

AIPMT 2011 Prelims — Chemistry Question Paper with Solutions

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

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1. The total number of atomic orbitals in fourth energy level of an atom is

- (A) 4
- (B) 8
- (C) 16
- (D) 32

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2. The electrode potentials for $\text{Cu}^{2+}(\text{aq}) + \text{e}^- \rightarrow \text{Cu}^+(\text{aq})$ and $\text{Cu}^+(\text{aq}) + \text{e}^- \rightarrow \text{Cu}(\text{s})$ are +0.15 V and +0.50 V respectively. The value of $E^\circ(\text{Cu}^{2+}/\text{Cu})$ will be

- (A) 0.150 V
- (B) 0.500 V
- (C) 0.325 V
- (D) 0.650 V

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3. Mole fraction of the solute in a 1.00 molal aqueous solution is

- (A) 1.7700
- (B) 0.1770
- (C) 0.0177
- (D) 0.0344

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4. A buffer solution is prepared in which the concentration of NH_3 is 0.30 M and the concentration of NH_4^+ is 0.20 M. If the equilibrium constant, K_b for NH_3 equals 1.8×10^{-5} , what is the pH of this solution?

- (A) 8.73
- (B) 9.08
- (C) 9.43
- (D) 11.72

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5. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?

- (A) $q = 0, \Delta T < 0, w \neq 0$
- (B) $q = 0, \Delta T \neq 0, w = 0$
- (C) $q \neq 0, \Delta T = 0, w = 0$
- (D) $q = 0, \Delta T = 0, w = 0$

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6. For the reaction $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$, the equilibrium constant is K_1 . The equilibrium constant is K_2 for the reaction $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$. What is K for the reaction $\text{NO}_2(\text{g}) \rightleftharpoons (1/2)\text{N}_2(\text{g}) + \text{O}_2(\text{g})$?

- (A) $1/(K_1K_2)$
- (B) $1/(2K_1K_2)$
- (C) $1/(4K_1K_2)$
- (D) $[1/(K_1K_2)]^{(1/2)}$

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7. If the enthalpy change for the transition of liquid water to steam is 30 kJ mol^{-1} at 27°C , the entropy change for the process would be

- (A) $100 \text{ J mol}^{-1} \text{ K}^{-1}$
- (B) $10 \text{ J mol}^{-1} \text{ K}^{-1}$
- (C) $1.0 \text{ J mol}^{-1} \text{ K}^{-1}$
- (D) $0.1 \text{ J mol}^{-1} \text{ K}^{-1}$

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8. The van't Hoff factor i for a compound which undergoes dissociation in one solvent and association in other solvent is respectively

- (A) Greater than one and greater than one
- (B) Less than one and greater than one
- (C) Less than one and less than one
- (D) Greater than one and less than one

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9. By what factors does the average velocity of a gaseous molecule increase when the temperature (in Kelvin) is doubled?

- (A) 1.4
- (B) 2.0
- (C) 2.8
- (D) 4.0

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10. Standard electrode potential for $\text{Sn}^{4+}/\text{Sn}^{2+}$ couple is $+0.15 \text{ V}$ and that for the Cr^{3+}/Cr couple is -0.74 V . These two couples in their standard state are connected to make a cell. The cell potential will be

- (A) $+1.83 \text{ V}$
- (B) $+1.19 \text{ V}$
- (C) $+0.89 \text{ V}$
- (D) $+0.18 \text{ V}$

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11. If the E°_{cell} for a given reaction has a negative value, then which of the following gives the correct relationships for the values of ΔG° and K_{eq} ?

- (A) $\Delta G^\circ > 0$; $K_{\text{eq}} < 1$
- (B) $\Delta G^\circ > 0$; $K_{\text{eq}} > 1$
- (C) $\Delta G^\circ < 0$; $K_{\text{eq}} > 1$
- (D) $\Delta G^\circ < 0$; $K_{\text{eq}} < 1$

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12. Two gases A and B having the same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molecular mass of A is 49 u. Molecular mass of B will be

- (A) 25.00 u
- (B) 50.00 u
- (C) 12.25 u
- (D) 6.50 u

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13. The freezing point depression constant for water is $-1.86^\circ\text{C m}^{-1}$. If 5.00 g Na_2SO_4 is dissolved in 45.0 g H_2O , the freezing point is changed by -3.82°C . Calculate the van't Hoff factor for Na_2SO_4

- (A) 0.381
- (B) 2.05
- (C) 2.63
- (D) 3.11

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14. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths i.e. λ_1 and λ_2 will be

- (A) $\lambda_1 = (1/2)\lambda_2$
- (B) $\lambda_1 = \lambda_2$
- (C) $\lambda_1 = 2\lambda_2$
- (D) $\lambda_1 = 4\lambda_2$

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15. Standard electrode potential of three metals X, Y and Z are -1.2 V, +0.5 V and -3.0 V respectively. The reducing power of these metals will be

- (A) $X > Y > Z$
- (B) $Y > Z > X$
- (C) $Y > X > Z$
- (D) $Z > X > Y$

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

- (A) $x/m = p \times T$
- (B) $x/m = f(p)$ at constant T
- (C) $x/m = f(T)$ at constant p
- (D) $p = f(T)$ at constant (x/m)

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17. Which one of the following statements for the order of a reaction is incorrect?

- (A) Order of reaction is always whole number
- (B) Order can be determined only experimentally
- (C) Order is not influenced by stoichiometric coefficient of the reactants
- (D) Order of reaction is sum of power to the concentration terms of reactants to express the rate of reaction

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18. Enthalpy change for the reaction, $4H(g) \rightarrow 2H_2(g)$ is -869.6 kJ. The dissociation energy of H-H bond is

- (A) +217.4 kJ
- (B) -434.8 kJ
- (C) -869.6 kJ
- (D) +434.8 kJ

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19. If $n = 6$, the correct sequence of filling of electrons will be

- (A) $ns \rightarrow np \rightarrow (n-1)d \rightarrow (n-2)f$
- (B) $ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$
- (C) $ns \rightarrow (n-1)d \rightarrow (n-2)f \rightarrow np$
- (D) $ns \rightarrow (n-2)f \rightarrow np \rightarrow (n-1)d$

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20. The correct order of increasing bond length of C-H, C-O, C-C and C=C is

- (A) $C-H < C-O < C-C < C=C$
- (B) $C-H < C=C < C-O < C-C$
- (C) $C-C < C=C < C-O < C-H$
- (D) $C-O < C-H < C-C < C=C$

21. A gaseous mixture was prepared by taking equal mole of CO and N₂. If the total pressure of the mixture was found 1 atmosphere, the partial pressure of the nitrogen (N₂) in the mixture is

- (A) 1 atm
- (B) 0.5 atm
- (C) 0.8 atm
- (D) 0.9 atm

22. Acidified K₂Cr₂O₇ solution turns green when Na₂SO₃ is added to it. This is due to the formation of

- (A) CrSO₄
- (B) Cr₂(SO₄)₃
- (C) CrO₄²⁻
- (D) Cr₂(SO₃)₃

23. Which of the following is least likely to behave as Lewis base?

- (A) OH⁻
- (B) H₂O
- (C) NH₃
- (D) BF₃

24. The complex [Pt(Py)(NH₃)BrCl] will have how many geometrical isomers?

- (A) 2
- (B) 3
- (C) 4
- (D) 0

25. The complexes [Co(NH₃)₆][Cr(CN)₆] and [Cr(NH₃)₆][Co(CN)₆] are the examples of which type of isomerism?

- (A) Geometrical isomerism
- (B) Linkage isomerism
- (C) Ionization isomerism
- (D) Coordination isomerism

26. The d-electron configurations of Cr²⁺, Mn²⁺, Fe²⁺ and Co²⁺ are d⁴, d⁵, d⁶ and d⁷ respectively. Which one of the following will exhibit minimum paramagnetic behaviour? (At. nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)

- (A) [Cr(H₂O)₆]²⁺
- (B) [Mn(H₂O)₆]²⁺
- (C) [Fe(H₂O)₆]²⁺
- (D) [Co(H₂O)₆]²⁺

27. Of the following complex ions, which is diamagnetic in nature?

- (A) [CoF₆]³⁻
- (B) [NiCl₄]²⁻
- (C) [Ni(CN)₄]²⁻
- (D) [CuCl₄]²⁻

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28. Which of the following has the minimum bond length?

- (A) O_2
- (B) O_2^+
- (C) O_2^-
- (D) O_2^{2-}

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29. The value of ΔH for the reaction $X_2(g) + 4Y_2(g) \rightleftharpoons 2XY_4(g)$ is less than zero.

Formation of $XY_4(g)$ will be favoured at

- (A) High pressure and low temperature
- (B) High temperature and high pressure
- (C) Low pressure and low temperature
- (D) High temperature and low pressure

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30. Which of the following pairs of metals is purified by van Arkel method?

- (A) Ni and Fe
- (B) Ga and In
- (C) Zr and Ti
- (D) Ag and Au

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31. What is the product obtained in the following reaction?

$C_6H_5NO_2 \xrightarrow{(Zn, NH_4Cl)} ?$

- (A) $C_6H_5NH_2$ (aniline)
- (B) C_6H_5NHOH (N-phenylhydroxylamine)
- (C) $C_6H_5-N=N-C_6H_5$ (azobenzene)
- (D) $C_6H_5-N(O^-)=N^+-C_6H_5$ (azoxybenzene)

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32. In a set of reactions m-bromobenzoic acid (A) gave a product D:

$A \xrightarrow{(SOCl_2)} B \xrightarrow{(NH_3)} C \xrightarrow{(NaOH, Br_2)} D$

Identify the product D.

- (A) 3-Bromobenzamide ($m\text{-Br-C}_6\text{H}_4\text{-CONH}_2$)
- (B) 3-Bromobenzenesulphonamide ($m\text{-Br-C}_6\text{H}_4\text{-SO}_2\text{NH}_2$)
- (C) 3-Aminobenzoic acid ($m\text{-H}_2\text{N-C}_6\text{H}_4\text{-COOH}$)
- (D) 3-Bromoaniline ($m\text{-Br-C}_6\text{H}_4\text{-NH}_2$)

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33. In Dumas' method of estimation of nitrogen 0.35 g of an organic compound gave 55 mL of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound would be (Aqueous tension at 300 K = 15 mm)

- (A) 14.45
- (B) 15.45
- (C) 16.45
- (D) 17.45

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34. Which one is a nucleophilic substitution reaction among the following?

- (A) $CH_3CHO + HCN \rightarrow CH_3CH(OH)CN$
- (B) $CH_3-CH=CH_2 + H_2O \xrightarrow{(H^+)} CH_3-CH(OH)-CH_3$
- (C) $RCHO + R'MgX \rightarrow R-CH(OH)-R'$
- (D) $CH_3-CH_2-CH(CH_3)-CH_2Br + NH_3 \rightarrow CH_3-CH_2-CH(CH_3)-CH_2NH_2$

35. Which of the following elements is present as the impurity to the maximum extent in the pig iron?

- (A) Phosphorus
- (B) Manganese
- (C) Carbon
- (D) Silicon

36. Considering the state of hybridization of carbon atoms, find out the molecule among the following which is linear?

- (A) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$
- (B) $\text{CH}_3\text{-CH=CH-CH}_3$
- (C) $\text{CH}_3\text{-C}\equiv\text{C-CH}_3$
- (D) $\text{CH}_2\text{=CH-CH}_2\text{-C}\equiv\text{CH}$

37. In the following reactions,

(a) $\text{CH}_3\text{-CH(CH}_3\text{)-CH(OH)-CH}_3 \xrightarrow{\text{H}^+/\text{heat}}$ A (major product) + B (minor product)

(b) A $\xrightarrow{\text{HBr, dark, in absence of peroxide}}$ C (major product) + D (minor product)

The major products (A) and (C) are respectively

- (A) $\text{CH}_2\text{=C(CH}_3\text{)-CH}_2\text{-CH}_3$ and $\text{CH}_3\text{-CBr(CH}_3\text{)-CH}_2\text{-CH}_3$
- (B) $\text{CH}_2\text{=C(CH}_3\text{)-CH}_2\text{-CH}_3$ and $\text{BrCH}_2\text{-CH(CH}_3\text{)-CH}_2\text{-CH}_3$
- (C) $\text{CH}_3\text{-C(CH}_3\text{)=CH-CH}_3$ and $\text{CH}_3\text{-CBr(CH}_3\text{)-CH}_2\text{-CH}_3$
- (D) $\text{CH}_3\text{-C(CH}_3\text{)=CH-CH}_3$ and $\text{CH}_3\text{-CH(CH}_3\text{)-CHBr-CH}_3$

38. The Lassaigne's extract is boiled with conc. HNO_3 while testing for halogens. By doing so it

- (A) Increases the concentration of NO_3^- ions
- (B) Decomposes Na_2S and NaCN , if formed
- (C) Helps in the precipitation of AgCl
- (D) Increases the solubility product of AgCl

39. Name the type of the structure of silicate in which one oxygen atom of $[\text{SiO}_4]^{4-}$ is shared?

- (A) Three dimensional
- (B) Linear chain silicate
- (C) Sheet silicate
- (D) Pyrosilicate

40. Clemmensen reduction of a ketone is carried out in the presence of which of the following?

- (A) H_2 and Pt as catalyst
- (B) Glycol with KOH
- (C) Zn-Hg with HCl
- (D) LiAlH_4

41. Which one of the following statements is not true regarding (+) Lactose?

- (A) (+) Lactose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ contains 8 -OH groups
- (B) On hydrolysis (+) Lactose gives equal amount of D(+) glucose and D(+) galactose
- (C) (+) Lactose is a β -glycoside formed by the union of a molecule of D(+) glucose and a molecule of D(+) galactose
- (D) (+) Lactose is a reducing sugar and does not exhibit mutarotation

42. Of the following which one is classified as polyester polymer?

- (A) Nylon-66
- (B) Terylene
- (C) Bakelite
- (D) Melamine

43. Which one of the following is employed as Antihistamine?

- (A) Omeprazole
- (B) Chloramphenicol
- (C) Diphenhydramine
- (D) Norethindrone

44. Which one of the following statements is not true?

- (A) Oxides of sulphur, nitrogen and carbon are the most widespread air pollutant
- (B) pH of drinking water should be between 5.5 – 9.5
- (C) Concentration of DO below 6 ppm is good for the growth of fish
- (D) Clean water would have a BOD value of less than 5 ppm

Answer key and explanations

1. Answer: (C) 16

The number of orbitals in shell n is n^2 . For $n = 4$ (4s, 4p, 4d, 4f: $1 + 3 + 5 + 7$) this is 16 orbitals. 32 is the maximum number of electrons ($2n^2$), not orbitals.

2. Answer: (C) 0.325 V

Potentials are not additive but free energies are: $\Delta G^\circ = -nFE^\circ$. $-2F \cdot E^\circ = -1F(0.15) - 1F(0.50)$, so $E^\circ(\text{Cu}^{2+}/\text{Cu}) = 0.65/2 = 0.325$ V. Simply adding the potentials gives 0.65 V, the trap.

3. Answer: (C) 0.0177

1.00 molal means 1 mol solute per 1000 g water, i.e. $1000/18 = 55.56$ mol water. Mole fraction of solute = $1/(1 + 55.56) = 0.0177$. Note this is the mole fraction, not the molality, so it must be much smaller than 1; 0.177 is a decimal slip.

4. Answer: (C) 9.43

$\text{pK}_b = -\log(1.8 \times 10^{-5}) = 4.74$. $\text{pOH} = \text{pK}_b + \log([\text{NH}_4^+]/[\text{NH}_3]) = 4.74 + \log(0.20/0.30) = 4.74 - 0.18 = 4.57$, so $\text{pH} = 14 - 4.57 = 9.43$. Swapping the ratio gives pOH 4.92 and pH 9.08, the trap.

5. Answer: (D) $q = 0$, $\Delta T = 0$, $w = 0$

In free expansion into vacuum, no work is done ($w = 0$) and in adiabatic conditions $q = 0$. Thus $\Delta U = 0$, and for an ideal gas U depends only on T , so $\Delta T = 0$ as well. A temperature drop would occur only for a real gas or reversible adiabatic expansion.

6. Answer: (D) $[1/(K_1K_2)]^{1/2}$

Adding the two given reactions gives $\text{N}_2 + 2\text{O}_2 \rightleftharpoons 2\text{NO}_2$ with $K = K_1K_2$. The required reaction is the reverse of this halved, so $K = (K_1K_2)^{-1/2} = [1/(K_1K_2)]^{1/2}$. Halving a reaction takes the square root of K ; it does not divide K by 2.

7. Answer: (A) $100 \text{ J mol}^{-1} \text{ K}^{-1}$

At the transition temperature $\Delta S = \Delta H/T = 30000 \text{ J mol}^{-1}/300 \text{ K} = 100 \text{ J mol}^{-1} \text{ K}^{-1}$. Forgetting to convert kJ to J gives 0.1, the trap.

8. Answer: (D) Greater than one and less than one

Dissociation increases the number of solute particles, so $i > 1$; association decreases it, so $i < 1$. Reversing these is the trap.

9. Answer: (A) 1.4

Average speed is proportional to $\sqrt{T}$ ($v = \sqrt{8RT/\pi M}$). Doubling the Kelvin temperature increases it by $\sqrt{2} \approx 1.4$ times. A factor 2 would apply to kinetic energy, not speed.

10. Answer: (C) +0.89 V

The couple with higher reduction potential, $\text{Sn}^{4+}/\text{Sn}^{2+}$, is the cathode and Cr is the anode. $E^\circ_{\text{cell}} = 0.15 - (-0.74) = +0.89$ V. Multiplying by stoichiometric coefficients (to get 1.83 V) is wrong since E° is intensive.

11. Answer: (A) $\Delta G^\circ > 0$; $K_{eq} < 1$

$\Delta G^\circ = -nFE^\circ_{cell}$, so a negative E°_{cell} makes ΔG° positive. Since $\Delta G^\circ = -RT \ln K$, a positive ΔG° means $\ln K < 0$, i.e. $K < 1$: the reaction is non-spontaneous as written.

12. Answer: (C) 12.25 u

Time to diffuse equal volumes is proportional to $\sqrt{M}$ (Graham's law). $t_A/t_B = 20/10 = 2 = \sqrt{(49/MB)}$, so $MB = 49/4 = 12.25$ u. Taking the time ratio directly instead of its square gives 24.5 u.

13. Answer: (C) 2.63

Moles of $\text{Na}_2\text{SO}_4 = 5.00/142 = 0.0352$ mol; molality = $0.0352/0.0450$ kg = 0.782 m. $i = \Delta T_f/(K_f \cdot m) = 3.82/(1.86 \times 0.782) = 3.82/1.455 = 2.63$. Ideal complete dissociation would give 3, so 3.11 is too high.

14. Answer: (C) $\lambda_1 = 2\lambda_2$

$E = hc/\lambda$, so $\lambda \propto 1/E$. E_2 is twice E_1 , so $\lambda_2 = \lambda_1/2$, i.e. $\lambda_1 = 2\lambda_2$. The higher-energy radiation has the shorter wavelength, so $\lambda_1 = \lambda_2/2$ is the reverse.

15. Answer: (D) $Z > X > Y$

The more negative the standard reduction potential, the more readily the metal is oxidised, so the stronger the reducing agent. Order: $Z (-3.0 \text{ V}) > X (-1.2 \text{ V}) > Y (+0.5 \text{ V})$.

16. Answer: (A) $x/m = p \times T$

Adsorption is described by isotherms (x/m as a function of p at constant T), isobars (x/m against T at constant p) and isosteres (p against T at constant x/m). A simple product $x/m = p \times T$ is not an adsorption relation.

17. Answer: (A) Order of reaction is always whole number

Order is an experimental quantity and can be zero, fractional or even negative, so the claim that it is always a whole number is incorrect. It is determined experimentally, does not have to follow stoichiometric coefficients, and equals the sum of the powers of concentration terms in the rate law.

18. Answer: (D) +434.8 kJ

$4\text{H(g)} \rightarrow 2\text{H}_2\text{(g)}$ forms two H-H bonds and releases 869.6 kJ. Breaking one mole of H-H bonds therefore needs $869.6/2 = +434.8$ kJ. Dissociation energy is always positive, so the negative values are wrong.

19. Answer: (B) $ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$

For $n = 6$ the Aufbau order is $6s \rightarrow 4f \rightarrow 5d \rightarrow 6p$ (as in Cs, Ba, La/Ce onwards, Hf, then Tl), i.e. $ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$. Filling np before the inner d and f orbitals is the trap.

20. Answer: (B) $\text{C-H} < \text{C}=\text{C} < \text{C-O} < \text{C-C}$

Typical bond lengths: $\text{C-H} \approx 109$ pm, $\text{C}=\text{C} \approx 134$ pm, $\text{C-O} \approx 143$ pm, $\text{C-C} \approx 154$ pm. So the increasing order is $\text{C-H} < \text{C}=\text{C} < \text{C-O} < \text{C-C}$. A double bond is shorter than any of the carbon single bonds to C or O.

21. Answer: (B) 0.5 atm

By Dalton's law, partial pressure = mole fraction $\times$ total pressure. Equal moles of CO and N_2 make the mole fraction of N_2 0.5, so $p(\text{N}_2) = 0.5 \times 1 = 0.5$ atm. Their equal molar masses do not change this.

22. Answer: (B) $\text{Cr}_2(\text{SO}_4)_3$

Sulphite reduces dichromate in acid: $\text{Cr}_2\text{O}_7^{2-} + 3\text{SO}_3^{2-} + 8\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{SO}_4^{2-} + 4\text{H}_2\text{O}$. The green colour is due to Cr^{3+} , i.e. $\text{Cr}_2(\text{SO}_4)_3$. Chromate is yellow and Cr would not be reduced to +2.

23. Answer: (D) BF_3

A Lewis base donates an electron pair. OH^- , H_2O and NH_3 all have lone pairs, whereas BF_3 has an incomplete octet on boron and accepts a pair, so it is a Lewis acid and least likely to act as a base.

24. Answer: (B) 3

$[\text{Pt}(\text{py})(\text{NH}_3)\text{BrCl}]$ is square planar of type $[\text{Mabcd}]$. Fixing one ligand, any of the other three can be trans to it, giving 3 geometrical isomers. Two isomers is the answer only for $[\text{Ma}_2\text{b}_2]$ -type complexes.

25. Answer: (D) Coordination isomerism

Both compounds have the same formula, but the ligands are exchanged between the cobalt and chromium centres of the cationic and anionic complexes. This is coordination isomerism. Ionisation isomerism would involve exchange of an ion between the coordination sphere and the counter-ion.

26. Answer: (D) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$

H_2O is a weak-field ligand, so all are high-spin: d^4 (Cr^{2+}) has 4 unpaired electrons, d^5 (Mn^{2+}) 5, d^6 (Fe^{2+}) 4 and d^7 (Co^{2+}) 3. Fewest unpaired electrons means least paramagnetism, so the cobalt complex. The manganese complex is the most paramagnetic.

27. Answer: (C) $[\text{Ni}(\text{CN})_4]^{2-}$

Ni^{2+} is d^8 ; strong-field CN^- pairs all electrons and gives a dsp^2 square planar complex with no unpaired electrons, so $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic. $[\text{NiCl}_4]^{2-}$ is tetrahedral sp^3 with 2 unpaired electrons, $[\text{CoF}_6]^{3-}$ has 4 and $[\text{CuCl}_4]^{2-}$ (d^9) has 1.

28. Answer: (B) O_2^+

MO bond orders: O_2^+ 2.5, O_2 2, O_2^- 1.5, O_2^{2-} 1. Bond length decreases as bond order increases, so O_2^+ has the shortest bond. Adding electrons fills π^* orbitals and lengthens the bond.

29. Answer: (A) High pressure and low temperature

The forward reaction reduces gas moles from 5 to 2, so high pressure shifts it forward (Le Chatelier). It is exothermic ($\Delta H < 0$), so low temperature favours products. Hence high pressure and low temperature.

30. Answer: (C) Zr and Ti

In the van Arkel method, the impure metal forms a volatile iodide (e.g. ZrI_4 , TiI_4) which is decomposed on a hot tungsten filament to give very pure metal. It is used for zirconium and titanium; nickel is refined by the Mond process instead.

31. Answer: (B) $\text{C}_6\text{H}_5\text{NHOH}$ (N-phenylhydroxylamine)

Nitrobenzene in neutral medium (Zn dust with NH_4Cl) is reduced only as far as N-phenylhydroxylamine, $\text{C}_6\text{H}_5\text{NHOH}$. Aniline forms in acidic medium (Sn/HCl or Fe/HCl), and azo/azoxy compounds in alkaline reductions.

32. Answer: (D) 3-Bromoaniline ($m\text{-Br-C}_6\text{H}_4\text{-NH}_2$)

SOCl_2 converts the acid to m-bromobenzoyl chloride, NH_3 converts it to m-bromobenzamide, and Br_2/NaOH (Hoffmann bromamide degradation) removes the carbonyl carbon to give m-bromoaniline. The amide is only the intermediate C, not the final product.

33. Answer: (C) 16.45

Pressure of dry $\text{N}_2 = 715 - 15 = 700$ mm. Volume at STP $= 55 \times (700/760) \times (273/300) = 46.1$ mL. Mass of $\text{N}_2 = 28 \times 46.1/22400 = 0.0576$ g, so %N $= 0.0576/0.35 \times 100 \approx 16.5$ (16.45). Forgetting the aqueous tension correction gives a higher value.

34. Answer: (D) $\text{CH}_3\text{-CH}_2\text{-CH}(\text{CH}_3)\text{-CH}_2\text{Br} + \text{NH}_3 \rightarrow \text{CH}_3\text{-CH}_2\text{-CH}(\text{CH}_3)\text{-CH}_2\text{NH}_2$

In the reaction of the primary alkyl bromide with NH_3 , the nucleophile NH_3 replaces Br^- , which is nucleophilic substitution. The cyanohydrin and Grignard reactions are nucleophilic additions to $\text{C}=\text{O}$, and acid-catalysed hydration of propene is electrophilic addition.

35. Answer: (C) Carbon

Pig iron from the blast furnace contains about 4% carbon, far more than its silicon, manganese or phosphorus impurities. That high carbon content is what makes it hard and brittle.

36. Answer: (C) $\text{CH}_3\text{-C}\equiv\text{C-CH}_3$

In $\text{CH}_3\text{-C}\equiv\text{C-CH}_3$ both triple-bonded carbons are sp hybridised (180°), so all four carbons lie on a straight line. Butane and but-2-ene contain sp^3 or sp^2 carbons that bend the chain, and pent-1-en-4-yne has sp^3 and sp^2 centres.

37. Answer: (C) $\text{CH}_3\text{-C}(\text{CH}_3)=\text{CH-CH}_3$ and $\text{CH}_3\text{-CBr}(\text{CH}_3)\text{-CH}_2\text{-CH}_3$

Protonation and loss of water from 3-methylbutan-2-ol gives a secondary carbocation, which undergoes a 1,2-hydride shift to the tertiary cation; loss of H^+ gives the more substituted alkene 2-methylbut-2-ene (Saytzeff). HBr adds by Markovnikov's rule without peroxide, giving 2-bromo-2-methylbutane. The 2-methylbut-1-ene or anti-Markovnikov products are the minor/trap options.

38. Answer: (B) Decomposes Na_2S and NaCN , if formed

If N or S is present, Na_2S and NaCN are in the Lassaigne extract and would give black Ag_2S or white AgCN with AgNO_3 , interfering with the halide test. Boiling with HNO_3 decomposes them (releasing H_2S and HCN). It does not change the solubility product of AgCl .

39. Answer: (D) Pyrosilicate

Sharing one oxygen atom between two SiO_4^{4-} tetrahedra gives the $\text{Si}_2\text{O}_7^{6-}$ unit, the pyrosilicate. Chains need two shared oxygens per tetrahedron, sheets three and three-dimensional networks all four.

40. Answer: (C) Zn-Hg with HCl

Clemmensen reduction converts $\text{C}=\text{O}$ to CH_2 using zinc amalgam and concentrated HCl . Hydrazine with KOH in ethylene glycol is the Wolff-Kishner reduction, and LiAlH_4 reduces ketones only to alcohols.

41. Answer: (D) (+) Lactose is a reducing sugar and does not exhibit mutarotation

Lactose has a free hemiacetal group on its glucose unit, so it is a reducing sugar and does show mutarotation; the statement that it does not mutarotate is false. It has 8 -OH groups, is a β -glycoside of D-galactose and D-glucose, and hydrolyses to equal amounts of the two.

42. Answer: (B) Terylene

Terylene (Dacron) is made from ethylene glycol and terephthalic acid, linked by ester bonds, so it is a polyester. Nylon-66 is a polyamide, while Bakelite and melamine are formaldehyde resins.

43. Answer: (C) Diphenhydramine

Diphenhydramine (Benadryl) blocks histamine receptors and is an antihistamine. Omeprazole is an antacid (proton pump inhibitor), chloramphenicol is an antibiotic and norethindrone is an antifertility drug.

44. Answer: (C) Concentration of DO below 6 ppm is good for the growth of fish

Fish need dissolved oxygen of about 6 ppm or more; DO below 6 ppm suppresses their growth, so calling it good is false. Clean water has BOD below 5 ppm, and oxides of S, N and C are the most widespread air pollutants.

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.