

AIPMT 2009 Prelims — Chemistry Question Paper with Solutions

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

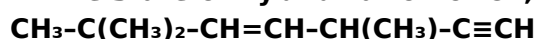
AIPMT 2009 Prelims · Q36

1. Sodium has body centred packing. Distance between two nearest atoms is 3.7 Å. The lattice parameter is:

- (A) 4.3 Å
- (B) 3.0 Å
- (C) 8.6 Å
- (D) 6.8 Å

AIPMT 2009 Prelims · Q151

2. The state of hybridization of C2, C3, C5 and C6 of the hydrocarbon



(numbered from the right: $\text{C}\equiv\text{CH}$ carbons are C1 and C2, the $\text{CH}(\text{CH}_3)$ carbon is C3, CH=CH are C4 and C5, the $\text{C}(\text{CH}_3)_2$ carbon is C6, end CH_3 is C7)

is in the following sequence:

- (A) sp^3 , sp^2 , sp^2 and sp
- (B) sp , sp^2 , sp^2 and sp^3
- (C) sp , sp^2 , sp^3 and sp^2
- (D) sp , sp^3 , sp^2 and sp^3

AIPMT 2009 Prelims · Q152

3. Oxidation numbers of P in PO_4^{3-} , of S in SO_4^{2-} and that of Cr in $\text{Cr}_2\text{O}_7^{2-}$, are respectively :

- (A) +3, +6 and +5
- (B) +5, +3 and +6
- (C) -3, +6 and +6
- (D) +5, +6 and +6

AIPMT 2009 Prelims · Q153

4. Lithium metal crystallises in a body centred cubic crystal. If the length of the side of the unit cell of lithium is 351 pm, the atomic radius of the lithium will be:

- (A) 151.8 pm
- (B) 75.5 pm
- (C) 300.5 pm
- (D) 240.8 pm

AIPMT 2009 Prelims · Q154

5. Which of the following reactions is an example of nucleophilic substitution reaction?

- (A) $2\text{RX} + 2\text{Na} \rightarrow \text{R-R} + 2\text{NaX}$
- (B) $\text{RX} + \text{H}_2 \rightarrow \text{RH} + \text{HX}$
- (C) $\text{RX} + \text{Mg} \rightarrow \text{RMgX}$
- (D) $\text{RX} + \text{KOH} \rightarrow \text{ROH} + \text{KX}$

AIPMT 2009 Prelims · Q155

6. In the case of alkali metals, the covalent character decreases in the order:

- (A) $\text{MF} > \text{MCl} > \text{MBr} > \text{MI}$
- (B) $\text{MF} > \text{MCl} > \text{MI} > \text{MBr}$
- (C) $\text{MI} > \text{MBr} > \text{MCl} > \text{MF}$
- (D) $\text{MCl} > \text{MI} > \text{MBr} > \text{MF}$

7. Which one of the elements with the following outer orbital configurations may exhibit the largest number of oxidation states?

- (A) $3d^5 4s^1$
- (B) $3d^5 4s^2$
- (C) $3d^2 4s^2$
- (D) $3d^3 4s^2$

8. The stability of +1 oxidation state increases in the sequence:

- (A) $Tl < In < Ga < Al$
- (B) $In < Tl < Ga < Al$
- (C) $Ga < In < Al < Tl$
- (D) $Al < Ga < In < Tl$

9. Given:

(i) $Cu^{2+} + 2e^- \rightarrow Cu$, $E^\circ = 0.337 V$

(ii) $Cu^{2+} + e^- \rightarrow Cu^+$, $E^\circ = 0.153 V$

Electrode potential, E° for the reaction, $Cu^+ + e^- \rightarrow Cu$, will be:

- (A) 0.90 V
- (B) 0.30 V
- (C) 0.38 V
- (D) 0.52 V

10. For the reaction $N_2 + 3H_2 \rightarrow 2NH_3$, if $d[NH_3]/dt = 2 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$, the value of $-d[H_2]/dt$ would be :

- (A) $4 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$
- (B) $6 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$
- (C) $1 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$
- (D) $3 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$

11. Consider the following reaction:

ethanol $\xrightarrow{(PBr_3)}$ X $\xrightarrow{(\text{alc. KOH})}$ Y $\xrightarrow{((i) H_2SO_4, \text{ room temperature; (ii) } H_2O, \text{ heat})}$ Z

The product Z is:

- (A) $CH_3CH_2-O-CH_2-CH_3$
- (B) $CH_3-CH_2-O-SO_3H$
- (C) CH_3CH_2OH
- (D) $CH_2=CH_2$

12. The energy absorbed by each molecule (A_2) of a substance is $4.4 \times 10^{-19} \text{ J}$ and bond energy per molecule is $4.0 \times 10^{-19} \text{ J}$. The kinetic energy of the molecule per atom will be:

- (A) $2.2 \times 10^{-19} \text{ J}$
- (B) $2.0 \times 10^{-19} \text{ J}$
- (C) $4.0 \times 10^{-20} \text{ J}$
- (D) $2.0 \times 10^{-20} \text{ J}$

13. Amongst the elements with following electronic configurations, which one of them may have the highest ionization energy?

- (A) $[Ne] 3s^2 3p^2$
- (B) $[Ar] 3d^{10} 4s^2 4p^3$
- (C) $[Ne] 3s^2 3p^1$
- (D) $[Ne] 3s^2 3p^3$

AIPMT 2009 Prelims · Q163

14. In the reaction $\text{BrO}_3^-(\text{aq}) + 5\text{Br}^-(\text{aq}) + 6\text{H}^+(\text{aq}) \rightarrow 3\text{Br}_2(\text{l}) + 3\text{H}_2\text{O}(\text{l})$, the rate of appearance of bromine (Br_2) is related to rate of disappearance of bromide ions as following:

- (A) $\frac{d[\text{Br}_2]}{dt} = -(5/3) \frac{d[\text{Br}^-]}{dt}$
- (B) $\frac{d[\text{Br}_2]}{dt} = (5/3) \frac{d[\text{Br}^-]}{dt}$
- (C) $\frac{d[\text{Br}_2]}{dt} = (3/5) \frac{d[\text{Br}^-]}{dt}$
- (D) $\frac{d[\text{Br}_2]}{dt} = -(3/5) \frac{d[\text{Br}^-]}{dt}$

AIPMT 2009 Prelims · Q164

15. A 0.0020 m aqueous solution of an ionic compound $\text{Co}(\text{NH}_3)_5(\text{NO}_2)\text{Cl}$ freezes at -0.00732°C . Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be ($K_f = -1.86^\circ\text{C/m}$)

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

AIPMT 2009 Prelims · Q165

16. What is the dominant intermolecular force or bond that must be overcome in converting liquid CH_3OH to a gas?

- (A) Dipole-dipole interaction
- (B) Covalent bonds
- (C) London dispersion force
- (D) Hydrogen bonding

AIPMT 2009 Prelims · Q166

17. Which of the following oxides is not expected to react with sodium hydroxide?

- (A) CaO
- (B) SiO_2
- (C) BeO
- (D) B_2O_3

AIPMT 2009 Prelims · Q167

18. The segment of DNA which acts as the instrumental manual for the synthesis of the protein is:

- (A) ribose
- (B) gene
- (C) nucleoside
- (D) nucleotide

AIPMT 2009 Prelims · Q168

19. Maximum number of electrons in a subshell of an atom is determined by the following:

- (A) $2l + 1$
- (B) $4l - 2$
- (C) $2n^2$
- (D) $4l + 2$

AIPMT 2009 Prelims · Q169

20. Half life period of a 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) $5.0 \times 10^{-3} \text{ s}^{-1}$

21. Which one of the following is employed as a tranquilizer?

- (A) Naproxen
- (B) Tetracycline
- (C) Chlorpheniramine
- (D) Equanil

22. Al_2O_3 is reduced by electrolysis at low potentials and high currents. If 4.0×10^4 amperes of current is passed through molten Al_2O_3 for 6 hours, what mass of aluminium is produced? (Assume 100% current efficiency. At. mass of Al = 27 g mol^{-1})

- (A) 8.1×10^4 g
- (B) 2.4×10^5 g
- (C) 1.3×10^4 g
- (D) 9.0×10^3 g

23. Benzene reacts with CH_3Cl in the presence of anhydrous AlCl_3 to form:

- (A) Chlorobenzene
- (B) Benzyl chloride
- (C) Xylene
- (D) Toluene

24. Which of the following is not a permissible arrangement of electrons in an atom?

- (A) $n = 5, l = 3, m = 0, s = +1/2$
- (B) $n = 3, l = 2, m = -3, s = -1/2$
- (C) $n = 3, l = 2, m = -2, s = -1/2$
- (D) $n = 4, l = 0, m = 0, s = -1/2$

25. Propionic acid with Br_2/P yields a dibromo product. Its structure would be:

- (A) $\text{CHBr}_2\text{-CH}_2\text{-COOH}$
- (B) $\text{CH}_2\text{Br-CH}_2\text{-COBr}$
- (C) $\text{CH}_3\text{-CBr}_2\text{-COOH}$
- (D) $\text{CH}_2\text{Br-CHBr-COOH}$

26. The values of ΔH and ΔS for the reaction, $\text{C}(\text{graphite}) + \text{CO}_2(\text{g}) \rightarrow 2\text{CO}(\text{g})$ are 170 kJ and 170 J K^{-1} , respectively. This reaction will be spontaneous at:

- (A) 910 K
- (B) 1110 K
- (C) 510 K
- (D) 710 K

27. Copper crystallises in a face-centred cubic lattice with a unit cell length of 361 pm. What is the radius of copper atom in pm?

- (A) 157
- (B) 181
- (C) 108
- (D) 128

AIPMT 2009 Prelims · Q178

28. Predict the product :

$\text{C}_6\text{H}_5\text{-NHCH}_3 + \text{NaNO}_2 + \text{HCl} \rightarrow \text{Product}$

- (A) $\text{C}_6\text{H}_5\text{-N(CH}_3\text{)-NO}_2$
- (B) Mixture of o- and p-nitroso-N-methylaniline ($\text{ON-C}_6\text{H}_4\text{-NHCH}_3$)
- (C) $\text{C}_6\text{H}_5\text{-N(OH)-CH}_3$
- (D) $\text{C}_6\text{H}_5\text{-N(CH}_3\text{)-N=O}$

AIPMT 2009 Prelims · Q179

29. $\text{HOH}_2\text{C-CH}_2\text{OH}$ on heating with periodic acid gives:

- (A) 2HCOOH
- (B) OHC-CHO
- (C) 2HCHO
- (D) 2CO_2

AIPMT 2009 Prelims · Q180

30. According to MO theory which of the following lists ranks the nitrogen species in terms of increasing bond order?

- (A) $\text{N}_2^{2-} < \text{N}_2^- < \text{N}_2$
- (B) $\text{N}_2 < \text{N}_2^{2-} < \text{N}_2^-$
- (C) $\text{N}_2^- < \text{N}_2^{2-} < \text{N}_2$
- (D) $\text{N}_2^- < \text{N}_2 < \text{N}_2^{2-}$

AIPMT 2009 Prelims · Q181

31. Out of TiF_6^{2-} , CoF_6^{3-} , Cu_2Cl_2 and NiCl_4^{2-} (Z of Ti = 22, Co = 27, Cu = 29, Ni = 28) the colourless species are:

- (A) Cu_2Cl_2 and NiCl_4^{2-}
- (B) TiF_6^{2-} and Cu_2Cl_2
- (C) CoF_6^{3-} and NiCl_4^{2-}
- (D) TiF_6^{2-} and CoF_6^{3-}

AIPMT 2009 Prelims · Q182

32. Which of the following molecules acts as a Lewis acid?

- (A) $(\text{CH}_3)_2\text{O}$
- (B) $(\text{CH}_3)_3\text{P}$
- (C) $(\text{CH}_3)_3\text{N}$
- (D) $(\text{CH}_3)_3\text{B}$

AIPMT 2009 Prelims · Q183

33. The IUPAC name of the compound having the formula $\text{CH}\equiv\text{C-CH=CH}_2$ is:

- (A) 1-butyne-3-ene
- (B) but-1-yne-3-ene
- (C) 1-butene-3-yne
- (D) 3-butene-1-yne

AIPMT 2009 Prelims · Q185

34. Which of the following does not show optical isomerism?

- (A) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]^0$
- (B) $[\text{Co}(\text{en})\text{Cl}_2(\text{NH}_3)_2]^+$
- (C) $[\text{Co}(\text{en})_3]^{3+}$
- (D) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (en = ethylenediamine)

AIPMT 2009 Prelims · Q186

35. Structures of some common polymers are given. Which one is not correctly presented?

- (A) Neoprene: $[-\text{CH}_2\text{-C}(\text{Cl})=\text{CH-CH}_2\text{-CH}_2-]_n$
- (B) Terylene: $[-\text{OC-C}_6\text{H}_4\text{-COOCH}_2\text{-CH}_2\text{-O-}]_n$
- (C) Nylon 66: $[-\text{NH}(\text{CH}_2)_6\text{NHCO}(\text{CH}_2)_4\text{-CO-}]_n$
- (D) Teflon: $[-\text{CF}_2\text{-CF}_2-]_n$

36. The ionization constant of ammonium hydroxide is 1.77×10^{-5} at 298 K. Hydrolysis constant of ammonium chloride is:

- (A) 6.50×10^{-12}
- (B) 5.65×10^{-13}
- (C) 5.65×10^{-12}
- (D) 5.65×10^{-10}

37. Consider the following reaction:

Phenol $\xrightarrow{\text{(Zn dust)}}$ X $\xrightarrow{\text{(CH}_3\text{Cl, anhydrous AlCl}_3\text{)}}$ Y $\xrightarrow{\text{(alkaline KMnO}_4\text{)}}$ Z

The product Z is:

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

38. The equivalent conductance of M/32 solution of a weak monobasic acid is 8.0 mhos cm^2 and at infinite dilution is 400 mhos cm^2 . The dissociation constant of this acid is:

- (A) 1.25×10^{-6}
- (B) 6.25×10^{-4}
- (C) 1.25×10^{-4}
- (D) 1.25×10^{-5}

39. The straight chain polymer is formed by:

- (A) hydrolysis of CH_3SiCl_3 followed by condensation polymerisation
- (B) hydrolysis of $(\text{CH}_3)_4\text{Si}$ by addition polymerisation
- (C) hydrolysis of $(\text{CH}_3)_2\text{SiCl}_2$ followed by condensation polymerisation
- (D) hydrolysis of $(\text{CH}_3)_3\text{SiCl}$ followed by condensation polymerisation

40. From the following bond energies:

H-H bond energy: $431.37 \text{ kJ mol}^{-1}$

C=C bond energy: $606.10 \text{ kJ mol}^{-1}$

C-C bond energy: $336.49 \text{ kJ mol}^{-1}$

C-H bond energy: $410.50 \text{ kJ mol}^{-1}$

Enthalpy for the reaction $\text{H}_2\text{C}=\text{CH}_2 + \text{H}-\text{H} \rightarrow \text{H}_3\text{C}-\text{CH}_3$ will be:

- (A) $-243.6 \text{ kJ mol}^{-1}$
- (B) $-120.0 \text{ kJ mol}^{-1}$
- (C) $553.0 \text{ kJ mol}^{-1}$
- (D) $1523.6 \text{ kJ mol}^{-1}$

41. 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded.

Amount of water produced in this reaction will be:

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

42. Among the following which is the strongest oxidising agent?

- (A) Br_2
- (B) I_2
- (C) Cl_2
- (D) F_2

43. In which of the following molecules / ions BF_3 , NO_2^- , NH_2^- and H_2O , the central atom is sp^2 hybridized?

- (A) NH_2^- and H_2O
- (B) NO_2^- and H_2O
- (C) BF_3 and NO_2^-
- (D) NO_2^- and NH_2^-

44. Nitrobenzene can be prepared from benzene by using a mixture of conc. HNO_3 and conc. H_2SO_4 . In the mixture, nitric acid acts as a/an:

- (A) acid
- (B) base
- (C) catalyst
- (D) reducing agent

45. Which of the following complex ions is expected to absorb visible light? (At. no. $\text{Zn} = 30$, $\text{Sc} = 21$, $\text{Ti} = 22$, $\text{Cr} = 24$)

- (A) $[\text{Ti}(\text{en})_2(\text{NH}_3)_2]^{4+}$
- (B) $[\text{Cr}(\text{NH}_3)_6]^{3+}$
- (C) $[\text{Zn}(\text{NH}_3)_6]^{2+}$
- (D) $[\text{Sc}(\text{H}_2\text{O})_3(\text{NH}_3)_3]^{3+}$

46. What is the $[\text{OH}^-]$ in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 M $\text{Ba}(\text{OH})_2$?

- (A) 0.40 M
- (B) 0.0050 M
- (C) 0.12 M
- (D) 0.10 M

47. Trichloroacetaldehyde, CCl_3CHO reacts with chlorobenzene in presence of sulphuric acid and produces:

- (A) $(p\text{-Cl-C}_6\text{H}_4)_3\text{CH}$
- (B) $(p\text{-Cl-C}_6\text{H}_4)_2\text{C}(\text{OH})\text{Cl}$
- (C) $(p\text{-Cl-C}_6\text{H}_4)_2\text{CH-CCl}_3$
- (D) $(p\text{-Cl-C}_6\text{H}_4)_2\text{C}(\text{Cl})\text{-CH}_2\text{Cl}$

48. For the reaction $\text{A} + \text{B} \rightarrow \text{products}$, it is observed that:

(a) on doubling the initial concentration of A only, the rate of reaction is also doubled and

(b) on doubling the initial concentrations of both A and B, there is a change by a factor of 8 in the rate of the reaction.

The rate of this reaction is given by:

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

49. Which of the following hormones contains iodine?

- (A) testosterone
 (B) adrenaline
 (C) thyroxine
 (D) insulin

Answer key and explanations**1. Answer: (A) 4.3 Å**

In a bcc lattice the nearest neighbours lie along the body diagonal, so $2r = d = \sqrt{3}a/2$. $a = 2 \times 3.7/\sqrt{3} \approx 4.27 \approx 4.3$ Å. Doubling 3.7 Å treats the structure as touching along the cube edge.

2. Answer: (D) sp, sp³, sp² and sp³

C2 is a triple-bonded carbon (sp). C3 is the CH(CH₃) carbon with only single bonds (sp³). C5 is a double-bonded carbon (sp²). C6 is the quaternary C(CH₃)₂ carbon (sp³). So the sequence is sp, sp³, sp², sp³.

3. Answer: (D) +5, +6 and +6

PO₄³⁻: $x - 8 = -3$, $x = +5$. SO₄²⁻: $x - 8 = -2$, $x = +6$. Cr₂O₇²⁻: $2x - 14 = -2$, $x = +6$. So +5, +6 and +6.

4. Answer: (A) 151.8 pm

In bcc the atoms touch along the body diagonal: $4r = \sqrt{3}a$. $r = 1.732 \times 351/4 \approx 152$ pm, matching 151.8 pm. 75.5 pm and 300.5 pm come from wrong geometric relations.

5. Answer: (D) RX + KOH → ROH + KX

In $RX + KOH(aq) \rightarrow ROH + KX$ the nucleophile OH⁻ replaces the halide ion, a nucleophilic substitution. Reaction with Na is the Wurtz coupling, with H₂ is a reduction, and with Mg forms a Grignard reagent.

6. Answer: (C) MI > MBr > MCl > MF

By Fajans' rules, larger anions are more easily polarised by the cation, so covalent character is highest for iodides and lowest for fluorides: MI > MBr > MCl > MF. The reverse order describes ionic character.

7. Answer: (B) 3d⁵4s²

3d⁵4s² (manganese) has seven electrons that can take part in bonding and shows oxidation states from +2 up to +7, the widest range here. 3d⁵4s¹ (Cr) goes up to +6, and the others to +4 and +5.

8. Answer: (D) Al < Ga < In < Tl

Because of the inert pair effect, the ns² pair becomes less available down group 13, so the +1 state becomes more stable from Al to Tl: Al < Ga < In < Tl. Tl⁺ is the most stable +1 ion of the group.

9. Answer: (D) 0.52 V

Combine free energies, not potentials: ΔG° for $Cu^+ + e^- \rightarrow Cu = \Delta G^\circ(i) - \Delta G^\circ(ii) = (-2 \times 0.337F) - (-1 \times 0.153F) = -0.521F$. With $n = 1$, $E^\circ = +0.52$ V. Simply subtracting the potentials gives 0.18 V and adding them gives 0.49 V, both wrong.

10. Answer: (D) $3 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$

Rate = $-(1/3)d[H_2]/dt = (1/2)d[NH_3]/dt$. So $-d[H_2]/dt = (3/2) \times 2 \times 10^{-4} = 3 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$. Multiplying by 3 alone gives 6×10^{-4} .

11. Answer: (C) CH₃CH₂OH

PBr₃ converts ethanol to bromoethane (X); alcoholic KOH eliminates HBr to give ethene (Y). Cold conc. H₂SO₄ adds across the double bond giving ethyl hydrogen sulphate, which on boiling with water is hydrolysed back to ethanol (Z). Ethyl hydrogen sulphate is only the intermediate.

12. Answer: (D) $2.0 \times 10^{-20} \text{ J}$

Energy left after breaking the bond = $4.4 \times 10^{-19} - 4.0 \times 10^{-19} = 0.4 \times 10^{-19} \text{ J}$ per molecule. It is shared by the two atoms: $2.0 \times 10^{-20} \text{ J}$ per atom. $4.0 \times 10^{-20} \text{ J}$ forgets to divide between the two atoms.

13. Answer: (D) [Ne] 3s²3p³

[Ne]3s²3p³ is phosphorus: a small period-3 atom with a stable half-filled 3p subshell, so it has the highest ionization energy here. [Ar]3d¹⁰4s²4p³ (arsenic) is also half-filled but larger, and the 3p¹ and 3p² atoms (Al, Si) lose electrons more easily.

14. Answer: (D) $d[Br_2]/dt = -(3/5) d[Br^-]/dt$

Rate = $(1/3)d[Br_2]/dt = -(1/5)d[Br^-]/dt$, so $d[Br_2]/dt = -(3/5)d[Br^-]/dt$. The minus sign is needed because [Br⁻] decreases while [Br₂] increases, and 5/3 inverts the stoichiometric ratio.

15. Answer: (D) 2

$\Delta T_f = iK_f m$, so $i = 0.00732/(1.86 \times 0.0020) \approx 1.97 \approx 2$. The compound is $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}$, giving one complex cation and one Cl^- ion. A value of 3 would need two ionisable chlorides.

16. Answer: (D) Hydrogen bonding

Methanol molecules are linked by $\text{O}-\text{H}\cdots\text{O}$ hydrogen bonds, which are the dominant forces to be overcome on boiling. Covalent bonds are broken only in a chemical change, and dipole-dipole and London forces are present but weaker.

17. Answer: (A) CaO

CaO is a basic oxide and does not react with the base NaOH . SiO_2 and B_2O_3 are acidic oxides and BeO is amphoteric, so all three dissolve in NaOH .

18. Answer: (B) gene

A gene is the segment of DNA that carries the coded information for making a particular protein. Ribose is a sugar, and nucleosides and nucleotides are only the building units of nucleic acids.

19. Answer: (D) $4l + 2$

A subshell with quantum number l has $(2l + 1)$ orbitals, each holding 2 electrons, so the maximum is $2(2l + 1) = 4l + 2$. $2l + 1$ counts orbitals, not electrons, and $2n^2$ is for a whole shell.

20. Answer: (B) $0.5 \times 10^{-3} \text{ s}^{-1}$

For a first-order reaction $k = 0.693/t_{1/2} = 0.693/1386 = 5.0 \times 10^{-4} \text{ s}^{-1} = 0.5 \times 10^{-3} \text{ s}^{-1}$. $5.0 \times 10^{-3} \text{ s}^{-1}$ is ten times too large.

21. Answer: (D) Equanil

Equanil (meprobamate) is a tranquilizer used to relieve anxiety. Naproxen is an analgesic, tetracycline an antibiotic and chlorpheniramine an antihistamine.

22. Answer: (A) $8.1 \times 10^4 \text{ g}$

Charge $Q = 4.0 \times 10^4 \times 6 \times 3600 = 8.64 \times 10^8 \text{ C}$. $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$, so moles of $\text{Al} = 8.64 \times 10^8 / (3 \times 96500) \approx 2984 \text{ mol}$, mass $\approx 2984 \times 27 \approx 8.1 \times 10^4 \text{ g}$. Forgetting the factor 3 gives $2.4 \times 10^5 \text{ g}$.

23. Answer: (D) Toluene

This is Friedel-Crafts alkylation: AlCl_3 generates CH_3^+ which substitutes on the ring, giving $\text{C}_6\text{H}_5\text{CH}_3$ (toluene). Chlorobenzene would need Cl_2 , benzyl chloride needs side-chain chlorination of toluene, and xylene needs a second methylation.

24. Answer: (B) $n = 3, l = 2, m = -3, s = -1/2$

For $l = 2$ the magnetic quantum number can only take values from -2 to $+2$, so $m = -3$ is not allowed. The other sets obey all the rules ($l < n$, $|m| \leq l$, $s = \pm 1/2$).

25. Answer: (C) $\text{CH}_3\text{-CBr}_2\text{-COOH}$

In the Hell-Volhard-Zelinsky reaction, Br_2/P replaces the α -hydrogens (on the carbon next to $-\text{COOH}$). Propionic acid has two α -H, so the dibromo product is $\text{CH}_3\text{-CBr}_2\text{-COOH}$. Substitution at the β -carbon or on both carbons does not occur.

26. Answer: (B) 1110 K

$\Delta G = \Delta H - T\Delta S$ becomes negative when $T > \Delta H/\Delta S = 170000 \text{ J} / 170 \text{ J K}^{-1} = 1000 \text{ K}$. Only 1110 K is above 1000 K. Remember to convert kJ to J before dividing.

27. Answer: (D) 128

In fcc atoms touch along the face diagonal: $4r = \sqrt{2}a$. $r = 1.414 \times 361/4 \approx 128 \text{ pm}$. Using the bcc relation ($\sqrt{3}a/4$) gives 157 pm.

28. Answer: (D) $\text{C}_6\text{H}_5\text{-N}(\text{CH}_3)\text{-N=O}$

N-methylaniline is a secondary amine; with HNO_2 (from $\text{NaNO}_2 + \text{HCl}$) the N-H hydrogen is replaced by $-\text{N=O}$, giving N-nitroso-N-methylaniline, $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)\text{-N=O}$. Ring nitrosation happens with tertiary aromatic amines such as N,N-dimethylaniline.

29. Answer: (C) 2HCHO

Periodic acid cleaves the C-C bond between the two $-\text{OH}$ bearing carbons of a 1,2-diol. Each CH_2OH becomes $\text{H}_2\text{C=O}$, so ethylene glycol gives two molecules of formaldehyde. Glyoxal would need oxidation without C-C cleavage.

30. Answer: (A) $\text{N}_2^{2-} < \text{N}_2^- < \text{N}_2$

N_2 (14 electrons) has bond order 3. Each extra electron enters an antibonding π^* orbital and lowers the bond order by $1/2$: $\text{N}_2^- = 2.5$, $\text{N}_2^{2-} = 2$. Increasing order: $\text{N}_2^{2-} < \text{N}_2^- < \text{N}_2$.

31. Answer: (B) TiF_6^{2-} and Cu_2Cl_2

Ti^{4+} in TiF_6^{2-} is $3d^0$ and Cu^+ in Cu_2Cl_2 is $3d^{10}$, so no d-d transition is possible and both are colourless. Co^{3+} ($3d^6$) and Ni^{2+} ($3d^8$) have partly filled d orbitals and are coloured.

32. Answer: (D) (CH₃)₃B

In (CH₃)₃B boron has only six valence electrons and an empty p orbital, so it accepts an electron pair: a Lewis acid. The O, P and N compounds each carry a lone pair and act as Lewis bases.

33. Answer: (C) 1-butene-3-yne

CH₂=CH-C≡CH: numbering from the double-bond end gives the double bond at C1 and the triple bond at C3, and when locants tie the double bond gets the lower number. The name is but-1-en-3-yne, written here as 1-butene-3-yne. Names with 'yne' cited first are wrong since 'ene' precedes 'yne'.

34. Answer: (A) [Co(NH₃)₃Cl₃]⁰

[Co(NH₃)₃Cl₃] is an MA₃B₃ octahedral complex; both its fac and mer forms have a mirror plane, so it is not optically active. [Co(en)₃]³⁺, cis-[Co(en)₂Cl₂]⁺ and one isomer of [Co(en)Cl₂(NH₃)₂]⁺ are chiral.

35. Answer: (A) Neoprene: [-CH₂-C(Cl)=CH-CH₂-CH₂-]_n

Neoprene is polychloroprene, [-CH₂-C(Cl)=CH-CH₂-]_n, made from chloroprene (four carbons per unit). The given formula has an extra CH₂, so it is incorrect. The terylene, nylon 66 and teflon repeat units are correctly shown.

36. Answer: (D) 5.65 × 10⁻¹⁰

For the salt of a weak base and strong acid, $K_h = K_w/K_b = 1.0 \times 10^{-14}/1.77 \times 10^{-5} = 5.65 \times 10^{-10}$. Values with 10⁻¹² or 10⁻¹³ come from slips in the exponent.

37. Answer: (B) Benzoic acid

Distilling phenol with zinc dust removes the -OH, giving benzene (X). Friedel-Crafts methylation gives toluene (Y). Alkaline KMnO₄ oxidises the whole side chain to -COOH, giving benzoic acid (Z), not just benzaldehyde.

38. Answer: (D) 1.25 × 10⁻⁵

Degree of dissociation $\alpha = 8.0/400 = 0.02$. $K_a = C\alpha^2/(1 - \alpha) \approx C\alpha^2 = (1/32)(0.02)^2 = 1.25 \times 10^{-5}$. Forgetting to square α gives 6.25×10^{-4} .

39. Answer: (C) hydrolysis of (CH₃)₂SiCl₂ followed by condensation polymerisation

(CH₃)₂SiCl₂ hydrolyses to (CH₃)₂Si(OH)₂, which has two -OH groups and condenses into long straight-chain silicones. CH₃SiCl₃ gives three -OH groups and a cross-linked polymer, while (CH₃)₃SiCl has only one and just caps chains.

40. Answer: (B) -120.0 kJ mol⁻¹

$\Delta H = \text{bonds broken} - \text{bonds formed} = [\text{BE}(\text{C}=\text{C}) + \text{BE}(\text{H}-\text{H})] - [\text{BE}(\text{C}-\text{C}) + 2\text{BE}(\text{C}-\text{H})] = (606.10 + 431.37) - (336.49 + 821.00) = -120.0 \text{ kJ mol}^{-1}$. The four C-H bonds common to both sides cancel out.

41. Answer: (B) 4 mol

2H₂ + O₂ → 2H₂O. 10 g H₂ = 5 mol and 64 g O₂ = 2 mol; 2 mol O₂ needs only 4 mol H₂, so O₂ is limiting and gives 4 mol of water. Taking H₂ as limiting would wrongly give 5 mol.

42. Answer: (D) F₂

F₂ has the highest standard reduction potential among the halogens (about +2.87 V), due to low F-F bond energy and high hydration energy of F⁻. So it is the strongest oxidising agent, and oxidising power falls F₂ > Cl₂ > Br₂ > I₂.

43. Answer: (C) BF₃ and NO₂⁻

BF₃ has three bond pairs and no lone pair, and NO₂⁻ has two σ bonds and one lone pair on N; both have three electron domains, so sp². NH₂⁻ and H₂O each have two bond pairs and two lone pairs (four domains), so they are sp³.

44. Answer: (B) base

H₂SO₄ is the stronger acid and protonates HNO₃: HNO₃ + 2H₂SO₄ → NO₂⁺ + H₃O⁺ + 2HSO₄⁻. Accepting a proton means nitric acid acts as a base here, producing the nitronium electrophile.

45. Answer: (B) [Cr(NH₃)₆]³⁺

Cr³⁺ is 3d³, so d-d transitions are possible and the complex absorbs visible light. Ti⁴⁺ and Sc³⁺ are 3d⁰ and Zn²⁺ is 3d¹⁰, so they have no d-d transitions and are colourless.

46. Answer: (D) 0.10 M

HCl gives 20 × 0.050 = 1.0 mmol H⁺; Ba(OH)₂ gives 30 × 0.10 × 2 = 6.0 mmol OH⁻. After neutralisation 5.0 mmol OH⁻ remain in 50 mL: [OH⁻] = 0.10 M. Forgetting that Ba(OH)₂ gives two OH⁻ per formula unit leads to a wrong value.

47. Answer: (C) (p-Cl-C₆H₄)₂CH-CCl₃

In conc. H₂SO₄, chloral condenses with two molecules of chlorobenzene at their para positions, losing water, to give DDT: (p-Cl-C₆H₄)₂CH-CCl₃. The CCl₃ group stays intact; it is not replaced by a third ring.

48. Answer: (A) rate = $k[A][B]^2$

Doubling [A] alone doubles the rate, so the order in A is 1. Doubling both raises the rate 8 times: $2^1 \times 2^n = 8$, so $n = 2$ for B. Rate = $k[A][B]^2$.

49. Answer: (C) thyroxine

Thyroxine, secreted by the thyroid gland, is an iodinated derivative of tyrosine. Testosterone is a steroid, adrenaline a catecholamine and insulin a polypeptide; none contain iodine.

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.