

SAAT Chemistry

Sample Paper – 7

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. A compound contains 40% carbon, 6.7% hydrogen and 53.3% oxygen by mass (atomic masses C = 12, H = 1, O = 16). Its empirical formula is

- (A) C_2H_4O
- (B) CH_2O
- (C) CHO
- (D) C_2H_2O

Q2. A solution is prepared by dissolving 2 mol of ethanol in 8 mol of water. The mole fraction of ethanol in the solution is

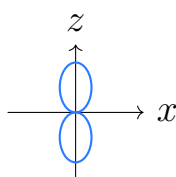
- (A) 0.2
- (B) 0.8
- (C) 0.25
- (D) 0.5



Q3. For the reaction $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$, the number of moles of hydrogen required to react completely with 2 mol of nitrogen is

- (A) 3 mol
- (B) 2 mol
- (C) 4 mol
- (D) 6 mol

Q4. The set of quantum numbers (n, l, m) that correctly represents a $2p_z$ orbital, sketched below, is

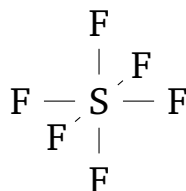


- (A) $(2, 0, 0)$
- (B) $(2, 1, +1)$
- (C) $(2, 1, 0)$
- (D) $(1, 0, 0)$

Q5. An element has the ground-state electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^3$. The element is

- (A) phosphorus ($Z = 15$)
- (B) nitrogen ($Z = 7$)
- (C) sulphur ($Z = 16$)
- (D) silicon ($Z = 14$)

Q6. The hybridization of the central sulphur atom in sulphur hexafluoride (SF_6), whose octahedral shape is shown, is



- (A) sp^3d
- (B) sp^3d^2
- (C) sp^3
- (D) sp^2

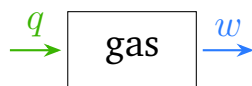
Q7. According to molecular orbital theory, the dihelium molecule (He_2) does not exist because its bond order is

- (A) 1
- (B) 0.5
- (C) 0
- (D) 2

Q8. In boron trifluoride (BF_3), the observed B–F bond length is shorter than expected for a pure single bond. This is best explained by

- (A) hydrogen bonding
- (B) sp^3 hybridization of boron
- (C) ionic character of the bond
- (D) $p\pi-p\pi$ back bonding from F to B

Q9. When a gas absorbs 200 J of heat and does 80 J of work on its surroundings, the change in internal energy ($\Delta U = q + w$) is



- (A) +120 J
- (B) +280 J
- (C) –120 J
- (D) –280 J

Q10. The relation between the standard Gibbs free-energy change of a cell reaction and its standard EMF is



- (A) $\Delta G^\circ = +nFE^\circ$
(B) $\Delta G^\circ = -nFE^\circ$
(C) $\Delta G^\circ = nF/E^\circ$
(D) $\Delta G^\circ = -E^\circ/nF$

Q11. Adding a catalyst to a reversible reaction already at equilibrium

- (A) shifts the equilibrium towards the products
(B) shifts the equilibrium towards the reactants
(C) does not shift the position of equilibrium
(D) increases the value of the equilibrium constant

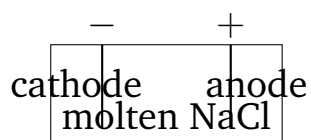
Q12. An aqueous solution of sodium acetate (CH_3COONa) is

- (A) neutral
(B) strongly acidic
(C) exactly pH 7 at all temperatures
(D) basic ($\text{pH} > 7$)

Q13. Assuming complete dissociation, the van't Hoff factor (i) for aqueous barium chloride (BaCl_2) is

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

Q14. In the electrolysis of molten sodium chloride using inert electrodes, shown below, the product liberated at the cathode is



- (A) chlorine gas
- (B) sodium metal
- (C) hydrogen gas
- (D) oxygen gas

Q15. For most chemical reactions, the effect of raising the temperature by about 10°C is to

- (A) halve the reaction rate
- (B) leave the rate unchanged
- (C) roughly double the reaction rate
- (D) stop the reaction

Q16. In which of the following reactions does chlorine undergo disproportionation?

- (A) $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$
- (B) $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$
- (C) $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$
- (D) $\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaCl} + \text{NaOCl} + \text{H}_2\text{O}$

Q17. Among the isoelectronic species O^{2-} , F^{-} , Na^{+} and Mg^{2+} (each with 10 electrons), the one with the largest ionic radius is

- (A) Mg^{2+}
- (B) O^{2-}
- (C) Na^{+}
- (D) F^{-}

Q18. An element with the electronic configuration $[\text{Ar}] 3d^5 4s^1$ belongs to the

- (A) *s*-block
- (B) *p*-block



(C) *d*-block

(D) *f*-block

Q19. The hydrides of the alkali metals (e.g. NaH) are best classified as

(A) ionic (saline) hydrides

(B) covalent (molecular) hydrides

(C) metallic (interstitial) hydrides

(D) electron-deficient hydrides

Q20. Orthoboric acid (H_3BO_3) behaves in aqueous solution as a

(A) strong tribasic acid

(B) strong dibasic acid

(C) strong monobasic acid

(D) weak monobasic Lewis acid

Q21. Among the oxoacids of nitrogen, which one is a strong oxidising agent in its concentrated form?

(A) HNO_2 (nitrous acid)

(B) HNO_3 (nitric acid)

(C) H_3PO_3 (phosphorous acid)

(D) H_3PO_4 (phosphoric acid)

Q22. Moist chlorine acts as a bleaching agent. Its bleaching action is due to

(A) oxidation by the nascent oxygen it liberates

(B) physical adsorption of the dye

(C) reduction of the coloured matter

(D) simple dilution of the colour

Q23. Transition metals readily trap small atoms such as H, C or N in the holes of their lattices to form

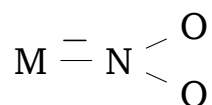


- (A) ionic salts
- (B) simple molecular compounds
- (C) interstitial compounds
- (D) noble-gas compounds

Q24. Misch metal, an alloy used in the flints of cigarette lighters and as a deoxidiser, consists mainly of

- (A) transition metals with carbon
- (B) alkali metals with oxygen
- (C) noble metals only
- (D) lanthanide metals with iron

Q25. Which of the following is an ambidentate ligand, able to bind a metal through either of two different donor atoms (one linkage shown)?



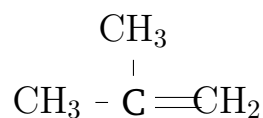
- (A) Cl^-
- (B) NO_2^-
- (C) NH_3
- (D) H_2O

Q26. For an octahedral complex with the configuration $t_{2g}^3 e_g^0$, the crystal-field stabilisation energy (CFSE), in units of Δ_o , is

- (A) $-1.2 \Delta_o$
- (B) $-0.6 \Delta_o$
- (C) $+1.2 \Delta_o$
- (D) 0

Q27. The IUPAC name of the alkene shown below is





- (A) but-1-ene
- (B) but-2-ene
- (C) 2-methylprop-1-ene
- (D) 2-methylbut-1-ene

Q28. The keto and enol forms of acetone are an example of

- (A) chain isomerism
- (B) geometrical isomerism
- (C) optical isomerism
- (D) tautomerism

Q29. The correct order of stability of the following carbanions is

- (A) $\text{CH}_3^- > (\text{CH}_3)_2\text{CH}^- > (\text{CH}_3)_3\text{C}^-$
- (B) $(\text{CH}_3)_3\text{C}^- > (\text{CH}_3)_2\text{CH}^- > \text{CH}_3^-$
- (C) $(\text{CH}_3)_2\text{CH}^- > \text{CH}_3^- > (\text{CH}_3)_3\text{C}^-$
- (D) all three are equally stable

Q30. The breaking down of higher hydrocarbons into smaller, more useful molecules (e.g. petrol) by heat or catalysts is called

- (A) polymerisation
- (B) cracking
- (C) aromatisation
- (D) isomerisation

Q31. When ethene is bubbled through a solution of bromine in carbon tetrachloride, as shown, the observation is





- (A) a yellow precipitate forms
- (B) a gas is evolved with effervescence
- (C) the red-brown colour of bromine is decolourised
- (D) no visible change occurs

Q32. Which of the following species is aromatic, obeying Huckel's $(4n + 2)\pi$ rule with a planar cyclic ring (benzene shown)?

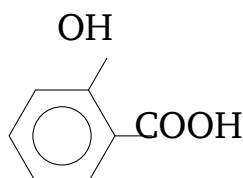


- (A) cyclobutadiene
- (B) cyclooctatetraene
- (C) cyclohexane
- (D) benzene

Q33. When 2-bromopropane is heated with alcoholic potassium hydroxide (KOH), the major product is

- (A) propene (elimination)
- (B) propan-2-ol (substitution)
- (C) propane
- (D) propan-1-ol

Q34. Heating sodium phenoxide with carbon dioxide under pressure, followed by acidification (Kolbe's reaction, phenol ring shown), gives



- (A) benzoic acid
- (B) salicylic acid (2-hydroxybenzoic acid)
- (C) picric acid
- (D) phenol again

Q35. Under ordinary conditions, ethers ($R-O-R'$) are

- (A) strongly acidic
- (B) strongly basic
- (C) highly reactive towards water
- (D) relatively inert and chemically unreactive

Q36. Reduction of propanal (CH_3CH_2CHO) with sodium borohydride ($NaBH_4$) gives

- (A) propanoic acid
- (B) propan-2-ol
- (C) propan-1-ol
- (D) propanone

Q37. Which of the following is the stronger acid, and why?

- (A) formic acid ($HCOOH$), since acetic acid has an electron-donating CH_3 group
- (B) acetic acid (CH_3COOH), since it has more carbons
- (C) both are equally strong
- (D) neither is acidic

Q38. Amines act as bases mainly because the nitrogen atom

- (A) readily accepts a proton by losing electrons
- (B) has a lone pair of electrons that it can donate
- (C) carries a positive charge



(D) forms hydrogen bonds with water

Q39. Amino acids that cannot be synthesised in the human body and must be obtained from the diet are called

(A) non-essential amino acids

(B) acidic amino acids

(C) essential amino acids

(D) basic amino acids

Q40. The monomer of natural rubber is

(A) ethene

(B) vinyl chloride

(C) styrene

(D) isoprene (2-methylbuta-1,3-diene)



Detailed Solutions

Q1.

Solution

Concept — Empirical formula: Divide each element's mass percentage by its atomic mass to get mole ratios, then reduce to whole numbers.

Step 1 — Moles: $C = \frac{40}{12} = 3.33$; $H = \frac{6.7}{1} = 6.7$; $O = \frac{53.3}{16} = 3.33$.

Step 2 — Simplest ratio: Divide by 3.33 \Rightarrow C:H:O = 1 : 2 : 1, i.e. CH₂O.

Why other options are wrong: C₂H₄O, CHO and C₂H₂O do not match the 1 : 2 : 1 ratio.

Final Answer: Empirical formula CH₂O \Rightarrow

Answer: (B) [Go Back to Q1](#)

Q2.

Solution

Concept — Mole fraction: $x_{\text{ethanol}} = \frac{n_{\text{ethanol}}}{n_{\text{ethanol}} + n_{\text{water}}}$.

Step 1 — Substitute: $x = \frac{2}{2 + 8} = \frac{2}{10}$.

Step 2 — Compute: $x = 0.2$.

Why other options are wrong: 0.8 is the mole fraction of water; 0.25 uses ratio 2/8; 0.5 assumes equal moles.

Final Answer: Mole fraction of ethanol = 0.2 \Rightarrow

Answer: (A) [Go Back to Q2](#)

Q3.

Solution

Concept — Stoichiometric ratio: The balanced equation fixes the mole ratio of reactants.

Step 1 — Read the ratio: N₂ : H₂ = 1 : 3.

Step 2 — Scale to 2 mol N₂: H₂ = 3 \times 2 = 6 mol.

Why other options are wrong: 3 mol is for 1 mol N₂; 2 and 4 ignore the 1 : 3 ratio.



Final Answer: 6 mol of $\text{H}_2 \Rightarrow$

Answer: (D) [Go Back to Q3](#)

Q4.

Solution

Concept — Quantum numbers of an orbital: A $2p$ orbital has $n = 2$, $l = 1$; the p_z orbital corresponds to the magnetic quantum number $m = 0$.

Step 1 — Assign n and l : “ $2p$ ” $\Rightarrow n = 2$, $l = 1$.

Step 2 — Identify p_z : The p_z lobe lies along the z -axis and is the $m = 0$ orbital $\Rightarrow (2, 1, 0)$.

Why other options are wrong: $(2, 0, 0)$ is the $2s$; $(2, 1, +1)$ is a p_x/p_y ($m = \pm 1$) orbital; $(1, 0, 0)$ is the $1s$.

Final Answer: $(2, 1, 0) \Rightarrow$

Answer: (C) [Go Back to Q4](#)

Q5.

Solution

Concept — Identifying an element from its configuration: The total number of electrons equals the atomic number Z .

Step 1 — Count electrons: $2 + 2 + 6 + 2 + 3 = 15$.

Step 2 — Identify: $Z = 15$ is phosphorus, lying in group 15, period 3.

Why other options are wrong: N is $Z = 7$; S is $Z = 16$ ($3p^4$); Si is $Z = 14$ ($3p^2$).

Final Answer: The element is phosphorus \Rightarrow

Answer: (A) [Go Back to Q5](#)

Q6.

Solution

Concept — Hybridization from electron domains: Six bonding pairs around the central atom give octahedral geometry and sp^3d^2 hybridization.

Step 1 — Count domains: S in SF_6 has 6 bond pairs and no lone pair.

Step 2 — Assign: Six domains $\Rightarrow sp^3d^2$, octahedral, bond angle 90° .



Why other options are wrong: sp^3d is trigonal bipyramidal (5 domains); sp^3 tetrahedral (4); sp^2 trigonal planar (3).

Final Answer: S is sp^3d^2 hybridized \Rightarrow

Answer: (B) [Go Back to Q6](#)

Q7.

Solution

Concept — Bond order (MOT): Bond order = $\frac{1}{2}(N_b - N_a)$. A bond order of 0 means no net bonding, so the molecule is unstable.

Step 1 — He₂ has 4 electrons: Configuration $\sigma_{1s}^2 \sigma_{1s}^{*2}$, so $N_b = 2$, $N_a = 2$.

Step 2 — Compute: Bond order = $\frac{1}{2}(2 - 2) = 0$, so He₂ does not exist.

Why other options are wrong: 1, 0.5 and 2 all imply a stable bond, contrary to observation.

Final Answer: Bond order = 0 \Rightarrow

Answer: (C) [Go Back to Q7](#)

Q8.

Solution

Concept — Back bonding: A filled p orbital of fluorine donates electron density into the empty $2p$ orbital of electron-deficient boron, giving partial double-bond character.

Step 1 — Identify the effect: BF₃ has an empty p orbital on B; F lone pairs overlap sideways ($p\pi-p\pi$).

Step 2 — Consequence: This back bonding shortens and strengthens the B–F bond beyond a pure single bond.

Why other options are wrong: There is no H-bonding; B is sp^2 (not sp^3); the bond is largely covalent, not ionic.

Final Answer: $p\pi-p\pi$ back bonding \Rightarrow

Answer: (D) [Go Back to Q8](#)



Q9.

Solution

Concept — First law of thermodynamics: $\Delta U = q + w$, where w is the work done *on* the system. Work done *by* the gas enters with a negative sign.

Step 1 — Assign signs: Heat absorbed $q = +200$ J; work done by gas $\Rightarrow w = -80$ J.

Step 2 — Compute: $\Delta U = 200 + (-80) = +120$ J.

Why other options are wrong: +280 adds the work with the wrong sign; the negative values reverse the heat term.

Final Answer: $\Delta U = +120$ J \Rightarrow **A**

Answer: (A) [Go Back to Q9](#)

Q10.

Solution

Concept — Gibbs energy and EMF: The maximum non-expansion (electrical) work of a cell equals ΔG° , giving $\Delta G^\circ = -nFE^\circ$.

Step 1 — Relation: n is moles of electrons, F the Faraday constant, E° the standard cell potential.

Step 2 — Sign: A positive E° (feasible cell) gives a negative ΔG° , consistent with spontaneity.

Why other options are wrong: The other forms have the wrong sign or place E°/F incorrectly.

Final Answer: $\Delta G^\circ = -nFE^\circ \Rightarrow$ **B**

Answer: (B) [Go Back to Q10](#)

Q11.

Solution

Concept — Catalyst and equilibrium: A catalyst speeds up the forward and reverse reactions equally, so it changes only the rate, not the position or constant.

Step 1 — Reason: It lowers the activation energy of both directions by the same amount.

Step 2 — Effect: Equilibrium is reached faster, but K_c and the equilibrium



amounts are unchanged.

Why other options are wrong: It shifts neither way and does not alter K_c .

Final Answer: No shift in equilibrium position \Rightarrow

Answer: (C) [Go Back to Q11](#)

Q12.

Solution

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

Step 1 — Identify: CH_3COONa comes from weak CH_3COOH and strong NaOH .

Step 2 — Hydrolysis: The acetate ion reacts with water, $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COOH} + \text{OH}^-$, releasing OH^- , so $\text{pH} > 7$.

Why other options are wrong: It is not neutral or acidic; the basic pH is not fixed at exactly 7.

Final Answer: The solution is basic ($\text{pH} > 7$) \Rightarrow

Answer: (D) [Go Back to Q12](#)

Q13.

Solution

Concept — van't Hoff factor: i equals the number of particles produced per formula unit on complete dissociation.

Step 1 — Dissociate: $\text{BaCl}_2 \rightarrow \text{Ba}^{2+} + 2\text{Cl}^-$ gives $1 + 2 = 3$ ions.

Step 2 — Result: $i = 3$.

Why other options are wrong: 2 is for a 1 : 1 salt (NaCl); 1 is for a non-electrolyte; 4 overcounts.

Final Answer: $i = 3 \Rightarrow$

Answer: (A) [Go Back to Q13](#)



Q14.

Solution

Concept — Electrolysis of a molten salt: Cations migrate to the cathode and are reduced; anions migrate to the anode and are oxidised.

Step 1 — At the cathode: $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$, depositing sodium metal.

Step 2 — At the anode: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$, liberating chlorine.

Why other options are wrong: Chlorine forms at the anode; in molten (water-free) NaCl no H_2 or O_2 is produced.

Final Answer: Sodium metal at the cathode \Rightarrow **B**

Answer: (B) [Go Back to Q14](#)

Q15.

Solution

Concept — Temperature and reaction rate: A rise of about 10°C increases the fraction of molecules exceeding the activation energy, roughly doubling the rate for many reactions.

Step 1 — Mechanism: Higher temperature shifts the Maxwell–Boltzmann distribution to higher energies (Arrhenius equation).

Step 2 — Effect: Rate increases markedly, commonly by a factor of about 2.

Why other options are wrong: Rate increases, not halves; it certainly does not stay constant or stop.

Final Answer: The rate roughly doubles \Rightarrow **C**

Answer: (C) [Go Back to Q15](#)

Q16.

Solution

Concept — Disproportionation: The same element is simultaneously oxidised and reduced in a single reaction.

Step 1 — Examine $\text{Cl}_2 + 2\text{NaOH}$: Chlorine starts at 0, becomes -1 in NaCl (reduced) and $+1$ in NaOCl (oxidised).

Step 2 — Conclude: Chlorine undergoes disproportionation here.

Why other options are wrong: In the others chlorine is only reduced (to -1);



there is no simultaneous oxidation.

Final Answer: $\text{Cl}_2 + 2\text{NaOH}$ shows disproportionation \Rightarrow **D**

Answer: (D) [Go Back to Q16](#)

Q17.

Solution

Concept — Isoelectronic ionic radii: For species with the same number of electrons, radius decreases as nuclear charge (Z) increases.

Step 1 — Compare Z : O^{2-} ($Z = 8$) $<$ F^- (9) $<$ Na^+ (11) $<$ Mg^{2+} (12).

Step 2 — Largest radius: The lowest Z pulls 10 electrons least, so O^{2-} is largest.

Why other options are wrong: Mg^{2+} is smallest; Na^+ and F^- are intermediate.

Final Answer: O^{2-} has the largest radius \Rightarrow **B**

Answer: (B) [Go Back to Q17](#)

Q18.

Solution

Concept — Block from configuration: The block is named after the subshell that receives the last (differentiating) electron.

Step 1 — Read config: $[\text{Ar}] 3d^5 4s^1$ is chromium; the last-filled subshell of interest is $3d$.

Step 2 — Assign block: A partially filled d subshell \Rightarrow d -block (transition element).

Why other options are wrong: s/p -block elements fill s/p subshells; f -block fills $4f/5f$.

Final Answer: It is a d -block element \Rightarrow **C**

Answer: (C) [Go Back to Q18](#)



Q19.

Solution

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

Step 1 — Look at NaH: Sodium readily transfers its electron, giving Na^+H^- .

Step 2 — Classify: Alkali-metal (and heavier alkaline-earth) hydrides are ionic/saline.

Why other options are wrong: Covalent hydrides are formed by p-block non-metals; interstitial hydrides by many d-block metals; electron-deficient hydrides by boron.

Final Answer: Ionic (saline) hydrides \Rightarrow

Answer: (A) [Go Back to Q19](#)

Q20.

Solution

Concept — Nature of boric acid: H_3BO_3 does not donate its own protons; it accepts OH^- from water, acting as a weak monobasic Lewis acid.

Step 1 — Reaction: $\text{B}(\text{OH})_3 + 2\text{H}_2\text{O} \rightleftharpoons [\text{B}(\text{OH})_4]^- + \text{H}_3\text{O}^+$.

Step 2 — Conclude: Only one H^+ effectively appears, so it is weak and monobasic.

Why other options are wrong: It is neither strong nor di-/tribasic in the Bronsted sense.

Final Answer: Weak monobasic Lewis acid \Rightarrow

Answer: (D) [Go Back to Q20](#)

Q21.

Solution

Concept — Oxidising oxoacids: Concentrated nitric acid, with nitrogen in its highest state +5, is a powerful oxidising agent.

Step 1 — Identify the highest oxidation state: In HNO_3 , N is +5, the maximum for nitrogen.

Step 2 — Conclude: Concentrated HNO_3 readily oxidises metals and non-metals,



e.g. $\text{Cu} \rightarrow \text{Cu}^{2+}$.

Why other options are wrong: HNO_2 is a weaker, milder oxidant; H_3PO_3 and H_3PO_4 are not strong oxidisers.

Final Answer: Nitric acid (HNO_3) \Rightarrow B

Answer: (B) [Go Back to Q21](#)

Q22.

Solution

Concept — Bleaching by chlorine: Moist chlorine reacts with water to give hypochlorous acid, which releases nascent oxygen.

Step 1 — Reactions: $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HOCl}$; $\text{HOCl} \rightarrow \text{HCl} + [\text{O}]$.

Step 2 — Action: The nascent oxygen oxidises the coloured matter to a colourless form (permanent, oxidative bleaching).

Why other options are wrong: Bleaching is by oxidation, not reduction, adsorption or dilution.

Final Answer: Oxidation by nascent oxygen \Rightarrow A

Answer: (A) [Go Back to Q22](#)

Q23.

Solution

Concept — Interstitial compounds: Transition metals have lattice voids that can trap small non-metal atoms (H, B, C, N).

Step 1 — Formation: Atoms like C or N occupy interstitial holes without much lattice distortion.

Step 2 — Properties: Such interstitial compounds are hard, high-melting and often non-stoichiometric (e.g. steel, TiC).

Why other options are wrong: They are not simple ionic, molecular or noble-gas compounds.

Final Answer: Interstitial compounds \Rightarrow C

Answer: (C) [Go Back to Q23](#)



Q24.

Solution

Concept — Misch metal: It is an alloy of lanthanide (rare-earth) metals together with iron and traces of other elements.

Step 1 — Composition: About 95% lanthanoid metals (mainly Ce, La, Nd) and around 5% iron.

Step 2 — Uses: Lighter flints, tracer bullets and as a deoxidiser/scavenger in steel making.

Why other options are wrong: It is not based on transition metals with carbon, alkali metals, or noble metals.

Final Answer: Lanthanide metals with iron \Rightarrow

Answer: (D) [Go Back to Q24](#)

Q25.

Solution

Concept — Ambidentate ligand: A monodentate ligand having two different donor atoms, coordinating through one or the other.

Step 1 — Examine NO_2^- : It can bind through nitrogen (nitro, $\text{M}-\text{NO}_2$) or through oxygen (nitrito, $\text{M}-\text{ONO}$).

Step 2 — Conclude: The nitrite ion is ambidentate (so is SCN^-).

Why other options are wrong: Cl^- , NH_3 and H_2O are ordinary monodentate ligands with a single donor atom.

Final Answer: NO_2^- is ambidentate \Rightarrow

Answer: (B) [Go Back to Q25](#)

Q26.

Solution

Concept — CFSE (octahedral): Each t_{2g} electron contributes $-0.4 \Delta_o$ and each e_g electron $+0.6 \Delta_o$.

Step 1 — Apply to $t_{2g}^3 e_g^0$: $3 \times (-0.4 \Delta_o) + 0 = -1.2 \Delta_o$.

Step 2 — Interpret: The half-filled t_{2g} set gives substantial stabilisation.



Why other options are wrong: $-0.6 \Delta_o$ is for $t_{2g}^1 e_g^1$ -type miscounts; $+1.2$ has the wrong sign; 0 ignores the t_{2g} occupancy.

Final Answer: $CFSE = -1.2 \Delta_o \Rightarrow$

Answer: (A) [Go Back to Q26](#)

Q27.

Solution

Concept — IUPAC naming of a branched alkene: Choose the longest chain containing the double bond, number to give it the lowest locant, and name substituents.

Step 1 — Identify the structure: $(CH_3)_2C=CH_2$ has a three-carbon propene chain with a methyl group on C-2.

Step 2 — Name: Double bond at C-1, methyl at C-2 \Rightarrow 2-methylprop-1-ene (isobutylene).

Why other options are wrong: but-1-ene and but-2-ene are straight C_4 chains; 2-methylbut-1-ene has five carbons.

Final Answer: 2-methylprop-1-ene \Rightarrow

Answer: (C) [Go Back to Q27](#)

Q28.

Solution

Concept — Tautomerism: Keto–enol tautomers are constitutional isomers that interconvert by the migration of a proton and a double bond.

Step 1 — For acetone: CH_3COCH_3 (keto) \rightleftharpoons $CH_3C(OH)=CH_2$ (enol).

Step 2 — Classify: This dynamic equilibrium is tautomerism, a special functional-group isomerism.

Why other options are wrong: It is not chain, geometrical or optical isomerism.

Final Answer: Keto–enol forms are tautomers \Rightarrow

Answer: (D) [Go Back to Q28](#)



Q29.

Solution

Concept — Carbanion stability: Alkyl groups are electron-donating, so they *destabilise* the electron-rich carbanion. Stability therefore decreases with more alkyl groups: methyl > 1° > 2° > 3°.

Step 1 — Compare: CH₃⁻ (no alkyl) is most stable; (CH₃)₃C⁻ (three methyls) is least stable.

Step 2 — Order: CH₃⁻ > (CH₃)₂CH⁻ > (CH₃)₃C⁻.

Why other options are wrong: The reverse order is correct for carbocations, not carbanions; they are not equally stable.

Final Answer: CH₃⁻ > (CH₃)₂CH⁻ > (CH₃)₃C⁻ ⇒

Answer: (A) [Go Back to Q29](#)

Q30.

Solution

Concept — Cracking: Long-chain hydrocarbons are broken into smaller alkanes and alkenes by heat (thermal) or catalysts (catalytic).

Step 1 — Process: e.g. C₁₂H₂₆ → C₈H₁₈ + C₄H₈, upgrading heavy fractions to petrol-range fuels.

Step 2 — Name: This decomposition is called cracking.

Why other options are wrong: Polymerisation joins small units; aromatisation makes rings; isomerisation rearranges without changing size.

Final Answer: The process is cracking ⇒

Answer: (B) [Go Back to Q30](#)

Q31.

Solution

Concept — Test for unsaturation: Alkenes add bromine across the double bond, removing the colour of bromine water/Br₂ in CCl₄.

Step 1 — Reaction: CH₂=CH₂ + Br₂ → CH₂Br-CH₂Br (1,2-dibromoethane).

Step 2 — Observation: The red-brown bromine colour rapidly disappears (de-colourised).



Why other options are wrong: No precipitate or gas is formed, and there is a clear colour change.

Final Answer: Bromine colour is decolourised \Rightarrow

Answer: (C) [Go Back to Q31](#)

Q32.

Solution

Concept — Aromaticity (Huckel's rule): A species is aromatic if it is cyclic, planar, fully conjugated and has $(4n + 2)\pi$ electrons.

Step 1 — Test benzene: Six π electrons ($n = 1$), planar, cyclic and conjugated \Rightarrow aromatic.

Step 2 — Conclude: Benzene satisfies all the criteria.

Why other options are wrong: Cyclobutadiene (4π) and cyclooctatetraene (8π , also non-planar) are not aromatic; cyclohexane is saturated (no π system).

Final Answer: Benzene is aromatic \Rightarrow

Answer: (D) [Go Back to Q32](#)

Q33.

Solution

Concept — Elimination vs substitution: Alcoholic KOH favours β -elimination (dehydrohalogenation) to give an alkene, whereas aqueous KOH favours substitution to an alcohol.

Step 1 — Reaction: $\text{CH}_3\text{CHBrCH}_3 \xrightarrow{\text{alc. KOH}} \text{CH}_3\text{CH}=\text{CH}_2 + \text{KBr} + \text{H}_2\text{O}$.

Step 2 — Product: Propene is the major product.

Why other options are wrong: Propan-2-ol forms with aqueous KOH (substitution); propane and propan-1-ol are not obtained here.

Final Answer: Propene (elimination) \Rightarrow

Answer: (A) [Go Back to Q33](#)



Q34.

Solution

Concept — Kolbe's reaction: Sodium phenoxide reacts with CO_2 (electrophilic substitution at the ortho position) to give, after acidification, salicylic acid.

Step 1 — Reaction: $\text{C}_6\text{H}_5\text{ONa} + \text{CO}_2 \xrightarrow{400\text{ K, pressure}} \text{sodium salicylate} \xrightarrow{\text{H}^+} \text{salicylic acid}$.

Step 2 — Product: 2-hydroxybenzoic acid (salicylic acid).

Why other options are wrong: Benzoic acid lacks the OH; picric acid needs nitration; phenol is the starting material.

Final Answer: Salicylic acid \Rightarrow **B**

Answer: (B) [Go Back to Q34](#)

Q35.

Solution

Concept — Reactivity of ethers: The C–O–C linkage is strong and non-polar enough that ethers resist attack by bases, oxidising agents and dilute acids.

Step 1 — Behaviour: They are good, inert solvents (e.g. diethyl ether) under ordinary conditions.

Step 2 — Exception: They are cleaved only by hot concentrated HI/HBr.

Why other options are wrong: Ethers are neither strongly acidic/basic nor reactive towards water.

Final Answer: Relatively inert and unreactive \Rightarrow **D**

Answer: (D) [Go Back to Q35](#)

Q36.

Solution

Concept — Reduction of a carbonyl: NaBH_4 reduces an aldehyde to a primary alcohol (and a ketone to a secondary alcohol).

Step 1 — Reaction: $\text{CH}_3\text{CH}_2\text{CHO} \xrightarrow{\text{NaBH}_4} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$.

Step 2 — Product: Propan-1-ol (a primary alcohol).

Why other options are wrong: Propanoic acid needs oxidation; propan-2-ol/propanone would come from a ketone, not propanal.



Final Answer: Propan-1-ol \Rightarrow

Answer: (C) [Go Back to Q36](#)

Q37.

Solution

Concept — Acid strength and inductive effect: An electron-donating group ($-\text{CH}_3$) destabilises the carboxylate, weakening the acid; formic acid lacks such a group.

Step 1 — Compare: In CH_3COOH the methyl group pushes electron density onto $-\text{COO}^-$, reducing acidity.

Step 2 — Conclude: HCOOH ($pK_a \approx 3.75$) is stronger than CH_3COOH ($pK_a \approx 4.76$).

Why other options are wrong: More carbons do not make acetic acid stronger; they are not equal, and both are acidic.

Final Answer: Formic acid is the stronger acid \Rightarrow

Answer: (A) [Go Back to Q37](#)

Q38.

Solution

Concept — Basicity of amines: The nitrogen of an amine carries a lone pair, which it can donate to a proton (Bronsted base) or to an electron-deficient species (Lewis base).

Step 1 — Reason: $\text{R-NH}_2 + \text{H}^+ \rightarrow \text{R-NH}_3^+$ uses the lone pair to bond the proton.

Step 2 — Conclude: The availability of this lone pair makes amines basic.

Why other options are wrong: Nitrogen does not lose electrons or carry a positive charge to act as a base; H-bonding is not the source of basicity.

Final Answer: Nitrogen donates its lone pair \Rightarrow

Answer: (B) [Go Back to Q38](#)



Q39.

Solution

Concept — Essential amino acids: Of the twenty protein amino acids, those the body cannot make at adequate rates must come from food.

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

Step 2 — Contrast: Those the body can synthesise are non-essential.

Why other options are wrong: “Acidic” and “basic” classify side-chain charge, not dietary need; non-essential is the opposite category.

Final Answer: They are essential amino acids \Rightarrow

Answer: (C) [Go Back to Q39](#)

Q40.

Solution

Concept — Monomer of natural rubber: Natural rubber is cis-1,4-polyisoprene, built from the diene isoprene.

Step 1 — Identify the monomer: Isoprene is 2-methylbuta-1,3-diene, $\text{CH}_2=\text{C}(\text{CH}_3)-\text{CH}=\text{CH}_2$.

Step 2 — Polymerisation: It polymerises to give the elastic cis-polyisoprene chain.

Why other options are wrong: Ethene gives polythene; vinyl chloride gives PVC; styrene gives polystyrene.

Final Answer: The monomer is isoprene \Rightarrow

Answer: (D) [Go Back to Q40](#)



Answer Key

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

