

AIPMT 2012 Prelims — Chemistry Question Paper with Solutions

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

AIPMT 2012 Prelims

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

- (A) Fehling solution test
- (B) Benedict test
- (C) Iodoform test
- (D) Tollens' reagent test

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2. p_A and p_B are the vapour pressures of pure liquid components A and B, respectively, of an ideal binary solution. If x_A represents the mole fraction of component A, the total pressure of the solution will be

- (A) $p_B + x_A(p_A - p_B)$
- (B) $p_A + x_A(p_B - p_A)$
- (C) $p_A + x_A(p_A - p_B)$
- (D) $p_B + x_A(p_B - p_A)$

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3. Equimolar solutions of the following substances were prepared separately. Which one of these will record the highest pH value?

- (A) BeCl_2
- (B) BaCl_2
- (C) AlCl_3
- (D) LiCl

AIPMT 2012 Prelims · Q3

4. Which one of the following is not a condensation polymer?

- (A) Neoprene
- (B) Melamine
- (C) Glyptal
- (D) Dacron

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5. In the following reaction:

$(\text{CH}_3)_3\text{C}-\text{CH}=\text{CH}_2 \xrightarrow{(\text{H}_2\text{O}/\text{H}^+)} \text{A (major product)} + \text{B (minor product)}$

The major product is

- (A) $(\text{CH}_3)_3\text{C}-\text{CH}_2-\text{CH}_2\text{OH}$
- (B) $(\text{CH}_3)_2\text{C}(\text{OH})-\text{CH}(\text{CH}_3)_2$
- (C) $\text{HOCH}_2-\text{C}(\text{CH}_3)(\text{OH})-\text{CH}_2\text{CH}_3$
- (D) $(\text{CH}_3)_3\text{C}-\text{CH}(\text{OH})-\text{CH}_3$

AIPMT 2012 Prelims · Q4

6. A metal crystallizes with a face-centered cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is

- (A) 204 pm
- (B) 288 pm
- (C) 408 pm
- (D) 144 pm

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7. The enthalpy of fusion of water is 1.435 kcal/mol. The molar entropy change for the melting of ice at 0°C is

- (A) 0.526 cal/(mol K)
- (B) 10.52 cal/(mol K)
- (C) 21.04 cal/(mol K)
- (D) 5.260 cal/(mol K)

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8. Limiting molar conductivity of NH_4OH , i.e. $\Lambda^\circ \text{m}(\text{NH}_4\text{OH})$, is equal to

- (A) $\Lambda^\circ \text{m}(\text{NH}_4\text{Cl}) + \Lambda^\circ \text{m}(\text{NaOH}) - \Lambda^\circ \text{m}(\text{NaCl})$
- (B) $\Lambda^\circ \text{m}(\text{NH}_4\text{Cl}) + \Lambda^\circ \text{m}(\text{NaCl}) - \Lambda^\circ \text{m}(\text{NaOH})$
- (C) $\Lambda^\circ \text{m}(\text{NaOH}) + \Lambda^\circ \text{m}(\text{NaCl}) - \Lambda^\circ \text{m}(\text{NH}_4\text{Cl})$
- (D) $\Lambda^\circ \text{m}(\text{NH}_4\text{OH}) + \Lambda^\circ \text{m}(\text{NH}_4\text{Cl}) - \Lambda^\circ \text{m}(\text{HCl})$

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9. Buffer solutions have constant acidity and alkalinity because:

- (A) they have fixed value of pH
- (B) these give unionised acid or base on reaction with added acid or alkali
- (C) acids and alkalies in these solutions are shielded from attack by other ions
- (D) they have large excess of H^+ or OH^- ions

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10. Which one of the following pairs is isostructural (i.e. having the same shape and hybridization)?

- (A) BF_4^- and NH_4^+
- (B) BCl_3 and BrCl_3
- (C) NH_3 and NO_3^-
- (D) NF_3 and BF_3

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11. pH of a saturated solution of $\text{Ba}(\text{OH})_2$ is 12. The value of solubility product (K_{sp}) of $\text{Ba}(\text{OH})_2$ is

- (A) 5.0×10^{-6}
- (B) 3.3×10^{-7}
- (C) 5.0×10^{-7}
- (D) 4.0×10^{-6}

AIPMT 2012 Prelims · Q9

12. Which one of the following is a mineral of iron?

- (A) Magnetite
- (B) Malachite
- (C) Cassiterite
- (D) Pyrolusite

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13. Deficiency of vitamin B_1 causes the disease

- (A) Sterility
- (B) Convulsions
- (C) Beri-Beri
- (D) Cheilosis

AIPMT 2012 Prelims · Q10

14. In Freundlich Adsorption isotherm, the value of $1/n$ is:

- (A) 1 in case of chemisorption
- (B) between 0 and 1 in all cases
- (C) between 2 and 4 in all cases
- (D) 1 in case of physical adsorption

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15. Acetone is treated with excess of ethanol in the presence of hydrochloric acid. The product obtained is:

- (A) $(\text{CH}_3)_2\text{C}(\text{OC}_2\text{H}_5)_2$
- (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{-CO-CH}_3$
- (C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{-CO-CH}_2\text{CH}_2\text{CH}_3$
- (D) $(\text{CH}_3)_2\text{C}(\text{OH})(\text{OC}_2\text{H}_5)$

AIPMT 2012 Prelims · Q11

16. Identify the alloy containing a non-metal as a constituent in it.

- (A) Bronze
- (B) Invar
- (C) Steel
- (D) Bell metal

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17. Which one of the following statements is incorrect about enzyme catalysis?

- (A) Enzymes are least reactive at optimum temperature
- (B) Enzymes are mostly proteinous in nature
- (C) Enzyme action is specific
- (D) Enzymes are denatured by ultraviolet rays and at high temperature

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18. In which of the following compounds, nitrogen exhibits highest oxidation state?

- (A) NH_2OH
- (B) N_2H_4
- (C) NH_3
- (D) N_3H

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19. Bond order of 1.5 is shown by:

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

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20. Maximum number of electrons in a subshell with $l = 3$ and $n = 4$ is:

- (A) 12
- (B) 14
- (C) 16
- (D) 10

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21. The correct set of four quantum numbers for the valence electron of rubidium atom ($Z = 37$) is

- (A) 5, 1, 0, $+1/2$
- (B) 5, 1, 1, $+1/2$
- (C) 6, 0, 0, $+1/2$
- (D) 5, 0, 0, $+1/2$

AIPMT 2012 Prelims · Q16

22. The protecting power of lyophilic colloidal sol is expressed in terms of

- (A) Oxidation number
- (B) Coagulation value
- (C) Gold number
- (D) Critical micelle concentration

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23. In a reaction, $A + B \rightarrow \text{Product}$, rate is doubled when the concentration of B is doubled, and rate increases by a factor of 8 when the concentrations of both the reactants (A and B) are doubled. Rate law for the reaction can be written as

- (A) $\text{Rate} = k[A]^2[B]$
- (B) $\text{Rate} = k[A][B]^2$
- (C) $\text{Rate} = k[A]^2[B]^2$
- (D) $\text{Rate} = k[A][B]$

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24. Which one of the following sets of monosaccharides forms sucrose?

- (A) α -D-Glucopyranose and β -D-fructopyranose
- (B) α -D-Galactopyranose and α -D-Glucopyranose
- (C) α -D-Glucopyranose and β -D-fructofuranose
- (D) β -D-Glucopyranose and α -D-fructofuranose

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25. In the following sequence of reactions

**$\text{CH}_3\text{-Br} \xrightarrow{(\text{KCN})} \text{A} \xrightarrow{(\text{H}_3\text{O}^+)} \text{B} \xrightarrow{(\text{LiAlH}_4, \text{ ether})} \text{C}$,
the end product (C) is**

- (A) Ethyl alcohol
- (B) Acetone
- (C) Methane
- (D) Acetaldehyde

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26. Which of the following acids does not exhibit optical isomerism?

- (A) Tartaric acid
- (B) Maleic acid
- (C) α -Amino acids
- (D) Lactic acid

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27. Which nomenclature is not according to IUPAC system?

- (A) $\text{CH}_3\text{-CO-CH}_2\text{-CH}_2\text{-CH}_2\text{-COOH}$: 5-oxohexanoic acid
- (B) $\text{Br-CH}_2\text{-CH=CH}_2$: 1-Bromo-prop-2-ene
- (C) $\text{CH}_3\text{-CH}_2\text{-C(Br)(CH}_3\text{)-CH}_2\text{-CH(CH}_3\text{)}_2$: 4-bromo-2,4-dimethylhexane
- (D) $(\text{CH}_3)_2\text{CH-CH(C}_6\text{H}_5\text{)-CH}_2\text{CH}_3$: 2-methylpentan-3-ylbenzene

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28. The pair of species with the same bond order is

- (A) N_2 , O_2
- (B) O_2^{2-} , B_2
- (C) O_2^+ , NO^+
- (D) NO , CO

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29. The correct order of decreasing acid strength of trichloroacetic acid (A), trifluoroacetic acid (B), acetic acid (C) and formic acid (D) is:

- (A) $A > C > B > D$
- (B) $B > A > D > C$
- (C) $B > D > C > A$
- (D) $A > B > C > D$

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30. Which of the following species contains three bond pairs and one lone pair around the central atom?

- (A) PCl_3
- (B) H_2O
- (C) BF_3
- (D) NH_2^-

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31. Among the following compounds the one that is most reactive towards electrophilic nitration is:

- (A) Benzene
- (B) Benzoic acid
- (C) Nitrobenzene
- (D) Toluene

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32. Identify the wrong statement in the following:

- (A) Atomic radius of the elements decreases as one moves across from left to right in the 2nd period of the periodic table
- (B) Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius
- (C) Amongst isoelectronic species, greater the negative charge on the anion, larger is the ionic radius
- (D) Atomic radius of the elements increases as one moves down the first group of the periodic table

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33. In a zero-order reaction for every 10° rise of temperature, the rate is doubled. If the temperature is increased from 10°C to 100°C , the rate of the reaction will become:

- (A) 128 times
- (B) 256 times
- (C) 512 times
- (D) 64 times

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34. Which of the statements is not true?

- (A) $\text{K}_2\text{Cr}_2\text{O}_7$ solution becomes yellow on increasing the pH beyond 7
- (B) On passing H_2S through acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution, a milky colour is observed
- (C) $\text{Na}_2\text{Cr}_2\text{O}_7$ is preferred over $\text{K}_2\text{Cr}_2\text{O}_7$ in volumetric analysis
- (D) $\text{K}_2\text{Cr}_2\text{O}_7$ solution in acidic medium is orange

AIPMT 2012 Prelims · Q28

35. Which one of the following statements regarding photochemical smog is not correct?

- (A) Photochemical smog does not cause irritation in eyes and throat
- (B) Carbon monoxide does not play any role in photochemical smog formation
- (C) Photochemical smog is an oxidizing agent in character
- (D) Photochemical smog is formed through photochemical reaction involving solar energy

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36. In which of the following reactions, standard reaction entropy change (ΔS°) is positive and standard Gibbs energy change (ΔG°) decreases sharply with increasing temperature?

- (A) $(1/2)\text{C}(\text{graphite}) + (1/2)\text{O}_2(\text{g}) \rightarrow (1/2)\text{CO}_2(\text{g})$
- (B) $\text{C}(\text{graphite}) + (1/2)\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g})$
- (C) $\text{CO}(\text{g}) + (1/2)\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
- (D) $\text{Mg}(\text{s}) + (1/2)\text{O}_2(\text{g}) \rightarrow \text{MgO}(\text{s})$

37. Which of the following statements is not valid for oxoacids of phosphorus?

- (A) All oxoacids contain at least one P=O unit and one P-OH group
- (B) Orthophosphoric acid is used in the manufacture of triple superphosphate
- (C) Hypophosphorous acid is a diprotic acid
- (D) All oxoacids contain tetrahedral four coordinated phosphorus

38. Predict the products in the given reaction:

m-Chlorobenzaldehyde (m-Cl-C₆H₄-CHO) —(50% KOH)→ ?

- (A) m-HO-C₆H₄-CH₂OH + m-HO-C₆H₄-COO⁻
- (B) m-Cl-C₆H₄-CH₂OH + m-Cl-C₆H₄-CH₂COO⁻
- (C) m-HO-C₆H₄-CH₂OH + m-HO-C₆H₄-OH
- (D) m-Cl-C₆H₄-CH₂OH + m-Cl-C₆H₄-COO⁻

39. Which one of the following is an outer orbital complex and exhibits paramagnetic behaviour?

- (A) [Co(NH₃)₆]³⁺
- (B) [Ni(NH₃)₆]²⁺
- (C) [Zn(NH₃)₆]²⁺
- (D) [Cr(NH₃)₆]³⁺

40. Standard enthalpy of vapourisation Δ_{vap}H° for water at 100°C is 40.66 kJ mol⁻¹.

The internal energy of vapourisation of water at 100°C (in kJ mol⁻¹) is

- (A) +40.66
- (B) +37.56
- (C) -43.76
- (D) +43.76

41. In the extraction of copper from its sulphide ore, the metal is finally obtained by the reduction of cuprous oxide with:

- (A) Carbon monoxide (CO)
- (B) Copper(I) sulphide (Cu₂S)
- (C) Sulphur dioxide (SO₂)
- (D) Iron sulphide (FeS)

42. Aluminium is extracted from alumina (Al₂O₃) by electrolysis of a molten mixture of

- (A) Al₂O₃ + KF + Na₃AlF₆
- (B) Al₂O₃ + HF + NaAlF₄
- (C) Al₂O₃ + CaF₂ + NaAlF₄
- (D) Al₂O₃ + Na₃AlF₆ + CaF₂

43. Which of the following statements is false?

- (A) Both starch and cellulose are polymers of glucose
- (B) Artificial silk is derived from cellulose
- (C) Nylon-66 is an example of elastomer
- (D) The repeat unit in natural rubber is isoprene

44. The number of octahedral void(s) per atom present in a cubic close-packed structure is

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

45. When Cl_2 gas reacts with hot and concentrated sodium hydroxide solution, the oxidation number of chlorine changes from

- (A) Zero to +1 and zero to -3
- (B) Zero to +1 and zero to -5
- (C) Zero to -1 and zero to +5
- (D) Zero to -1 and zero to +3

46. Which one of the alkali metals forms only the normal oxide, M_2O , on heating in air?

- (A) Na
- (B) Rb
- (C) K
- (D) Li

47. Sulphur trioxide can be obtained by which of the following reactions?

- (A) $\text{H}_2\text{SO}_4 + \text{PCl}_5 \xrightarrow{\text{heat}}$
- (B) $\text{CaSO}_4 + \text{C} \xrightarrow{\text{heat}}$
- (C) $\text{Fe}_2(\text{SO}_4)_3 \xrightarrow{\text{heat}}$
- (D) $\text{S} + \text{H}_2\text{SO}_4 \xrightarrow{\text{heat}}$

Answer key and explanations

1. Answer: (C) Iodoform test

CH_3CHO contains a $\text{CH}_3\text{CO}-$ group and gives a yellow iodoform precipitate with I_2/NaOH , while $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$ has no methyl ketone/aldehyde group and does not. Both are aldehydes with α -hydrogen, so both reduce Tollens' reagent and (being aliphatic-type aldehydes) Fehling's and Benedict's solutions, which therefore cannot distinguish them.

2. Answer: (A) $p_B + xA(p_A - p_B)$

By Raoult's law, $p = p_A \cdot x_A + p_B \cdot x_B$ with $x_B = 1 - x_A$, so $p = p_B + xA(p_A - p_B)$. The expression starting with p_A would require the mole fraction of B to multiply $(p_B - p_A)$.

3. Answer: (B) BaCl_2

BaCl_2 is a salt of a strong acid and a strong base, so it does not hydrolyse and its solution is neutral ($\text{pH} \approx 7$). BeCl_2 and AlCl_3 hydrolyse strongly to give acidic solutions, and LiCl is very slightly acidic due to the small, polarising Li^+ . So BaCl_2 has the highest pH.

4. Answer: (A) Neoprene

Neoprene is an addition polymer formed by free-radical polymerisation of chloroprene, with no small molecule eliminated. Melamine-formaldehyde resin, glyptal and dacron are all formed by condensation with loss of water.

5. Answer: (B) $(\text{CH}_3)_2\text{C}(\text{OH})-\text{CH}(\text{CH}_3)_2$

Protonation of the alkene gives the secondary carbocation $(\text{CH}_3)_3\text{C}-\text{C}^+\text{H}-\text{CH}_3$, which undergoes a 1,2-methyl shift to the more stable tertiary carbocation $(\text{CH}_3)_2\text{C}^+-\text{CH}(\text{CH}_3)_2$. Water attacks this to give 2,3-dimethylbutan-2-ol, $(\text{CH}_3)_2\text{C}(\text{OH})-\text{CH}(\text{CH}_3)_2$. The unrearranged alcohol $(\text{CH}_3)_3\text{C}-\text{CH}(\text{OH})-\text{CH}_3$ is the minor product.

6. Answer: (B) 288 pm

In an fcc lattice atoms touch along the face diagonal: $4r = \sqrt{2} a$, so the diameter $2r = a/\sqrt{2} = 408/1.414 \approx 288$ pm. 204 pm is just half the edge length, which is valid for simple cubic contact only along the edge.

7. Answer: (D) 5.260 cal/(mol K)

$\Delta S_{\text{fus}} = \Delta H_{\text{fus}}/T = 1435 \text{ cal mol}^{-1}/273 \text{ K} = 5.26 \text{ cal mol}^{-1} \text{ K}^{-1}$. 0.526 results from a misplaced decimal and 10.52 from doubling.

8. Answer: (A) $\Delta^\circ m(\text{NH}_4\text{Cl}) + \Delta^\circ m(\text{NaOH}) - \Delta^\circ m(\text{NaCl})$

By Kohlrausch's law, $\Delta^\circ m(\text{NH}_4\text{OH}) = \lambda^\circ(\text{NH}_4^+) + \lambda^\circ(\text{OH}^-) = [\lambda^\circ(\text{NH}_4^+) + \lambda^\circ(\text{Cl}^-)] + [\lambda^\circ(\text{Na}^+) + \lambda^\circ(\text{OH}^-)] - [\lambda^\circ(\text{Na}^+) + \lambda^\circ(\text{Cl}^-)] = \Delta^\circ m(\text{NH}_4\text{Cl}) + \Delta^\circ m(\text{NaOH}) - \Delta^\circ m(\text{NaCl})$. The combination subtracting NaOH would cancel the OH^- contribution instead.

9. Answer: (B) these give unionised acid or base on reaction with added acid or alkali

A buffer contains a weak acid with its conjugate base (or a weak base with its conjugate acid). Added H^+ or OH^- is consumed to form the weakly ionised acid or base, so $[\text{H}^+]$ changes very little. A buffer's pH is not fixed absolutely (it depends on the ratio of components), and it does not hold a large excess of H^+ or OH^- .

10. Answer: (A) BF_4^- and NH_4^+

In BF_4^- and NH_4^+ the central atom has four bond pairs and no lone pair: sp^3 , tetrahedral. BCl_3 is trigonal planar while BrCl_3 is T-shaped; NH_3 is pyramidal while NO_3^- is trigonal planar; NF_3 is pyramidal while BF_3 is planar.

11. Answer: (C) 5.0×10^{-7}

pH 12 means $\text{pOH} = 2$ and $[\text{OH}^-] = 10^{-2} \text{ M}$, so $[\text{Ba}^{2+}] = 5 \times 10^{-3} \text{ M}$. $K_{\text{sp}} = [\text{Ba}^{2+}][\text{OH}^-]^2 = 5 \times 10^{-3} \times (10^{-2})^2 = 5 \times 10^{-7}$. Writing 4s^3 with $s = 10^{-2}$ wrongly treats $[\text{OH}^-]$ as the solubility, giving 4×10^{-6} .

12. Answer: (A) Magnetite

Magnetite, Fe_3O_4 , is an iron ore. Malachite is a copper ore ($\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$), cassiterite is tin ore (SnO_2) and pyrolusite is manganese ore (MnO_2).

13. Answer: (C) Beri-Beri

Thiamine (vitamin B_1) deficiency causes beri-beri. Cheilosis is caused by riboflavin (B_2) deficiency, convulsions by pyridoxine (B_6) deficiency and sterility by vitamin E deficiency.

14. Answer: (B) between 0 and 1 in all cases

In the Freundlich isotherm $x/m = k p^{1/n}$, the exponent $1/n$ lies between 0 and 1, reflecting that adsorption rises less than proportionally with pressure. $1/n = 1$ is only the limiting low-pressure case and is not specific to either physisorption or chemisorption.

15. Answer: (A) $(\text{CH}_3)_2\text{C}(\text{OC}_2\text{H}_5)_2$

In dry HCl, acetone adds one ethanol to give a hemiketal, which with excess ethanol loses water and adds a second ethanol to give the ketal 2,2-diethoxypropane, $(\text{CH}_3)_2\text{C}(\text{OC}_2\text{H}_5)_2$. The hemiketal $(\text{CH}_3)_2\text{C}(\text{OH})(\text{OC}_2\text{H}_5)$ is only the intermediate, and no C-C bond forming product like a higher ketone is formed.

16. Answer: (C) Steel

Steel is an alloy of iron with carbon, a non-metal. Bronze (Cu-Sn), invar (Fe-Ni) and bell metal (Cu-Sn) contain only metals.

17. Answer: (A) Enzymes are least reactive at optimum temperature

Enzymes show maximum (not least) activity at their optimum temperature, so that statement is incorrect. The other statements are true: most enzymes are proteins, their action is highly specific, and heat or UV radiation denatures them.

18. Answer: (D) N_3H

Oxidation states of N: $\text{NH}_2\text{OH} -1$, $\text{N}_2\text{H}_4 -2$, $\text{NH}_3 -3$, and in N_3H (hydrazoic acid) $3x + 1 = 0$, so $x = -1/3$. The highest (least negative) is $-1/3$ in N_3H . NH_2OH at -1 is the nearest trap.

19. Answer: (C) O_2^-

By MO theory, O_2^- has 10 bonding and 7 antibonding electrons (valence), bond order = $(10 - 7)/2 = 1.5$. O_2 is 2, O_2^+ is 2.5 and O_2^{2-} is 1.

20. Answer: (B) 14

$l = 3$ is an f subshell, with $2l + 1 = 7$ orbitals, each holding 2 electrons: 14 electrons. The value $n = 4$ only fixes the shell (4f) and does not change the subshell capacity; 10 is the capacity of a d subshell ($l = 2$).

21. Answer: (D) 5, 0, 0, $+1/2$

Rb ($Z = 37$) is $[\text{Kr}] 5\text{s}^1$, so the valence electron has $n = 5$, $l = 0$ (s), $m = 0$ and $s = +1/2$. Sets with $l = 1$ describe a 5p electron, and $n = 6$ is the wrong shell.

22. Answer: (C) Gold number

The protective power of a lyophilic colloid is expressed by its gold number: the milligrams of it needed to prevent coagulation of 10 mL of gold sol by 1 mL of 10% NaCl. Coagulation value refers to electrolytes coagulating a sol, not to protection.

23. Answer: (A) Rate = $k[A]^2[B]$

Let rate = $k[A]^x[B]^y$. Doubling [B] doubles the rate, so $y = 1$. Doubling both gives $2^{x+1} = 8$, so $x = 2$. Rate = $k[A]^2[B]$. $k[A][B]^2$ would also give 8 for doubling both, but it would quadruple, not double, the rate on doubling [B].

24. Answer: (C) α -D-Glucopyranose and β -D-fructofuranose

Sucrose is formed by a glycosidic link between C1 of α -D-glucopyranose and C2 of β -D-fructofuranose. Fructose occurs as the five-membered furanose ring in sucrose, not as fructopyranose, and galactose is a component of lactose.

25. Answer: (A) Ethyl alcohol

$\text{CH}_3\text{Br} + \text{KCN}$ gives CH_3CN ; acid hydrolysis converts it to CH_3COOH ; LiAlH_4 then reduces the acid to $\text{CH}_3\text{CH}_2\text{OH}$, ethyl alcohol, as the end product. Acetaldehyde is not isolated because LiAlH_4 reduces carboxylic acids all the way to primary alcohols.

26. Answer: (B) Maleic acid

Maleic acid ($\text{cis-HOOC-CH=CH-COOH}$) is planar with no chiral carbon, so it shows geometrical but not optical isomerism. Lactic acid, tartaric acid and α -amino acids (except glycine) have chiral carbons.

27. Answer: (B) $\text{Br-CH}_2\text{-CH=CH}_2$: 1-Bromo-prop-2-ene

$\text{Br-CH}_2\text{-CH=CH}_2$ must be numbered to give the double bond the lowest locant, so its IUPAC name is 3-bromoprop-1-ene, not 1-bromoprop-2-ene. The other names are correct: 5-oxohexanoic acid, 4-bromo-2,4-dimethylhexane (locants 2,4,4 beat 3,3,5) and (2-methylpentan-3-yl)benzene.

28. Answer: (B) O_2^{2-} , B_2

O_2^{2-} (18 electrons) has bond order 1 and B_2 (10 electrons) also has bond order 1. $\text{N}_2 = 3$ vs $\text{O}_2 = 2$; $\text{O}_2^+ = 2.5$ vs $\text{NO}^+ = 3$; $\text{NO} = 2.5$ vs $\text{CO} = 3$.

29. Answer: (B) $\text{B} > \text{A} > \text{D} > \text{C}$

Electron-withdrawing ($-I$) groups stabilise the carboxylate ion. F is more electronegative than Cl, so $\text{CF}_3\text{COOH} > \text{CCl}_3\text{COOH}$; HCOOH is stronger than CH_3COOH because CH_3 is electron-releasing. Order: trifluoroacetic > trichloroacetic > formic > acetic.

30. Answer: (A) PCl_3

P in PCl_3 has 5 valence electrons: three form bonds with Cl and two remain as one lone pair (pyramidal). H_2O and NH_3 each have two bond pairs and two lone pairs, and BF_3 has three bond pairs and no lone pair.

31. Answer: (D) Toluene

The $-\text{CH}_3$ group of toluene donates electron density to the ring ($+I$ and hyperconjugation), activating it for electrophilic nitration, so toluene reacts faster than benzene. $-\text{COOH}$ and $-\text{NO}_2$ withdraw electrons and deactivate the ring.

32. Answer: (B) Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius

In an isoelectronic series, a larger positive charge pulls the same number of electrons more strongly and gives a smaller radius; so a smaller positive charge gives a larger, not smaller, radius. The other statements are correct: radius decreases across a period, increases down a group, and increases with greater negative charge.

33. Answer: (C) 512 times

From 10°C to 100°C is a 90° rise, i.e. nine 10° steps. Rate becomes $2^9 = 512$ times. 256 (2^8) comes from miscounting the steps. The zero order of the reaction does not affect the temperature factor.

34. Answer: (C) $\text{Na}_2\text{Cr}_2\text{O}_7$ is preferred over $\text{K}_2\text{Cr}_2\text{O}_7$ in volumetric analysis

$\text{Na}_2\text{Cr}_2\text{O}_7$ is hygroscopic, so $\text{K}_2\text{Cr}_2\text{O}_7$, which is not, is preferred as a primary standard in volumetric analysis; the statement favouring sodium dichromate is false. The others are true: raising pH converts orange $\text{Cr}_2\text{O}_7^{2-}$ to yellow CrO_4^{2-} , and H_2S is oxidised to colloidal sulphur, giving a milky appearance.

35. Answer: (A) Photochemical smog does not cause irritation in eyes and throat

Photochemical smog contains ozone, PAN and aldehydes and causes irritation of the eyes and throat, so the statement saying it does not is incorrect. It is oxidising, forms through sunlight-driven reactions of NO_x and hydrocarbons, and CO does not play a role in its formation.

36. Answer: (B) $\text{C(graphite)} + (1/2)\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g})$

In $\text{C(graphite)} + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g})$, gaseous moles increase from $\frac{1}{2}$ to 1, so ΔS° is clearly positive and $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$ falls steeply as T rises. Forming CO_2 from C keeps gas moles unchanged ($\Delta S^\circ \approx 0$), while $\text{CO} \rightarrow \text{CO}_2$ and $\text{Mg} \rightarrow \text{MgO}$ decrease gas moles ($\Delta S^\circ < 0$).

37. Answer: (C) Hypophosphorous acid is a diprotic acid

Hypophosphorous acid, H_3PO_2 , has two P-H bonds and only one P-OH group, so it is monoprotic (monobasic), not diprotic. All phosphorus oxoacids do contain tetrahedral four-coordinated P with at least one P=O and one P-OH, and H_3PO_4 is used to make triple superphosphate.

38. Answer: (D) $\text{m-Cl-C}_6\text{H}_4\text{-CH}_2\text{OH} + \text{m-Cl-C}_6\text{H}_4\text{-COO}^-$

m-Chlorobenzaldehyde has no α -hydrogen, so with concentrated (50%) KOH it undergoes the Cannizzaro reaction: one molecule is reduced to m-chlorobenzyl alcohol and another oxidised to m-chlorobenzoate. The aryl C-Cl bond is not hydrolysed under these conditions, so products with -OH replacing Cl are wrong.

39. Answer: (B) $[\text{Ni}(\text{NH}_3)_6]^{2+}$

Ni^{2+} is d^8 ; in an octahedral complex the two remaining inner d orbitals are not vacant, so it uses $4s4p^34d^2$ (sp^3d^2 , outer orbital) and keeps two unpaired electrons, making it paramagnetic. $[\text{Co}(\text{NH}_3)_6]^{3+}$ is inner orbital and diamagnetic, $[\text{Zn}(\text{NH}_3)_6]^{2+}$ is outer orbital but diamagnetic (d^{10}), and $[\text{Cr}(\text{NH}_3)_6]^{3+}$ is inner orbital (d^2sp^3).

40. Answer: (B) +37.56

For $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{g})$, $\Delta n_g = 1$. $\Delta U = \Delta H - \Delta n_g RT = 40.66 - (8.314 \times 10^{-3} \times 373) = 40.66 - 3.10 = 37.56 \text{ kJ mol}^{-1}$. 43.76 comes from adding RT instead of subtracting it.

41. Answer: (B) Copper(I) sulphide (Cu_2S)

In the Bessemer converter, part of Cu_2S is oxidised to Cu_2O , which then reacts with remaining Cu_2S (self-reduction): $2\text{Cu}_2\text{O} + \text{Cu}_2\text{S} \rightarrow 6\text{Cu} + \text{SO}_2$. SO_2 is a product, not the reducing agent, and CO is not used for copper from sulphide ores.

42. Answer: (D) $\text{Al}_2\text{O}_3 + \text{Na}_3\text{AlF}_6 + \text{CaF}_2$

In the Hall-Héroult process, alumina is electrolysed in molten cryolite (Na_3AlF_6) with fluorspar (CaF_2) added to lower the melting point and raise conductivity. KF, HF and NaAlF_4 are not used.

43. Answer: (C) Nylon-66 is an example of elastomer

Nylon-66 is a polyamide fibre with strong hydrogen bonding between chains, not an elastomer (rubber-like polymer). The other statements are correct: starch and cellulose are glucose polymers, rayon (artificial silk) is regenerated cellulose, and natural rubber is a polymer of isoprene.

44. Answer: (B) 1

A ccp (fcc) unit cell has 4 atoms and 4 octahedral voids (1 at the body centre + 12 edge centres $\times \frac{1}{4}$), so there is 1 octahedral void per atom. 2 is the number of tetrahedral voids per atom.

45. Answer: (C) Zero to -1 and zero to +5

With hot concentrated NaOH, chlorine disproportionates: $3\text{Cl}_2 + 6\text{NaOH} \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$. Chlorine goes from 0 to -1 in chloride and 0 to +5 in chlorate. The change 0 to +1 (hypochlorite) occurs with cold dilute NaOH.

46. Answer: (D) Li

Lithium, the smallest alkali metal ion, forms only the normal oxide Li_2O on burning in air. Sodium forms mainly the peroxide Na_2O_2 , while potassium and rubidium form superoxides MO_2 .

47. Answer: (C) $\text{Fe}_2(\text{SO}_4)_3 \xrightarrow{\text{heat}}$

Iron(III) sulphate decomposes on heating: $\text{Fe}_2(\text{SO}_4)_3 \rightarrow \text{Fe}_2\text{O}_3 + 3\text{SO}_3$. Sulphur with hot concentrated H_2SO_4 gives SO_2 , H_2SO_4 with PCl_5 gives chlorosulphonic acid/sulphuryl chloride, and CaSO_4 with carbon is reduced to CaS or SO_2 , not SO_3 .

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