaldehyde is a planar molecule.

Reason: It contains sp^2 hybridised carbon atom.

[NCERT Exemplar Problem]

Ans. (a)

43. Assertion: Compounds containing —CHO group are easily oxidised to corresponding carboxylic acids.

Reason: Carboxylic acids can be reduced to alcohols by treatment with $LiAlH_4$.

[NCERT Exemplar Problem]

Ans. (b)

44. Assertion: The α -hydrogen atom in carbonyl compounds is less acidic.

Reason: The anion formed after the loss of α -hydrogen atom is resonance stabilised.

[NCERT Exemplar Problem]

Ans. (d)

45. Assertion: Aldehydes and ketones, both react with Tollen's reagent to form silver mirror.

Reason: Both, aldehydes and ketones contain a carbonyl group. [NCERT Exemplar Problem]

Ans. (d)

46. Assertion: Oxidation of ketones is easier than aldehydes.

Reason: C—C bond of ketones is stronger than C—H bond of aldehydes.

[CBSE 2020]

Ans. (d)

Case-based Questions

47. The following table has boiling points of different classes of compounds. Study the table and answer the questions based on table and related studied concepts.

Compound	Boiling point
1. Ethanal	20.2 °C
2. Ethanol	78 °C
3. Acetone	56.2 °C

4. Acetic acid	118 °C
5. Acetic anhydride	139.8 °C
6. Diethyl ether	34.6 °C
7. Acetamide	222 °C
8. Ethyl acetate	77.1 °C

- (i) Which of the following has lowest boiling point?
 (a) Ethanal (b) Acetone (c) Acetic acid (d) Diethyl ether
- (ii) Which of the following has highest boiling point?
 (a) Acetic acid
 (b) Acetic anhydride
 (c) Acetyl chloride
 (d) Ethyl acetate
- (iii) Among acid derivatives which have higher melting and boiling points?
 (a) Esters (b) Amides
 (c) Acid anhydrides (d) Acid halides

Ans. (i) (d) (ii) (b) (iii) (b)

48. Read the following passage and answer the questions as follow:

Aldehydes, Ketones, Carboxylic acids and their derivatives are collectively called carboxyl compounds which are widely spread both in plants and animal kingdom. They play an important role in biological processes. They are responsible for fragrance and flavour of naturally occurring compounds *e.g.*, Vanilline (from vanilla beans), salicylaldehyde (from meadowsweet), cinnamaldehyde (from cinnamon) and isoamyl acetate (from banana) have pleasant flavour.

Acetone and acetic acid are widely used as solvents. Various carboxylic acids are used to prepare drugs (Analgesics, antipyretics etc.).

- (i) IUPAC name of vanillin is:
 (a) 4-hydroxy – 2 methoxy benzaldehyde
 (b) 2-hydroxy – 4 methoxy benzaldehyde
 (c) 4-hydroxy – 3 methoxy benzaldehyde
 (d) none of these
- (ii) All aldehydes turn Schiff's reagent–
 (a) blue (b) red (c) pink (d) green
- (iii) When acetic acid is heated with P_2O_5 :
 (a) Acetic anhydride is formed (b) Acetaldehyde is formed
 (c) Formaldehyde is formed (d) None of these

Ans. (i) (c) (ii) (c) (iii) (a)

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49. Study the table in which pka of various is given. Answer the questions based on table and related studied concepts.

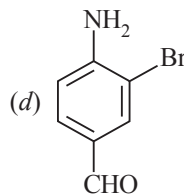
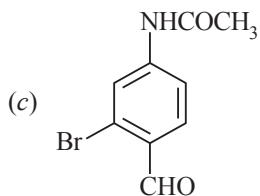
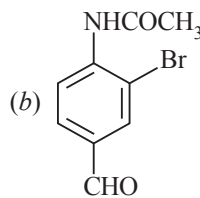
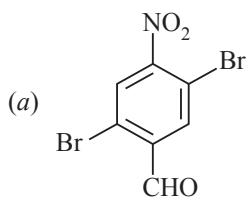
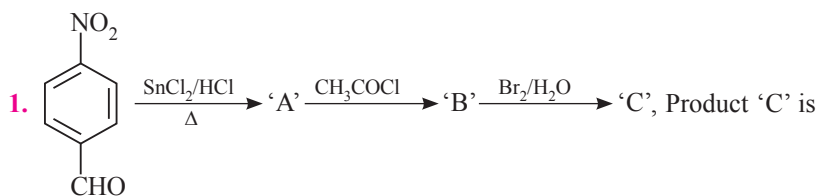
Compounds	pka
1. Acetic acid	4.76
2. HCOOH	3.75
3. CH ₃ CH ₂ COOH	4.38
4. ClCH ₂ COOH	2.87
5. FCH ₂ COOH	2.59
6. CH ₂ = CH-COOH	4.30
7. Benzoic acid	4.19
8. <i>p</i> -Toluic acid	4.38
9. Salicylic acid	2.98
10. <i>p</i> -nitro benzoic acid	3.44
11. <i>p</i> -methoxy benzoic acid	4.88
12. <i>p</i> -chloro benzoic acid	3.99
13. <i>p</i> -hydroxy benzoic acid	4.58

- (i) HCOOH is stronger than CH₃COOH, due to
- hydrogen bonding
 - Covalent bonding
 - HCOO⁻ is more stable than CH₃COO⁻
 - CH₃COO⁻ is more stable than HCOO⁻
- (ii) *p*-hydroxy benzoic acid more acidic than *p*-methoxy benzoic acid because
- OH has more -I effect than -OCH₃ group
 - OH has less -I effect than -OCH₃ group
 - due to ionic bonding
 - due to hydrogen bonding
- (iii) When salicylic acid is heated with Zn dust:
- acetic acid is formed
 - formic acid is formed
 - benzoic acid is formed
 - none of these
- Ans.** (i) (c) (ii) (a) (iii) (c)

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AMINES

Multiple Choice Questions



Ans. (d)

2. The major product of the reaction between *m*-dinitro benzene with NH_4HS is

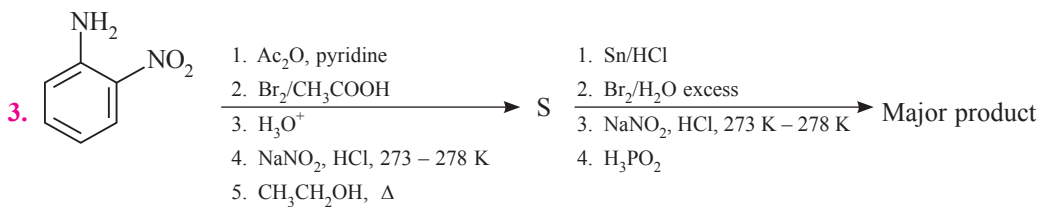
(a) *p*-Dinitro benzene

(b) *m*-Diamino benzene

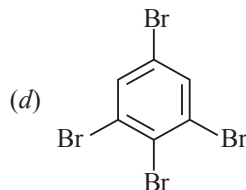
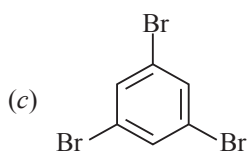
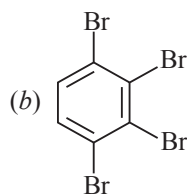
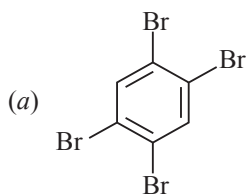
(c) *m*-nitroaniline

(d) *p*-Diamino benzene

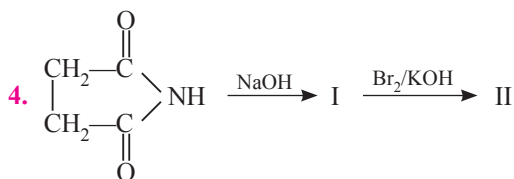
Ans. (c)



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Ans. (d)



(a) β -Alanine

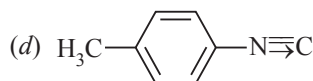
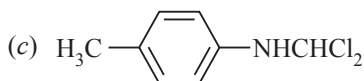
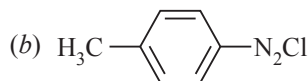
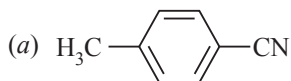
(b) α -Alanine

(c) Ethylene diamine

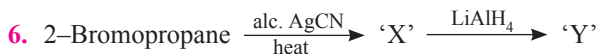
(d) Oxamide

Ans. (a)

5. The reaction of *p*-Toluidine with CHCl_3 and KOH gives.



Ans. (d)



The IUPAC name of 'Y' is


(a) N-isopropyl methanamine

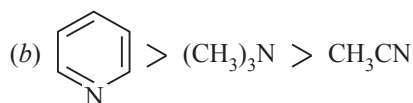
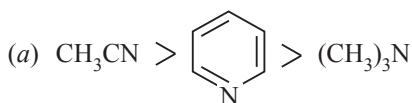
(b) N-methyl propan-2-amine

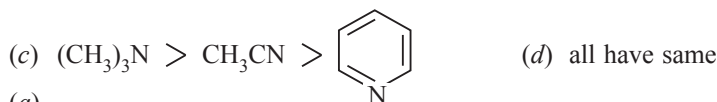
(c) N-methyl propanamine

(d) butan-2-amine

Ans. (b)

7. Among $(\text{CH}_3)_3\text{N}$,  and CH_3CN , the electronegativity in the order.





Ans. (a)

8. The best reagent for converting 2-Phenyl propanamide into 2-phenyl propanamine is

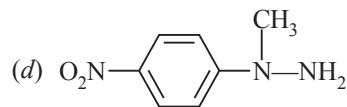
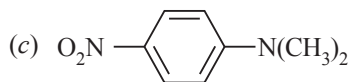
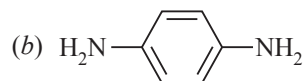
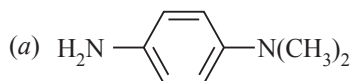
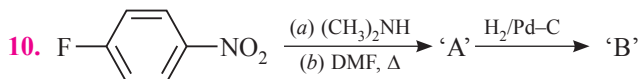
- (a) Br_2/NaOH (b) excess of H_2 (c) I_2/P_4 (d) LiAlH_4 in ether

Ans. (d)

9. Which one of the following can be prepared by Gabriel phthalimide synthesis?

- (a) Aniline (b) *o*-Toluidine
(c) Benzylamine (d) N-Methyl ethanamine

Ans. (c)



Ans. (a)

11. 4-Nitrotoluene is treated with bromine to get P. 'P' is reduced with Sn/HCl to get compound 'Q'. 'Q' is diazotised and the product is treated with phosphinic acid to get compound 'R'. 'R' is oxidised with alkaline KMnO_4 to get 'S'. Compound 'S' is

- (a) 2-Bromo-4-hydroxy benzoic acid (b) 2-Bromo benzoic acid
(c) 3-Bromo benzoic acid (d) 4-Bromo benzoic acid

Ans. (b)

12. CH_3CONH_2 on reaction with NaOH and Br_2 in alcoholic medium gives [CBSE 2020]

- (a) $\text{CH}_3\text{CH}_2\text{NH}_2$ (b) $\text{CH}_3\text{CH}_2\text{Br}$
(c) CH_3NH_2 (d) CH_3COONa

Ans. (c)

13. In order to prepare a 1° amine from an alkyl halide with simultaneous addition of one CH_2 group in the carbon chain, the reagent used as source of nitrogen is _____.

[NCERT Exemplar Problem]

- (a) Sodium amide, NaNH_2 (b) Sodium azide, NaN_3
(c) Potassium cyanide, KCN (d) Potassium phthalimide, $\text{C}_6\text{H}_4(\text{CO})_2\text{N}^-\text{K}^+$

Ans. (c)

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14. Amongst the given set of reactants, the most appropriate for preparing 2° amine is _____.

- (a) 2° R—Br + NH₃ [NCERT Exemplar Problem]
 (b) 2° R—Br + NaCN followed by H₂/Pt
 (c) 1° R—NH₂ + RCHO followed by H₂/Pt
 (d) 1° R—Br (2 mol) + potassium phthalimide followed by H₃O⁺/heat

Ans. (c)

15. The order of basic strength of amines in aqueous solution is

- (a) (CH₃)₃N > (CH₃)₂NH > CH₃NH₂ > NH₃
 (b) CH₃NH₂ > (CH₃)₂NH > (CH₃)₃N > NH₃
 (c) NH₃ > (CH₃)₃N > (CH₃)₂NH > CH₃NH₂
 (d) (CH₃)₂NH > CH₃NH₂ > (CH₃)₃N > NH₃

Ans. (d)

16. Which of the following is a 3° amine?

[NCERT Exemplar Problem]

- (a) 1-methylcyclohexylamine
 (b) Triethyl amine
 (c) tert-butylamine
 (d) N-methylaniline

Ans. (b)

17. The correct IUPAC name for CH₂=CHCH₂NHCH₃ is

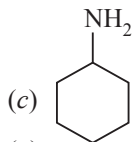
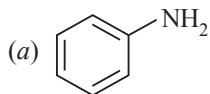
[NCERT Exemplar Problem]

- (a) Allylmethylamine
 (b) 2-amino-4-pentene
 (c) 4-aminopent-1-ene
 (d) N-methylprop-2-en-1-amine

Ans. (d)

18. Which of the following is the weakest Brønsted base?

[NCERT Exemplar Problem]



Ans. (a)

19. Which of the following reagents would not be a good choice for reducing an aryl nitro compound to an amine?

- (a) H₂ (excess)/Pt
 (b) LiAlH₄ in ether
 (c) Fe and HCl
 (d) Sn and HCl [NCERT Exemplar Problem]

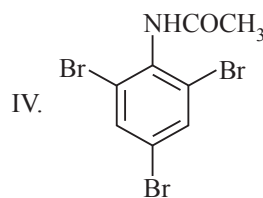
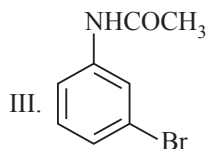
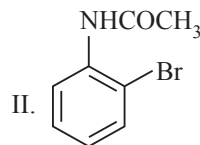
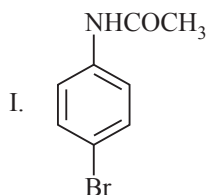
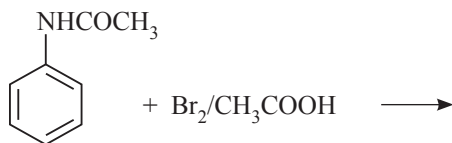
Ans. (b)

20. Which of the following cannot be prepared by Sandmeyer's reaction?

- | | |
|------------------|-------------------|
| I. Chlorobenzene | II. Bromobenzene |
| III. Iodobenzene | IV. Fluorobenzene |
| (a) I and II | (b) II and III |
| (c) II and IV | (d) III and IV |

Ans. (d)

21. The product of the following reaction is _____.



- | | |
|---------------|----------------|
| (a) I and II | (b) II and III |
| (c) II and IV | (d) III and IV |

Ans. (a)

22. Under which of the following reaction conditions, aniline gives *p*-nitro derivative as the major product?

- I. Acetyl chloride/pyridine followed by reaction with conc. H_2SO_4 + conc. HNO_3 .
- II. Acetic anhydride/pyridine followed by conc. H_2SO_4 + conc. HNO_3 .
- III. Dil. HCl followed by reaction with conc. H_2SO_4 + conc. HNO_3 .
- IV. Reaction with conc. HNO_3 + conc. H_2SO_4 .

- | | |
|---------------|----------------|
| (a) I and II | (b) II and III |
| (c) II and IV | (d) III and IV |

Ans. (a)

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23. Match the reactions given in Column I with the statements given in Column II.

Column I

- (A) Ammonolysis
 (B) Gabriel phthalimide synthesis
 (C) Hoffmann Bromamide reaction
 (D) Carbylamine reaction

Column II

- (i) Amine with lesser number of carbon atoms
 (ii) Detection test for primary amines.
 (iii) Reaction of phthalimide with KOH and R—X
 (iv) Reaction of alkylhalides with NH_3

- (a) (A) — (iv), (B) — (iii), (c) — (i), (D) — (ii)
 (b) (A) — (iii), (B) — (iv), (c) — (ii), (D) — (i)
 (c) (A) — (iv), (B) — (ii), (c) — (iii), (D) — (i)
 (d) (A) — (iii), (B) — (iv), (c) — (i), (D) — (ii)

Ans. (a)

24. Diethyl amine, when treated with HNO_2 gives

- (a) Diethyl ammonium nitrite
 (b) Ethyl alcohol
 (c) N-nitroso diethyl amine
 (d) Triethyl ammonium nitrite

Ans. (c)

25. Choose the amide which on reduction with LiAlH_4 gives secondary amine.

- (a) Ethanamide
 (b) N-Methyl ethanamide
 (c) N, N-diethyl ethanamide
 (d) Benzamide

Ans. (b)

26. In the nitration of benzene using a mixture of conc. H_2SO_4 and conc. HNO_3 , the species which initiates the reaction is _____.

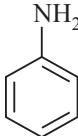
[NCERT Exemplar Problem]

- (a) NO_2 (b) NO^+ (c) NO_2^+ (d) NO_2^-

Ans. (c)

27. The most reactive amine towards dilute hydrochloric acid is _____.

[NCERT Exemplar Problem]

- (a) $\text{CH}_3\text{—NH}_2$ (b) $\begin{array}{l} \text{H}_3\text{C} \\ \diagdown \\ \text{N} \\ \diagup \\ \text{H}_3\text{C} \end{array} \text{—NH}$
 (c) $\begin{array}{l} \text{H}_3\text{C} \\ \diagdown \\ \text{N} \text{—} \text{CH}_3 \\ \diagup \\ \text{H}_3\text{C} \end{array}$ (d) 

Ans. (b)

28. Acid anhydrides on reaction with primary amines give _____.

[NCERT Exemplar Problem]

- (a) amide (b) imide
(c) secondary amine (d) imine

Ans. (a)

29. The reaction $\text{ArN}_2^+\text{Cl}^- \xrightarrow{\text{Cu/HCl}} \text{ArCl} + \text{N}_2 + \text{CuCl}$ is named as _____.

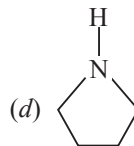
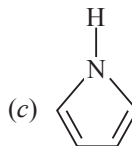
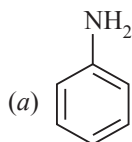
[NCERT Exemplar Problem]

- (a) Sandmeyer reaction (b) Gatterman reaction
(c) Claisen reaction (d) Carbylamine reaction

Ans. (b)

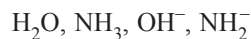
30. Among the following amines, the strongest Brönsted base is _____.

[NCERT Exemplar Problem]



Ans. (d)

31. The correct decreasing order of basic strength of the following species is _____.



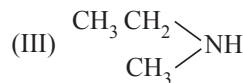
[NCERT Exemplar Problem]

- (a) $\text{NH}_2^- > \text{OH}^- > \text{NH}_3 > \text{H}_2\text{O}$ (b) $\text{OH}^- > \text{NH}_2^- > \text{H}_2\text{O} > \text{NH}_3$
(c) $\text{NH}_3 > \text{H}_2\text{O} > \text{NH}_2^- > \text{OH}^-$ (d) $\text{H}_2\text{O} > \text{NH}_3 > \text{OH}^- > \text{NH}_2^-$

Ans. (a)

32. Which of the following should be most volatile?

[NCERT Exemplar Problem]



- (a) II (b) IV (c) I (d) III

Ans. (b)

Assertion-Reason Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Assertion (A) and Reason (R) are true but R is the correct explanation of Assertion (A)
- (b) Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
- (c) Assertion (A) is true but Reason (R) is false
- (d) Assertion (A) is false but Reason (R) is true.

33. Assertion: Acetanilide is less basic than aniline.

Reason: Acetylation of aniline results in decrease of electron density on nitrogen.

[NCERT Exemplar Problem]

Ans. (a)

34. Assertion: Only a small amount of HCl is required in the reduction of nitro compounds with iron scrap and HCl in the presence of steam.

Reason: FeCl₂ formed gets hydrolysed to release HCl during the reaction.

[NCERT Exemplar Problem]

Ans. (a)

35. Assertion: N, N-Diethylbenzene sulphonamide is insoluble in alkali.

Reason: Sulphonyl group attached to nitrogen atom is strong electron withdrawing group.

[NCERT Exemplar Problem]

Ans. (b)

36. Assertion: Aniline does not undergo Friedel Crafts reaction.

Reason: Friedel Crafts is an electrophilic substitution reaction.

Ans. (b)

37. Assertion: Friedel Crafts reaction is used to introduce an alkyl or acyl group in benzene.

Reason: Benzene is solvent for the Friedel Crafts alkylation of bromobenzene.

Ans. (c)

Case-based Questions

38. Read given passage and answer the questions that follow:

Amines are classified as primary, secondary and tertiary amines. Primary amines cannot be obtained by ammonolysis of alkyl halide because we will get mixture of 1°, 2° and 3° amines. Cyanides, on reduction give primary amines where as isocyanides on reduction give secondary amines. Nitro compounds, on reduction also give primary amines. Primary amines react with CHCl₃ and KOH to form foul smelling isocyanide. They react with HNO₂ and liberate N₂ gas. They react with Hinsberg's reagent to form salt soluble in KOH. Secondary amine form yellow oily compounds with HNO₂ and salt formed with C₆H₅SO₂Cl, is insoluble in KOH. 3° amines form salt soluble in water with HNO₂ but does not react with C₆H₅SO₂Cl.

(i) Which of the following does not react with p-toluene sulphonyl chloride (Hinsberg's reagent)?

- (a) CH_3NH_2 (b) $\text{C}_2\text{H}_5\text{—NH}_2$
 (c) $(\text{CH}_3)_3\text{N}$ (d) CH_3NHCH_3

(ii) Benzyl amine reacts with CHCl_3 and KOH to give

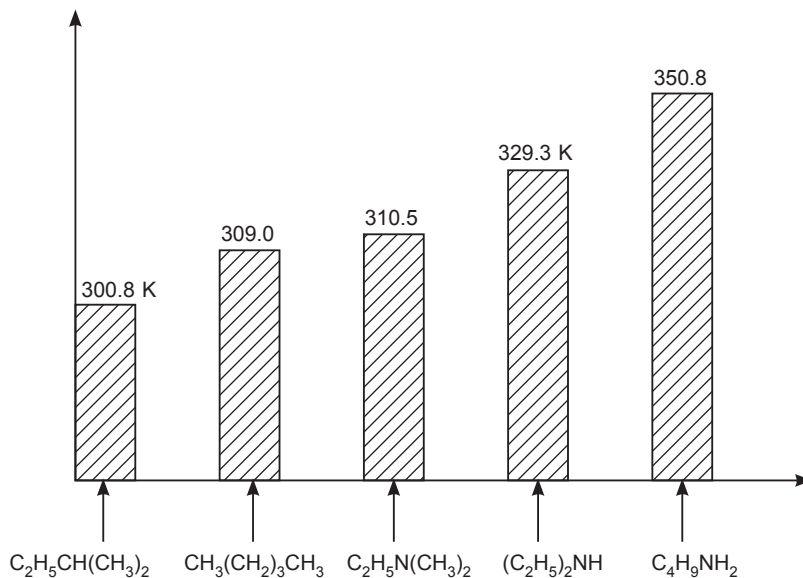
- (a) Benzyl cyanide (b) Phenyl cyanide
 (c) Benzyl isocyanide (d) Phenyl isocyanide

(iii) Benzene diazonium chloride, on warming with water gives

- (a) Benzene (b) Phenol
 (c) Aniline (iv) Chlorobenzene

Ans. (i) (c) (ii) (c) (iii) (b)

39. Observe the histogram showing boiling points of pentane, iso pentane, 1° , 2° and 3° amines. Answer the questions that follow based on table and related concepts.



(i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ has higher boiling point than $(\text{C}_2\text{H}_5)_2\text{NH}$ and $\text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2$. It is because

- (a) Extent of H-bonding is more in $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ than 2° and 3° amines.
 (b) Extent of H-bonding is less in $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ than 2° and 3° amines.
 (c) Extent of H-bonding is more in 3° amines than $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ and lesser than 2° amines.
 (d) None of these

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(ii) H-bonds are stronger in alcohols than amines:

- (a) due to O is less electronegative than N
- (b) due to O is more electronegative than N
- (c) due to O is more electropositive than N
- (d) none of these

(iii) The correct increasing order of boiling points of compounds shown in graph is:

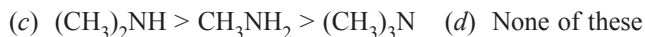
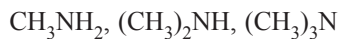
- (a) $\text{CH}_3(\text{CH}_2)_3\text{CH}_3 < \text{C}_2\text{H}_5\text{CH}(\text{CH}_3)_2 < \text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2 < \text{C}_4\text{H}_9\text{NH}_2$
- (b) $\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)_2 < \text{CH}_3(\text{CH}_2)_3\text{CH}_3 < \text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2 < (\text{C}_2\text{H}_5)_2\text{NH} < \text{C}_4\text{H}_9\text{NH}_2$
- (c) $\text{C}_4\text{H}_9\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH} < \text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2 < \text{CH}_3(\text{CH}_2)_3\text{CH}_3 < \text{C}_2\text{H}_5\text{CH}(\text{CH}_3)_2$
- (d) none of these

Ans. (i) (a) (ii) (b) (iii) (b)

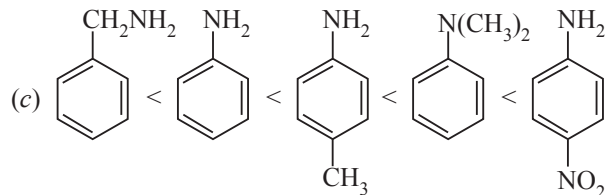
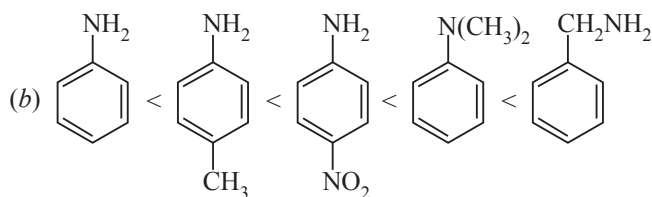
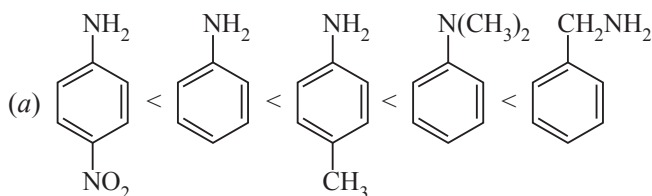
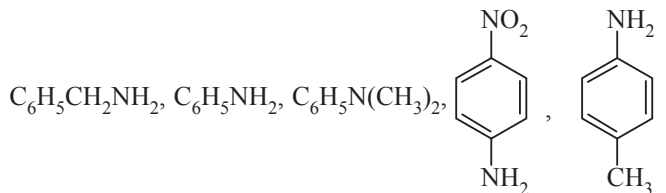
40. Table relates various amines with pK_b values. Study this table and answer the questions related to table and studied concepts.

Compounds	pK_b
1. Ammonia	4.75
2. CH_3NH_2	3.38
3. $(\text{CH}_3)_2\text{NH}$	3.27
4. $(\text{CH}_3)_3\text{N}$	4.22
5. $\text{CH}_3\text{CH}_2\text{NH}_2$	3.29
6. $(\text{C}_2\text{H}_5)_2\text{NH}$	3.00
7. $(\text{C}_2\text{H}_5)_3\text{N}$	3.25
8. $\text{C}_6\text{H}_5\text{NH}_2$	9.38
9. $\text{C}_6\text{H}_5\text{NHCH}_3$	9.30
10. $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)_2$	8.92
11. $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$	4.70
12. <i>p</i> -nitro aniline	13.0
13. <i>p</i> -Toluidine	9.21
14. <i>p</i> -Anisidine	8.71

(i) The correct decreasing order of basic character in aq. solution of following compounds is:



(ii) The correct increasing order of basic character of the following compound is:



(d) None of these

(iii) Which of the following is weakest base?



Ans. (i) (c)

(ii) (a)

(iii) (c)

Part-II

[Practice Papers]

1

PRACTICE PAPER

[Time Allowed: 90 Minutes]

[Maximum Marks: 35]

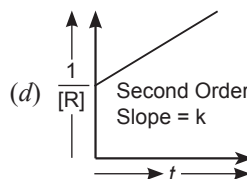
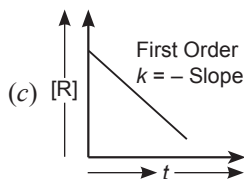
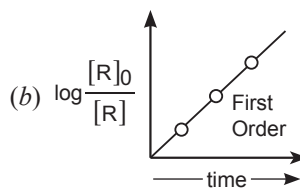
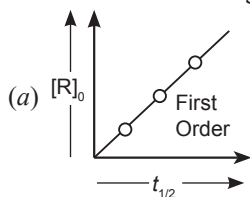
General Instructions:

- The Question Paper contains three sections.
- Section A** has **25** questions. Attempt any **20** questions.
- Section B** has **24** questions. Attempt any **20** questions.
- Section C** has **6** questions. Attempt any **5** questions.
- All questions carry equal marks.
- There is **no** negative marking.

SECTION-A

This section consists of 25 multiple choice questions with overall choice to attempt *any 20* questions. In case more than desirable number of questions are attempted, **ONLY** first 20 will be considered for evaluation.

1. Which of the following plot is not correct.



Ans. (a)

2. The oxidation state of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$ is

- (a) +1 (b) +2 (c) +3 (d) 0

Ans. (c)

3. Which of the following has 5 unpaired electrons.

- (a) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ (b) $[\text{Mn}(\text{CN})_6]^{3-}$ (c) $[\text{CrCl}_3(\text{H}_2\text{O})_3]$ (d) $[\text{Ag}(\text{CN})_2]^-$

Ans. (a)

4. The reason for charge on colloidal particles is

- (a) frictional rubbing (b) electron capture during Bredig's arc method
(c) Selective adsorption of common ion (d) All of these

Ans. (d)

5. Stability of colloidal solution is due to

- (a) Brownian movement (b) Equal and same charge on particles
(c) Both (a) and (b) (d) None of these

Ans. (c)

6. If KI is added in excess in $\text{AgNO}_3(aq)$, the AgI will be

- (a) +vely charged (b) -vely charged
(c) No charge (d) it will become lyophilic sol.

Ans. (b)

7. Arsenic sulphide sol can be most easily coagulated by

- (a) PO_4^{3-} (b) Al^{3+} (c) Mg^{2+} (d) Na^+

Ans. (b)

8. Lyophilic sols are coagulated by

- (a) heating (b) Freezing (c) change in pH (d) All of these

Ans. (d)

9. If the initial concentration of reactant is doubled, $t_{1/2}$ is also doubled, the order of reaction is

- (a) zero (b) 1 (c) 2 (d) 3

Ans. (a)

10. Mechanism of a hypothetical reaction $\text{X}_2 + \text{Y}_2 \longrightarrow 2 \text{XY}$ is given below:

- (a) $\text{X}_2 \rightleftharpoons \text{X} + \text{X}$ (fast) (b) $\text{X} + \text{Y}_2 \longrightarrow \text{XY} + \text{Y}$ (slow)
(c) $\text{X} + \text{Y} \longrightarrow \text{XY}$ (fast)

The overall order of reaction is

- (a) 2 (b) 0 (c) 1.5 (d) 1

Ans. (c)

11. Extent of adsorption of adsorbate from solution phase increases with _____.

- (a) increase in amount of adsorbate in solution.
(b) decrease in surface area of adsorbent.
(c) increase in temperature of solution.
(d) decrease in amount of adsorbate in solution.

Ans. (a)

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12. Physical adsorption of a gaseous species may change to chemical adsorption with _____.
- (a) decrease in temperature (b) increase in temperature
(c) increase in surface area of adsorbent (d) decrease in surface area of adsorbent

Ans. (b)

13. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it take for 100% completion?
- (a) 1.26×10^{15} s (b) 2.52×10^{14} s (c) 2.52×10^{28} s (d) infinite

Ans. (d)

14. The unit of rate constant depends upon the
- (a) molecularity of the reaction. (b) activation energy of the reaction.
(c) order of the reaction. (d) temperature of the reaction.

Ans. (c)

15. $t_{1/2}$ for a chemical reaction is 30 min. The time taken for 90% reaction to be complete will be
- (a) 100 min (b) 200 min (c) 300 min (d) 400 min

Ans. (a)

16. If conc. of reactant 'A' is increased 10 times and rate of reaction becomes 100 times. What is order with respect to 'A'?
- (a) 1 (b) 2 (c) 3 (d) 4

Ans. (b)

17. The half life period of first order reaction is 1386 seconds. The specific rate constant of the reaction is
- (a) $0.5 \times 10^{-2} \text{ s}^{-1}$ (b) $0.5 \times 10^{-3} \text{ s}^{-1}$ (c) $5.0 \times 10^{-2} \text{ s}^{-1}$ (d) $5.0 \times 10^{-3} \text{ s}^{-1}$

Ans. (b)

18. The name of complex $[\text{Fe}(\text{CN})_6]^{3-}$ is
- (a) Tricyanido ferrate (III) ion (b) Hexacyanido ferrate (III) ion
(c) Hexacyanido iron (III) (d) Hexacyanido ferrate (II) ion

Ans. (b)

19. The sum of coordination number of oxidation number of the metal M in the complex $[\text{M}(\text{en})_2 \text{C}_2\text{O}_4] \text{Cl}$ are
- (a) 7 (b) 8 (c) 9 (d) 6

Ans. (c)

20. Which of the following will not give test for Cl^- with $\text{AgNO}_3(\text{aq})$ at 25°C ?
- (a) $\text{CoCl}_3 \cdot 5\text{NH}_3$ (b) $\text{CoCl}_3 \cdot 6\text{NH}_3$ (c) $\text{CoCl}_3 \cdot 3\text{NH}_3$ (d) $\text{CoCl}_3 \cdot 4\text{NH}_3$

Ans. (c)

21. Which of these statements about $[\text{Co}(\text{CN})_6]^{3-}$ is true?
- (a) It has 4 unpaired electron, high spin (b) No unpaired electron, high spin
(c) No unpaired electron, low spin (d) 4 unpaired electron, low spin

Ans. (c)

22. Correct increasing order of wavelength of absorption in visible region for complex of Co^{3+} is
 (a) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$ (b) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$
 (c) $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ (d) $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$

Ans. (d)

23. Which of the following statements related to lanthanoids is incorrect?
 (a) Eu shows + 2 oxidation state (b) $\text{Pr}(\text{OH})_3$ to $\text{Lu}(\text{OH})_3$, basicity decreases
 (c) All lanthanoids more reactive than Al (d) Ce^{4+} is used as oxidising agent

Ans. (c)

24. In which of the following pairs, both the ions are coloured in aqueous solutions?
 (a) Sc^{3+} , Ti (b) Sc^{3+} , Co^{2+} (c) Ni^{2+} , Cu^+ (d) Ni^{2+} , Ti^{3+}
 [Atomic no of Sc = 21, Ti = 22, Ni = 28, Co = 27, Cu = 29]

Ans. (d)

25. Generally transition elements form coloured salts due to the presence of unpaired electrons. Which of the following compounds will be coloured in solid state?
 (a) Ag_2SO_4 (b) CuF_2 (c) ZnF_2 (d) Cu_2Cl_2

Ans. (b)

SECTION-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

26. Which of the following expression is correct for ' K_a ' in terms of Λ° and Λ , where 'C' is molarity.

$$(a) K_a = \frac{C\Lambda_m^\circ}{\Lambda_m(\Lambda_m^\circ - \Lambda)} \quad (b) K_a = \frac{C\Lambda_m^2}{\Lambda_m(\Lambda_m^\circ - \Lambda)}$$

$$(c) K_a = \frac{C\Lambda_m^2}{\Lambda_m^\circ} \quad (d) K_a = \frac{C\Lambda_m^2}{(\Lambda_m^\circ - \Lambda)}$$

Ans. (b)

27. The relationship between specific conductance (κ) and resistivity (ρ) is

$$(a) \kappa = \frac{1}{\rho} \quad (b) \kappa \times \rho = R$$

$$(c) \kappa \times \frac{1}{R} = \rho \quad (d) \kappa = \frac{1}{R} \times \rho$$

Ans. (a)

28. Λ_m° for NaCl, HCl and CH_3COONa are 126.0, 426. 100 $\text{S cm}^2 \text{mol}^{-1}$ respectively. If the conductance of 0.001 m CH_3COOH is $5 \times 10^{-5} \text{ S cm}^{-1}$, the degree of dissociation of CH_3COOH is:
 (a) 10% (b) 12.5% (c) 15% (d) 10.5%

Ans. (b)

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29. $\Lambda_m^0 \text{H}_2\text{O}$ is equal to _____.

(a) $\Lambda_m^0(\text{HCl}) + \Lambda_m^0(\text{NaOH}) - \Lambda_m^0(\text{NaCl})$

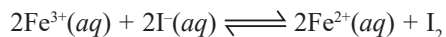
(b) $\Lambda_m^0(\text{HNO}_3) + \Lambda_m^0(\text{NaNO}_3) - \Lambda_m^0(\text{NaOH})$

(c) $\Lambda_m^0(\text{NH}_4\text{OH}) + \Lambda_m^0(\text{HCl}) - \Lambda_m^0(\text{NH}_4\text{Cl})$

(d) None of these

Ans. (a)

30. The equilibrium constant of the following reaction at 298 K is 1×10^8 for



$$E_{\text{I}_2|\text{I}^{-}}^{\circ} = +0.54 \text{ V} \quad E_{\text{Fe}^{3+}|\text{Fe}}^{\circ} = ?$$

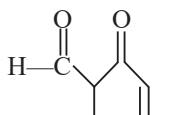
(a) + 1.006 V

(b) + 0.77 V

(c) - 0.77 V

(d) - 0.625 V

Ans. (b)

31. The IUPAC name of the compound 

(a) 2-Formyl hex-2-en-3-one

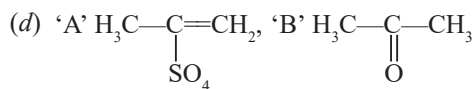
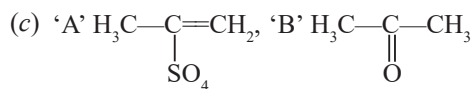
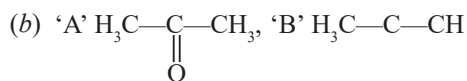
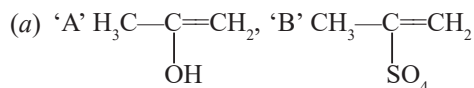
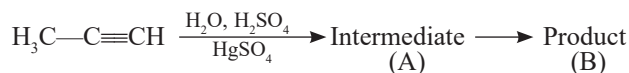
(b) 5-methyl-4-oxo hex-2-en-5al

(c) 3-keto-2-methyl hex-5-en-al

(d) 3-keto-2-methyl hex-4-en-1-al

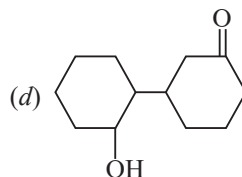
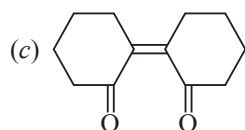
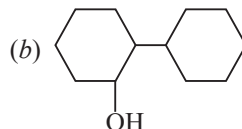
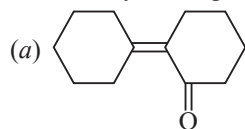
Ans. (d)

32. Predict the correct intermediate and the product in the following reaction:



Ans. (c)

33. Of the following which is the product formed when cyclohexanone undergoes aldol condensation followed by heating?



Ans. (a)

34. Arrange the following in order of increasing acidity.

- A. *o*-nitrobenzoic acid B. *p*-nitrobenzoic acid
 C. *p*-hydroxybenzoic acid D. benzoic acid
 (a) $A < B < C < D$ (b) $B < C < A < D$ (c) $C < B < D < A$ (d) $C < D < B < A$

Ans. (d)

35. Which of the following carboxylic acid can undergo decarboxylation easily?

- (a) $\text{C}_6\text{H}_5-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2\text{COOH}$ (b) $\text{C}_6\text{H}_5-\underset{\text{OH}}{\text{CH}}-\text{COOH}$
 (c) $\text{C}_6\text{H}_5-\underset{\text{NH}_2}{\text{CH}}-\text{COOH}$ (d) $\text{C}_6\text{H}_5\text{COCO}_2\text{H}$

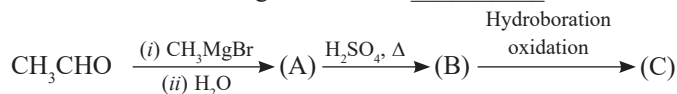
Ans. (a)

36. The increasing order of the rate of HCN addition to compound A to D is

- A. HCHO B. CH_3COCH_3 C. PhCOCH_3 D. PhCOPh
 (where Ph is phenyl group)
 (a) $D < B < C < A$ (b) $D < C < B < A$ (c) $C < D < B < A$ (d) $A < B < C < D$

Ans. (b)

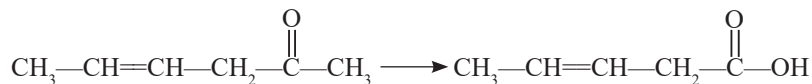
37. Compounds A and C in the following reaction are _____.



- (a) identical (b) positional isomers (c) functional isomers (d) optical isomers

Ans. (b)

38. Which is the most suitable reagent for the following conversion?



- (a) Tollen's reagent (b) Benzoyl peroxide
 (c) I_2 and NaOH solution (d) Sn and NaOH solution

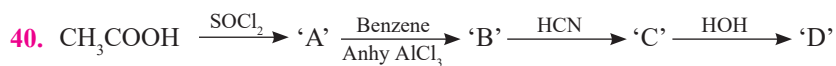
Ans. (c)

39. The product obtained by condensation of Acetophenone in presence of NaOH

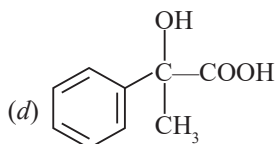
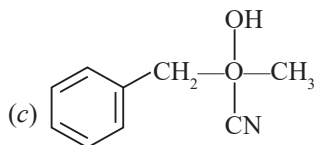
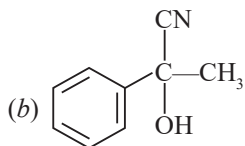
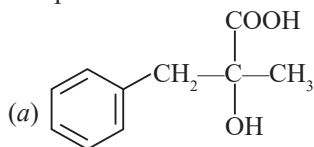
- (a) 3-hydroxy-3-methyl-1, 3 diphenyl propanone
 (b) 3-hydroxy-3-phenyl acetophenone
 (c) Phorone
 (d) Mesityl oxide

Ans. (a)

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The product 'D' is:



Ans. (d)

41. Reduction of aldehydes and ketones into hydrocarbons using zinc amalgam and conc. HCl is called:

(a) Cope reduction

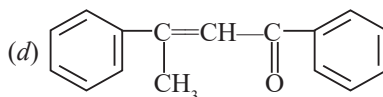
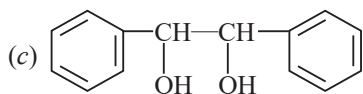
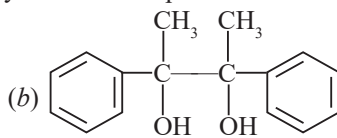
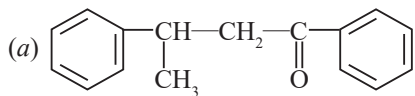
(b) Dow reduction

(c) Wolff Kishner reduction

(d) Clemens reduction

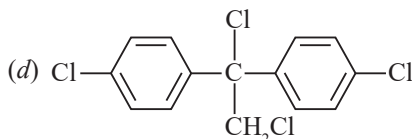
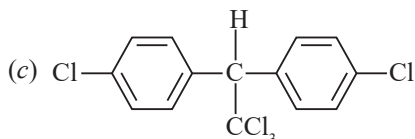
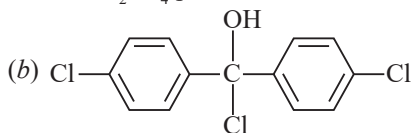
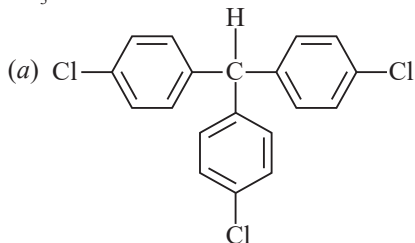
Ans. (d)

42. Acetophenone when reacted with base $\text{C}_2\text{H}_5\text{ONa}$, yields a stable product:



Ans. (d)

43. $\text{CCl}_3\text{—C(=O)—H}$ reacts with chlorobenzene in presence of conc. H_2SO_4 produces



Ans. (c)

44. The oxidation state of Fe in $[\text{Fe}(\text{CO})_5]$ is
 (a) 0 (b) 1 (c) 2 (d) 3

Ans. (a)

In the following questions (Q. No. 45 to 49), a statement of assertion is followed by a statement of a reason is given. Choose the correct answer out of the following choices.

- (a) Both A and R are true and R is the correct explanation of A.
 (b) Both A and R are true but R is not the correct explanation of A.
 (c) A is true but R is false.
 (d) A is false but R is true.

45. **Assertion:** Cu^{2+} iodide is not known.

Reason: Cu^{2+} oxidises I^- to iodine.

Ans. (a)

46. **Assertion:** Sc^{3+} is a coloured ion.

Reason: Colour of *d*-block elements is due to *d-d* transition.

Ans. (d)

47. **Assertion:** Transition metals form protective oxide films.

Reason: Oxides of transition metals are always stoichiometric.

Ans. (c)

48. **Assertion:** Low spin tetrahedral complexes are rarely observed.

Reason: Crystal field splitting energy is less than pairing energy for tetrahedral complexes.

Ans. (a)

49. **Assertion:** CrO crystallises in a hexagonal close-packed array of oxide ions with two out of every three octahedral holes occupied by chromium ions.

Reason: Transition metal oxide may be hexagonal close-packed lattice of oxide ions with metal ions filling the octahedral voids.

Ans. (d)

SECTION-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

50. Match the reactions given in Column I with the suitable reagents given in Column II.

Column I (Reactions)	Column II (Reagents)
(A) Benzophenone \rightarrow Diphenylmethane	(i) LiAlH_4
(B) Benzaldehyde \rightarrow 1-Phenylethanol	(ii) DIBAL—H
(C) Cyclohexanone \rightarrow Cyclohexanol	(iii) $\text{Zn}(\text{Hg})/\text{Conc. HCl}$
(D) Phenyl benzoate \rightarrow Benzaldehyde	(iv) $\text{CH}_3\text{MgBr}, \text{H}_2\text{O}/\text{H}^+$

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- (a) (A) – (iii), (B) – (iv), (C) – (i), (D) – (ii)
 (b) (A) – (iv), (B) – (ii), (C) – (iii), (D) – (i)
 (c) (A) – (ii), (B) – (iii), (C) – (i), (D) – (iv)
 (d) (A) – (i), (B) – (ii), (C) – (iv), (D) – (iii)

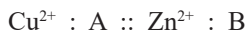
Ans. (a)

51. Which of the following analogies is correct?

- (a) $(\text{CH}_3)_3\text{CNH}_2$: 3° Amine :: $(\text{CH}_3)_2\text{NH}$: 2° Amine
 (b) $\text{C}_2\text{H}_5\text{NH}_2$: Most soluble in water :: $(\text{CH}_3)_3\text{N}$: Least soluble in water
 (c) RNH_2 : Trigonal planar :: $\text{R}_4\text{N}^+\text{Cl}^-$: Tetrahedral
 (d) $\text{C}_6\text{H}_5\text{NH}_2$: σ^- & p -directing :: $\text{C}_6\text{H}_5\text{NHCOCH}_3$: m -directing

Ans. (b)

52. Complete the following analogy:



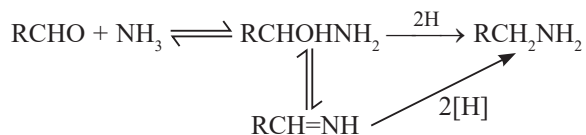
- (a) A : Blue B : Yellow (b) A : Paramagnetic B : Diamagnetic
 (c) A : White B : Blue (d) A : Diamagnetic B : Paramagnetic

Ans. (b)

CASE-1

Read the passage given below and answer the following questions (53-55):

Reductive alkylation is the term applied to the process of introducing alkyl groups into ammonia or a primary or secondary amine by means of an aldehyde or ketone in the presence of a reducing agent. The present discussion is limited to those reductive alkylations in which the reducing agent is hydrogen and a catalyst or “nascent” hydrogen, usually from a metalacid combination; most of these reductive alkylations have been carried out with hydrogen and a catalyst. The principal variation excluded is that in which the reducing agent is formic acid or one of its derivatives; this modification is known as the Leuckart reaction. The process of reductive alkylation of ammonia consists in the addition of ammonia to a carbonyl compound and reduction of the addition compound or its dehydration product. The reaction usually is carried out in ethanol solution when the reduction is to be effected catalytically.



Since the primary amine is formed in the presence of the aldehyde it may react in the same way as ammonia, yielding an addition compound, a Schiff's base ($\text{RCH}=\text{NCH}_2\text{R}$) and finally, a secondary amine. Similarly, the primary amine may react with the imine, forming an addition product which also is reduced to a secondary amine. Finally, the secondary amine may react with either the aldehyde or the imine to give products which are reduced to tertiary amines.

2

PRACTICE PAPER

[Time Allowed: 90 Minutes]

[Maximum Marks: 35]

General Instructions:

- The Question Paper contains three sections.
- Section A** has **25** questions. Attempt any **20** questions.
- Section B** has **24** questions. Attempt any **20** questions.
- Section C** has **6** questions. Attempt any **5** questions.
- All questions carry equal marks.
- There is **no** negative marking.

SECTION–A

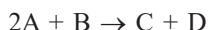
This section consists of 25 multiple choice questions with overall choice to attempt *any 20* questions. In case more than desirable number of questions are attempted, **ONLY** first 20 will be considered for evaluation.

1. Which will have highest conductance?

- (a) Ag at 30°C (b) Ag at 60°C (c) Cu at 30°C (d) Cu at 60°C

Ans. (a)

2. The non-stoichiometric reaction:



Initial conc. (A)	Initial conc. of (B)	Initial rate (Mol L ⁻¹)
0.1 M	0.1 M	1.2×10^{-3}
0.1 M	0.2 M	1.2×10^{-3}
0.2 M	0.1 M	2.4×10^{-3}

The rate law for formation of C is

(a) $\frac{d[c]}{dt} = k[A]$

(b) $\frac{d[c]}{dt} = k[A] [B]$

(c) $\frac{d[c]}{dt} = k[A]^2 [B]^1$

(d) $\frac{d[c]}{dt} = k[A] [B]^2$

Ans. (a)

3. A first order reaction is 50% complete in 69.3 minutes. Time required for 99.9% completion of this reaction is

(a) 693 min (b) 6.93 min (c) 0.693 min (d) 6930 min

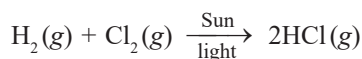
Ans. (a)

4. For the first order reaction half life is 14 seconds, the time required for the initial concentration to reduce $\frac{1}{8}$ th of its initial value is

(a) $(14)^3$ seconds (b) 28 seconds (c) 42 seconds (d) 56 seconds

Ans. (c)

5. The order of reaction



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

Ans. (a)

6. The correct ascending order of adsorption of the following gases on the same mass of charcoal at same temperature and pressure is

(a) $\text{CH}_4 < \text{H}_2 < \text{SO}_2$ (b) $\text{H}_2 < \text{CH}_4 < \text{SO}_2$ (c) $\text{SO}_2 < \text{CH}_4 < \text{H}_2$ (d) $\text{H}_2 < \text{SO}_2 < \text{CH}_4$

Ans. (b)

7. The formation of micelles takes place only above

(a) Inversion temperature (b) Boyle's temperature
(c) Critical temperature (d) Kraft temperature

Ans. (d)

8. Colloidion is 4% solution of which one of the following in alcohol-ether mixture.

(a) Nitroglycerin (b) Cellulose acetate
(c) Glycol dinitrate (d) Nitrocellulose

Ans. (d)

9. If 'x' is amount of adsorbate and 'm' is amount of adsorbent, which of the following is not related to adsorption process?

(a) $\frac{x}{m} = f(P)$ at constant T (b) $\frac{x}{m} = f(T)$ at constant 'P'
(c) $P = f(T)$ at constant $\frac{x}{m}$ (d) $\frac{m}{x} = P \times T$

Ans. (d)

10. A plot of $\log \frac{x}{m}$ vs $\log p$ for adsorption of gas on a solid gives in straight line with slope equal to

(a) n (b) $\frac{1}{n}$ (c) $\log k$ (d) $-\log k$

Ans. (b)

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11. The protective power of lyophilic colloidal sol is expressed in terms of

- (a) coagulation value (b) gold number
(c) CMC (Critical Micelle Concentration) (d) oxidation numbers

Ans. (b)

12. During the adsorption of gas on the surface of solid, which of the following is true?

- (a) $\Delta G < 0$, $\Delta H > 0$, $\Delta S < 0$ (b) $\Delta G > 0$, $\Delta H < 0$, $\Delta S < 0$
(c) $\Delta G < 0$, $\Delta H < 0$, $\Delta S < 0$ (d) $\Delta G < 0$, $\Delta H < 0$, $\Delta S > 0$

Ans. (c)

13. The best coagulant for the precipitation of $\text{Fe}(\text{OH})_3$ sol is

- (a) Na_2HPO_3 (b) NaNO_3
(c) Na_3PO_4 (d) Na_2SO_4

Ans. (c)

14. The electronic configuration of $\text{Cu}(\text{II})$ is $3d^9$ whereas that of $\text{Cu}(\text{I})$ is $3d^{10}$. Which of the following is correct?

- (a) $\text{Cu}(\text{II})$ is more stable
(b) $\text{Cu}(\text{II})$ is less stable
(c) $\text{Cu}(\text{I})$ and $\text{Cu}(\text{II})$ are equally stable
(d) Stability of $\text{Cu}(\text{I})$ and $\text{Cu}(\text{II})$ depends on nature of copper salts

Ans. (a)

15. In the complex ion $[\text{AuXe}_4]^{2+}$, Xe acts as:

- (a) central atom (b) ligand
(c) chelating agent (d) electrophile

Ans. (b)

16. Hybridisation shown by Au in $[\text{AuXe}_4]^{2+}$ is :

- (a) sp^3 (b) sp^2d
(c) sp^3d^2 (d) sp^2

Ans. (a)

17. Complex compounds are formed by

- (a) Krypton (b) Radon
(c) Helium (d) Xenon

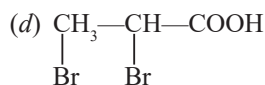
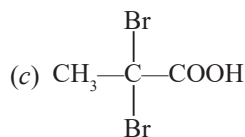
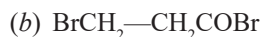
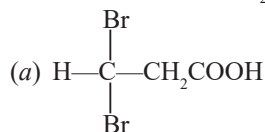
Ans. (d)

18. Xe is a _____ ligand

- (a) ambidentate (b) bidentate
(c) unidentate (d) hexadentate

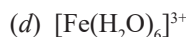
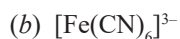
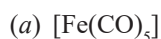
Ans. (c)

19. Propanoic acid with Br_2/P_4 yields a dibromo product. The structure will be

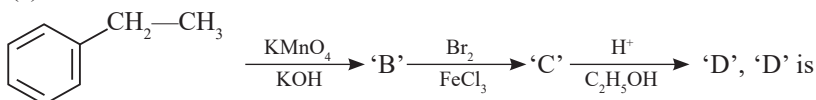


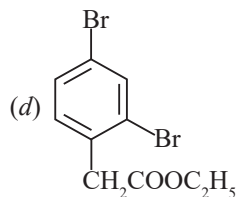
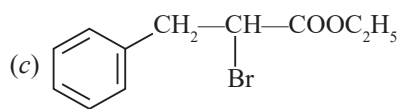
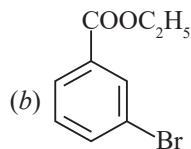
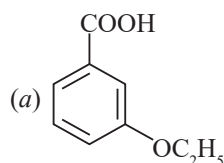
Ans. (c)

20. The stabilisation of coordination compounds due to chelation is called the chelate effect. Which of the following is the most stable complex species?



Ans. (c)

21. 



Ans. (b)

22. CH_3CHO and $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$ can be distinguished chemically by

(a) Benedict's test

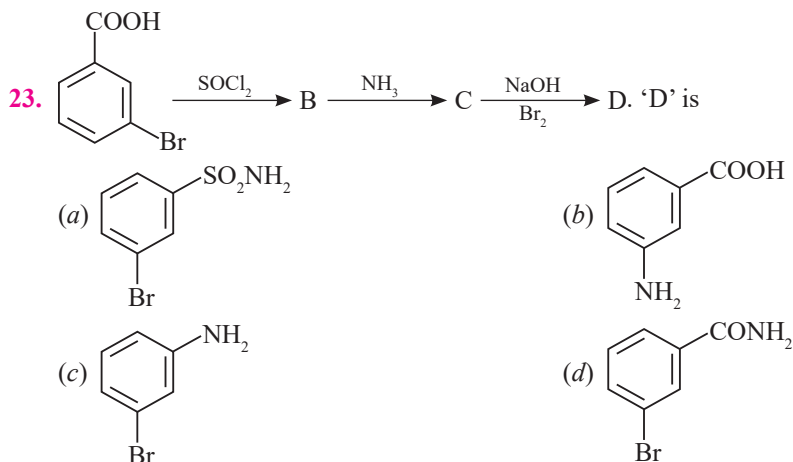
(b) Iodoform test

(c) Tollen's reagent test

(d) Fehling's solution test

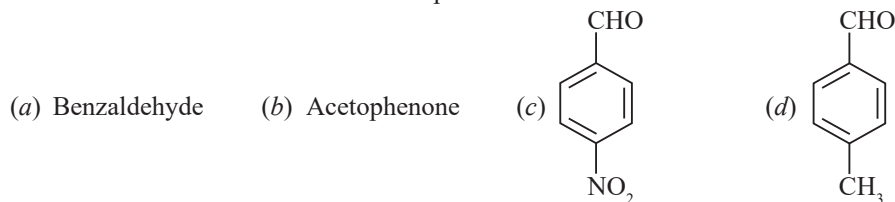
Ans. (b)

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Ans. (c)

24. Which is most reactive towards Nucleophilic substitution reaction?



Ans. (c)

25. Which of the following is not soluble in NaHCO_3 ?

- (a) 2, 4, 6-Trinitrophenol (b) Benzoic acid
(c) *o*-Nitrophenol (d) Benzene sulphonic acid

Ans. (c)

SECTION-B

This section consists of 24 multiple choice questions with overall choice to attempt *any* 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

26. Pick out the correct statement with respect to $[\text{Mn}(\text{CN})_6]^{2-}$

- (a) It is sp^2d^2 hybridised, tetrahedral (b) It is d^2sp^3 hybridised, octahedral
(c) It is dsp^2 hybridised, square planar (d) It is sp^3d^2 hybridised octahedral

Ans. (b)

27. The pair having the same magnetic moment is

- (At No. Cr = 24, Mn = 25, Fe = 26, Co = 27)
- (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{CoCl}_4]^{2-}$ (b) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
(c) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ (d) $[\text{CoCl}_4]^{2-}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

Ans. (b)

28. Among the ligands NH_3 , en, CN^- and CO, the correct order of field strength is
- (a) $\text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$ (b) $\text{CN}^- < \text{NH}_3 < \text{CO} < \text{en}$
 (c) $\text{en} < \text{CN}^- < \text{NH}_3 < \text{CO}$ (d) $\text{CO} < \text{NH}_3 < \text{en} < \text{CN}^-$

Ans. (a)

29. The oxidation state of Ni in $[\text{Ni}(\text{CO})_4]$ is

(a) 0 (b) 2 (c) 3 (d) 4

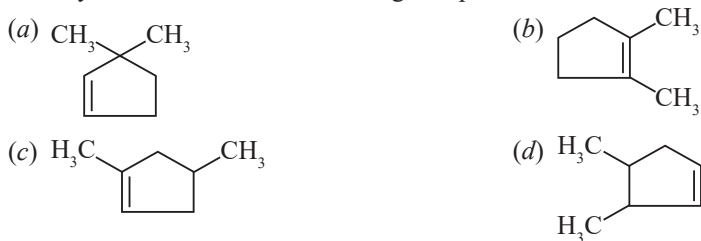
Ans. (a)

30. The formula of the complex triamminetri (nitrito-O) Cobalt (III) is

(a) $[\text{Co}(\text{ONO})_3(\text{NH}_3)_3]$ (b) $[\text{Co}(\text{NO}_2)_3(\text{NH}_3)_3]$
 (c) $[\text{Co}(\text{ONO}_2)_3(\text{NH}_3)_3]$ (d) $[\text{Co}(\text{NO}_2)(\text{NH}_3)_3]$

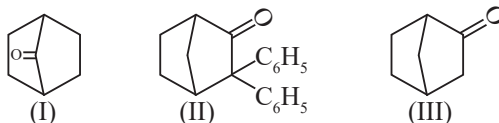
Ans. (a)

31. A single compound of the structure $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$ is obtained from ozonolysis of which of the following compound?



Ans. (c)

32. Which among the given molecules can exhibit tautomerism?



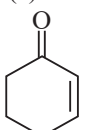
(a) III only (b) Both I and III (c) Both I and II (d) Both II and III

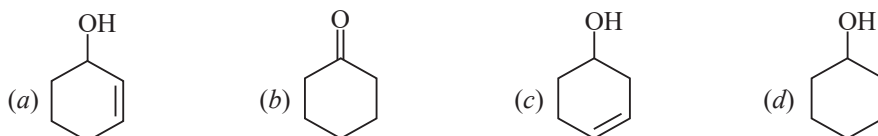
Ans. (a)

33. The product formed by the reaction of an aldehyde with a primary amine is

(a) Carboxylic acid (b) Aromatic acid
 (c) Schiff's base (d) Ketone

Ans. (c)

34.  $\xrightarrow[\text{Pd/C, ethanol}]{\text{H}_2(\text{gas, 1 atm})}$ A is



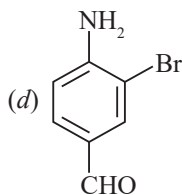
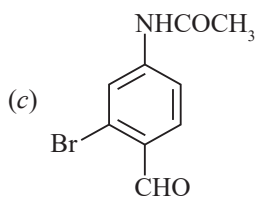
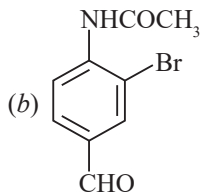
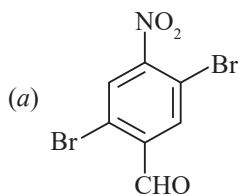
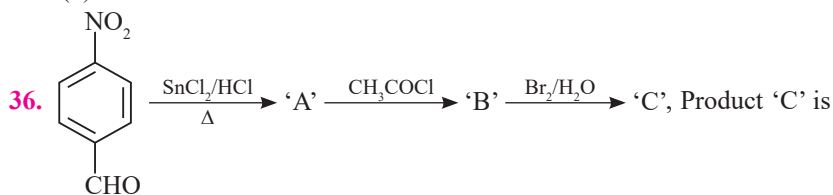
Ans. (b)

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35. The product obtained by condensation of Acetone in presence of NaOH

- (a) 3-hydroxy-3-methyl-1, 3 diphenyl propanone
 (b) 3-hydroxy-3-phenyl acetophenone
 (c) Phorone
 (d) Mesityl oxide

Ans. (d)

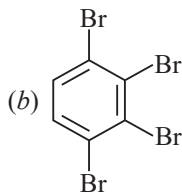
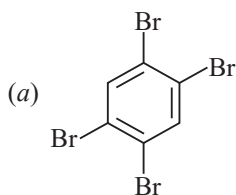
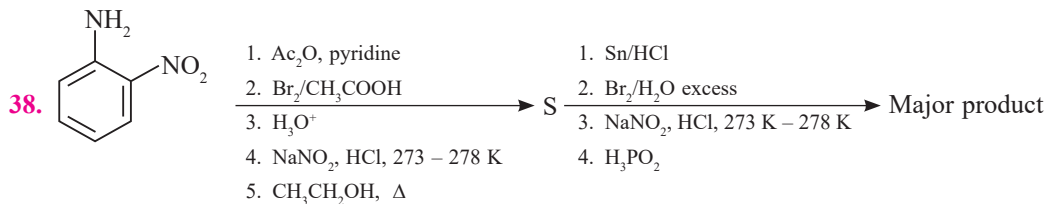


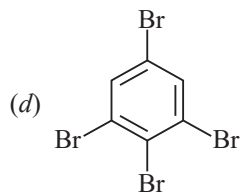
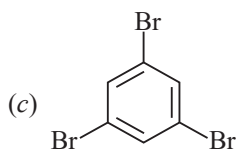
Ans. (d)

37. The major product of the reaction between *m*-dinitro benzene with NH_4HS is

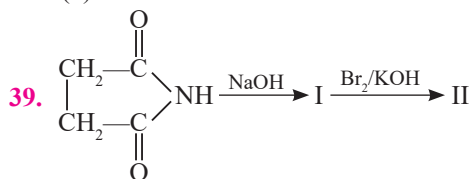
- (a) *p*-Dinitro benzene
 (b) *m*-Diamino benzene
 (c) *m*-nitroaniline
 (d) *p*-Diamino benzene

Ans. (c)





Ans. (d)



(a) β -Alanine

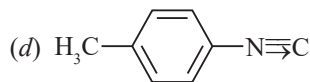
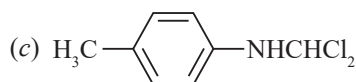
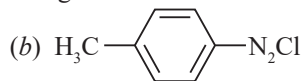
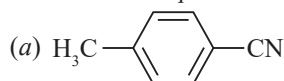
(b) α -Alanine

(c) Ethylene diamine

(d) Oxamide

Ans. (a)

40. The reaction of *p*-Toluidine with CHCl_3 and KOH gives.



Ans. (d)

41. 'A' $\xrightarrow{\text{Reduction}}$ 'B' $\xrightarrow{\text{HNO}_2}$ $\text{CH}_3\text{CH}_2\text{OH}$

The compound 'A' is

(a) propane nitrile

(b) ethane nitrile

(c) nitro methane

(d) methyl isocyanate

Ans. (b)

42. CH_3CONH_2 on reaction with NaOH and Br_2 in alcoholic medium gives

(a) $\text{CH}_3\text{CH}_2\text{NH}_2$

(b) $\text{CH}_3\text{CH}_2\text{Br}$

(c) CH_3NH_2

(d) CH_3COONa

Ans. (c)

43. In order to prepare a 1° amine from an alkyl halide with simultaneous addition of one CH_2 group in the carbon chain, the reagent used as source of nitrogen is _____.

(a) Sodium amide, NaNH_2

(b) Sodium azide, NaN_3

(c) Potassium cyanide, KCN

(d) Potassium phthalimide, $\text{C}_6\text{H}_4(\text{CO})_2\text{N}^-\text{K}^+$

Ans. (c)

44. The order of basic strength of amines in aqueous solution is

(a) $(\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > \text{NH}_3$

(b) $\text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N} > \text{NH}_3$

(c) $\text{NH}_3 > (\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2$

(d) $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$

Ans. (d)

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In the following questions (Q. No. 45 to 49), a statement of assertion is followed by a statement of a reason is given. Choose the correct answer out of the following choices.

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true but R is not the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false but R is true.

45. Assertion: Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.

Reason: For weak electrolytes degree of dissociation increases with dilution of solution.

Ans. (a)

46. Assertion: Conductivity of an electrolyte increases with decrease in concentration.

Reason: Number of ions per unit volume decreases on dilution.

Ans. (d)

47. Assertion: Cations of transition elements occur in various valence states.

Reason: Large number of oxides of transition elements are possible.

Ans. (b)

48. Assertion: Crystal structure of oxides of transition metals often show defects.

Reason: Ligand field effect cause distortions in crystal structures.

Ans. (a)

49. Assertion: $d_{x^2-y^2}$ and d_{z^2} have higher energy than d_{xy} , d_{yz} , d_{zx} orbitals in octahedral crystal field.

Reason: d_{xy} , d_{yz} , d_{zx} have higher energy than $d_{x^2-y^2}$ and d_{z^2} in tetrahedral field.

Ans. (b)

SECTION-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

50. Match the items of Column I and Column II.

Column I	Column II
(A) Mathematical expression for rate of reaction	(i) rate constant
(B) Rate of reaction for zero order reaction is equal to	(ii) rate law
(C) Units of rate constant for zero order reaction is same as that of	(iii) order of slowest step
(D) Order of a complex reaction is determined by	(iv) rate of a reaction

