SAAT Chemistry

Sample Paper – 8

Duration: 40 Minutes **Maximum Marks: 40**

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry section of the **SAAT** (Siksha 'O' Anusandhan Admission Test).
- Each correct answer carries **+1 mark**. There is **no negative marking** for incorrect or unattempted answers.
- Only **one** option is correct. Attempt every question, since wrong answers are not penalised.
- Use of mobile phones, calculators, or other electronic gadgets is strictly prohibited.

Q1. The number of moles of oxygen atoms present in 1 mol of phosphoric acid (H_3PO_4) is

(A) 4 mol

(B) 1 mol

(C) 3 mol

(D) 2 mol

Q2. The volume occupied by 0.25 mol of an ideal gas at STP (1 mol occupies 22.4 L) is

(A) 11.2 L

(B) 5.6 L

(C) 22.4 L

(D) 2.24 L

Q3. On complete combustion, 1 mol of methane (CH_4) produces carbon dioxide. The mass of CO_2 (molar mass 44 g/mol) released is

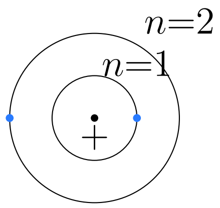
(A) 88 g

(B) 22 g

(C) 44 g

(D) 16 g

Q4. In the Bohr model of the hydrogen atom the radius of an orbit is proportional to n^2, as suggested below. The ratio of the radius of the $n = 2$ orbit to that of the $n = 1$ orbit is



(A) $2 : 1$

(B) $1 : 4$

(C) $1 : 2$

(D) $4 : 1$

Q5. The number of d-electrons present in the Co^{3+} ion ($Z = 27$) is

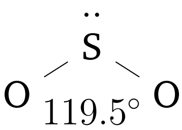
(A) 6

(B) 7

(C) 5

(D) 4

Q6. The hybridization of the central sulphur atom in the bent sulphur dioxide molecule (SO_2), shown below, is



(A) sp^3

(B) sp^2

(C) sp

(D) sp^3d

Q7. The molecular nitrogen molecule (N_2, 14 electrons) has 10 electrons in bonding molecular orbitals and 4 in antibonding orbitals. Its bond order is

(A) 1

(B) 2

(C) 3

(D) 2.5

Q8. The correct order of bond angles among water, ammonia and methane is

(A) $H_2O > NH_3 > CH_4$

(B) $NH_3 > CH_4 > H_2O$

(C) $H_2O > CH_4 > NH_3$

(D) $CH_4 > NH_3 > H_2O$

Q9. The enthalpy of neutralisation of a strong acid by a strong base is approximately constant. Its value is close to

(A) -57.1 kJ/mol

(B) $+57.1$ kJ/mol

(C) -13.7 kJ/mol

(D) -100 kJ/mol

Q10. Which of the following statements is a correct expression of the second law of thermodynamics?

(A) Energy can neither be created nor destroyed.

(B) The entropy of the universe increases in every spontaneous process.

(C) The entropy of a perfect crystal is zero at 0 K.

(D) The internal energy of an isolated system is constant.

Q11. For a reversible reaction, if the reaction quotient Q is less than the equilibrium constant K $(Q < K)$, the reaction will

(A) already be at equilibrium

(B) shift towards the reactants (backward)

(C) shift towards the products (forward)

(D) stop completely

Q12. An aqueous solution of ammonium chloride (NH_4Cl) is

(A) neutral

(B) strongly basic

(C) amphoteric

(D) acidic

Q13. A sample of water contains 0.005 g of dissolved salt in 1 kg of solution. The concentration of the salt in parts per million (ppm) is

(A) 50 ppm

(B) 5 ppm

(C) 0.5 ppm

(D) 500 ppm

Q14. During the electrolysis of concentrated aqueous sodium chloride (brine), the gas liberated at the anode is

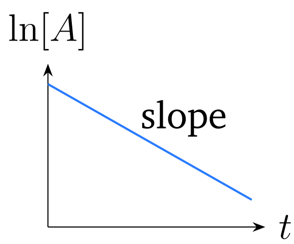
(A) hydrogen

(B) oxygen

(C) chlorine

(D) sodium vapour

Q15. For a first-order reaction, a plot of $\ln[A]$ against time t gives a straight line whose slope equals



(A) $-k$

(B) $+k$

(C) $-2.303\,k$

(D) $k/2.303$

Q16. Using $PV = nRT$ with $R = 0.0821\ \mathrm{L\,atm\,K^{-1}mol^{-1}}$, the volume occupied by 2 mol of an ideal gas at 300 K and 2 atm is

(A) 49.3 L

(B) 12.3 L

(C) 98.5 L

(D) 24.6 L

Q17. The correct order of first ionization enthalpy among the elements sodium (Na), magnesium (Mg) and aluminium (Al) is

(A) $\mathrm{Na > Mg > Al}$

(B) $\mathrm{Mg > Al > Na}$

(C) $\mathrm{Al > Mg > Na}$

(D) $\mathrm{Na > Al > Mg}$

Q18. An element has the outer (valence) electronic configuration $3s^2 3p^3$. The element is

(A) phosphorus

(B) nitrogen

(C) sulphur

(D) aluminium

Q19. Which of the following hydrides is essentially ionic (saline) in nature?

(A) CH_4

(B) NH_3

(C) CaH_2

(D) HCl

Q20. Silicones are synthetic polymers whose backbone is made up of repeating units of

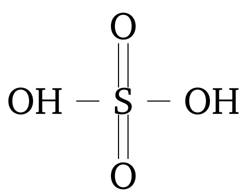
(A) C–C bonds

(B) Si–Si bonds

(C) C–O bonds

(D) Si–O bonds

Q21. In a molecule of sulphuric acid (H_2SO_4), whose tetrahedral structure is shown, the number of S=O (double-bond) linkages on the central sulphur atom is



(A) 1

(B) 2

(C) 3

(D) 4

Q22. Which of the following is an interhalogen compound?

(A) ClF_3

(B) $HClO_4$

(C) $NaCl$

(D) OF_2

Q23. Among the first transition series, which element exhibits the highest (maximum) oxidation state of $+7$ in its compounds?

(A) Chromium (Cr)

(B) Iron (Fe)

(C) Manganese (Mn)

(D) Vanadium (V)

Q24. The separation of individual lanthanide elements from one another is difficult mainly because they

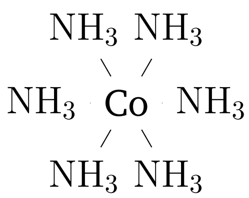
(A) are radioactive

(B) have a stable $+2$ oxidation state

(C) are gaseous at room temperature

(D) have very similar sizes and chemical properties

Q25. The overall charge on the octahedral complex ion formed by a Co^{3+} centre with six neutral ammonia ligands, shown below, is



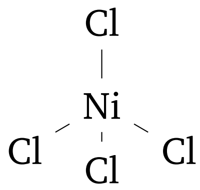
(A) $+3$

(B) $+6$

(C) 0

(D) -3

Q26. The complex ion $[NiCl_4]^{2-}$, shown below, is tetrahedral. The number of unpaired electrons present in it is



(A) 0

(B) 2

(C) 4

(D) 1

Q27. The IUPAC name of the compound $(CH_3)_2CHCH_2Cl$ is

(A) 2-chlorobutane

(B) 2-chloro-2-methylpropane

(C) 1-chloro-2-methylpropane

(D) 1-chlorobutane

Q28. The total number of structural (chain) isomers possible for the alkane pentane (C_5H_{12}) is

(A) 2

(B) 5

(C) 4

(D) 3

Q29. Among the following acids, which is the strongest, owing to the electron-withdrawing inductive effect of the chlorine atoms?

(A) $Cl_3C{-}COOH$ (trichloroacetic acid)

(B) $CH_3{-}COOH$ (acetic acid)

(C) $ClCH_2{-}COOH$ (chloroacetic acid)

(D) $Cl_2CH{-}COOH$ (dichloroacetic acid)

Q30. Under ordinary conditions, alkanes such as ethane do not react with

(A) chlorine in sunlight

(B) steam (water)

(C) oxygen on combustion

(D) bromine in sunlight

Q31. The hydroboration-oxidation of propene ($CH_3CH{=}CH_2$) with B_2H_6 followed by alkaline H_2O_2 gives, as the major product,

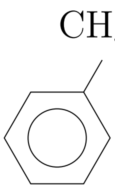
(A) propanone

(B) propanoic acid

(C) propan-2-ol

(D) propan-1-ol

Q32. When toluene (methylbenzene), shown below, is oxidised with hot alkaline $KMnO_4$, the product formed is



(A) benzaldehyde

(B) phenol

(C) benzoic acid

(D) benzene

Q33. DDT, a well-known organochlorine compound, was widely used as a/an

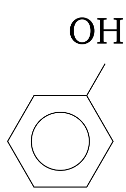
(A) insecticide

(B) fertiliser

(C) antibiotic

(D) anaesthetic

Q34. When phenol, shown below, is treated with chloroform and aqueous NaOH (Reimer–Tiemann reaction), the major product formed is



(A) benzoic acid

(B) salicylaldehyde (2-hydroxybenzaldehyde)

(C) anisole

(D) picric acid

Q35. Which of the following ethers is a symmetrical (simple) ether?

(A) $CH_3-O-C_2H_5$

(B) $CH_3-O-C_6H_5$

(C) $C_2H_5-O-C_2H_5$

(D) $CH_3-O-C_3H_7$

Q36. The reduction of the carbonyl group of a ketone to a CH_2 group using amalgamated zinc and concentrated HCl is known as the

(A) aldol reaction

(B) Cannizzaro reaction

(C) Wolff–Kishner reduction

(D) Clemmensen reduction

Q37. The acid derivative formed when acetic acid (CH_3COOH) is treated with thionyl chloride ($SOCl_2$) is

(A) acetamide

(B) acetyl chloride (CH_3COCl)

(C) acetic anhydride

(D) ethyl acetate

Q38. In the Hofmann bromamide degradation reaction, an amide ($R{-}CONH_2$) is converted by Br_2 and KOH into

(A) a primary amine ($R{-}NH_2$) with one fewer carbon

(B) a nitrile ($R{-}CN$)

(C) a carboxylic acid ($R{-}COOH$)

(D) a secondary amine (R_2NH)

Q39. Amino acids that cannot be synthesised by the human body and must be supplied through the diet are called

(A) non-essential amino acids

(B) neutral amino acids

(C) acidic amino acids

(D) essential amino acids

Q40. Which of the following is used as an antiseptic to kill or prevent the growth of micro-organisms on living tissue?

(A) paracetamol

(B) aspirin

(C) dettol (chloroxylenol)

(D) penicillin

Detailed Solutions

Q1.

Solution

Concept — Atoms per formula unit: The moles of an atom equal the moles of compound times the number of those atoms in the formula.

Step 1 — Read the formula: H_3PO_4 contains 4 oxygen atoms per molecule.

Step 2 — Compute: 1 mol $\times 4 = 4$ mol of O atoms.

Why other options are wrong: 3 counts H; 1 counts P; 2 is an arbitrary value.

Final Answer: 4 mol of oxygen atoms $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Molar gas volume at STP: 1 mol of an ideal gas occupies 22.4 L at STP, so $V = n \times 22.4$ L.

Step 1 — Substitute: $V = 0.25 \times 22.4$.

Step 2 — Compute: $V = 5.6$ L.

Why other options are wrong: 11.2 L is for 0.5 mol; 22.4 L is for 1 mol; 2.24 L is for 0.1 mol.

Final Answer: $V = 5.6$ L $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Combustion stoichiometry: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$; 1 mol CH_4 gives 1 mol CO_2.

Step 1 — Moles of CO_2: 1 mol $CH_4 \rightarrow 1$ mol CO_2.

Step 2 — Mass: $1 \times 44 = 44$ g.

Why other options are wrong: 88 g is for 2 mol; 22 g halves it; 16 g is the mass of CH_4 itself.

Final Answer: 44 g of $CO_2 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Bohr orbit radius: $r_n \propto n^2$, so $\frac{r_2}{r_1} = \frac{2^2}{1^2}$.

Step 1 — Substitute: $\frac{r_2}{r_1} = \frac{4}{1}$.

Step 2 — State the ratio: $r_2 : r_1 = 4 : 1$.

Why other options are wrong: $2 : 1$ ignores the square; $1 : 4$ and $1 : 2$ invert the ratio.

Final Answer: $r_2 : r_1 = 4 : 1 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — d-electron count of an ion: Write the neutral atom configuration and remove the required electrons (4s first, then 3d).

Step 1 — Co ($Z = 27$): $[\mathrm{Ar}]3d^7 4s^2$. For Co^{3+} remove $4s^2$ and one $3d$: $[\mathrm{Ar}]3d^6$.

Step 2 — Count d-electrons: $3d^6 \Rightarrow 6$ d-electrons.

Why other options are wrong: 7 is neutral Co's d-count; 5 and 4 remove the wrong number of electrons.

Final Answer: 6 d-electrons $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Hybridization from steric number: Sulphur in SO_2 has two bond pairs and one lone pair (steric number 3).

Step 1 — Count electron domains: 2 bonding regions +1 lone pair = 3 domains.

Step 2 — Assign hybridization: Three domains $\Rightarrow sp^2$, giving a bent shape with an angle near 119.5°.

Why other options are wrong: sp is for 2 domains (linear); sp^3 is 4 domains; sp^3d is 5 domains.

Final Answer: Sulphur is sp^2 hybridized $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Bond order (MOT): Bond order $= \frac{1}{2}(N_b - N_a)$.

Step 1 — Substitute: $N_b = 10$, $N_a = 4$.

Step 2 — Compute: Bond order $= \frac{1}{2}(10 - 4) = 3$.

Why other options are wrong: 1 and 2 use wrong electron counts; 2.5 is the bond order of N_2^+.

Final Answer: Bond order $= 3 \Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Bond angle and lone pairs: More lone pairs on the central atom press the bond pairs together, decreasing the bond angle.

Step 1 — Angles: $CH_4 = 109.5^\circ$ (no lone pair), $NH_3 = 107^\circ$ (one lone pair), $H_2O = 104.5^\circ$ (two lone pairs).

Step 2 — Order: $CH_4 > NH_3 > H_2O$.

Why other options are wrong: They reverse or scramble the lone-pair effect on the angles.

Final Answer: $CH_4 > NH_3 > H_2O \Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Enthalpy of neutralisation: For a strong acid and strong base it corresponds to the formation of 1 mol of water and is nearly constant.

Step 1 — Recall the value: $H^+ + OH^- \to H_2O$, $\Delta H \approx -57.1$ kJ/mol.

Step 2 — Note the sign: The process is exothermic, so ΔH is negative.

Why other options are wrong: $+57.1$ has the wrong sign; -13.7 is in kcal/mol (a unit slip); -100 is too large.

Final Answer: $\Delta H \approx -57.1$ kJ/mol $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Second law of thermodynamics: It states that in any spontaneous (real) process the total entropy of the universe increases.

Step 1 — Identify the correct statement: "The entropy of the universe increases in every spontaneous process."

Why other options are wrong: "Energy cannot be created/destroyed" is the first law; "perfect crystal entropy is zero at 0 K" is the third law; "internal energy of an isolated system is constant" is also the first law.

Final Answer: Entropy of the universe increases $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Reaction quotient vs equilibrium constant: The system moves to make Q approach K.

Step 1 — Compare: $Q < K$ means the products are too few relative to equilibrium.

Step 2 — Predict shift: The reaction proceeds in the forward direction (towards products) until $Q = K$.

Why other options are wrong: $Q = K$ would be equilibrium; $Q > K$ shifts backward; reactions never simply stop.

Final Answer: Shifts forward (towards products) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Salt hydrolysis: A salt of a strong acid and a weak base hydrolyses to give an acidic solution.

Step 1 — Identify the parents: NH_4Cl comes from HCl (strong acid) and NH_4OH (weak base).

Step 2 — Conclusion: The NH_4^+ ion hydrolyses to release H^+, making the solution acidic ($\text{pH} < 7$).

Why other options are wrong: It is not neutral (that needs a strong acid + strong base); it is not basic; it is not amphoteric.

Final Answer: The solution is acidic $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Parts per million: $\text{ppm} = \dfrac{\text{mass of solute}}{\text{mass of solution}} \times 10^6$.

Step 1 — Convert masses: solute $= 0.005$ g, solution $= 1000$ g.

Step 2 — Compute: $\dfrac{0.005}{1000} \times 10^6 = 5$ ppm.

Why other options are wrong: 50, 0.5 and 500 misplace the decimal in the ratio.

Final Answer: 5 ppm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Electrolysis of brine: In concentrated NaCl solution, chloride ions are preferentially discharged at the anode (over-potential of O_2).

Step 1 — Anode reaction: $2Cl^- \to Cl_2 + 2e^-$.

Step 2 — Product: Chlorine gas is liberated at the anode (hydrogen at the cathode, NaOH in solution).

Why other options are wrong: Hydrogen forms at the cathode; oxygen forms only from dilute/pure water; sodium is not liberated from aqueous solution.

Final Answer: Chlorine gas at the anode $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Integrated first-order law: $\ln[A] = \ln[A]_0 - kt$, which is a straight line of the form $y = c + (\text{slope})t$.

Step 1 — Compare with $y = mx + c$: slope $m = -k$.

Step 2 — Interpret: The line falls with time, so the slope is $-k$.

Why other options are wrong: $+k$ has the wrong sign; $-2.303k$ and $k/2.303$ belong to the $\log_{10}$ form of the equation, not the natural-log plot.

Final Answer: Slope $= -k \Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Ideal gas law: $V = \dfrac{nRT}{P}$.

Step 1 — Substitute: $V = \dfrac{2 \times 0.0821 \times 300}{2}$.

Step 2 — Compute: numerator $= 49.26$; $V = 24.6$ L.

Why other options are wrong: 49.3 L forgets to divide by $P = 2$; 12.3 L and 98.5 L use wrong n or P.

Final Answer: $V \approx 24.6$ L $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Ionization enthalpy across period 3: IE generally rises across a period, but Mg ($3s^2$, fully filled) is anomalously higher than Al ($3s^2 3p^1$), whose $3p$ electron is easier to remove.

Step 1 — Place the values: Na (lowest) $<$ Al $<$ Mg.

Step 2 — Write decreasing order: $\mathrm{Mg} > \mathrm{Al} > \mathrm{Na}$.

Why other options are wrong: "$\mathrm{Al} > \mathrm{Mg}$" ignores the stable $3s^2$ of Mg; the others misplace Na.

Final Answer: $\mathrm{Mg} > \mathrm{Al} > \mathrm{Na} \Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Element from valence configuration: Add the inner electrons to find the atomic number.

Step 1 — Full configuration: $1s^2 2s^2 2p^6 3s^2 3p^3$ gives $Z = 15$.

Step 2 — Identify: $Z = 15$ is phosphorus.

Why other options are wrong: Nitrogen is $2s^2 2p^3$; sulphur is $3s^2 3p^4$; aluminium is $3s^2 3p^1$.

Final Answer: The element is phosphorus $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Types of hydrides: Highly electropositive s-block metals form ionic (saline) hydrides containing the H^- ion.

Step 1 — Examine CaH_2**:** Calcium (group 2) transfers electrons to hydrogen, giving Ca^{2+} and H^- ions.

Why other options are wrong: CH_4, NH_3 and HCl are covalent (molecular) hydrides.

Final Answer: CaH_2 is ionic $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Structure of silicones: Silicones are organosilicon polymers with an $(-Si-O-Si-O-)$ backbone and organic groups on the silicon atoms.

Step 1 — Identify the repeating link: The chain is built from alternating $Si-O$ bonds.

Why other options are wrong: $C-C$ and $C-O$ describe organic polymers; pure $Si-Si$ chains are not the silicone backbone.

Final Answer: The backbone is made of $Si-O$ bonds $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Structure of H_2SO_4: Sulphur is tetrahedral, bonded to two $-OH$ groups (single bonds) and two oxygen atoms by double bonds.

Step 1 — Count S=O bonds: There are two S=O double bonds and two S–OH single bonds.

Step 2 — State: Number of S=O linkages $= 2$.

Why other options are wrong: 1, 3 and 4 do not match the tetrahedral sulphur structure of sulphuric acid.

Final Answer: Two S=O double bonds $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Interhalogen compounds: These contain two different halogen atoms only, of the type XX'_n.

Step 1 — Examine ClF_3: It is made of chlorine and fluorine, two different halogens, so it is an interhalogen.

Why other options are wrong: $HClO_4$ is an oxoacid; NaCl is an ionic salt; OF_2 contains oxygen, not two halogens.

Final Answer: ClF_3 is an interhalogen $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Maximum oxidation state: In the $3d$ series the highest oxidation state usually equals the number of $3d + 4s$ electrons available.

Step 1 — Manganese: Mn is $[Ar]3d^5 4s^2$, giving a maximum of $+7$ (as in $KMnO_4$).

Why other options are wrong: Cr maxes at $+6$ ($K_2Cr_2O_7$); Fe usually $+3$; V at $+5$.

Final Answer: Manganese shows $+7 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Lanthanide chemistry: Because of the lanthanide contraction, successive lanthanides differ very little in size and almost all show the same $+3$ state.

Step 1 — Consequence: Their ions have nearly identical sizes and chemistry, so they behave alike.

Step 2 — Effect: This similarity makes their mutual separation very difficult.

Why other options are wrong: Lanthanides are not generally radioactive, are not gaseous, and $+3$ (not $+2$) is their common state.

Final Answer: Very similar size and properties $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Charge on a complex ion: Overall charge = metal oxidation state + sum of ligand charges.

Step 1 — Ligand charge: NH_3 is neutral, so six of them contribute 0.

Step 2 — Add: $(+3) + 0 = +3$.

Why other options are wrong: $+6$, 0 and -3 ignore the neutral ammonia ligands or the metal charge.

Final Answer: The ion is $[Co(NH_3)_6]^{3+} \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — CFT for tetrahedral Ni^{2+}: Cl^- is a weak-field ligand, so $[NiCl_4]^{2-}$ is high-spin tetrahedral.

Step 1 — Ni^{2+} is d^8: In a tetrahedral field ($e^4t_2^4$) the t_2 set holds the last 4 electrons with 2 unpaired.

Step 2 — Count: Number of unpaired electrons $= 2$ (paramagnetic).

Why other options are wrong: 0 would be diamagnetic (that is square-planar $[Ni(CN)_4]^{2-}$); 4 and 1 miscount the d^8 tetrahedral arrangement.

Final Answer: 2 unpaired electrons $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — IUPAC naming of haloalkanes: Number the longest chain to give the halogen the lowest locant; name substituents alphabetically.

Step 1 — Structure: $(CH_3)_2CHCH_2Cl$ is a 3-carbon propane chain with a methyl branch on C-2 and Cl on C-1.

Step 2 — Name: 1-chloro-2-methylpropane.

Why other options are wrong: 2-chlorobutane and 1-chlorobutane have a 4-carbon chain; 2-chloro-2-methylpropane puts Cl on the central carbon (a tertiary halide).

Final Answer: 1-chloro-2-methylpropane $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Chain isomers of pentane: Count the distinct carbon skeletons for C_5H_{12}.

Step 1 — List them: n-pentane, 2-methylbutane (isopentane), and 2,2-dimethylpropane (neopentane).

Step 2 — Total: 3 structural isomers.

Why other options are wrong: 2 is for butane; 5 and 4 overcount the skeletons of C_5H_{12}.

Final Answer: 3 isomers $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Inductive effect on acidity: Electron-withdrawing chlorine atoms stabilise the carboxylate anion, increasing acid strength; more Cl means stronger acid.

Step 1 — Compare: acetic (0 Cl) $<$ chloroacetic (1) $<$ dichloroacetic (2) $<$ trichloroacetic (3).

Step 2 — Pick: $Cl_3C{-}COOH$ is the strongest.

Why other options are wrong: Acetic is the weakest; chloroacetic and dichloroacetic have fewer electron-withdrawing chlorines.

Final Answer: Trichloroacetic acid is strongest $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Inertness of alkanes: Saturated hydrocarbons are chemically unreactive towards most polar reagents under ordinary conditions.

Step 1 — Examine the choices: Alkanes burn in oxygen and undergo free-radical halogenation with Cl_2/Br_2 in light, but they do not react with steam (water) under ordinary conditions.

Why other options are wrong: Chlorination, bromination (in sunlight) and combustion all occur readily with alkanes.

Final Answer: Alkanes do not react with steam $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Hydroboration-oxidation: It adds water with anti-Markovnikov orientation; the $-OH$ goes to the less substituted (terminal) carbon.

Step 1 — Apply to propene: $CH_3CH{=}CH_2$ gives $-OH$ on the terminal CH_2.

Step 2 — Product: propan-1-ol ($CH_3CH_2CH_2OH$).

Why other options are wrong: propan-2-ol is the Markovnikov (acid-hydration) product; propanone and propanoic acid are oxidation products, not formed here.

Final Answer: propan-1-ol $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Side-chain oxidation: Hot alkaline $KMnO_4$ oxidises any alkyl side chain on a benzene ring (with at least one benzylic H) all the way to a $-COOH$ group.

Step 1 — Oxidise toluene: The $-CH_3$ group is converted to $-COOH$.

Step 2 — Product: benzoic acid (C_6H_5COOH).

Why other options are wrong: Benzaldehyde is only a partial-oxidation product (needs milder conditions); phenol and benzene are not formed.

Final Answer: benzoic acid ⇒ C

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Uses of haloalkanes/haloarenes: DDT (dichlorodiphenyl-trichloroethane) is a chlorinated organic compound.

Step 1 — Recall its use: DDT was historically used as a powerful insecticide.

Why other options are wrong: It is not a fertiliser, antibiotic or anaesthetic.

Final Answer: DDT is an insecticide ⇒ A

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Reimer–Tiemann reaction: Phenol with $CHCl_3$ and aqueous NaOH introduces a $-CHO$ group at the ortho position.

Step 1 — Mechanism: $CHCl_3 + NaOH$ generates dichlorocarbene, which attacks the ortho carbon of the phenoxide.

Step 2 — Product: salicylaldehyde (2-hydroxybenzaldehyde).

Why other options are wrong: Salicylic acid comes from the Kolbe reaction (CO_2); anisole is from methylation; picric acid from nitration.

Final Answer: salicylaldehyde ⇒ B

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Symmetrical ethers: A simple (symmetrical) ether has two identical alkyl/aryl groups on either side of the oxygen.

Step 1 — Examine $C_2H_5-O-C_2H_5$: Both groups are ethyl, so it is diethyl ether, a symmetrical ether.

Why other options are wrong: The others ($CH_3-O-C_2H_5$, $CH_3-O-C_6H_5$,

$CH_3-O-C_3H_7$) have two different groups, so they are mixed (unsymmetrical) ethers.

Final Answer: Diethyl ether is symmetrical $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Carbonyl-to-methylene reductions: Zinc amalgam (Zn-Hg) with concentrated HCl reduces $>C{=}O$ to $>CH_2$ — this is the Clemmensen reduction.

Step 1 — Match reagents: amalgamated zinc + conc. HCl ⇒ Clemmensen.

Why other options are wrong: Wolff–Kishner uses NH_2NH_2/KOH; the aldol and Cannizzaro are not reductions of $C{=}O$ to CH_2.

Final Answer: Clemmensen reduction $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Acid derivatives: Thionyl chloride converts a carboxylic acid into the corresponding acid chloride (acyl chloride).

Step 1 — Reaction: $CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 + HCl$.

Step 2 — Product: acetyl chloride (CH_3COCl).

Why other options are wrong: Acetamide needs NH_3; acetic anhydride needs a dehydrating route; ethyl acetate needs ethanol (esterification).

Final Answer: acetyl chloride $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Hofmann bromamide degradation: An amide treated with Br_2 and KOH loses one carbon and forms a primary amine.

Step 1 — Reaction: $R-CONH_2 + Br_2 + 4KOH \rightarrow R-NH_2 + K_2CO_3 + 2KBr + 2H_2O$.

Step 2 — Note carbon count: The amine $R-NH_2$ has one fewer carbon than the starting amide.

Why other options are wrong: It gives neither a nitrile, a carboxylic acid, nor a secondary amine.

Final Answer: A primary amine with one fewer carbon $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Classification of amino acids: Amino acids the body cannot make must come from food.

Step 1 — Definition: Such dietary-required amino acids are called essential amino acids (e.g. valine, leucine, lysine).

Why other options are wrong: Non-essential amino acids are synthesised in the body; "acidic" and "neutral" classify side-chain nature, not dietary need.

Final Answer: They are essential amino acids $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept — Antiseptics vs antibiotics: Antiseptics are applied to living tissue to kill or stop the growth of micro-organisms.

Step 1 — Identify: Dettol (chloroxylenol with terpineol) is a common antiseptic.

Why other options are wrong: Paracetamol and aspirin are analgesics/antipyretics; penicillin is an antibiotic (taken internally, not an external antiseptic).

Final Answer: Dettol is an antiseptic $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q40

Answer Key

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