

NEET 2018 — Chemistry Question Paper with Solutions

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

NEET 2018 · Q46

1. The correct order of N-compounds in its decreasing order of oxidation states is

- (A) HNO_3 , NH_4Cl , NO , N_2
- (B) HNO_3 , NO , NH_4Cl , N_2
- (C) HNO_3 , NO , N_2 , NH_4Cl
- (D) NH_4Cl , N_2 , NO , HNO_3

NEET 2018 · Q47

2. Which one of the following elements is unable to form MF_6^{3-} ion?

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

NEET 2018 · Q48

3. Considering Ellingham diagram, which of the following metals can be used to reduce alumina?

- (A) Mg
- (B) Zn
- (C) Fe
- (D) Cu

NEET 2018 · Q49

4. The correct order of atomic radii in group 13 elements is

- (A) $\text{B} < \text{Ga} < \text{Al} < \text{Tl} < \text{In}$
- (B) $\text{B} < \text{Al} < \text{Ga} < \text{In} < \text{Tl}$
- (C) $\text{B} < \text{Al} < \text{In} < \text{Ga} < \text{Tl}$
- (D) $\text{B} < \text{Ga} < \text{Al} < \text{In} < \text{Tl}$

NEET 2018 · Q51

5. In the structure of ClF_3 , the number of lone pairs of electrons on central atom 'Cl' is

- (A) four
- (B) two
- (C) one
- (D) three

NEET 2018 · Q52

6. Identify the major products P, Q and R in the following sequence of reactions:

Benzene + $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ —(Anhydrous AlCl_3)→ P; P —(i) O_2 , (ii) $\text{H}_3\text{O}^+/\Delta$ → Q + R

- (A) $\text{P} = \text{C}_6\text{H}_5\text{CH}(\text{CH}_3)_2$, $\text{Q} = \text{C}_6\text{H}_5\text{OH}$, $\text{R} = \text{CH}_3\text{CH}(\text{OH})\text{CH}_3$
- (B) $\text{P} = \text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{Q} = \text{C}_6\text{H}_5\text{CHO}$, $\text{R} = \text{C}_6\text{H}_5\text{COOH}$
- (C) $\text{P} = \text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_3$, $\text{Q} = \text{C}_6\text{H}_5\text{CHO}$, $\text{R} = \text{CH}_3\text{CH}_2\text{OH}$
- (D) $\text{P} = \text{C}_6\text{H}_5\text{CH}(\text{CH}_3)_2$, $\text{Q} = \text{C}_6\text{H}_5\text{OH}$, $\text{R} = \text{CH}_3\text{COCH}_3$

NEET 2018 · Q53

7. Which of the following compounds can form a zwitterion?

- (A) Benzoic acid
- (B) Acetanilide
- (C) Aniline
- (D) Glycine

NEET 2018 · Q55

8. Nitration of aniline in strong acidic medium also gives m-nitroaniline because

- (A) In absence of substituents nitro group always goes to m-position.
- (B) In electrophilic substitution reactions amino group is meta directive.
- (C) In spite of substituents nitro group always goes to only m-position.
- (D) In acidic (strong) medium aniline is present as anilinium ion.

NEET 2018 · Q56

9. The difference between amylose and amylopectin is

- (A) Amylopectin have 1 → 4 α-linkage and 1 → 6 β-linkage
- (B) Amylose have 1 → 4 α-linkage and 1 → 6 β-linkage
- (C) Amylopectin have 1 → 4 α-linkage and 1 → 6 α-linkage
- (D) Amylose is made up of glucose and galactose

NEET 2018 · Q57

10. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4 . The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be

- (A) 2.8
- (B) 3.0
- (C) 1.4
- (D) 4.4

NEET 2018 · Q58

11. Which of the following oxides is most acidic in nature?

- (A) BaO
- (B) BeO
- (C) MgO
- (D) CaO

NEET 2018 · Q59

12. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity?

- (A) N_2O
- (B) NO_2
- (C) N_2O_5
- (D) NO

NEET 2018 · Q60

13. The compound A on treatment with Na gives B, and with PCl_5 gives C. B and C react together to give diethyl ether. A, B and C are in the order

- (A) $\text{C}_2\text{H}_5\text{Cl}$, C_2H_6 , $\text{C}_2\text{H}_5\text{OH}$
- (B) $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_2\text{H}_5\text{Cl}$, $\text{C}_2\text{H}_5\text{ONa}$
- (C) $\text{C}_2\text{H}_5\text{OH}$, C_2H_6 , $\text{C}_2\text{H}_5\text{Cl}$
- (D) $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_2\text{H}_5\text{ONa}$, $\text{C}_2\text{H}_5\text{Cl}$

NEET 2018 · Q61

14. The compound C_7H_8 undergoes the following reactions: $\text{C}_7\text{H}_8 \xrightarrow{(3\text{Cl}_2/\Delta)} \text{A} \xrightarrow{(\text{Br}_2/\text{Fe})} \text{B} \xrightarrow{(\text{Zn}/\text{HCl})} \text{C}$. The product 'C' is

- (A) 3-bromo-2,4,6-trichlorotoluene
- (B) o-bromotoluene
- (C) m-bromotoluene
- (D) p-bromotoluene

NEET 2018 · Q62

15. Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. (A) is

- (A) $\text{CH}_3 - \text{CH}_3$
- (B) $\text{CH}_2 = \text{CH}_2$
- (C) $\text{CH} \equiv \text{CH}$
- (D) CH_4

NEET 2018 · Q63

16. Which of the following molecules represents the order of hybridisation sp^2 , sp^2 , sp , sp from left to right atoms?

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

NEET 2018 · Q66

17. In the reaction: phenol + CHCl_3 + $\text{NaOH} \rightarrow$ sodium salt of o-hydroxybenzaldehyde (o-formyl sodium phenoxide, O^-Na^+ with $-\text{CHO}$ at the ortho position), the electrophile involved is

- (A) dichloromethyl anion ($^-\text{CHCl}_2$)
- (B) formyl cation (^+CHO)
- (C) dichloromethyl cation ($^+\text{CHCl}_2$)
- (D) dichlorocarbene ($:\text{CCl}_2$)

NEET 2018 · Q67

18. Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to their

- (A) more extensive association of carboxylic acid via van der Waals force of attraction
- (B) formation of carboxylate ion
- (C) formation of intramolecular H-bonding
- (D) formation of intermolecular H-bonding

NEET 2018 · Q68

19. Compound A, $\text{C}_8\text{H}_{10}\text{O}$, is found to react with NaOI (produced by reacting Y with NaOH) and yields a yellow precipitate with characteristic smell. A and Y are respectively

- (A) $\text{C}_6\text{H}_5\text{-CH(OH)-CH}_3$ and I_2
- (B) $\text{C}_6\text{H}_5\text{-CH}_2\text{-CH}_2\text{-OH}$ and I_2
- (C) $\text{H}_3\text{C-C}_6\text{H}_4\text{-CH}_2\text{-OH}$ (p-methylbenzyl alcohol) and I_2
- (D) $\text{CH}_3\text{-C}_6\text{H}_3(\text{CH}_3)\text{-OH}$ (dimethylphenol, CH_3 groups ortho and para to OH) and I_2

NEET 2018 · Q69

20. Match the metal ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code: Column I: a. Co^{3+} b. Cr^{3+} c. Fe^{3+} d. Ni^{2+} ; Column II: i. $\sqrt{8}$ B.M. ii. $\sqrt{35}$ B.M. iii. $\sqrt{3}$ B.M. iv. $\sqrt{24}$ B.M. v. $\sqrt{15}$ B.M.

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

NEET 2018 · Q70

21. Which one of the following ions exhibits d-d transition and paramagnetism as well?

- (A) MnO_4^-
- (B) $\text{Cr}_2\text{O}_7^{2-}$
- (C) CrO_4^{2-}
- (D) MnO_4^{2-}

NEET 2018 · Q71

22. Iron carbonyl, $\text{Fe}(\text{CO})_5$ is

- (A) trinuclear
- (B) mononuclear
- (C) tetranuclear
- (D) dinuclear

NEET 2018 · Q72

23. The type of isomerism shown by the complex $[\text{CoCl}_2(\text{en})_2]$ is

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

NEET 2018 · Q73

24. The geometry and magnetic behaviour of the complex $[\text{Ni}(\text{CO})_4]$ are

- (A) square planar geometry and paramagnetic
- (B) tetrahedral geometry and diamagnetic
- (C) square planar geometry and diamagnetic
- (D) tetrahedral geometry and paramagnetic

NEET 2018 · Q74

25. Following solutions were prepared by mixing different volumes of NaOH and HCl of different concentrations: a. 60 mL M/10 HCl + 40 mL M/10 NaOH b. 55 mL M/10 HCl + 45 mL M/10 NaOH c. 75 mL M/5 HCl + 25 mL M/5 NaOH d. 100 mL M/10 HCl + 100 mL M/10 NaOH. pH of which one of them will be equal to 1?

- (A) d
- (B) a
- (C) b
- (D) c

NEET 2018 · Q75

26. On which of the following properties does the coagulating power of an ion depend?

- (A) Both magnitude and sign of the charge on the ion
- (B) Size of the ion alone
- (C) The magnitude of the charge on the ion alone
- (D) The sign of charge on the ion alone

NEET 2018 · Q76

27. Given van der Waals constant for NH_3 , H_2 , O_2 and CO_2 are respectively 4.17, 0.244, 1.36 and 3.59, which one of the following gases is most easily liquefied?

- (A) O_2
- (B) H_2
- (C) NH_3
- (D) CO_2

NEET 2018 · Q77

28. The solubility of BaSO_4 in water is $2.42 \times 10^{-3} \text{ g L}^{-1}$ at 298 K. The value of its solubility product (K_{sp}) will be (Given molar mass of $\text{BaSO}_4 = 233 \text{ g mol}^{-1}$)

- (A) $1.08 \times 10^{-14} \text{ mol}^2 \text{ L}^{-2}$
- (B) $1.08 \times 10^{-12} \text{ mol}^2 \text{ L}^{-2}$
- (C) $1.08 \times 10^{-10} \text{ mol}^2 \text{ L}^{-2}$
- (D) $1.08 \times 10^{-8} \text{ mol}^2 \text{ L}^{-2}$

NEET 2018 · Q78

29. In which case is the number of molecules of water maximum?

- (A) 0.00224 L of water vapours at 1 atm and 273 K
- (B) 0.18 g of water
- (C) 18 mL of water
- (D) 10^{-3} mol of water

NEET 2018 · Q79

30. The correct difference between first- and second-order reactions is that

- (A) a first-order reaction can be catalyzed; a second-order reaction cannot be catalyzed
- (B) the half-life of a first-order reaction does not depend on $[A]_0$; the half-life of a second-order reaction does depend on $[A]_0$
- (C) the rate of a first-order reaction does not depend on reactant concentrations; the rate of a second-order reaction does depend on reactant concentrations
- (D) the rate of a first-order reaction does depend on reactant concentrations; the rate of a second-order reaction does not depend on reactant concentrations

NEET 2018 · Q80

31. Among CaH_2 , BeH_2 , BaH_2 , the order of ionic character is

- (A) $\text{BeH}_2 < \text{BaH}_2 < \text{CaH}_2$
- (B) $\text{CaH}_2 < \text{BeH}_2 < \text{BaH}_2$
- (C) $\text{BeH}_2 < \text{CaH}_2 < \text{BaH}_2$
- (D) $\text{BaH}_2 < \text{BeH}_2 < \text{CaH}_2$

NEET 2018 · Q82

32. For the redox reaction $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \rightarrow \text{Mn}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$, the correct coefficients of the reactants for the balanced equation are (MnO_4^- , $\text{C}_2\text{O}_4^{2-}$, H^+)

- (A) 2, 16, 5
- (B) 2, 5, 16
- (C) 16, 5, 2
- (D) 5, 16, 2

NEET 2018 · Q83

33. Which one of the following conditions will favour maximum formation of the product in the reaction, $\text{A}_2(\text{g}) + \text{B}_2(\text{g}) \rightleftharpoons \text{X}_2(\text{g})$ $\Delta_r H = -X \text{ kJ}$?

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

NEET 2018 · Q84

34. When initial concentration of the reactant is doubled, the half-life period of a zero order reaction

- (A) is tripled
- (B) is doubled
- (C) is halved
- (D) remains unchanged

NEET 2018 · Q85

35. The bond dissociation energies of X_2 , Y_2 and XY are in the ratio of 1 : 0.5 : 1. ΔH for the formation of XY is -200 kJ mol^{-1} . The bond dissociation energy of X_2 will be

- (A) 800 kJ mol^{-1}
- (B) 100 kJ mol^{-1}
- (C) 200 kJ mol^{-1}
- (D) 400 kJ mol^{-1}

NEET 2018 · Q86

36. The correction factor 'a' to the ideal gas equation corresponds to

- (A) electric field present between the gas molecules
- (B) volume of the gas molecules
- (C) density of the gas molecules
- (D) forces of attraction between the gas molecules

NEET 2018 · Q87

37. Consider the following species: CN^+ , CN^- , NO and CN . Which one of these will have the highest bond order?

- (A) CN^+
- (B) CN^-
- (C) NO
- (D) CN

NEET 2018 · Q88

38. Magnesium reacts with an element (X) to form an ionic compound. If the ground state electronic configuration of (X) is $1s^2 2s^2 2p^3$, the simplest formula for this compound is

- (A) Mg_2X
- (B) MgX_2
- (C) Mg_2X_3
- (D) Mg_3X_2

NEET 2018 · Q89

39. Iron exhibits bcc structure at room temperature. Above 900°C , it transforms to fcc structure. The ratio of density of iron at room temperature to that at 900°C (assuming molar mass and atomic radii of iron remains constant with temperature) is

- (A) $3\sqrt{3}/(4\sqrt{2})$
- (B) $4\sqrt{3}/(3\sqrt{2})$
- (C) $\sqrt{3}/\sqrt{2}$
- (D) $1/2$

NEET 2018 · Q90

40. Which one is a wrong statement?

- (A) The electronic configuration of N atom is $1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$ shown in boxes as $[\uparrow\downarrow][\uparrow\downarrow][\uparrow][\uparrow][\downarrow]$
- (B) An orbital is designated by three quantum numbers while an electron in an atom is designated by four quantum numbers.
- (C) Total orbital angular momentum of electron in 's' orbital is equal to zero.
- (D) The value of m for d_{z^2} is zero.

Answer key and explanations

1. Answer: (C) HNO_3 , NO , N_2 , NH_4Cl

Oxidation states of N: HNO_3 +5, NO +2, N_2 0, NH_4Cl -3. So the decreasing order is $HNO_3 > NO > N_2 > NH_4Cl$; the reverse sequence is increasing order.

2. Answer: (A) B

Boron has no d orbitals in its valence shell, so its maximum covalency is 4 (as in BF_4^-). Al, Ga and In can use d orbitals to expand to six-coordination, giving MF_6^{3-} .

3. Answer: (A) Mg

A metal can reduce an oxide if its own oxide line lies below in the Ellingham diagram (more negative ΔG°). The MgO line lies below Al_2O_3 at high temperature, so Mg can reduce alumina; Zn, Fe and Cu oxides lie above it.

4. Answer: (D) $\text{B} < \text{Ga} < \text{Al} < \text{In} < \text{Tl}$

Ga (135 pm) is slightly smaller than Al (143 pm) because the poorly shielding 3d electrons raise its effective nuclear charge. In (167 pm) and Tl (170 pm) follow, so $\text{B} < \text{Ga} < \text{Al} < \text{In} < \text{Tl}$. The simple monotonic order ignores this anomaly.

5. Answer: (B) two

Cl has 7 valence electrons; 3 form bonds with F, leaving 4 electrons = 2 lone pairs. Five electron pairs give a trigonal bipyramidal arrangement with the two lone pairs equatorial, hence the T-shape.

6. Answer: (D) $\text{P} = \text{C}_6\text{H}_5\text{CH}(\text{CH}_3)_2$, $\text{Q} = \text{C}_6\text{H}_5\text{OH}$, $\text{R} = \text{CH}_3\text{-CO-CH}_3$

In Friedel-Crafts alkylation the n-propyl carbocation rearranges to the more stable isopropyl cation, giving cumene. Air oxidation gives cumene hydroperoxide, which on acid hydrolysis gives phenol and acetone (not propan-2-ol).

7. Answer: (D) Glycine

Glycine has both an acidic -COOH and a basic -NH_2 group, so an internal proton transfer gives $\text{H}_3\text{N}^+\text{-CH}_2\text{-COO}^-$. Benzoic acid and aniline have only one of these groups, and the N in acetanilide is not basic.

8. Answer: (D) In acidic (strong) medium aniline is present as anilinium ion.

In strongly acidic nitrating mixture, aniline is protonated to the anilinium ion $\text{C}_6\text{H}_5\text{NH}_3^+$, whose -NH_3^+ group is electron-withdrawing and meta-directing. The free -NH_2 group itself is ortho/para-directing.

9. Answer: (C) Amylopectin have $1 \rightarrow 4$ α -linkage and $1 \rightarrow 6$ α -linkage

Amylose is an unbranched chain of α -D-glucose with $\text{C1} \rightarrow \text{C4}$ α -glycosidic links. Amylopectin is branched: $\text{C1} \rightarrow \text{C4}$ α -links in the chain and $\text{C1} \rightarrow \text{C6}$ α -links at branch points. Starch has no β -links, and amylose contains only glucose.

10. Answer: (A) 2.8

HCOOH ($2.3/46 = 0.05$ mol) $\rightarrow \text{CO} + \text{H}_2\text{O}$; $\text{H}_2\text{C}_2\text{O}_4$ ($4.5/90 = 0.05$ mol) $\rightarrow \text{CO} + \text{CO}_2 + \text{H}_2\text{O}$. KOH absorbs CO_2 (and water), leaving 0.1 mol $\text{CO} = 0.1 \times 28 = 2.8$ g. 4.4 g would be the CO_2 mass if it were wrongly counted.

11. Answer: (B) BeO

Down group 2 metallic character increases, so the oxides become more basic: $\text{BeO} < \text{MgO} < \text{CaO} < \text{BaO}$ in basicity. BeO is amphoteric and thus the most acidic; BaO is the most basic.

12. Answer: (C) N_2O_5

NO , NO_2 and N_2O are released both naturally (lightning, soil bacteria) and by combustion and fertilisers. N_2O_5 is an unstable solid anhydride and is not a common atmospheric pollutant.

13. Answer: (D) $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_2\text{H}_5\text{ONa}$, $\text{C}_2\text{H}_5\text{Cl}$

Ethanol with Na gives sodium ethoxide; with PCl_5 it gives chloroethane. Williamson synthesis $\text{C}_2\text{H}_5\text{ONa} + \text{C}_2\text{H}_5\text{Cl} \rightarrow \text{C}_2\text{H}_5\text{OC}_2\text{H}_5$. Na does not convert ethanol to ethane, and the order of B and C matters.

14. Answer: (C) m-bromotoluene

Toluene with Cl_2 under heat (side-chain chlorination) gives $\text{C}_6\text{H}_5\text{CCl}_3$. The -CCl_3 group is electron-withdrawing and meta-directing, so Br_2/Fe gives m-bromobenzotrichloride; Zn/HCl reduces -CCl_3 back to -CH_3 , giving m-bromotoluene. Direct bromination of toluene would give the ortho/para products.

15. Answer: (D) CH_4

$\text{CH}_4 + \text{Br}_2 \rightarrow \text{CH}_3\text{Br}$; Wurtz coupling $2\text{CH}_3\text{Br} + 2\text{Na} \rightarrow \text{C}_2\text{H}_6$, a gas with fewer than four carbons. Ethane would give butane (four carbons), and ethene/ethyne add bromine rather than substitute.

16. Answer: (B) $\text{CH}_2 = \text{CH} - \text{C} \equiv \text{CH}$

In $\text{CH}_2=\text{CH}-\text{C}\equiv\text{CH}$ the two doubly bonded carbons are sp^2 and the two triply bonded carbons are sp . Buta-1,3-diene is all sp^2 , and but-2-ene has sp^3 end carbons.

17. Answer: (D) dichlorocarbene ($:\text{CCl}_2$)

In the Reimer-Tiemann reaction, OH^- removes a proton from CHCl_3 and the -CCl_3 loses Cl^- to give dichlorocarbene $:\text{CCl}_2$, an electron-deficient electrophile that attacks the phenoxide ring at the ortho position. The dichloromethyl anion is a nucleophile, not an electrophile.

18. Answer: (D) formation of intermolecular H-bonding

Carboxylic acids form strong intermolecular hydrogen bonds and exist as dimers even in the vapour phase, raising the boiling point. Intramolecular H-bonding would lower, not raise, the boiling point.

19. Answer: (A) $\text{C}_6\text{H}_5\text{-CH(OH)-CH}_3$ and I_2

The yellow precipitate with antiseptic smell is iodoform, formed by NaOI (from $\text{I}_2 + \text{NaOH}$). It requires a $\text{CH}_3\text{CH(OH)-}$ or $\text{CH}_3\text{CO-}$ unit; 1-phenylethanol has it, while 2-phenylethanol, p-methylbenzyl alcohol and the dimethylphenol do not.

20. Answer: (C) a-iv, b-v, c-ii, d-i

$\mu = \sqrt{n(n+2)}$: Co^{3+} ($3d^6$, 4 unpaired) $\sqrt{24}$; Cr^{3+} ($3d^3$, 3 unpaired) $\sqrt{15}$; Fe^{3+} ($3d^5$, 5 unpaired) $\sqrt{35}$; Ni^{2+} ($3d^8$, 2 unpaired) $\sqrt{8}$. Matching Ni^{2+} with $\sqrt{3}$ would assume only one unpaired electron.

21. Answer: (D) MnO_4^{2-}

In MnO_4^{2-} manganese is +6 ($3d^1$): one unpaired electron makes it paramagnetic and allows d-d transitions. MnO_4^- (Mn^{+7}), $\text{Cr}_2\text{O}_7^{2-}$ and CrO_4^{2-} (Cr^{+6}) are d^0 and diamagnetic; their colour is due to charge transfer.

22. Answer: (B) mononuclear

Fe(CO)_5 contains a single Fe atom bonded to five CO ligands, so it is mononuclear (trigonal bipyramidal). $\text{Fe}_2(\text{CO})_9$ is the dinuclear and $\text{Fe}_3(\text{CO})_{12}$ the trinuclear carbonyl.

23. Answer: (C) Geometrical isomerism

The octahedral $[\text{MA}_2(\text{AA})_2]$ complex can have the two Cl ligands cis or trans, so it shows geometrical isomerism (the cis form is also optically active). It has no counter-ion exchange, no complex cation-anion pair and no ambidentate ligand, so the other types do not apply.

24. Answer: (B) tetrahedral geometry and diamagnetic

Ni is in the 0 state ($3d^8 4s^2$); the strong-field CO ligands pair all electrons into $3d^{10}$, and sp^3 hybridisation gives a tetrahedral, diamagnetic complex. Square planar dsp^2 geometry is for Ni^{2+} with strong-field ligands like CN^- .

25. Answer: (D) c

For c: $\text{HCl} = 75 \times 0.2 = 15 \text{ mmol}$, $\text{NaOH} = 25 \times 0.2 = 5 \text{ mmol}$; excess $\text{H}^+ = 10 \text{ mmol}$ in $100 \text{ mL} = 0.1 \text{ M}$, so $\text{pH} = 1$. Mixture a leaves 0.02 M H^+ , b leaves 0.01 M H^+ , and d is exactly neutral.

26. Answer: (A) Both magnitude and sign of the charge on the ion

By the Hardy-Schulze rule, only ions of charge opposite to the colloid coagulate it (sign), and coagulating power increases sharply with the valency of that ion (magnitude). Neither factor alone is enough.

27. Answer: (C) NH_3

The van der Waals constant 'a' measures intermolecular attraction; the larger 'a', the higher the critical temperature and the easier the liquefaction. NH_3 has the largest value (4.17), H_2 the smallest.

28. Answer: (C) $1.08 \times 10^{-10} \text{ mol}^2 \text{ L}^{-2}$

Molar solubility $s = 2.42 \times 10^{-3}/233 = 1.04 \times 10^{-5} \text{ mol L}^{-1}$. For $\text{BaSO}_4 \rightleftharpoons \text{Ba}^{2+} + \text{SO}_4^{2-}$, $K_{sp} = s^2 = 1.08 \times 10^{-10} \text{ mol}^2 \text{ L}^{-2}$. Squaring the gram solubility without converting to moles gives a wrong exponent.

29. Answer: (C) 18 mL of water

18 mL of liquid water (density 1 g/mL) is $18 \text{ g} = 1 \text{ mol}$. The others are 10^{-4} mol (0.00224 L of vapour at STP), 0.01 mol (0.18 g) and 10^{-3} mol , so 18 mL has the most molecules.

30. Answer: (B) the half-life of a first-order reaction does not depend on $[\text{A}]_0$; the half-life of a second-order reaction does depend on $[\text{A}]_0$

For first order $t_{1/2} = 0.693/k$, independent of $[\text{A}]_0$, while for second order $t_{1/2} = 1/(k[\text{A}]_0)$. Rates of both orders depend on concentration, and either type can be catalysed.

31. Answer: (C) $\text{BeH}_2 < \text{CaH}_2 < \text{BaH}_2$

Down group 2 the metal becomes larger and more electropositive, so ionic character of the hydrides increases: BeH_2 (covalent, polymeric) $< \text{CaH}_2 < \text{BaH}_2$. Placing BaH_2 below CaH_2 contradicts this trend.

32. Answer: (B) 2, 5, 16

Mn goes from +7 to +2 (gain $5e^-$) and each $\text{C}_2\text{O}_4^{2-}$ loses $2e^-$. Equalising electrons: $2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-}$; balancing O and H gives $2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 16\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O}$.

33. Answer: (C) Low temperature and high pressure

The forward reaction is exothermic, so low temperature favours the product. It also reduces gas moles from 2 to 1, so high pressure shifts equilibrium forward (Le Chatelier). High temperature would favour the reverse reaction.

34. Answer: (B) is doubled

For a zero-order reaction $t_{1/2} = [A]_0/2k$, directly proportional to initial concentration, so doubling $[A]_0$ doubles $t_{1/2}$. A half-life independent of concentration is the first-order case.

35. Answer: (A) 800 kJ mol⁻¹

Let $BE(X_2) = a$, $BE(Y_2) = 0.5a$, $BE(XY) = a$. For $\frac{1}{2}X_2 + \frac{1}{2}Y_2 \rightarrow XY$: $\Delta H = \frac{1}{2}a + \frac{1}{4}a - a = -a/4 = -200$, so $a = 800 \text{ kJ mol}^{-1}$. Forgetting the $\frac{1}{2}$ coefficients (forming $2XY$) gives 400 kJ mol^{-1} .

36. Answer: (D) forces of attraction between the gas molecules

In the van der Waals equation $(P + an^2/V^2)(V - nb) = nRT$, the term with 'a' corrects the pressure for intermolecular attractive forces. The constant 'b' is the one that corrects for the volume of the molecules.

37. Answer: (B) CN⁻

By MO theory: CN^- (14 electrons) has bond order 3; CN (13) and NO (15) have 2.5; CN^+ (12) has 2. So CN^- has the highest bond order; removing an electron from CN lowers it.

38. Answer: (D) Mg₃X₂

X is nitrogen, which gains 3 electrons to form N^{3-} , while Mg forms Mg^{2+} . Charge balance requires 3 Mg^{2+} for 2 N^{3-} , giving Mg_3X_2 (magnesium nitride). Mg_2X_3 reverses the subscripts.

39. Answer: (A) $3\sqrt{3}/(4\sqrt{2})$

$\rho \propto Z/a^3$. bcc: $Z = 2$, $a = 4r/\sqrt{3}$; fcc: $Z = 4$, $a = 2\sqrt{2}r$. $\rho_{\text{bcc}}/\rho_{\text{fcc}} = [2 \times 3\sqrt{3}/(64r^3)] / [4/(16\sqrt{2}r^3)] = 3\sqrt{6}/8 = 3\sqrt{3}/(4\sqrt{2})$. The bcc form is less dense, so a ratio greater than 1 is wrong.

40. Answer: (A) The electronic configuration of N atom is $1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$ shown in boxes as $[\uparrow\downarrow][\uparrow\downarrow][\uparrow][\uparrow][\downarrow]$

By Hund's rule, the three unpaired 2p electrons of nitrogen must have parallel spins; the box diagram with one 2p electron spin-down is wrong. An s electron has $l = 0$ so zero orbital angular momentum, and d_{z^2} corresponds to $m = 0$.

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