SAAT Chemistry

Sample Paper – 10

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. When 4 g of hydrogen (H_2) reacts with 32 g of oxygen (O_2) to form water, the maximum mass of water that can be produced is (atomic masses: H = 1, O = 16)

(A) 36 g

(B) 18 g

(C) 32 g

(D) 72 g

Q2. The total number of moles of ions produced when 1 mol of aluminium sulphate, $Al_2(SO_4)_3$, is completely dissolved in water is

(A) 2

(B) 5

(C) 3

(D) 4

Q3. The total number of atoms present in 16 g of methane (CH_4, molar mass 16 g/mol) is ($N_A = 6.022 \times 10^{23}$)

(A) 6.022×10^{23}

(B) 1.2×10^{24}

(C) 3.011×10^{24}

(D) 5×10^{23}

Q4. In the hydrogen atom, the spectral line of *longest* wavelength in the Lyman series arises from the electronic transition

(A) $n = 3 \rightarrow n = 1$

(B) $n = 4 \rightarrow n = 2$

(C) $n = 3 \rightarrow n = 2$

(D) $n = 2 \rightarrow n = 1$

Q5. The number of valence electrons in a sulphur atom ($Z = 16$) is

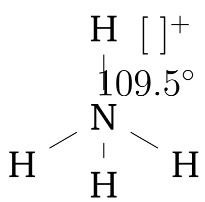
(A) 4

(B) 6

(C) 2

(D) 8

Q6. The hybridization of the central nitrogen atom in the ammonium ion (NH_4^+), whose tetrahedral shape is shown, is



(A) sp

(B) sp^2

(C) sp^3

(D) sp^3d

Q7. According to molecular orbital theory, regarding the magnetic nature of N_2 and O_2, which statement is correct?

(A) N_2 is diamagnetic while O_2 is paramagnetic

(B) Both are paramagnetic

(C) N_2 is paramagnetic while O_2 is diamagnetic

(D) Both are diamagnetic

Q8. Which of the following molecules exhibits intermolecular hydrogen bonding?

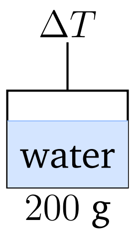
(A) CH_4

(B) H_2S

(C) PH_3

(D) HF

Q9. In the calorimetry set-up shown, the heat required to raise the temperature of 200 g of water by 10 °C is (specific heat of water = $4.2\ \mathrm{J\,g^{-1}\,K^{-1}}$)



(A) 4200 J

(B) 8400 J

(C) 840 J

(D) 2100 J

Q10. For a reaction with $\Delta H = +30\ \mathrm{kJ\,mol^{-1}}$ and $\Delta S = +100\ \mathrm{J\,K^{-1}\,mol^{-1}}$, the minimum temperature above which the reaction becomes spontaneous is

(A) 300 K

(B) 100 K

(C) 30 K

(D) 3000 K

Q11. For a weak electrolyte, the degree of dissociation α at equilibrium is defined as

(A) the total number of moles of electrolyte taken

(B) the number of undissociated moles per litre

(C) the fraction of the electrolyte that has dissociated into ions

(D) the rate of the forward reaction

Q12. Which of the following salts, on dissolving in water, gives a *basic* solution?

(A) NH_4Cl

(B) $(NH_4)_2SO_4$

(C) $NaCl$

(D) CH_3COONa

Q13. Among 0.1 m aqueous solutions of the following, which shows the *highest* elevation in boiling point? (assume complete dissociation of electrolytes)

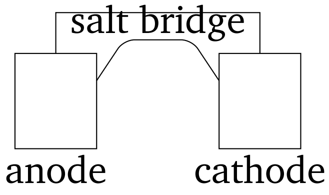
(A) $NaCl$

(B) $AlCl_3$

(C) glucose

(D) $CaCl_2$

Q14. The main function of the salt bridge in a galvanic cell, shown below, is to



(A) maintain electrical neutrality and complete the circuit

(B) act as the site of oxidation

(C) supply electrons to the external circuit

(D) increase the cell EMF indefinitely

Q15. In a multi-step reaction mechanism, the overall rate of the reaction is governed by

(A) the fastest step

(B) the step with the most molecules

(C) the slowest (rate-determining) step

(D) the final product-forming step

Q16. The oxidation number of nitrogen in nitric acid (HNO_3) is

(A) $+3$

(B) -3

(C) $+4$

(D) $+5$

Q17. Compared with its neutral parent atom, a cation is

(A) smaller in size

(B) larger in size

(C) equal in size

(D) always identical in radius

Q18. The net positive charge experienced by a valence electron, after accounting for the screening by inner electrons, is called the

(A) total nuclear charge

(B) effective nuclear charge

(C) ionic charge

(D) formal charge

Q19. Among the alkaline earth metals beryllium, magnesium, calcium and barium, which is the *most* reactive towards water?

(A) Beryllium

(B) Magnesium

(C) Barium

(D) Calcium

Q20. Graphite is a good conductor of electricity, whereas diamond is not. This is because in graphite

(A) all four valence electrons of each carbon are used in σ bonds

(B) the carbon atoms are sp^3 hybridized

(C) it contains free metallic ions

(D) each carbon is sp^2 hybridized, leaving one delocalised electron per atom

Q21. The property of sulphur atoms to link together forming long $-\mathrm{S}-\mathrm{S}-$ chains and rings (e.g. S_8) is known as

(A) catenation

(B) allotropy

(C) disproportionation

(D) polymerisation by addition

Q22. Which noble gas is used to fill electric light bulbs and to provide an inert atmosphere in high-temperature metallurgical operations such as welding?

(A) Helium

(B) Argon

(C) Neon

(D) Krypton

Q23. Zinc is generally *not* regarded as a typical transition metal because

(A) it has a fully filled $4s$ orbital

(B) it is a soft, low-melting metal

(C) it shows several oxidation states

(D) its ion and atom both have a completely filled $3d^{10}$ configuration

Q24. A direct consequence of the lanthanide contraction is that the atomic radii of

(A) all lanthanides are equal

(B) the actinides increase steadily

(C) zirconium (Zr) and hafnium (Hf) are almost identical

(D) potassium and sodium become equal

Q25. According to Werner's theory of coordination compounds, the *secondary valence* of a metal corresponds to its

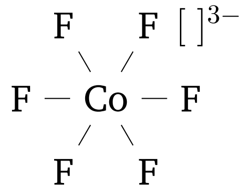
(A) coordination number

(B) oxidation number

(C) atomic number

(D) ionic charge only

Q26. The spin-only magnetic moment of the octahedral complex ion $[CoF_6]^{3-}$ (high spin, Co^{3+}, d^6), shown below, is approximately (use $\mu = \sqrt{n(n+2)}$ BM)



(A) 0 BM

(B) 4.90 BM

(C) 2.83 BM

(D) 5.92 BM

Q27. The IUPAC name of the ester $CH_3COOC_2H_5$ is

(A) methyl ethanoate

(B) ethyl methanoate

(C) ethyl ethanoate

(D) methyl propanoate

Q28. How many geometrical (cis–trans) isomers are possible for but-2-ene, $CH_3 - CH{=}CH - CH_3$, shown below?

$$CH_3 - CH{=}CH - CH_3$$

(A) 3

(B) 1

(C) 4

(D) 2

Q29. Among the following alkenes, which is the *most* stable (most substituted double bond)?

(A) ethene ($CH_2{=}CH_2$)

(B) 2,3-dimethylbut-2-ene $\big((CH_3)_2C{=}C(CH_3)_2\big)$

(C) propene ($CH_3CH{=}CH_2$)

(D) but-1-ene ($CH_3CH_2CH{=}CH_2$)

Q30. In a saturated alkane, all the carbon–carbon and carbon–hydrogen bonds are

(A) single covalent (σ) bonds

(B) ionic bonds

(C) one σ and one π bond each

(D) coordinate bonds

Q31. The catalytic hydrogenation of ethene ($CH_2{=}CH_2$), shown below, in the presence of finely divided nickel gives

$$CH_2{=}CH_2 \xrightarrow{H_2,\ Ni} ?$$

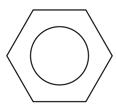
(A) ethyne

(B) ethanol

(C) ethanal

(D) ethane

Q32. Benzene, shown below, is unusually stable compared with a hypothetical cyclohexatriene. This extra stability is called its



(A) lattice energy

(B) ionization energy

(C) resonance (delocalisation) energy

(D) activation energy

Q33. When an optically active alkyl halide undergoes an S_N1 reaction through a planar carbocation intermediate, the product is

(A) a racemic mixture (largely racemised)

(B) a single inverted enantiomer only

(C) the unchanged starting material

(D) a meso compound

Q34. Phenol gives a characteristic *violet* colouration when treated with neutral

(A) aqueous NaOH

(B) ferric chloride ($FeCl_3$)

(C) Tollens' reagent

(D) Fehling's solution

Q35. Which of the following compounds is an *ether*?

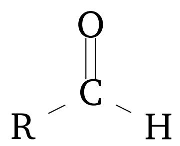
(A) CH_3CH_2OH

(B) CH_3CHO

(C) $CH_3{-}O{-}CH_3$

(D) CH_3COOH

Q36. Which reagent can be used to distinguish an aldehyde (carbonyl group shown) from a ketone by forming a brick-red precipitate with the aldehyde only?



(A) aqueous NaCl

(B) dilute H_2SO_4

(C) bromine water
(D) Fehling's solution

Q37. The correct order of *decreasing* acidic strength among acetic acid, phenol and ethanol is

(A) acetic acid $>$ phenol $>$ ethanol
(B) phenol $>$ acetic acid $>$ ethanol
(C) ethanol $>$ phenol $>$ acetic acid
(D) acetic acid $>$ ethanol $>$ phenol

Q38. Aniline ($C_6H_5NH_2$) is a *weaker* base than ammonia or aliphatic amines because

(A) nitrogen has no lone pair
(B) the lone pair on nitrogen is delocalised into the benzene ring
(C) it is a stronger acid
(D) it cannot accept a proton at all

Q39. Enzymes, which catalyse biochemical reactions in living organisms, are chemically

(A) lipids
(B) carbohydrates
(C) proteins
(D) nucleic acids

Q40. Unlike soaps, synthetic detergents can be used effectively in hard water because they

(A) are sodium salts of long-chain carboxylic acids
(B) form insoluble scum with Ca^{2+} and Mg^{2+} ions
(C) are biodegradable in every case
(D) form soluble calcium and magnesium salts and do not precipitate

Detailed Solutions

Q1.

Solution

Concept — Limiting reagent: $2H_2 + O_2 \rightarrow 2H_2O$. Identify which reactant runs out first.

Step 1 — Moles: $H_2 = \frac{4}{2} = 2$ mol; $O_2 = \frac{32}{32} = 1$ mol.

Step 2 — Ratio: 2 mol H_2 needs exactly 1 mol O_2, so both are consumed completely, giving 2 mol H_2O.

Step 3 — Mass: $2 \times 18 = 36$ g water.

Why other options are wrong: 18 g is only 1 mol; 32 and 72 g ignore the stoichiometry.

Final Answer: 36 g of water $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Ions from an ionic salt: Count the cations and anions released on full dissociation.

Step 1 — Dissociation: $Al_2(SO_4)_3 \rightarrow 2\,Al^{3+} + 3\,SO_4^{2-}$.

Step 2 — Total ions: $2 + 3 = 5$ mol of ions per mole of salt.

Why other options are wrong: 2 counts only cations; 3 only anions; 4 is incorrect.

Final Answer: 5 mol of ions $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Atoms from moles: Atoms $= n \times$ (atoms per formula unit) $\times N_A$.

Step 1 — Moles of CH_4: $n = \frac{16}{16} = 1$ mol.

Step 2 — Atoms: Each CH_4 has 5 atoms, so $1 \times 5 \times 6.022 \times 10^{23} = 3.011 \times 10^{24}$ atoms.

Why other options are wrong: 6.022×10^{23} counts molecules only; 1.2×10^{24} uses 2 atoms; 5×10^{23} is mis-scaled.

Final Answer: 3.011×10^{24} atoms $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Lyman series: All transitions end at $n = 1$. The longest wavelength corresponds to the *smallest* energy gap, i.e. the transition from the nearest higher level.

Step 1 — Smallest gap to $n = 1$: The transition $n = 2 \to n = 1$ has the least energy and hence the longest wavelength.

Why other options are wrong: $n = 3 \to 1$ is a larger gap (shorter λ); $n = 4 \to 2$ and $n = 3 \to 2$ belong to the Balmer series.

Final Answer: $n = 2 \to n = 1 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Valence electrons: The electrons in the outermost (n) shell.

Step 1 — Configuration of S ($Z = 16$): $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^4$.

Step 2 — Outermost shell ($n = 3$): $3s^2\, 3p^4 = 6$ valence electrons.

Why other options are wrong: 4 counts only p; 2 only s; 8 exceeds the outer count.

Final Answer: 6 valence electrons $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Hybridization of NH_4^+**:** Count σ bonds and lone pairs on the central atom.

Step 1 — Bonding in NH_4^+**:** Nitrogen forms four N–H σ bonds with no lone pair (the lone pair is used to bond the fourth H).

Step 2 — Hybridization: Four electron domains $\Rightarrow sp^3$, tetrahedral.

Why other options are wrong: sp (linear) and sp^2 (trigonal planar) have fewer domains; sp^3d needs five.

Final Answer: Nitrogen is $sp^3 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Magnetism from MOT: A species is paramagnetic if it has unpaired electrons.

Step 1 — N_2 **(14 e⁻):** All molecular orbitals up to $\sigma 2p_z$ are filled in pairs; no unpaired electrons $\Rightarrow$ diamagnetic.

Step 2 — O_2 **(16 e⁻):** Two electrons occupy the degenerate π^*2p orbitals singly $\Rightarrow$ two unpaired electrons $\Rightarrow$ paramagnetic.

Why other options are wrong: They reverse or misstate the magnetic character.

Final Answer: N_2 diamagnetic, O_2 paramagnetic $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Hydrogen bonding: Requires H bonded to a highly electronegative atom (F, O or N).

Step 1 — Examine HF: H is bonded to fluorine, the most electronegative element, so HF forms strong intermolecular H-bonds.

Why other options are wrong: CH_4, H_2S and PH_3 lack H bonded to F/O/N, so no significant H-bonding.

Final Answer: HF shows hydrogen bonding $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Calorimetry: $q = m\,c\,\Delta T$.

Step 1 — Substitute: $q = 200 \times 4.2 \times 10$.

Step 2 — Compute: $q = 8400$ J.

Why other options are wrong: 4200 J uses $\Delta T = 5$; 840 J drops a factor of 10; 2100 J uses wrong values.

Final Answer: $q = 8400$ J $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Threshold of spontaneity: A reaction with $+\Delta H$ and $+\Delta S$ becomes spontaneous when $\Delta G = \Delta H - T\Delta S < 0$, i.e. above $T = \Delta H/\Delta S$.

Step 1 — Convert units: $\Delta H = 30000$ J/mol, $\Delta S = 100$ J/K·mol.

Step 2 — Compute: $T = \dfrac{30000}{100} = 300$ K.

Why other options are wrong: 30 K and 100 K ignore unit conversion; 3000 K is off by a factor of 10.

Final Answer: $T = 300$ K $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Degree of dissociation: $\alpha = \dfrac{\text{moles dissociated}}{\text{moles initially taken}}$.

Step 1 — Definition: It is the *fraction* of the electrolyte that has broken into ions at equilibrium.

Why other options are wrong: It is a fraction, not a total amount, not the undissociated moles, and not a rate.

Final Answer: Fraction dissociated into ions $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q11

Q12.

Solution

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

Step 1 — Examine CH_3COONa**:** From strong base NaOH and weak acid CH_3COOH; the acetate ion hydrolyses to make the solution basic (pH > 7).

Why other options are wrong: NH_4Cl and $(NH_4)_2SO_4$ are acidic (weak base + strong acid); $NaCl$ is neutral.

Final Answer: CH_3COONa gives a basic solution $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Colligative property: $\Delta T_b = i\,K_b\,m$. For equal molality, the largest van't Hoff factor i gives the highest elevation.

Step 1 — Compute i**:** $AlCl_3 \to Al^{3+} + 3Cl^-$, $i = 4$; $CaCl_2$, $i = 3$; $NaCl$, $i = 2$; glucose, $i = 1$.

Step 2 — Largest i**:** $AlCl_3$ with $i = 4$ gives the maximum ΔT_b.

Why other options are wrong: They have smaller i values.

Final Answer: $AlCl_3 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Salt bridge: It connects the two half-cells while preventing direct mixing.

Step 1 — Function: It allows ion migration to balance charge build-up, maintaining electrical neutrality in both half-cells and completing the internal circuit.

Why other options are wrong: Electrons flow through the external wire, not the bridge; oxidation occurs at the anode; the bridge does not raise EMF indefinitely.

Final Answer: Maintains neutrality and completes the circuit $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — Rate-determining step: The slowest elementary step controls the overall rate of a multi-step reaction.

Step 1 — Reasoning: Just as the slowest worker sets the pace, the slowest step is the bottleneck and determines the observed rate law.

Why other options are wrong: The fastest step is not limiting; molecularity or being the final step does not determine the rate.

Final Answer: The slowest (rate-determining) step $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Oxidation number: Sum of oxidation numbers in a neutral molecule is zero.

Step 1 — Assign: $\text{H} = +1$, $\text{O} = -2\ (\times 3 = -6)$.

Step 2 — Solve for N: $+1 + x - 6 = 0 \Rightarrow x = +5$.

Why other options are wrong: $+3$ is N in HNO_2; $+4$ is in NO_2; -3 is in NH_3.

Final Answer: N is $+5$ in HNO_3 $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Cation size: Removing electron(s) reduces electron–electron repulsion and increases effective nuclear charge per electron.

Step 1 — Result: A cation is always *smaller* than its parent atom; often an entire shell is lost.

Why other options are wrong: A cation is never larger or equal to the neutral atom.

Final Answer: A cation is smaller than its parent atom $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Effective nuclear charge: $Z_{\text{eff}} = Z - S$, where S is the screening by inner electrons.

Step 1 — Definition: The net positive charge actually felt by a valence electron is the effective nuclear charge.

Why other options are wrong: Total nuclear charge ignores screening; ionic and formal charges are different concepts.

Final Answer: Effective nuclear charge $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Reactivity of group-2 metals: Reactivity towards water increases down the group as ionization enthalpy falls.

Step 1 — Order: $\text{Be} < \text{Mg} < \text{Ca} < \text{Ba}$ in reactivity.

Step 2 — Pick: Barium is the most reactive of those listed.

Why other options are wrong: Be reacts hardly at all; Mg reacts only with hot water/steam; Ca is less reactive than Ba.

Final Answer: Barium $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Structure of graphite: Layered sheets of sp^2 carbons.

Step 1 — Bonding: Each carbon uses three electrons in σ bonds; the fourth electron is delocalised over the layer.

Step 2 — Conduction: These mobile π electrons carry current, so graphite conducts.

Why other options are wrong: In diamond all four electrons are in σ bonds (sp^3), leaving none free; graphite has no metallic ions.

Final Answer: Each C is sp^2 with one delocalised electron $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Catenation: The self-linking of like atoms through covalent bonds into chains or rings.

Step 1 — Sulphur: Sulphur shows strong catenation, forming S_8 rings and longer $-S-S-$ chains.

Why other options are wrong: Allotropy is the existence of different forms; disproportionation is a redox process; this is not addition polymerisation.

Final Answer: The property is catenation $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Uses of noble gases: Argon is cheap, abundant and chemically inert.

Step 1 — Application: Argon fills incandescent bulbs (prevents filament oxidation) and shields the weld pool in arc welding.

Why other options are wrong: Helium is used in balloons/cryogenics; neon in glow signs; krypton in special lamps, but argon is the standard for bulbs and welding.

Final Answer: Argon $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Definition of a transition metal: An element having a partially filled d subshell in the atom or in one of its common ions.

Step 1 — Zinc: Zn is $[\mathrm{Ar}]3d^{10}4s^2$ and Zn^{2+} is $3d^{10}$ — both completely filled d.

Step 2 — Conclusion: Since neither the atom nor its ion has a partly filled d shell, Zn is not a typical transition metal.

Why other options are wrong: A filled $4s$ or being soft/low-melting is not the defining criterion; Zn shows essentially only the $+2$ state.

Final Answer: $3d^{10}$ in both atom and ion $\Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Lanthanide contraction: The size decrease across the $4f$ series almost cancels the expected increase from period 5 to period 6 in the d-block.

Step 1 — Consequence: Zirconium (period 5) and hafnium (period 6) end up with nearly identical atomic radii and very similar chemistry.

Why other options are wrong: Lanthanide radii actually decrease (not equal); actinides do not increase steadily; Na and K are unrelated.

Final Answer: Zr and Hf have almost identical radii $\Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Werner's theory: A metal has a *primary* valence (ionisable, = oxidation number) and a *secondary* valence (non-ionisable, = coordination number).

Step 1 — Secondary valence: It equals the number of ligands directly attached, i.e. the coordination number.

Why other options are wrong: Oxidation number is the primary valence; atomic number and ionic charge are unrelated to secondary valence.

Final Answer: Secondary valence = coordination number $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Spin-only magnetic moment: $\mu = \sqrt{n(n+2)}$ BM, where n is the number of unpaired electrons.

Step 1 — $[CoF_6]^{3-}$: Co^{3+} is d^6; F^- is a weak-field ligand, so the complex is high spin with $t_{2g}^4 e_g^2$ giving $n = 4$ unpaired electrons.

Step 2 — Compute: $\mu = \sqrt{4(4+2)} = \sqrt{24} \approx 4.90$ BM.

Why other options are wrong: 0 is low-spin d^6; 2.83 is $n = 2$; 5.92 is $n = 5$.

Final Answer: $\mu \approx 4.90$ BM $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Naming esters: An ester $R-COO-R'$ is named "(alkyl from R') (acid as -oate)".

Step 1 — Identify parts: CH_3COO- comes from ethanoic (acetic) acid $\rightarrow$ "ethanoate"; $-C_2H_5$ is the ethyl group.

Step 2 — Combine: ethyl ethanoate.

Why other options are wrong: methyl ethanoate is CH_3COOCH_3; ethyl methanoate is $HCOOC_2H_5$; methyl propanoate is $C_2H_5COOCH_3$.

Final Answer: ethyl ethanoate $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Geometrical isomerism: A C=C with two *different* groups on each doubly bonded carbon gives cis and trans forms.

Step 1 — Examine but-2-ene: Each alkene carbon bears one CH_3 and one H, so both cis and trans exist.

Step 2 — Count: Exactly 2 geometrical isomers (cis and trans).

Why other options are wrong: 3, 1 and 4 are incorrect counts for this simple disubstituted alkene.

Final Answer: 2 isomers $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Alkene stability: Stability increases with the number of alkyl substituents on the double bond (hyperconjugation + inductive stabilisation).

Step 1 — Compare substitution: 2,3-dimethylbut-2-ene is tetrasubstituted; propene and but-1-ene are monosubstituted; ethene is unsubstituted.

Step 2 — Pick: The tetrasubstituted alkene is the most stable.

Why other options are wrong: They are less substituted and therefore less stable.

Final Answer: 2,3-dimethylbut-2-ene $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Bonding in alkanes: Alkanes are saturated; carbon is sp^3 hybridized.

Step 1 — Bond type: Every C–C and C–H bond is a single covalent (σ) bond formed by head-on orbital overlap.

Why other options are wrong: There are no π bonds (no unsaturation), no ionic or coordinate bonds in a simple alkane.

Final Answer: All are single covalent (σ) bonds $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Catalytic hydrogenation: H_2 adds across the C=C double bond over a metal catalyst.

Step 1 — Reaction: $CH_2{=}CH_2 + H_2 \xrightarrow{Ni} CH_3{-}CH_3$.

Step 2 — Product: ethane.

Why other options are wrong: ethyne is more unsaturated; ethanol and ethanal require O, which is not added here.

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

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Resonance energy: Delocalisation of the six π electrons over the ring lowers benzene's energy below that of a localised cyclohexatriene.

Step 1 — Identify: This stabilisation (about $150\ \text{kJ mol}^{-1}$) is the resonance (delocalisation) energy.

Why other options are wrong: Lattice energy applies to ionic solids; ionization and activation energies are different quantities.

Final Answer: Resonance (delocalisation) energy $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — S_N1 stereochemistry: The intermediate is a planar carbocation that the nucleophile can attack from either face.

Step 1 — Outcome: Attack from both faces gives roughly equal amounts of the two enantiomers, i.e. a racemic (largely racemised) mixture, with loss of optical activity.

Why other options are wrong: Pure inversion is the S_N2 result; the starting material is not recovered; no meso compound forms from a single stereocentre.

Final Answer: A racemic mixture ⇒ A

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Test for phenols: Phenols form coloured iron(III) complexes.

Step 1 — Reaction: Neutral $FeCl_3$ with phenol gives a violet/purple coloured complex — a confirmatory test for the phenolic –OH.

Why other options are wrong: NaOH only forms the salt (no colour); Tollens' and Fehling's are tests for aldehydes/reducing sugars.

Final Answer: Neutral $FeCl_3$ gives a violet colour ⇒ B

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Ether functional group: An ether has the structure $R-O-R'$, with oxygen bonded to two carbon atoms.

Step 1 — Identify: CH_3-O-CH_3 (dimethyl ether / methoxymethane) fits this pattern.

Why other options are wrong: CH_3CH_2OH is an alcohol; CH_3CHO an aldehyde; CH_3COOH a carboxylic acid.

Final Answer: CH_3-O-CH_3 is the ether ⇒ C

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Distinguishing aldehyde and ketone: Aldehydes are readily oxidised; ketones are not.

Step 1 — Fehling's test: Aldehydes reduce blue Fehling's solution to a brick-red precipitate of Cu_2O; ketones do not react.

Why other options are wrong: dilute H_2SO_4, bromine water and NaCl do not give this selective brick-red test.

Final Answer: Fehling's solution ⇒ D

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Relative acidity: Carboxylic acid > phenol > water > alcohol, judged by conjugate-base stability.

Step 1 — Compare: Acetate is strongly resonance stabilised (most acidic); phenoxide is resonance stabilised but less so; ethoxide has no resonance (least acidic).

Step 2 — Order: acetic acid > phenol > ethanol.

Why other options are wrong: They place phenol or ethanol above acetic acid, contradicting conjugate-base stability.

Final Answer: acetic acid > phenol > ethanol ⇒ A

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Basicity of aniline: Basicity depends on the availability of the nitrogen lone pair.

Step 1 — Resonance: In aniline the N lone pair is delocalised into the benzene ring, so it is less available to accept a proton.

Step 2 — Conclusion: Hence aniline is a weaker base than ammonia or aliphatic amines.

Why other options are wrong: Nitrogen does retain a lone pair; aniline is not a strong acid; it can accept a proton, just less readily.

Final Answer: Lone pair delocalised into the ring ⇒ B

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — Enzymes: Enzymes are biological catalysts.

Step 1 — Chemical nature: Almost all enzymes are globular *proteins* (a few catalytic RNAs aside), built from amino acids.

Why other options are wrong: Lipids, carbohydrates and nucleic acids are different biomolecule classes; enzymes are proteins.

Final Answer: Enzymes are proteins $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Soaps vs detergents in hard water: Soaps (Na salts of fatty acids) form insoluble scum with Ca^{2+}/Mg^{2+}; detergents do not.

Step 1 — Detergent behaviour: The calcium and magnesium salts of detergents are *soluble*, so detergents do not precipitate and work even in hard water.

Why other options are wrong: Being fatty-acid salts and forming scum describe soaps; biodegradability is not the reason they work in hard water.

Final Answer: Their Ca/Mg salts are soluble (no scum) $\Rightarrow \boxed{D}$

Answer: (D) 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	B
6	C	7	A	8	D	9	B	10	A
11	C	12	D	13	B	14	A	15	C
16	D	17	A	18	B	19	C	20	D
21	A	22	B	23	D	24	C	25	A
26	B	27	C	28	D	29	B	30	A
31	D	32	C	33	A	34	B	35	C
36	D	37	A	38	B	39	C	40	D