JCECE Chemistry Sample Paper – 7

Duration: 60 Minutes **Maximum Marks: 50**

Instructions

- This paper contains **50** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry portion of **JCECE** entrance.
- Each correct answer carries **+1 mark**. There is -0.25 **mark** for each incorrect answer; unattempted questions get 0.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 and Class 12 NCERT Chemistry (Jharkhand JAC / CBSE aligned) – Physical, Organic and Inorganic.**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, if 2 mol of N_2 is mixed with 3 mol of H_2, the limiting reagent is:

(A) N_2

(B) NH_3

(C) H_2

(D) neither (exact stoichiometry)

Q2. In a hydrogen atom an electron falls from $n = 2$ to $n = 1$, releasing energy 1.635×10^{-18} J. Taking $h = 6.63 \times 10^{-34}$ J s, the frequency of the emitted photon is:

(A) 2.47×10^{14} Hz

(B) 4.93×10^{14} Hz

(C) 1.23×10^{15} Hz

(D) 2.47×10^{15} Hz

Q3. For the principal quantum number $n = 3$ (whose subshells are sketched), the maximum number of electrons that can be accommodated is:

$3s, 3p, 3d$ subshells

(A) 8

(B) 9

(C) 32

(D) 18

Q4. The density of carbon dioxide gas (CO_2, molar mass 44 g/mol) at 300 K and 1.0 atm, taking $R = 0.0821$ L atm $\text{mol}^{-1}\text{K}^{-1}$, is approximately:

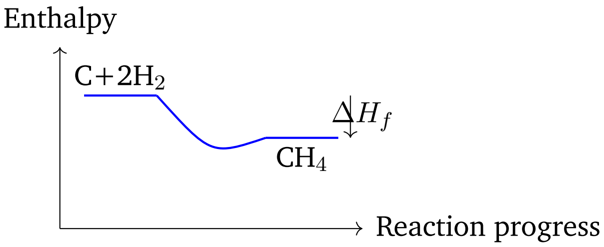
(A) 0.90 g/L

(B) 1.79 g/L

(C) 3.58 g/L

(D) 0.045 g/L

Q5. From the energy diagram, the standard enthalpy of formation of methane is found using $\Delta H_f = \Delta H_c(\text{C}) + 2\Delta H_c(\text{H}_2) - \Delta H_c(\text{CH}_4)$. Given $\Delta H_c(\text{C}) = -394$, $\Delta H_c(\text{H}_2) = -286$ and $\Delta H_c(\text{CH}_4) = -890$ kJ/mol, $\Delta H_f(\text{CH}_4)$ is:



(A) $+76$ kJ/mol

(B) -1570 kJ/mol

(C) -76 kJ/mol

(D) $+210$ kJ/mol

Q6. The enthalpy of atomization of methane $CH_4(g) \to C(g) + 4H(g)$ is 1648 kJ/mol. The average C–H bond enthalpy is:

(A) 412 kJ/mol

(B) 1648 kJ/mol

(C) 824 kJ/mol

(D) 206 kJ/mol

Q7. For the equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, an increase in total pressure (at constant temperature) will:

(A) shift the equilibrium towards the reactants

(B) shift the equilibrium towards NH_3 (forward)

(C) have no effect on the position of equilibrium

(D) decrease the value of K_c

Q8. The hydrogen-ion concentration $[H^+]$ of an aqueous solution whose pH is 4 at $25°$C is:

(A) 4 M

(B) 1×10^{-10} M

(C) 1×10^{-2} M

(D) 1×10^{-4} M

Q9. An acetic acid / acetate buffer ($pK_a = 4.74$) is to be prepared at $pH = 4.74$. The required ratio $[CH_3COO^-]/[CH_3COOH]$ (Henderson equation) is:

(A) 1

(B) 10

(C) 0.1

(D) 4.74

Q10. The vapour pressure of pure water at a given temperature is 24 mm Hg. On dissolving a non-volatile solute so that the mole fraction of water becomes 0.90, the vapour pressure of the solution (Raoult's law) is:

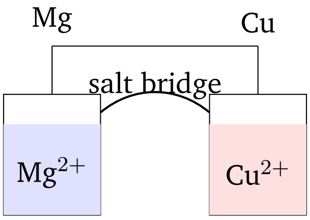
(A) 24 mm Hg

(B) 2.4 mm Hg

(C) 21.6 mm Hg

(D) 26.7 mm Hg

Q11. For the galvanic cell shown, $E^\circ_{\mathrm{Mg^{2+}/Mg}} = -2.37$ V and $E^\circ_{\mathrm{Cu^{2+}/Cu}} = +0.34$ V. The electrode acting as the anode (negative electrode) is:



(A) the Cu electrode

(B) the Mg electrode

(C) both electrodes equally

(D) neither electrode

Q12. For a weak monobasic acid, the molar conductivity at a given concentration is $\Lambda_m = 15$ S cm^{2}mol^{-1} and the limiting molar conductivity is $\Lambda^\circ_m = 390$ S cm^{2}mol^{-1}. The degree of dissociation α is:

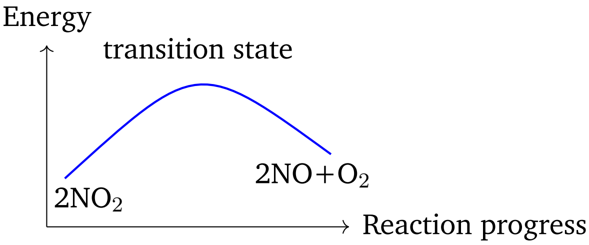
(A) 0.0385

(B) 0.385

(C) 0.260

(D) 26.0

Q13. For the elementary single-step reaction whose collision is depicted, $2NO_2 \rightarrow 2NO +$ (assumed bimolecular), the molecularity of the reaction is:



(A) 1

(B) 3

(C) 0

(D) 2

Q14. For a second-order reaction $t_{1/2} = \dfrac{1}{k[\mathrm{A}]_0}$. If $k = 0.05$ L mol^{-1}min^{-1} and $[\mathrm{A}]_0 = 2$ mol/L, the half-life is:

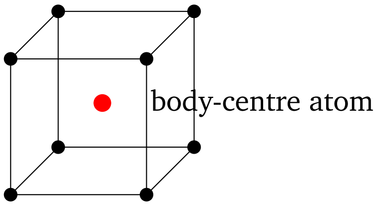
(A) 5 min

(B) 20 min

(C) 40 min

(D) 10 min

Q15. The number of atoms per unit cell in a body-centred cubic (bcc) lattice, as illustrated by the cube shown, is:



(A) 4

(B) 2

(C) 1

(D) 6

Q16. The oxidation number of chromium (Cr) in the dichromate ion $\mathrm{Cr_2O_7^{2-}}$ is:

(A) $+3$

(B) $+7$

(C) $+6$

(D) $+2$

Q17. A solution of sulphuric acid (H_2SO_4, a dibasic acid) has a molarity of 0.5 M. Its normality is:

(A) 1.0 N

(B) 0.5 N

(C) 0.25 N

(D) 2.0 N

Q18. The IUPAC name of the compound CH_3–$CHBr$–CH_2–CH_3 is:

(A) 1-bromobutane

(B) 3-bromobutane

(C) 2-bromopropane

(D) 2-bromobutane

Q19. The total number of structural (constitutional) isomers of the bromobutane C_4H_9Br is:

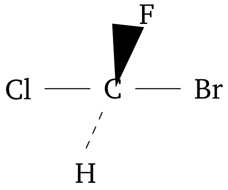
(A) 2

(B) 3

(C) 4

(D) 5

Q20. For the chiral carbon of bromochlorofluoromethane $CHBrClF$ (wedge–dash structure shown), with priority order $Br > Cl > F > H$ and H pointing away from the viewer, the configuration $Br \to Cl \to F$ appearing clockwise is:



(A) S configuration

(B) R configuration

(C) achiral (no configuration)

(D) meso compound

Q21. Which of the following groups, when attached to a benzene ring, shows a $+M$ (electron-donating mesomeric / resonance) effect?

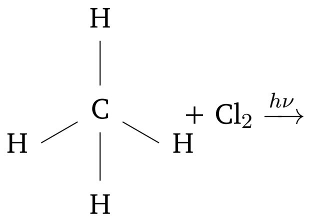
(A) $-\mathrm{OCH_3}$ (methoxy)

(B) $-\mathrm{NO_2}$ (nitro)

(C) $-\mathrm{CN}$ (cyano)

(D) $-\mathrm{COOH}$ (carboxyl)

Q22. When methane (shown) reacts with chlorine in the presence of ultraviolet light, the substitution proceeds by a:



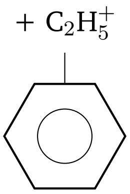
(A) nucleophilic addition mechanism

(B) electrophilic addition mechanism

(C) carbocation (ionic) mechanism

(D) free-radical chain (substitution) mechanism

Q23. When benzene (shown) is treated with chloroethane $\mathrm{C_2H_5Cl}$ in the presence of anhydrous $\mathrm{AlCl_3}$, the electrophilic substitution product is:



(A) acetophenone

(B) chlorobenzene

(C) nitrobenzene

(D) ethylbenzene

Q24. In the alkaline hydrolysis of a chiral primary alkyl halide by the S_N2 mechanism, the stereochemical outcome at the carbon bearing the halogen is:

(A) retention of configuration

(B) racemisation (50:50 mixture)

(C) inversion of configuration (Walden inversion)

(D) no defined stereochemical change

Q25. Ethanol reacts with acetic acid in the presence of a little concentrated H_2SO_4. The organic product (Fischer esterification) is:

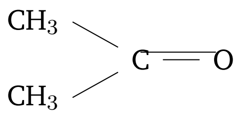
(A) ethyl alcohol

(B) ethyl acetate

(C) acetaldehyde

(D) diethyl ether

Q26. Acetone (whose carbonyl group is shown) is reduced with sodium borohydride ($NaBH_4$). The product is:



(A) propan-2-ol (isopropanol)

(B) propan-1-ol

(C) propanoic acid

(D) propane

Q27. When acetic acid (CH_3COOH) is reduced with lithium aluminium hydride ($LiAlH_4$), the product is:

(A) acetaldehyde

(B) acetone

(C) methane

(D) ethanol

Q28. In the Hinsberg test, a tertiary amine $(CH_3)_3N$ treated with benzenesulphonyl chloride:

(A) gives a product soluble in alkali (KOH)

(B) gives a product insoluble in alkali

(C) gives a carbylamine smell

(D) does not react (no replaceable H on N)

Q29. Enzymes act as efficient biological catalysts mainly because they:

(A) increase the activation energy of the reaction

(B) lower the activation energy by providing an alternative pathway

(C) change the equilibrium constant of the reaction

(D) are consumed completely in the reaction

Q30. Bakelite, a thermosetting phenolic resin, is a condensation polymer of:

(A) phenol and formaldehyde

(B) ethene molecules

(C) adipic acid and hexamethylenediamine

(D) isoprene units

Q31. The correct order of stability of carbanions (most stable first) among the following is:

(A) tertiary $>$ secondary $>$ primary $>$ methyl

(B) secondary $>$ tertiary $>$ primary $>$ methyl

(C) methyl $>$ primary $>$ secondary $>$ tertiary

(D) all carbanions are equally stable

Q32. Sodium phenoxide is heated with CO_2 under pressure and then acidified to give salicylic acid. This reaction is known as:

(A) Cannizzaro reaction

(B) Friedel–Crafts reaction

(C) Kolbe's reaction (Kolbe–Schmitt)

(D) Wurtz reaction

Q33. A compound gives a yellow precipitate of iodoform (CHI_3) when warmed with I_2 and NaOH. Which compound responds positively to this test?

(A) benzaldehyde (C_6H_5CHO)

(B) ethanol (CH_3CH_2OH)

(C) methanol (CH_3OH)

(D) diethyl ether

Q34. The reagent used to dehydrate a primary amide ($R–CONH_2$) into the corresponding nitrile ($R–CN$) is:

(A) P_2O_5 (phosphorus pentoxide)

(B) dilute H_2SO_4

(C) aqueous NaOH

(D) $LiAlH_4$

Q35. The first ionization energy of nitrogen is higher than that of oxygen. The best reason for this anomaly is:

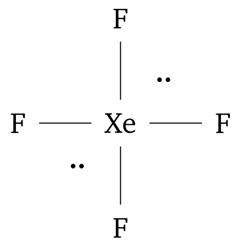
(A) oxygen has a smaller atomic radius than nitrogen

(B) nitrogen has a stable, exactly half-filled $2p^3$ configuration

(C) oxygen has a higher nuclear charge that is fully shielded

(D) nitrogen is more metallic than oxygen

Q36. According to VSEPR theory, the molecular shape of xenon tetrafluoride $\mathrm{XeF_4}$ (with two lone pairs on Xe, shown) is:



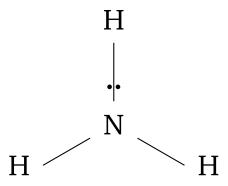
(A) octahedral

(B) tetrahedral

(C) square planar

(D) trigonal bipyramidal

Q37. In the ammonia molecule $\mathrm{NH_3}$ (shown), the total number of electron pairs (bond pairs + lone pairs) around the nitrogen atom is:



(A) 2

(B) 5

(C) 3

(D) 4

Q38. Among the alkali metals, the strongest reducing agent in aqueous solution (most negative E°, owing to its very high hydration enthalpy) is:

(A) sodium (Na)

(B) potassium (K)

(C) lithium (Li)

(D) caesium (Cs)

Q39. In group 13, the relative stability of the $+1$ oxidation state compared with $+3$:

(A) decreases down the group

(B) is the same for all the elements

(C) increases down the group (maximum for Tl)

(D) is shown only by boron

Q40. Producer gas, made by passing air over red-hot coke, is mainly a mixture of:

(A) carbon monoxide and nitrogen ($CO + N_2$)

(B) carbon monoxide and hydrogen ($CO + H_2$)

(C) carbon dioxide and hydrogen ($CO_2 + H_2$)

(D) methane and hydrogen ($CH_4 + H_2$)

Q41. The correct order of thermal stability of the group-15 hydrides (most stable first) is:

(A) $BiH_3 > SbH_3 > AsH_3 > PH_3 > NH_3$

(B) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

(C) $PH_3 > NH_3 > AsH_3 > SbH_3 > BiH_3$

(D) all are equally stable

Q42. The bond angle in water (H_2O, 104.5°) is larger than that in hydrogen sulphide (H_2S, 92°). The main reason is:

(A) oxygen is more electronegative, so bonding pairs are closer to O and repel more

(B) sulphur has no lone pairs

(C) water has sp hybridization

(D) H_2S has more bond pairs than H_2O

Q43. The oxidation number of chlorine in perchloric acid $HClO_4$ is:

(A) $+5$

(B) $+7$

(C) $+3$

(D) $+1$

Q44. Among the noble gases, the formation of clathrate (cage) compounds with water or quinol is shown most readily by the heavier members because they:

(A) have the smallest atomic size

(B) are the most chemically reactive

(C) have the highest ionization enthalpy

(D) are larger and more easily polarised (e.g. Kr, Xe)

Q45. Transition metals form hard interstitial compounds (e.g. steel, tungsten carbide) because:

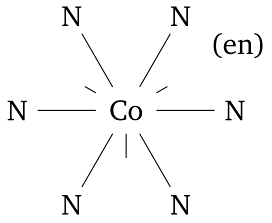
(A) they have completely filled d orbitals

(B) small atoms (H, C, N, B) occupy the interstitial voids of the metal lattice

(C) they are radioactive

(D) they have only s electrons

Q46. In the octahedral complex $[Co(en)_3]^{3+}$ (shown, en = ethylenediamine), the denticity of each ethylenediamine ligand is:



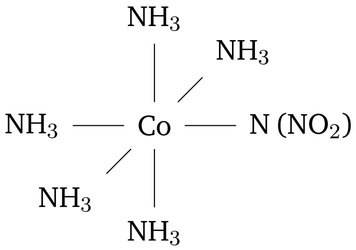
(A) monodentate (1)

(B) tridentate (3)

(C) bidentate (2)

(D) hexadentate (6)

Q47. The complex pair $[\mathrm{Co(NH_3)_5(NO_2)}]^{2+}$ and $[\mathrm{Co(NH_3)_5(ONO)}]^{2+}$ (the ambidentate $\mathrm{NO_2^-}$ ligand bound through N or O, shown) are examples of:



(A) linkage isomerism

(B) geometrical isomerism

(C) optical isomerism

(D) coordination isomerism

Q48. The Ellingham diagram (a plot of ΔG° versus temperature for the formation of oxides) is used in metallurgy primarily to:

(A) identify the colour of an ore

(B) measure the density of a metal

(C) determine the crystal structure of a metal

(D) choose a suitable reducing agent for an oxide ore

Q49. Water gas (synthesis gas), produced by passing steam over red-hot coke, is a mixture of:

(A) carbon monoxide and hydrogen $(\mathrm{CO} + \mathrm{H_2})$

(B) carbon monoxide and nitrogen $(\mathrm{CO} + \mathrm{N_2})$

(C) carbon dioxide and nitrogen $(\mathrm{CO_2} + \mathrm{N_2})$

(D) methane and oxygen $(\mathrm{CH_4} + \mathrm{O_2})$

Q50. In Lassaigne's test, the presence of nitrogen in an organic compound is confirmed by the formation of a Prussian-blue colour, which is due to:

(A) silver chloride (AgCl)

(B) ferric ferrocyanide $(\mathrm{Fe_4[Fe(CN)_6]_3})$

(C) barium sulphate $(\mathrm{BaSO_4})$

(D) sodium thiocyanate (NaSCN)

Detailed Solutions

Q1.

Solution

Concept — Limiting reagent: The reactant that is completely consumed first (gives the least product) limits the reaction.

Step 1 — Write the stoichiometry: $1\,N_2$ needs $3\,H_2$.

Step 2 — H_2 **required for** 2 **mol** N_2**:** $2 \times 3 = 6$ mol H_2.

Step 3 — Compare with supply: Only 3 mol H_2 is available, but 6 mol is needed.

Step 4 — Conclude: H_2 runs out first, so H_2 is the limiting reagent.

Why other options are wrong:

- (A) N_2 is in excess (3 mol H_2 uses only 1 mol N_2).
- (B) NH_3 is a product, not a reactant.
- (D) the mixture is not in exact $1{:}3$ ratio.

Final Answer: H_2 is limiting $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Planck relation: The photon energy is $E = h\nu$, so the frequency is $\nu = \dfrac{E}{h}$.

Step 1 — List data: $E = 1.635 \times 10^{-18}$ J, $h = 6.63 \times 10^{-34}$ J s.

Step 2 — Write the formula: $\nu = \dfrac{E}{h}$.

Step 3 — Substitute: $\nu = \dfrac{1.635 \times 10^{-18}}{6.63 \times 10^{-34}}$.

Step 4 — Divide the mantissas: $\dfrac{1.635}{6.63} = 0.2466$.

Step 5 — Divide the powers: $10^{-18}/10^{-34} = 10^{16}$.

Step 6 — Combine: $\nu = 0.2466 \times 10^{16} = 2.47 \times 10^{15}$ Hz.

Why other options are wrong:

- (A) and (B) are out by a factor of 10.
- (C) uses a wrong mantissa.

Final Answer: $\nu = 2.47 \times 10^{15}$ Hz $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Maximum electrons in a shell: The maximum number of electrons in a principal shell is $2n^2$.

Step 1 — Identify n: $n = 3$.

Step 2 — Square n: $n^2 = 9$.

Step 3 — Apply $2n^2$: $2 \times 9 = 18$.

Step 4 — Cross-check by subshells: $3s(2) + 3p(6) + 3d(10) = 18$.

Why other options are wrong:

- (A) 8 is $2n^2$ for $n = 2$.
- (B) 9 is the number of orbitals, not electrons.
- (C) 32 is $2n^2$ for $n = 4$.

Final Answer: $2n^2 = 18$ electrons $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Density of an ideal gas: From $PV = nRT$ with $n = \dfrac{m}{M}$, the density is $d = \dfrac{PM}{RT}$.

Step 1 — List data: $P = 1.0$ atm, $M = 44$ g/mol, $R = 0.0821$, $T = 300$ K.

Step 2 — Write the formula: $d = \dfrac{PM}{RT}$.

Step 3 — Numerator: $PM = 1.0 \times 44 = 44$.

Step 4 — Denominator: $RT = 0.0821 \times 300 = 24.63$.

Step 5 — Divide: $d = \dfrac{44}{24.63} = 1.79$ g/L.

Why other options are wrong:

- (A) uses $M = 22$.
- (C) doubles the correct value.
- (D) inverts the ratio.

Final Answer: $d = 1.79$ g/L $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Enthalpy of formation from combustion data: $\Delta H_f(\mathrm{CH_4}) = \Delta H_c(\mathrm{C}) + 2\,\Delta H_c(\mathrm{H_2}) - \Delta H_c(\mathrm{CH_4})$.

Step 1 — List data: $\Delta H_c(\mathrm{C}) = -394$, $\Delta H_c(\mathrm{H_2}) = -286$, $\Delta H_c(\mathrm{CH_4}) = -890$ kJ/mol.

Step 2 — Combustion of carbon term: -394.

Step 3 — Two hydrogen terms: $2 \times (-286) = -572$.

Step 4 — Sum reactant terms: $-394 + (-572) = -966$.

Step 5 — Subtract methane combustion: $\Delta H_f = -966 - (-890) = -966 + 890$.

Step 6 — Evaluate: $\Delta H_f = -76$ kJ/mol.

Why other options are wrong:

- (A) has the wrong sign.
- (B) forgets to subtract $\Delta H_c(\mathrm{CH_4})$.
- (D) uses one $\mathrm{H_2}$ term.

Final Answer: $\Delta H_f(\mathrm{CH_4}) = -76$ kJ/mol $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Average bond enthalpy: For CH_4, four equivalent C–H bonds are broken, so the average C–H bond enthalpy $= \dfrac{\text{enthalpy of atomization}}{4}$.

Step 1 — List data: enthalpy of atomization $= 1648$ kJ/mol; number of C–H bonds $= 4$.

Step 2 — Write the formula: $\bar{E}_{\mathrm{C-H}} = \dfrac{1648}{4}$.

Step 3 — Divide: $\dfrac{1648}{4} = 412$.

Step 4 — Conclude: the average C–H bond enthalpy is 412 kJ/mol.

Why other options are wrong:

- (B) quotes the total atomization enthalpy.
- (C) divides by 2.
- (D) divides by 8.

Final Answer: $\bar{E}_{\mathrm{C-H}} = 412 \text{ kJ/mol} \Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q6**

Q7.

Solution

Concept — Le Chatelier (pressure): Increasing pressure shifts a gaseous equilibrium towards the side with fewer moles of gas.

Step 1 — Count moles of gas: reactants $= 1 + 3 = 4$ mol; products $= 2$ mol.

Step 2 — Identify the smaller side: the product side (2 mol) has fewer gas molecules.

Step 3 — Apply the principle: higher pressure favours the side of fewer moles.

Step 4 — Conclude: equilibrium shifts forward, towards NH_3.

Why other options are wrong:

- (A) is the reverse direction.
- (C) pressure does affect this reaction ($\Delta n_g \neq 0$).
- (D) K_c depends only on temperature, not pressure.

Final Answer: shifts towards $NH_3 \Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q7

Q8.

Solution

Concept — $[H^+]$ from pH: $\mathrm{pH} = -\log[H^+]$, so $[H^+] = 10^{-\mathrm{pH}}$.

Step 1 — Identify pH: $\mathrm{pH} = 4$.

Step 2 — Write the inverse formula: $[H^+] = 10^{-\mathrm{pH}}$.

Step 3 — Substitute: $[H^+] = 10^{-4}$.

Step 4 — Conclude: $[H^+] = 1 \times 10^{-4}$ M.

Why other options are wrong:

- (A) quotes the pH as a concentration.
- (B) is $[OH^-]$ (10^{-10}).
- (C) corresponds to $\mathrm{pH} = 2$.

Final Answer: $[H^+] = 1 \times 10^{-4}\ \mathrm{M} \Rightarrow \boxed{\mathrm{D}}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q8

Q9.

Solution

Concept — Henderson–Hasselbalch: $\mathrm{pH} = \mathrm{p}K_a + \log \dfrac{[\text{salt}]}{[\text{acid}]}$.

Step 1 — Set $\mathrm{pH} = \mathrm{p}K_a$**:** $4.74 = 4.74 + \log \dfrac{[CH_3COO^-]}{[CH_3COOH]}$.

Step 2 — Isolate the log term: $\log \dfrac{[\text{salt}]}{[\text{acid}]} = 4.74 - 4.74 = 0$.

Step 3 — Remove the logarithm: $\dfrac{[\text{salt}]}{[\text{acid}]} = 10^0$.

Step 4 — Evaluate: $10^0 = 1$.

Why other options are wrong:

- (B) is the ratio for $\mathrm{pH} = \mathrm{p}K_a + 1$.
- (C) is the ratio for $\mathrm{pH} = \mathrm{p}K_a - 1$.
- (D) confuses the ratio with $\mathrm{p}K_a$.

Final Answer: ratio $= 1 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Raoult's law: For a non-volatile solute, $P_{\text{soln}} = x_{\text{solvent}} \times P^\circ_{\text{solvent}}$.

Step 1 — List data: $P^\circ = 24$ mm Hg, $x_{\text{water}} = 0.90$.

Step 2 — Write the formula: $P_{\text{soln}} = x_{\text{water}} P^\circ$.

Step 3 — Substitute: $P_{\text{soln}} = 0.90 \times 24$.

Step 4 — Multiply: $0.90 \times 24 = 21.6$.

Step 5 — Conclude: $P_{\text{soln}} = 21.6$ mm Hg.

Why other options are wrong:

- (A) ignores the lowering.
- (B) multiplies by 0.1 (mole fraction of solute).
- (D) raises the vapour pressure, which is impossible.

Final Answer: $P_{\text{soln}} = 21.6$ mm Hg $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Anode of a galvanic cell: The electrode with the lower (more negative) reduction potential is oxidised; it is the anode (negative electrode).

Step 1 — Compare potentials: $E^\circ_{\text{Mg}^{2+}/\text{Mg}} = -2.37$ V is much more negative than $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34$ V.

Step 2 — Identify the oxidised species: the more negative electrode (Mg) loses electrons.

Step 3 — Assign roles: Mg is the anode; Cu is the cathode.

Step 4 — Conclude: the Mg electrode is the anode (negative electrode).

Why other options are wrong:

- (A) Cu has the higher potential, so it is the cathode.
- (C) and (D) only one electrode is the anode.

Final Answer: Mg electrode is the anode $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept — Degree of dissociation: For a weak electrolyte, $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$.

Step 1 — List data: $\Lambda_m = 15$, $\Lambda_m^\circ = 390$ S cm^2 mol^{-1}.

Step 2 — Write the formula: $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$.

Step 3 — Substitute: $\alpha = \frac{15}{390}$.

Step 4 — Divide: $\alpha = 0.0385$.

Why other options are wrong:

- (B) is out by a factor of 10.
- (C) uses a wrong ratio.
- (D) is α multiplied by 100 but mis-scaled.

Final Answer: $\alpha = 0.0385 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Molecularity: For an elementary reaction, the molecularity is the number of reactant species (atoms, ions or molecules) that collide in the single rate-determining step.

Step 1 — Read the elementary step: $2NO_2 \rightarrow 2NO + O_2$ occurs in one step.

Step 2 — Count colliding species: two NO_2 molecules collide.

Step 3 — Conclude: the molecularity is 2 (bimolecular).

Why other options are wrong:

- (A) 1 would be unimolecular (one species).
- (B) 3 would need three colliding species.
- (C) molecularity is never zero.

Final Answer: molecularity $= 2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept — Second-order half-life: $t_{1/2} = \dfrac{1}{k[\text{A}]_0}$.

Step 1 — List data: $k = 0.05\ \text{L mol}^{-1}\ \text{min}^{-1}$, $[\text{A}]_0 = 2$ mol/L.

Step 2 — Denominator: $k[\text{A}]_0 = 0.05 \times 2 = 0.1$.

Step 3 — Take the reciprocal: $t_{1/2} = \dfrac{1}{0.1}$.

Step 4 — Evaluate: $t_{1/2} = 10$ min.

Why other options are wrong:

- (A) uses $k[\text{A}]_0 = 0.2$.
- (B) forgets $[\text{A}]_0$.
- (C) doubles the answer.

Final Answer: $t_{1/2} = 10$ min $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Atoms per bcc unit cell: A bcc cell has 8 corner atoms (each shared by 8 cells) and 1 atom at the body centre (wholly inside).

Step 1 — Corner contribution: $8 \times \dfrac{1}{8} = 1$.

Step 2 — Body-centre contribution: $1 \times 1 = 1$.

Step 3 — Add: $Z = 1 + 1 = 2$.

Step 4 — Conclude: there are 2 atoms per bcc unit cell.

Why other options are wrong:

- (A) 4 is for an fcc cell.
- (C) 1 is for a simple cubic cell.
- (D) 6 over-counts.

Final Answer: $Z = 2 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Oxidation number in an oxoanion: The sum of oxidation numbers equals the ion charge; oxygen is taken as -2.

Step 1 — Let Cr oxidation number be x: ion is $\mathrm{Cr_2O_7^{2-}}$.

Step 2 — Write the balance: $2x + 7(-2) = -2$.

Step 3 — Simplify: $2x - 14 = -2$.

Step 4 — Solve: $2x = 12 \Rightarrow x = +6$.

Why other options are wrong:

- (A) $+3$ is Cr in $\mathrm{Cr^{3+}}$.
- (B) $+7$ ignores the ionic charge.
- (D) $+2$ uses wrong arithmetic.

Final Answer: Cr is $+6 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Normality and molarity: Normality $=$ Molarity $\times\, n$-factor. For $\mathrm{H_2SO_4}$ the acid n-factor (basicity) is 2.

Step 1 — List data: molarity $= 0.5$ M, n-factor $= 2$.

Step 2 — Write the formula: $N = M \times n$.

Step 3 — Substitute: $N = 0.5 \times 2$.

Step 4 — Evaluate: $N = 1.0$ N.

Why other options are wrong:

- (B) uses n-factor $= 1$.
- (C) divides instead of multiplying.
- (D) uses n-factor $= 4$.

Final Answer: $N = 1.0$ N $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — IUPAC naming of a haloalkane: Number the longest chain to give the halogen the lowest locant; name the halogen as a prefix.

Step 1 — Count carbons: CH_3–CHBr–CH_2–CH_3 has a chain of 4 carbons (butane).

Step 2 — Locate Br: the bromine is on carbon-2 (lowest locant from the nearer end).

Step 3 — Assemble the name: prefix bromo at position 2 on butane.

Step 4 — Conclude: the name is 2-bromobutane.

Why other options are wrong:

- (A) 1-bromobutane has Br on C-1.
- (B) 3-bromobutane is the same as 2-bromobutane numbered from the wrong end (higher locant).
- (C) names only a 3-carbon chain.

Final Answer: 2-bromobutane $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Constitutional isomers of C_4H_9Br: Count distinct carbon skeletons and distinct positions of Br.

Step 1 — Straight chain (butane): 1-bromobutane and 2-bromobutane (Br on C-1 or C-2).

Step 2 — Branched chain (isobutane): 1-bromo-2-methylpropane and 2-bromo-2-methylpropane.

Step 3 — Count: $2 + 2 = 4$ structural isomers.

Step 4 — Conclude: there are 4 constitutional isomers.

Why other options are wrong:

- (A) 2 counts only the straight-chain isomers.
- (B) 3 misses one branched isomer.
- (D) 5 over-counts (no fifth distinct structure exists).

Final Answer: 4 isomers $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — R/S assignment: Rank the four groups by priority; with the lowest priority pointing away, a clockwise $1 \rightarrow 2 \rightarrow 3$ sequence is R, anticlockwise is S.

Step 1 — Assign priorities: $\mathrm{Br}(1) > \mathrm{Cl}(2) > \mathrm{F}(3) > \mathrm{H}(4)$.

Step 2 — Orient lowest group: H is on the dashed bond, pointing away from the viewer (correct orientation).

Step 3 — Trace $1 \rightarrow 2 \rightarrow 3$: the question states $\mathrm{Br} \rightarrow \mathrm{Cl} \rightarrow \mathrm{F}$ is clockwise.

Step 4 — Apply the rule: a clockwise sequence with H away gives the R configuration.

Why other options are wrong:

- (A) S would require an anticlockwise sense.
- (C) the carbon has four different groups, so it is chiral.
- (D) a single chiral centre cannot be meso.

Final Answer: R configuration $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept — Mesomeric (M) effect: Groups that donate electron density into the ring through resonance show $+M$; groups that withdraw show $-M$.

Step 1 — Examine $-\mathrm{OCH_3}$: the oxygen lone pair is delocalised into the ring, donating electron density ($+M$).

Step 2 — Examine the others: $-\mathrm{NO_2}$, $-\mathrm{CN}$ and $-\mathrm{COOH}$ pull electron density out of the ring ($-M$).

Step 3 — Conclude: only $-\mathrm{OCH_3}$ has a $+M$ effect.

Why other options are wrong:

- (B), (C) and (D) are all $-M$ (electron-withdrawing) groups.

Final Answer: $-\mathrm{OCH_3}$ shows $+M \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Halogenation of alkanes: The chlorination of methane in UV light proceeds by a free-radical chain mechanism (initiation, propagation, termination).

Step 1 — Initiation: UV light homolyses $\mathrm{Cl_2}$ into two $\mathrm{Cl}\cdot$ radicals.

Step 2 — Propagation: $\mathrm{Cl}\cdot$ abstracts H from $\mathrm{CH_4}$, generating $\mathrm{CH_3}\cdot$, which then reacts with $\mathrm{Cl_2}$.

Step 3 — Classify: radicals (not ions) are the intermediates, so the mechanism is free-radical substitution.

Why other options are wrong:

- (A) and (B) alkanes are saturated; they do not undergo addition.
- (C) carbocations are not formed in radical halogenation.

Final Answer: free-radical chain substitution $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

Concept — Friedel–Crafts alkylation: Benzene reacts with an alkyl halide in the presence of anhydrous $\mathrm{AlCl_3}$; the alkyl group substitutes a ring hydrogen.

Step 1 — Generate the electrophile: $\mathrm{AlCl_3}$ helps form the ethyl cation $\mathrm{C_2H_5^+}$.

Step 2 — Electrophilic substitution: $\mathrm{C_2H_5^+}$ attacks the ring, replacing an H.

Step 3 — Identify the product: an ethyl group attached to benzene gives ethylbenzene.

Why other options are wrong:

- (A) acetophenone comes from acylation with $\mathrm{CH_3COCl}$.
- (B) chlorobenzene needs $\mathrm{Cl_2/AlCl_3}$.
- (C) nitrobenzene needs $\mathrm{HNO_3/H_2SO_4}$.

Final Answer: ethylbenzene $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — S_N2 stereochemistry: The nucleophile attacks from the side opposite the leaving group, so the configuration is inverted (Walden inversion).

Step 1 — Mechanism type: S_N2 is a one-step, back-side attack.

Step 2 — Geometry change: the three remaining groups flip like an umbrella in the wind.

Step 3 — Conclude: the product shows inversion of configuration.

Why other options are wrong:

- (A) retention is not seen in S_N2.
- (B) racemisation is characteristic of S_N1.
- (D) the stereochemistry is well defined (inversion).

Final Answer: inversion of configuration $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Fischer esterification: A carboxylic acid plus an alcohol with an acid catalyst gives an ester and water.

Step 1 — Identify reactants: ethanol (CH_3CH_2OH) and acetic acid (CH_3COOH).

Step 2 — Form the ester linkage: $-COOH$ and $-OH$ combine, eliminating water.

Step 3 — Name the product: $CH_3COOC_2H_5$ is ethyl acetate.

Why other options are wrong:

- (A) ethyl alcohol is a reactant.
- (C) acetaldehyde is an oxidation product, not an ester.
- (D) diethyl ether forms from two alcohols, not acid + alcohol.

Final Answer: ethyl acetate $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Reduction of a ketone: $NaBH_4$ reduces the carbonyl ($> C{=}O$) of a ketone to a secondary alcohol ($> CH{-}OH$).

Step 1 — Identify the carbonyl: acetone is $(CH_3)_2C{=}O$.

Step 2 — Add hydride and H: the $C{=}O$ becomes $C{-}OH$.

Step 3 — Name the product: $(CH_3)_2CHOH$ is propan-2-ol (isopropanol).

Why other options are wrong:

- (B) propan-1-ol would need a different carbon skeleton.
- (C) $NaBH_4$ does not oxidise to an acid.
- (D) the C=O is reduced to an alcohol, not all the way to an alkane.

Final Answer: propan-2-ol $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept — Reduction of a carboxylic acid: $LiAlH_4$ is a strong reducing agent that reduces $-COOH$ all the way to a primary alcohol ($-CH_2OH$).

Step 1 — Identify the acid: acetic acid is CH_3COOH.

Step 2 — Reduce $-COOH$: it converts to $-CH_2OH$.

Step 3 — Name the product: CH_3CH_2OH is ethanol.

Why other options are wrong:

- (A) $LiAlH_4$ does not stop at the aldehyde.
- (B) acetone is a ketone, not formed here.
- (C) the C–C framework is retained, so methane is wrong.

Final Answer: ethanol $\Rightarrow \boxed{D}$

Answer: (D) **Go Back to Q27**

Q28.

Solution

Concept — Hinsberg test: The reagent (benzenesulphonyl chloride) reacts only with amines that have a replaceable N–H. A tertiary amine has no N–H hydrogen.

Step 1 — Examine $(CH_3)_3N$: nitrogen bears three methyl groups and no hydrogen.

Step 2 — Apply the reagent: there is no N–H to be substituted by the sulphonyl group.

Step 3 — Conclude: a tertiary amine does not react in the Hinsberg test.

Why other options are wrong:

- (A) an alkali-soluble product is given by a primary amine.
- (B) an alkali-insoluble product is given by a secondary amine.
- (C) the carbylamine smell is from the isocyanide test, not Hinsberg.

Final Answer: no reaction (no N–H) $\Rightarrow \boxed{D}$

Answer: (D) **Go Back to Q28**

Q29.

Solution

Concept — Enzyme catalysis: Like all catalysts, enzymes speed up a reaction by lowering its activation energy, providing an alternative reaction pathway, without being consumed.

Step 1 — Recall catalyst action: a catalyst offers a lower-energy route.

Step 2 — Effect on activation energy: the energy barrier E_a is reduced.

Step 3 — Conclude: enzymes lower the activation energy.

Why other options are wrong:

- (A) catalysts lower, not raise, E_a.
- (C) a catalyst does not change K (equilibrium position).
- (D) a catalyst is regenerated, not consumed.

Final Answer: lower the activation energy $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Bakelite: It is a thermosetting condensation polymer formed from phenol and formaldehyde (a phenol–formaldehyde resin).

Step 1 — Recall the monomers: phenol and methanal (formaldehyde).

Step 2 — Type of polymerisation: condensation, releasing water.

Step 3 — Conclude: bakelite is made from phenol + formaldehyde.

Why other options are wrong:

- (B) ethene gives polythene (addition polymer).
- (C) adipic acid + hexamethylenediamine gives nylon-6,6.
- (D) isoprene gives natural rubber.

Final Answer: phenol and formaldehyde $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Carbanion stability: Carbanions are stabilised by electron-withdrawing groups and destabilised by electron-donating alkyl groups. More alkyl groups make a carbanion less stable.

Step 1 — Effect of alkyl groups: alkyl groups push electron density onto the negative carbon, destabilising it.

Step 2 — Order of substitution: methyl has no alkyl groups; tertiary has three.

Step 3 — Stability order: methyl $>$ primary $>$ secondary $>$ tertiary.

Why other options are wrong:

- (A) is the carbocation order, the reverse of carbanions.
- (B) is internally inconsistent.
- (D) the substituents clearly differentiate stability.

Final Answer: methyl $>$ primary $>$ secondary $>$ tertiary $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Kolbe's reaction (Kolbe–Schmitt): Sodium phenoxide heated with CO_2 under pressure, followed by acidification, gives salicylic acid (2-hydroxybenzoic acid).

Step 1 — Reactants: sodium phenoxide and CO_2.

Step 2 — Product after acidification: the ortho carboxylic acid, salicylic acid.

Step 3 — Name the reaction: this is Kolbe's (Kolbe–Schmitt) reaction.

Why other options are wrong:

- (A) Cannizzaro involves aldehydes without α-H.
- (B) Friedel–Crafts uses alkyl/acyl halides with $AlCl_3$.
- (D) Wurtz couples alkyl halides with sodium.

Final Answer: Kolbe's reaction $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Iodoform test: A positive iodoform test is given by ethanol, acetaldehyde and methyl ketones, i.e. compounds with a CH_3CO- group or a $CH_3CH(OH)-$ group.

Step 1 — Examine ethanol: CH_3CH_2OH has the $CH_3CH(OH)-$ unit, so it responds.

Step 2 — Reaction: $I_2/NaOH$ oxidises and halogenates it to give yellow CHI_3.

Step 3 — Conclude: ethanol gives a positive iodoform test.

Why other options are wrong:

- (A) benzaldehyde lacks the required $CH_3CO/CH_3CH(OH)$ group.
- (C) methanol has no such group.
- (D) diethyl ether is unreactive here.

Final Answer: ethanol $\Rightarrow \boxed{B}$

$\boxed{\text{Answer: (B)}}$ **Go Back to Q33**

Q34.

Solution

Concept — Amide to nitrile: A primary amide loses water on heating with a dehydrating agent such as P_2O_5 to give a nitrile.

Step 1 — Reaction: $R\text{–}CONH_2 \xrightarrow{P_2O_5,\ \Delta} R\text{–}CN + H_2O$.

Step 2 — Role of P_2O_5: it removes the elements of water from the amide.

Step 3 — Conclude: the dehydrating reagent is P_2O_5.

Why other options are wrong:

- (B) dilute H_2SO_4 would hydrolyse, not dehydrate.
- (C) NaOH would hydrolyse the amide.
- (D) $LiAlH_4$ reduces the amide to an amine.

Final Answer: $P_2O_5 \Rightarrow \boxed{A}$

$\boxed{\text{Answer: (A)}}$ **Go Back to Q34**

Q35.

Solution

Concept — IE anomaly (N vs O): A half-filled subshell ($2p^3$ in N) has extra stability, so removing an electron from N needs more energy than from O.

Step 1 — Write configurations: N is $1s^2 2s^2 2p^3$; O is $1s^2 2s^2 2p^4$.

Step 2 — Compare stability: N has a stable, exactly half-filled $2p^3$ set.

Step 3 — Oxygen's electron: in O, the fourth $2p$ electron is paired and easier to remove (electron–electron repulsion).

Step 4 — Conclude: N has the higher first ionization energy due to its half-filled stability.

Why other options are wrong:

- (A) atomic size alone would predict the opposite trend within the period.
- (C) the half-filled stability, not shielding, is the key factor.
- (D) metallic character is irrelevant here.

Final Answer: half-filled $2p^3$ stability of N $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q35

Q36.

Solution

Concept — VSEPR for XeF_4: Xe has 4 bond pairs and 2 lone pairs (AX_4E_2). The lone pairs occupy opposite axial positions, leaving four F atoms in a plane.

Step 1 — Count electron domains: 4 bond pairs $+2$ lone pairs $= 6$ (octahedral electron geometry).

Step 2 — Place lone pairs: the two lone pairs go trans to each other (axial).

Step 3 — Shape of atoms: the four F atoms lie in one plane.

Step 4 — Conclude: the molecular shape is square planar.

Why other options are wrong:

- (A) octahedral ignores the two lone pairs.
- (B) tetrahedral is for AX_4 with no lone pairs.
- (D) trigonal bipyramidal needs 5 bond pairs.

Final Answer: square planar $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q36

Q37.

Solution

Concept — Electron pairs around N in NH_3: Count the bond pairs (one per N–H bond) plus the lone pairs on nitrogen.

Step 1 — Bond pairs: three N–H bonds give 3 bond pairs.

Step 2 — Lone pairs: nitrogen has 1 lone pair.

Step 3 — Total electron pairs: $3 + 1 = 4$.

Step 4 — Conclude: there are 4 electron pairs (sp^3, tetrahedral electron geometry).

Why other options are wrong:

- (A) 2 omits two bond pairs and the lone pair.
- (B) 5 over-counts.
- (C) 3 counts only the bond pairs, missing the lone pair.

Final Answer: 4 electron pairs $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q37

Q38.

Solution

Concept — Reducing power in aqueous solution: Lithium has the most negative standard electrode potential because of its exceptionally high hydration enthalpy, making it the strongest reducing agent in water.

Step 1 — Recall E° values: $E^\circ_{Li^+/Li} = -3.04$ V is the most negative among alkali metals.

Step 2 — Reason: the very small Li^+ ion is strongly hydrated, releasing large hydration energy.

Step 3 — Conclude: Li is the strongest reducing agent in aqueous solution.

Why other options are wrong:

- (A), (B) and (D) Na, K and Cs have less negative E° in water than Li.

Final Answer: lithium (Li) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — Inert pair effect in group 13: Down the group, the ns^2 electrons become reluctant to take part in bonding, so the lower $(+1)$ oxidation state becomes more stable; this is greatest for thallium.

Step 1 — Trend down the group: B, Al favour $+3$; Tl strongly favours $+1$.

Step 2 — Reason: the inert pair effect grows with increasing atomic number.

Step 3 — Conclude: stability of $+1$ relative to $+3$ increases down the group, maximum for Tl.

Why other options are wrong:

- (A) the $+1$ stability increases, not decreases, down the group.
- (B) it clearly varies down the group.
- (D) heavier members (Tl) show it most, not boron.

Final Answer: increases down the group (Tl) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Producer gas: Made by passing air (not steam) over red-hot coke, it is mainly carbon monoxide diluted by the nitrogen of air.

Step 1 — Reaction: $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$ with N_2 of air carried along.

Step 2 — Composition: CO (the fuel) plus N_2.

Step 3 — Conclude: producer gas is mainly $\text{CO} + \text{N}_2$.

Why other options are wrong:

- (B) $\text{CO} + \text{H}_2$ is water gas (steam over coke).
- (C) and (D) do not match the air-over-coke process.

Final Answer: $CO + N_2 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q40

Q41.

Solution

Concept — Thermal stability of group-15 hydrides: Stability decreases as the E–H bond weakens down the group, so NH_3 is the most stable and BiH_3 the least.

Step 1 — Bond strength trend: the E–H bond strength falls $N > P > As > Sb > Bi$.

Step 2 — Relate to stability: stronger bond means more thermally stable hydride.

Step 3 — Write the order: $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$.

Why other options are wrong:

- (A) is the exact reverse.
- (C) wrongly places PH_3 above NH_3.
- (D) the hydrides differ markedly in stability.

Final Answer: $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept — Bond angle H_2O vs H_2S: Oxygen is far more electronegative than sulphur, so in water the bonding pairs are drawn closer to O and repel each other more, widening the angle.

Step 1 — Compare electronegativity: O $(3.5) >$ S (2.5).

Step 2 — Effect on bond pairs: in H_2O the bond pairs sit nearer O, increasing bond-pair–bond-pair repulsion.

Step 3 — Result: larger angle in H_2O $(104.5°)$ than in H_2S $(92°$, almost pure p orbitals).

Why other options are wrong:

- (B) both have two lone pairs.

- (C) water is sp^3, not sp.
- (D) both have the same number of bond pairs.

Final Answer: higher electronegativity of O $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q42

Q43.

Solution

Concept — Oxidation number in an oxoacid: In $HClO_4$, take H as $+1$ and O as -2; the molecule is neutral.

Step 1 — Let Cl be x: $HClO_4$.

Step 2 — Write the balance: $(+1) + x + 4(-2) = 0$.

Step 3 — Simplify: $1 + x - 8 = 0$.

Step 4 — Solve: $x = +7$.

Why other options are wrong:

- (A) $+5$ is Cl in $HClO_3$.
- (C) $+3$ is Cl in $HClO_2$.
- (D) $+1$ is Cl in $HClO$.

Final Answer: Cl is $+7 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept — Clathrate (cage) compounds: Heavier noble gases (Kr, Xe) are larger and more easily polarised, so they fit into and are trapped within cavities of water or quinol lattices.

Step 1 — Trend in size/polarisability: both increase down the group.

Step 2 — Relate to clathrate formation: larger, more polarisable atoms are held more firmly in the host cages.

Step 3 — Conclude: clathrates form most readily with the larger, more polarisable Kr and Xe.

Why other options are wrong:

- (A) small atoms (He, Ne) escape the cages, so they do not form clathrates.
- (B) noble gases are essentially unreactive; clathrates are physical, not chemical, trapping.
- (C) high ionization enthalpy is not the deciding factor.

Final Answer: larger, more polarisable atoms (Kr, Xe) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q44

Q45.

Solution

Concept — Interstitial compounds: Transition metals have lattices with voids large enough to trap small atoms such as H, C, N or B; these interstitial atoms make the material hard and rigid.

Step 1 — Recall the structure: the metal lattice has interstitial holes.

Step 2 — Trapping small atoms: H, C, N, B occupy these holes.

Step 3 — Conclude: this is why steel and tungsten carbide are hard interstitial compounds.

Why other options are wrong:

- (A) filled d orbitals are unrelated to interstitial formation.
- (C) transition metals are not all radioactive.
- (D) they have partially filled d, not only s, electrons.

Final Answer: small atoms occupy interstitial voids $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q45

Q46.

Solution

Concept — Denticity: Denticity is the number of donor atoms of a ligand that bind to the central metal. Ethylenediamine (en) has two nitrogen donor atoms.

Step 1 — Structure of en: $H_2N-CH_2-CH_2-NH_2$ has two $-NH_2$ donor groups.

Step 2 — Count donor atoms used: both N atoms coordinate to Co.

Step 3 — Conclude: en is bidentate (denticity $= 2$).

Why other options are wrong:

- (A) monodentate would use one donor atom.
- (B) tridentate would use three.
- (D) hexadentate (like EDTA) uses six.

Final Answer: bidentate $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q46

Q47.

Solution

Concept — Linkage isomerism: It arises when an ambidentate ligand (here NO_2^-) can bind to the metal through different donor atoms (N or O).

Step 1 — Identify the ligand: NO_2^- is ambidentate (nitro –N or nitrito –O).

Step 2 — Compare the two complexes: one binds through N ($-NO_2$), the other through O ($-ONO$).

Step 3 — Conclude: the pair shows linkage isomerism.

Why other options are wrong:

- (B) geometrical isomerism is about cis/trans spatial arrangement.
- (C) optical isomerism concerns non-superimposable mirror images.
- (D) coordination isomerism needs both ions to be complex.

Final Answer: linkage isomerism $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q47

Q48.

Solution

Concept — Ellingham diagram: It plots ΔG° of oxide formation against temperature, helping to predict which reducing agent can reduce a given metal oxide at a given temperature.

Step 1 — What the plot shows: the relative stabilities of oxides via ΔG°.

Step 2 — Use: a metal whose oxide line lies lower can reduce the oxide of a metal whose line lies higher.

Step 3 — Conclude: the diagram is used to select a suitable reducing agent for an ore.

Why other options are wrong:

- (A), (B) and (C) colour, density and crystal structure are not obtained from an Ellingham diagram.

Final Answer: choose a reducing agent $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q48**

Q49.

Solution

Concept — Water gas (synthesis gas): Produced by passing steam over red-hot coke, it is an equimolar mixture of carbon monoxide and hydrogen.

Step 1 — Reaction: $C + H_2O \xrightarrow{\Delta} CO + H_2$.

Step 2 — Composition: CO and H_2.

Step 3 — Conclude: water gas is $CO + H_2$.

Why other options are wrong:

- (B) $CO + N_2$ is producer gas (air over coke).
- (C) and (D) do not match the steam-over-coke reaction.

Final Answer: $CO + H_2 \Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q49**

Q50.

Solution

Concept — Lassaigne's test for nitrogen: Nitrogen converts to $NaCN$ on fusion with sodium; this reacts with Fe^{2+} then Fe^{3+} to give the Prussian-blue ferric ferrocyanide.

Step 1 — Sodium fusion: the element N forms $NaCN$.

Step 2 — Add $FeSO_4$: forms sodium ferrocyanide $Na_4[Fe(CN)_6]$.

Step 3 — Add Fe^{3+}**:** gives $Fe_4[Fe(CN)_6]_3$, Prussian blue.

Step 4 — Conclude: the blue colour is due to ferric ferrocyanide.

Why other options are wrong:

- (A) $AgCl$ is a white precipitate (halide test).
- (C) $BaSO_4$ is the sulphate test.
- (D) $NaSCN$ (blood-red with Fe^{3+}) indicates N and S together, not the Prussian blue.

Final Answer: ferric ferrocyanide (Prussian blue) $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q50**

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	D	3	D	4	B	5	C
6	A	7	B	8	D	9	A	10	C
11	B	12	A	13	D	14	D	15	B
16	C	17	A	18	D	19	C	20	B
21	A	22	D	23	D	24	C	25	B
26	A	27	D	28	D	29	B	30	A
31	C	32	C	33	B	34	A	35	B
36	C	37	D	38	C	39	C	40	A
41	B	42	A	43	B	44	D	45	B
46	C	47	A	48	D	49	A	50	B