NEET 2023 Manipur — Chemistry Question Paper with Solutions

48 Chemistry questions as set in the paper · answers checked by RankUp

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1. Incorrect set of quantum numbers from the following is :

(A) n = 4, ℓ = 3, mℓ = −3, −2, −1, 0, +1, +2, +3, ms = −1/2
(B) n = 5, ℓ = 2, mℓ = −2, −1, +1, +2, ms = +1/2
(C) n = 4, ℓ = 2, mℓ = −2, −1, 0, +1, +2, ms = −1/2
(D) n = 5, ℓ = 3, mℓ = −3, −2, −1, 0, +1, +2, +3, ms = +1/2

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2. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : Ionisation enthalpy increases along each series of the transition elements from left to right. However, small variations occur.
Reason (R) : There is corresponding increase in nuclear charge which accompanies the filling of electrons in the inner d-orbitals.
In the light of the above statements, choose the most appropriate answer from the options given below :

(A) (A) is correct but (R) is not correct.
(B) (A) is not correct but (R) is correct.
(C) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(D) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

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3. For a weak acid HA, the percentage of dissociation is nearly 1% at equilibrium. If the concentration of acid is 0.1 mol L^{-1}, then the correct option for its K_a at the same temperature is :

(A) 1×10^{-4}
(B) 1×10^{-6}
(C) 1×10^{-5}
(D) 1×10^{-3}

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4. The density of 1 M solution of a compound 'X' is 1.25 g mL^{-1}. The correct option for the molality of solution is (Molar mass of compound X = 85 g):

(A) 0.705 m
(B) 1.208 m
(C) 1.165 m
(D) 0.858 m

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5. Consider the given reaction:
CH_3COCH_3 —(dil $Ba(OH)_2$)→ "X"
The functional groups present in compound "X" are:

(A) ketone and double bond
(B) double bond and aldehyde
(C) alcohol and aldehyde
(D) alcohol and ketone

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6. The E⊖ values for

$Al^{+}/Al = +0.55$ V and $Tl^{+}/Tl = -0.34$ V

$Al^{3+}/Al = -1.66$ V and $Tl^{3+}/Tl = +1.26$ V

Identify the incorrect statement

(A) Al is more electropositive than Tl

(B) Tl^{3+} is a better reducing agent than Tl^{1+}

(C) Al^{+} is unstable in solution

(D) Tl can be easily oxidised to Tl^{+} than Tl^{3+}

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7. The correct order of dipole moments for molecules NH_3, H_2S, CH_4 and HF, is:

(A) $CH_4 > H_2S > NH_3 > HF$

(B) $H_2S > NH_3 > HF > CH_4$

(C) $NH_3 > HF > CH_4 > H_2S$

(D) $HF > NH_3 > H_2S > CH_4$

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8. Molar conductance of an electrolyte increases with dilution according to the equation:

$\Lambda m = \Lambda°m - A\sqrt{c}$

Which of the following statements are true?

(A) This equation applies to both strong and weak electrolytes.

(B) Value of the constant A depends upon the nature of the solvent.

(C) Value of constant A is same for both $BaCl_2$ and $MgSO_4$

(D) Value of constant A is same for both $BaCl_2$ and $Mg(OH)_2$

Choose the most appropriate answer from the options given below:

(A) (A) and (B) only

(B) (A), (B) and (C) only

(C) (B) and (C) only

(D) (B) and (D) only

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9. The correct value of cell potential in volt for the reaction that occurs when the following two half cells are connected, is

$Fe^{2+}(aq) + 2e^{-} \rightarrow Fe(s)$, $E° = -0.44$ V

$Cr_2O_7^{2-}(aq) + 14H^{+} + 6e^{-} \rightarrow 2Cr^{3+} + 7H_2O$, $E° = +1.33$ V

(A) +1.77 V

(B) +2.65 V

(C) +0.01 V

(D) +0.89 V

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10. $R\text{-}COOH \xrightarrow{\text{(i) "X", (ii) } H_2O/HCl} R\text{-}CH_2OH$

$R\text{-}CH{=}CH_2 \xrightarrow{\text{(i) "X", (ii) } H_2O,\ NaOH,\ H_2O_2} R\text{-}CH_2\text{-}CH_2\text{-}OH$

Identify 'X' in above reactions

(A) B_2H_6

(B) $LiAlH_4$

(C) $NaBH_4$

(D) H_2/Pd

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11. For a reaction 3 A → 2 B
The average rate of appearance of B is given by Δ[B]/Δt. The correct relation between the average rate of appearance of B with the average rate of disappearance of A is given in option :

(A) $-\Delta[A]/\Delta t$
(B) $-3\Delta[A]/2\Delta t$
(C) $-2\Delta[A]/3\Delta t$
(D) $\Delta[A]/\Delta t$

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12. The following conversion is known as:
$C_6H_5COCl \xrightarrow{(H_2,\ Pd\text{-}BaSO_4)} C_6H_5CHO$

(A) Stephen reaction
(B) Gattermann-Koch reaction
(C) Etard reaction
(D) Rosenmund reaction

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13. Which one of the following represents all isoelectronic species ?

(A) Na^+, Cl^-, O^-, NO^+
(B) N_2O, N_2O_4, NO^+, NO
(C) Na^+, Mg^{2+}, O^-, F^-
(D) Ca^{2+}, Ar, K^+, Cl^-

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14. Given below are two statements:
Statement I : The value of wave function, ψ depends upon the coordinates of the electron in the atom.
Statement II : The probability of finding an electron at a point within an atom is proportional to the orbital wave function.
In the light of the above statements, choose the correct answer from the options given below:

(A) Statement I is true but Statement II is false.
(B) Statement I is false but Statement II is true.
(C) Both Statement I and Statement II are true.
(D) Both Statement I and Statement II are false.

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15. Which of the following is correctly matched?

(A) Basic oxides ⇒ In_2O_3, K_2O, SnO_2
(B) Neutral oxides ⇒ CO, NO_2, N_2O
(C) Acidic oxides ⇒ Mn_2O_7, SO_2, TeO_3
(D) Amphoteric oxides ⇒ BeO, Ga_2O_3, GeO

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16. Which amongst the following reactions of alkyl halides produces isonitrile as a major product?
(A) R – X + HCN →
(B) R – X + AgCN →
(C) R – X + KCN →
(D) $R - X + NaCN \xrightarrow{(H_2O\ /\ C_2H_5OH)}$
Choose the most appropriate answer from the options given below :

(A) (D) only
(B) (C) and (D) only
(C) (B) only
(D) (A) and (B) only

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17. Match the List - I with List - II

List - I (Hydride): (A) NaH, (B) PH_3, (C) GeH_4, (D) $LaH_{2.87}$

List - II (Type of Hydride): (I) Electron precise, (II) Saline, (III) Metallic, (IV) Electron rich

Choose the correct answer from the options given below :

(A) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
(B) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
(C) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)
(D) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

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18. Which one of the following statements is incorrect related to Molecular Orbital Theory?

(A) The π* antibonding molecular orbital has a node between the nuclei.
(B) In the formation of bonding molecular orbital, the two electron waves of the bonding atoms reinforce each other.
(C) Molecular orbitals obtained from 2Px and 2Py orbitals are symmetrical around the bond axis.
(D) A π-bonding molecular orbital has larger electron density above and below the internuclear axis.

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19. An acidic buffer is prepared by mixing :

(A) weak acid and it's salt with strong base
(B) equal volumes of equimolar solutions of weak acid and weak base
(C) strong acid and it's salt with strong base
(D) strong acid and it's salt with weak base (The pK_a of acid = pK_b of the base)

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20. Reagents which can be used to convert alcohols to carboxylic acids, are

(A) CrO_3 – H_2SO_4
(B) $K_2Cr_2O_7$ + H_2SO_4
(C) $KMnO_4$ + KOH/H_3O^+
(D) Cu, 573 K
(E) CrO_3, $(CH_3CO)_2O$

Choose the most appropriate answer from the options given below :

(A) (B), (C) and (D) only
(B) (B), (D) and (E) only
(C) (A), (B) and (C) only
(D) (A), (B) and (E) only

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21. Select the element (M) whose trihalides cannot be hydrolysed to produce an ion of the form $[M(H_2O)_6]^{3+}$

(A) Ga
(B) In
(C) Al
(D) B

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22. The correct option for the rate law that corresponds to overall first order reaction is

(A) Rate = $k[A]^0[B]^2$
(B) Rate = k[A][B]
(C) Rate = k[A]^(1/2)$[B]^2$
(D) Rate = k[A]^(−1/2)[B]^(3/2)

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23. Which amongst the following compounds will show geometrical isomerism?

(A) Pent-1-ene
(B) 2, 3-Dimethylbut-2-ene
(C) 2-Methylprop-1-ene
(D) 3, 4-Dimethylhex-3-ene

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24. Given below are two statements:
Statement I : Hydrated chlorides and bromides of Ca, Sr and Ba on heating undergo hydrolysis.
Statement II : Hydrated chlorides and bromides of Be and Mg on heating undergo dehydration.
In the light of the above statements, choose the correct answer from the options given below :

(A) Statement-I is correct but Statement-II is false.
(B) Statement-I is incorrect but Statement-II is true.
(C) Both Statement-I and Statement-II are true.
(D) Both Statement-I and Statement-II are false.

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25. The correct order for the rate of α, β-dehydrohalogenation for the following compounds is _____.
(i) $CH_2=CH-CH_2-CH_2-I$
(ii) $CH_3-CH_2-CH_2-CH_2-I$
(iii) $CH_3-CH_2-CH(I)-CH_3$

(A) (i) < (ii) < (iii)
(B) (ii) < (i) < (iii)
(C) (iii) < (ii) < (i)
(D) (ii) < (iii) < (i)

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26. Type of isomerism exhibited by compounds $[Cr(H_2O)_6]Cl_3$, $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$, $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$ and the value of coordination number (CN) of central metal ion in all these compounds, respectively is :

(A) Geometrical isomerism, CN = 2
(B) Optical isomerism, CN = 4
(C) Ionisation isomerism, CN = 4
(D) Solvate isomerism, CN = 6

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27. The correct sequence given below containing neutral, acidic, basic and amphoteric oxide each, respectively, is

(A) NO, ZnO, CO_2, CaO
(B) ZnO, NO, CaO, CO_2
(C) NO, CO_2, ZnO, CaO
(D) NO, CO_2, CaO, ZnO

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28. Choose the correct sequence of reagents in the conversion of 4-nitrotoluene to 2-bromotoluene.

(A) $NaNO_2$/HCl; Sn/HCl; Br_2; H_2O/H_3PO_2
(B) Sn/HCl; $NaNO_2$/HCl; Br_2; H_2O/H_3PO_2
(C) Br_2; Sn/HCl; $NaNO_2$/HCl; H_2O/H_3PO_2
(D) Sn/HCl; Br_2; $NaNO_2$/HCl; H_2O/H_3PO_2

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29. Identify the product in the following reaction

Chlorocyclobutane (cyclobutyl chloride, C_4H_7–Cl) —(i) KCN, (ii) H_2O/HCl, Δ, (iii) Br_2/red phosphorus, (iv) H_2O→ Product

(A) Cyclobutanecarbonyl bromide (C_4H_7–COBr)
(B) 1-Bromocyclobutane-1-carboxylic acid (Br and COOH on the same ring carbon)
(C) 1-Bromo-1-chlorocyclobutane (Br and Cl on the same ring carbon)
(D) Bromocyclobutane (C_4H_7–Br)

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30. Given below are two statements:

Statement I : In an organic compound, when inductive and electromeric effects operate in opposite directions, the inductive effect predominates.

Statement II : Hyperconjugation is observed in o-xylene.

In the light of the above statements, choose the correct answer from the options given below :

(A) Statement-I is true but Statement-II is false.
(B) Statement-I is false but Statement-II is true.
(C) Both Statement-I and Statement-II are true.
(D) Both Statement-I and Statement-II are false.

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31. The correct option for a redox couple is:

(A) Both are oxidised forms involving same element.
(B) Both are reduced forms involving same element.
(C) Both the reduced and oxidised forms involve same element.
(D) Cathode and anode together.

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32. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Ionisation enthalpies of early actinoids are lower than for early lanthanoids.

Reason (R) : Electrons are entering 5f orbitals in actinoids which experience greater shielding from nuclear charge.

In the light of the above statements, choose the correct answer from the options given below :

(A) (A) is true but (R) is false.
(B) (A) is false but (R) is true.
(C) Both (A) and (R) are true and (R) is the correct explanation of (A).
(D) Both (A) and (R) are true but (R) is not the correct explanation of (A).

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33. Consider the following reaction :-

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$, $\Delta_r H^\circ = -483.64$ kJ.

What is the enthalpy change for decomposition of one mole of water? (Choose the right option).

(A) 120.9 kJ
(B) 241.82 kJ
(C) 18 kJ
(D) 100 kJ

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34. Which amongst the following aqueous solution of electrolytes will have minimum elevation in boiling point? Choose the correct option :-

(A) 0.05 M NaCl
(B) 0.1 M KCl
(C) 0.1 M $MgSO_4$
(D) 1 M NaCl

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35. Identify 'X' in the following reaction.
Br–C_6H_4–Cl (para; 1.0 mol) + Mg (1.0 mol) —(dry ether)→ Intermediate —(D_2O)→ X

(A) p-Cl–C_6H_4–D (1-chloro-4-deuteriobenzene)
(B) p-DO–C_6H_4–OD
(C) p-D–C_6H_4–D (1,4-dideuteriobenzene)
(D) p-D–C_6H_4–Br (1-bromo-4-deuteriobenzene)

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36. The major product formed in the following conversion is _____.
2-(2-Oxopropyl)cyclopentan-1-one (cyclopentanone carrying –CH_2–CO–CH_3 on the carbon next to C=O) —(i) $NaBH_4$, (ii) H_2SO_4, Δ→ Major product

(A) 1-(Prop-1-en-1-yl)cyclopent-1-ene (ring C=C at the substituted carbon, conjugated with side-chain –CH=CH–CH_3)
(B) 1-(Prop-2-en-1-yl)cyclopent-1-ene (ring C=C at the substituted carbon, side chain –CH_2–CH=CH_2)
(C) 2-(Prop-1-en-1-yl)cyclopentan-1-one
(D) 3-(Prop-1-en-1-yl)cyclopent-1-ene (ring C=C not at the substituted carbon)

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37. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : Lithium and beryllium unlike their other respective group members form compounds with pronounced ionic character.
Reason (R) : Lithium and Magnesium have similar properties due to diagonal relationship.
In the light of the above statements, choose the correct answer from the options given below:

(A) (A) is true but (R) is false.
(B) (A) is false but (R) is true.
(C) Both (A) and (R) are true and (R) is the correct explanation of (A).
(D) Both (A) and (R) are true but (R) is not the correct explanation of (A).

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38. Cheilosis occurs due to deficiency of _____.

(A) thiamine
(B) nicotinamide
(C) pyridoxamine
(D) riboflavin

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39. Which amongst the following is used in controlling depression and hypetension?

(A) Seldane
(B) Valium
(C) Equanil
(D) Prontosil

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40. The correct van der Waals equation for 1 mole of a real gas is :

(A) $(p + a/V^2)(V - b) = RT$
(B) $(p + V^2/a)(V - b) = RT$
(C) $(p + a^2/V^2)(V^2 - nb) = RT$
(D) $(p + an^2/V)(V - nb) = nRT$

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41. The correct option in which the density of argon (Atomic mass = 40) is highest:

(A) STP
(B) 0°C, 2 atm
(C) 0°C, 4 atm
(D) 273°C, 4 atm

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42. Which of the following is a positively charged sol?

(A) Methylene blue sol
(B) Congo red sol
(C) Silver sol
(D) Sb_2S_3 sol

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43. Match List - I with List - II
List - I (Mixtures/Sample): (A) Glycerol from spent lye, (B) Chloroform + Aniline, (C) Fractions of crude oil, (D) Aniline + Water
List - II (Technique used for purification): (I) Steam distillation, (II) Fractional distillation, (III) Distillation under reduced pressure, (IV) Distillation
Choose the correct answer from the options given below :

(A) (A) - (III), (B) - (IV), (C) - (II), (D) - (I)
(B) (A) - (IV), (B) - (II), (C) - (I), (D) - (III)
(C) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(D) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

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44. Given below are two statements:
Statement I : High density polythene is formed in the presence of catalyst triethylaluminium and titanium tetrachloride.
Statement II : High density polymers are chemically inert.
In the light of the above statements, choose the correct answer from the options given below :

(A) Statement I is correct but Statement II is false.
(B) Statement I is incorrect but Statement II is true.
(C) Both Statement I and Statement II are true.
(D) Both Statement I and Statement II are false.

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45. How many number of tetrahedral voids are formed in 5 mol of a compound having cubic close packed structure? (Choose the correct option)

(A) 1.550×10^{24}
(B) 3.011×10^{25}
(C) 3.011×10^{24}
(D) 6.022×10^{24}

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46. Read the following statements and choose the set of correct statements :

(A) Chrome steel is used for cutting tools and crushing machines.

(B) The fine dust of aluminium is used in paints and lacquers.

(C) Copper is used for reduction of alcohol

(D) Zinc dust is used as a reducing agent in the manufacture of paints

(E) Iron is used for galvanising zinc

Choose the most appropriate answer from the options given below :

(A) (D) and (E) only

(B) (A) and (D) only

(C) (A), (B) and (D) only

(D) (B), (C) and (D) only

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47. How are edge length 'a' of the unit cell and radius 'r' of the sphere related to each other in ccp structure? (Choose correct option for your answer)

(A) a = 2r

(B) a = r/2√2

(C) a = 4r/√3

(D) a = 2√2 r

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48. Which statement is not true about photochemical smog?

(A) Photochemical smog is harmful to humans but has no effect on plants.

(B) Plants like Pinus, Juniparus can help in reducing the photochemical smog.

(C) Photochemical smog occurs in warm, dry and sunny climate.

(D) Common components of Photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyl nitrate.

Answer key and explanations

1. Answer: (B) n = 5, ℓ = 2, mℓ = −2, −1, +1, +2, ms = +1/2

For a given ℓ, mℓ takes all $2\ell + 1$ integer values from $-\ell$ to $+\ell$ including zero. With $\ell = 2$ the set must be −2, −1, 0, +1, +2; the set for n = 5, $\ell = 2$ leaves out m$\ell = 0$, so it is incorrect. The other sets list every allowed mℓ and have $\ell < n$.

2. Answer: (C) Both (A) and (R) are correct and (R) is the correct explanation of (A).

Across a transition series the nuclear charge rises by one unit at each step while the added electron goes into the inner (n−1)d subshell, which shields the outer ns electrons only partly. The effective nuclear charge on the 4s electrons therefore rises, so ionisation enthalpy generally increases, with small irregularities from the changing d-configurations. The Reason states exactly this cause, so both are correct and the Reason explains the Assertion.

3. Answer: (C) 1×10^{-5}

For a weak acid with small α, $K_a \approx C\alpha^2$. Here α = 0.01 and C = 0.1 mol L^{-1}, so $K_a = 0.1 \times (0.01)^2 = 1 \times 10^{-5}$. Taking $K_a = C\alpha$ (giving 1×10^{-3}) forgets that α must be squared.

4. Answer: (D) 0.858 m

Take 1 L of solution: mass = 1000 mL × 1.25 g mL^{-1} = 1250 g, containing 1 mol (85 g) of X. Mass of solvent = 1250 − 85 = 1165 g = 1.165 kg, so molality = 1 mol / 1.165 kg = 0.858 m. The value 1.165 is the solvent mass in kg, not the molality.

5. Answer: (D) alcohol and ketone

Dilute base brings about aldol addition of two acetone molecules, giving diacetone alcohol, $(CH_3)_2C(OH)–CH_2–CO–CH_3$ (4-hydroxy-4-methylpentan-2-one). It contains a tertiary alcohol group and a ketone group. The C=C containing product (mesityl oxide) forms only on dehydration with heat or acid, which is not part of this step.

6. Answer: (B) Tl^{3+} is a better reducing agent than Tl^{1+}

The large positive E⊖ for Tl^{3+}/Tl (+1.26 V) shows Tl^{3+} is readily reduced, i.e. it is a strong oxidising agent, not a better reducing agent than Tl^{+}; that statement is incorrect. The negative value for Tl^{+}/Tl shows Tl is easily oxidised to Tl^{+}, Al^{3+}/Al at −1.66 V shows Al is far more electropositive, and the positive value for Al^{+}/Al shows Al^{+} tends to be reduced, so it is unstable.

7. Answer: (D) HF > NH_3 > H_2S > CH_4

HF has the most polar bond and the largest dipole moment (about 1.8 D); NH_3 is pyramidal with a lone pair adding to the bond moments (about 1.47 D); H_2S is bent but S–H bonds are weakly polar (about 0.95 D); tetrahedral CH_4 has zero dipole moment. Hence HF > NH_3 > H_2S > CH_4.

8. Answer: (D) (B) and (D) only

The Debye–Hückel–Onsager relation $\Lambda m = \Lambda^\circ m - A\sqrt{c}$ holds only for strong electrolytes, so the claim that it applies to weak electrolytes too is false. The constant A depends on the solvent, the temperature and the charge type of the electrolyte: $BaCl_2$ and $Mg(OH)_2$ are both 2:1 types and share the same A, whereas $MgSO_4$ is a 2:2 type with a different A. So only the solvent-dependence statement and the $BaCl_2$/$Mg(OH)_2$ statement are true.

9. Answer: (A) +1.77 V

Dichromate has the higher reduction potential, so it is reduced at the cathode and iron is oxidised at the anode. $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 1.33 - (-0.44) = +1.77$ V. Standard potentials are intensive, so they are not multiplied by the stoichiometric factors; adding them as 1.33 − 0.44 gives the wrong 0.89 V.

10. Answer: (A) B_2H_6

Diborane reduces carboxylic acids to primary alcohols, and it also adds to alkenes (hydroboration); oxidation of the trialkylborane with alkaline H_2O_2 gives the anti-Markovnikov alcohol R–CH_2–CH_2–OH. $LiAlH_4$ reduces the acid but does not react with an isolated C=C, $NaBH_4$ reduces neither, and H_2/Pd would simply hydrogenate the alkene.

11. Answer: (C) $-2\Delta[A]/3\Delta t$

Rate $= -(1/3)\Delta[A]/\Delta t = (1/2)\Delta[B]/\Delta t$, so $\Delta[B]/\Delta t = -(2/3)\Delta[A]/\Delta t$. Inverting the ratio to $-3\Delta[A]/2\Delta t$ is the common slip; B forms more slowly than A is used up, so the factor must be 2/3.

12. Answer: (D) Rosenmund reaction

Catalytic hydrogenation of an acyl chloride over palladium poisoned with $BaSO_4$ stops at the aldehyde; this is the Rosenmund reduction. The Stephen reaction starts from a nitrile with $SnCl_2$/HCl, the Gattermann-Koch reaction formylates benzene with CO/HCl, and the Etard reaction oxidises toluene with chromyl chloride.

13. Answer: (D) Ca^{2+}, Ar, K^+, Cl^-

Ca^{2+} (20 − 2), Ar (18), K^+ (19 − 1) and Cl^- (17 + 1) each have 18 electrons, so they are isoelectronic. In the Na^+, Mg^{2+}, O^-, F^- set, O^- has only 9 electrons while the others have 10, and the other sets mix species with very different electron counts.

14. Answer: (A) Statement I is true but Statement II is false.

ψ is a mathematical function of the electron's coordinates, so Statement I is true. The probability of finding the electron at a point is proportional to $|\psi|^2$, the square of the wave function, not to ψ itself, so Statement II is false.

15. Answer: (C) Acidic oxides ⇒ Mn_2O_7, SO_2, TeO_3

Mn_2O_7 (highest oxidation state of Mn), SO_2 and TeO_3 all dissolve in water or react with bases to give acids, so the acidic set is correct. SnO_2 is amphoteric rather than basic, NO_2 is acidic rather than neutral, and GeO is acidic rather than amphoteric, which spoils the other three sets.

16. Answer: (C) (B) only

AgCN is largely covalent, so the cyanide attacks through its nitrogen lone pair and the alkyl isocyanide R–NC is the main product. KCN and NaCN are ionic and attack through the more nucleophilic carbon, giving alkyl cyanides R–CN, and HCN is not used to make isonitriles. So only the silver cyanide reaction qualifies.

17. Answer: (D) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

NaH is an ionic (saline) hydride of an s-block metal; PH_3 has a lone pair on P beyond its bonds, so it is electron rich; GeH_4, like CH_4, has exactly enough electrons for its bonds, so it is electron precise; and the non-stoichiometric $LaH_{2.87}$ is a metallic (interstitial) hydride.

18. Answer: (C) Molecular orbitals obtained from 2Px and 2Py orbitals are symmetrical around the bond axis.

With z as the bond axis, the 2px and 2py orbitals overlap sideways to form π and π* orbitals, which are not symmetrical about the bond axis (they change sign on rotation and have a nodal plane containing the axis); only σ orbitals are cylindrically symmetrical. The other statements correctly describe the π* node between nuclei, constructive interference in bonding MOs, and electron density above and below the axis in π bonding MOs.

19. Answer: (A) weak acid and it's salt with strong base

An acidic buffer such as CH_3COOH/CH_3COONa needs a weak acid together with its conjugate base supplied by its salt with a strong base; the pair neutralises both added acid and added base. A strong acid is fully ionised and cannot act as a reservoir, and a weak acid–weak base mixture is not an acidic buffer.

20. Answer: (C) (A), (B) and (C) only

Primary alcohols are oxidised all the way to carboxylic acids by strong oxidants: Jones reagent (CrO_3–H_2SO_4), acidified dichromate, and alkaline $KMnO_4$ followed by acidification. Hot copper at 573 K only dehydrogenates alcohols to aldehydes or ketones, and CrO_3 in acetic anhydride is used to stop oxidation at the aldehyde stage (as the diacetate), so neither gives the acid.

21. Answer: (D) B

Boron has no available d-orbitals, so its maximum covalency is 4 and it cannot hold six water molecules; BCl_3 hydrolyses to boric acid instead. Al, Ga and In can expand their coordination to six and form $[M(H_2O)_6]^{3+}$ in water.

22. Answer: (D) Rate = k[A]^(−1/2)[B]^(3/2)

Overall order is the sum of the exponents: 0 + 2 = 2, 1 + 1 = 2, 1/2 + 2 = 5/2, and −1/2 + 3/2 = 1. Only the rate law with [A]^(−1/2)[B]^(3/2) is first order overall; a negative order for one reactant is allowed.

23. Answer: (D) 3, 4-Dimethylhex-3-ene

Geometrical isomerism needs two different groups on each doubly bonded carbon. In 3,4-dimethylhex-3-ene, $CH_3CH_2C(CH_3)=C(CH_3)CH_2CH_3$, each alkene carbon carries a methyl and an ethyl group, so cis and trans forms exist. Pent-1-ene and 2-methylprop-1-ene have a $=CH_2$ end, and 2,3-dimethylbut-2-ene has two identical methyls on each carbon.

24. Answer: (D) Both Statement-I and Statement-II are false.

The behaviour is the reverse of what is stated: hydrated halides of the small, highly polarising Be^{2+} and Mg^{2+} ions hydrolyse on heating (e.g. $MgCl_2{\cdot}6H_2O$ gives MgO/Mg(OH)Cl and HCl), while those of Ca, Sr and Ba simply lose water and give the anhydrous halides. So both statements are false.

25. Answer: (D) (ii) < (iii) < (i)

In 4-iodobut-1-ene the β-hydrogen is allylic and elimination gives the conjugated buta-1,3-diene, so it reacts fastest. A secondary iodide (2-iodobutane) eliminates faster than a primary one (1-iodobutane) because it gives a more substituted alkene and has more β-hydrogens. Order: 1-iodobutane < 2-iodobutane < 4-iodobut-1-ene.

26. Answer: (D) Solvate isomerism, CN = 6

The three compounds differ only in whether water is bound to Cr as a ligand or held outside as water of crystallisation (with Cl^- moving correspondingly), which is solvate (hydrate) isomerism. In each, Cr is bonded to six ligands (6 H_2O, 5 H_2O + Cl, or 4 H_2O + 2 Cl), so CN = 6.

27. Answer: (D) NO, CO_2, CaO, ZnO

NO is a neutral oxide, CO_2 is acidic (gives carbonic acid), CaO is basic (gives $Ca(OH)_2$), and ZnO is amphoteric (dissolves in both acids and alkalis). Only the sequence NO, CO_2, CaO, ZnO follows the required order; swapping ZnO and CaO is the usual trap.

28. Answer: (C) Br_2; Sn/HCl; $NaNO_2$/HCl; H_2O/H_3PO_2

Brominate first: in 4-nitrotoluene both the activating CH_3 (ortho) and the NO_2 group (meta) direct Br to C-2, giving 2-bromo-4-nitrotoluene. Sn/HCl reduces NO_2 to NH_2, $NaNO_2$/HCl forms the diazonium salt and H_3PO_2/H_2O replaces it by H, leaving 2-bromotoluene. Reducing before brominating would let the strongly directing NH_2 send Br ortho to itself, which after deamination gives 3-bromotoluene.

29. Answer: (B) 1-Bromocyclobutane-1-carboxylic acid (Br and COOH on the same ring carbon)

KCN substitutes Cl by CN, and acid hydrolysis converts the nitrile to cyclobutanecarboxylic acid. Br_2 with red phosphorus (Hell–Volhard–Zelinsky reaction) brominates the α-carbon via the acyl bromide, and the final water step hydrolyses the acyl bromide back to the acid, giving 1-bromocyclobutane-1-carboxylic acid. The acyl bromide is only an intermediate before step (iv).

30. Answer: (B) Statement-I is false but Statement-II is true.

When the inductive and electromeric effects oppose each other, the electromeric effect (a temporary, complete shift of π electrons) predominates, so Statement I is false. o-Xylene has methyl groups with α-C–H bonds attached to the benzene ring, so σ–π hyperconjugation occurs and Statement II is true.

31. Answer: (C) Both the reduced and oxidised forms involve same element.

A redox couple is the oxidised and reduced form of the same species taking part in a half-reaction, e.g. Zn^{2+}/Zn or Cu^{2+}/Cu. It is not two oxidised or two reduced forms, and the cathode and anode together make a cell, not a couple.

32. Answer: (C) Both (A) and (R) are true and (R) is the correct explanation of (A).

5f orbitals penetrate the inner electron core less than 4f orbitals, so 5f electrons are more effectively shielded from the nucleus and are held less tightly. This is exactly why the early actinoids have lower ionisation enthalpies than the early lanthanoids, so both statements are true and the Reason explains the Assertion.

33. Answer: (B) 241.82 kJ

Formation of 2 mol of water releases 483.64 kJ, so forming 1 mol releases 483.64/2 = 241.82 kJ. Decomposition is the reverse reaction, so $\Delta H = +241.82$ kJ per mole of water. Halving twice (120.9 kJ) wrongly treats the value as being for 4 mol.

34. Answer: (A) 0.05 M NaCl

$\Delta T_b \propto i \times m$. Effective particle concentrations: 0.05 M NaCl → $2 \times 0.05 = 0.1$; 0.1 M KCl → 0.2; 0.1 M $MgSO_4$ → 0.2; 1 M NaCl → 2. The 0.05 M NaCl solution has the fewest solute particles, so the smallest elevation.

35. Answer: (A) p-Cl–C_6H_4–D (1-chloro-4-deuteriobenzene)

The C–Br bond is weaker and more reactive than C–Cl, so one mole of Mg inserts selectively at the C–Br bond, giving p-ClC_6H_4MgBr. D_2O then replaces MgBr by D, giving 1-chloro-4-deuteriobenzene. With only one equivalent of Mg the chlorine is untouched, so the dideuterio product does not form.

36. Answer: (A) 1-(Prop-1-en-1-yl)cyclopent-1-ene (ring C=C at the substituted carbon, conjugated with side-chain –CH=CH–CH_3)

$NaBH_4$ reduces both ketone groups to secondary alcohols. Hot H_2SO_4 dehydrates both; elimination favours the most substituted, conjugated diene, with the ring C=C at the substituted carbon and the side-chain C=C next to it (–CH=CH–CH_3), i.e. 1-(prop-1-en-1-yl)cyclopent-1-ene. The terminal-alkene and non-conjugated isomers are less stable, and the keto-alkene would need a ketone that $NaBH_4$ has already reduced.

37. Answer: (B) (A) is false but (R) is true.

Li^+ and Be^{2+} are very small with high polarising power, so their compounds have pronounced covalent, not ionic, character; the Assertion is false. Lithium does resemble magnesium (diagonal relationship) because of similar size and charge/size ratio, so the Reason is true.

38. Answer: (D) riboflavin

Cheilosis (fissuring at the corners of the mouth and lips) is a classic symptom of vitamin B_2 (riboflavin) deficiency. Thiamine deficiency causes beriberi, nicotinamide deficiency pellagra, and pyridoxine deficiency convulsions.

39. Answer: (C) Equanil

Equanil (meprobamate) is the tranquilliser used to control depression and hypertension. Seldane (terfenadine) is an antihistamine, Valium is a tranquilliser for anxiety and stress, and Prontosil is an early sulpha antibacterial drug.

40. Answer: (A) $(p + a/V^2)(V - b) = RT$

The van der Waals equation for n moles is $(p + an^2/V^2)(V - nb) = nRT$; for n = 1 it becomes $(p + a/V^2)(V - b) = RT$. The other forms invert the a/V^2 term or have the wrong powers.

41. Answer: (C) 0°C, 4 atm

For an ideal gas $d = pM/RT$, so density is highest at the highest pressure and lowest temperature. At 0°C and 4 atm, $d = 4 \times 40/(0.0821 \times 273) \approx 7.1$ g L^{-1}, versus about 1.8 at STP, 3.6 at 0°C and 2 atm, and 3.6 at 273°C (546 K) and 4 atm.

42. Answer: (A) Methylene blue sol

Basic dyes such as methylene blue form positively charged sols. Acid dyes like congo red, metal sols such as silver, and metal sulphide sols such as Sb_2S_3 are negatively charged.

43. Answer: (A) (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

Glycerol decomposes at its boiling point, so it is recovered from spent lye by distillation under reduced pressure. Chloroform (b.p. 334 K) and aniline (b.p. 457 K) differ widely in boiling point, so simple distillation works. Crude oil fractions have close boiling points and need fractional distillation, and aniline is steam volatile and immiscible with water, so it is separated by steam distillation.

44. Answer: (C) Both Statement I and Statement II are true.

High density polythene is made by polymerising ethene with the Ziegler–Natta catalyst, triethylaluminium with titanium tetrachloride, at low pressure. Its closely packed linear chains make it chemically inert, tough and hard, so both statements are true.

45. Answer: (D) 6.022×10^{24}

In a close packed structure there are 2 tetrahedral voids per particle. Particles = $5 \times 6.022 \times 10^{23} = 3.011 \times 10^{24}$, so tetrahedral voids = $2 \times 3.011 \times 10^{24} = 6.022 \times 10^{24}$. The value 3.011×10^{24} is the number of octahedral voids (one per particle).

46. Answer: (C) (A), (B) and (D) only

Chrome steel is used for cutting tools and crushing machinery, fine aluminium dust is used in paints and lacquers, and zinc dust is a reducing agent in making dyes and paints, so these three are correct. Copper is used to dehydrogenate (oxidise) alcohols, not reduce them, and it is zinc that is used to galvanise iron, not the reverse.

47. Answer: (D) $a = 2\sqrt{2}\, r$

In ccp (fcc) the spheres touch along the face diagonal: $\sqrt{2}\, a = 4r$, so $a = 4r/\sqrt{2} = 2\sqrt{2}\, r$. $a = 2r$ is for simple cubic and $a = 4r/\sqrt{3}$ is for body-centred cubic.

48. Answer: (A) Photochemical smog is harmful to humans but has no effect on plants.

Photochemical smog damages plants as well as people: ozone and PAN injure leaves and plant growth, so the claim that it has no effect on plants is untrue. It forms in warm, dry, sunny weather, contains O_3, NO, acrolein, formaldehyde and PAN, and plants such as Pinus and Juniperus help reduce it.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.