PGIMER BSc Nursing Chemistry

Sample Paper – 7

Duration: 23 Minutes **Maximum Marks: 25**

Instructions

- This paper contains **25** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry portion of the **PGIMER BSc Nursing** entrance exam.
- Each correct answer carries **+1 mark**. **0.25 mark** is deducted for every incorrect answer. Unattempted questions carry **0 marks**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 and 12 (NCERT) Chemistry**.
- The exam is conducted as a computer-based test. Personal calculators, mobile phones, log tables, and other electronic gadgets are strictly prohibited.

Q1. Magnesium burns in oxygen according to $2Mg + O_2 \rightarrow 2MgO$. The mass of magnesium oxide formed when 12 g of magnesium is completely burnt is (atomic masses: Mg $= 24$, O $= 16$):

(A) 40 g

(B) 20 g

(C) 10 g

(D) 24 g

Q2. The maximum number of electrons that can be accommodated in the M shell ($n = 3$) of an atom is:

(A) 8

(B) 9

(C) 18

(D) 32

Q3. The correct order of *increasing* first ionization energy of the elements B, C, N and O is:

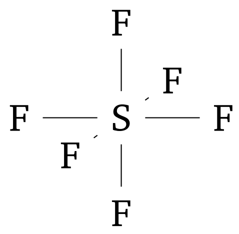
(A) $B < C < N < O$

(B) $O < N < C < B$

(C) $B < C < O < N$

(D) $N < O < C < B$

Q4. The hybridization of the central sulphur atom in sulphur hexafluoride (SF_6), whose octahedral shape is shown, is:



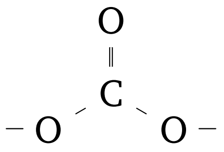
(A) sp^3d^2

(B) sp^3d

(C) sp^3

(D) sp^2

Q5. The carbonate ion (CO_3^{2-}), one canonical form of which is shown, is described by how many equivalent resonance (canonical) structures?



(A) 1

(B) 2

(C) 4

(D) 3

Q6. For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, shown schematically below, the sign of the entropy change (ΔS) of the system is:

$$\text{4 moles of gas} \longrightarrow \text{2 moles of gas}$$

(A) $\Delta S > 0$ (positive)

(B) $\Delta S = 0$

(C) $\Delta S < 0$ (negative)

(D) cannot be predicted

Q7. The degree of dissociation of a weak acid of concentration 0.1 M and dissociation constant $K_a = 1.0 \times 10^{-5}$ is (use Ostwald's dilution law $\alpha = \sqrt{K_a/C}$):

(A) 0.01

(B) 0.1

(C) 0.001

(D) 0.02

Q8. In acidic medium the permanganate ion is reduced according to $MnO_4^- + 8H^+ + n\,e^- \rightarrow Mn^{2+} + 4H_2O$. The number of electrons (n) transferred is:

(A) 3

(B) 5

(C) 2

(D) 1

Q9. The correct relation between the standard cell potential E°_{cell} and the equilibrium constant K at 298 K (n = moles of electrons) is:

(A) $E^\circ_{\text{cell}} = \dfrac{0.059}{n} \log K$

(B) $E^\circ_{\text{cell}} = \dfrac{0.059}{n} \ln K$

(C) $E^\circ_{\text{cell}} = -\dfrac{0.059}{n} \log K$

(D) $E^\circ_{\text{cell}} = \dfrac{n}{0.059} \log K$

Q10. The molecularity of the elementary reaction $2\text{NO}(g) + \text{O}_2(g) \rightarrow 2\text{NO}_2(g)$ is:

(A) 2

(B) 3

(C) 1

(D) cannot be defined

Q11. The osmotic pressure of a 0.1 M aqueous solution of a non-electrolyte at 300 K is (use $\pi = CRT$, $R = 0.0821$ L atm mol^{-1} K^{-1}):

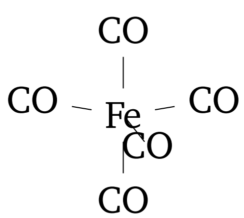
(A) 2.46 atm

(B) 24.6 atm

(C) 0.246 atm

(D) 1.23 atm

Q12. The effective atomic number (EAN) of iron in iron pentacarbonyl $[\text{Fe(CO)}_5]$, shown below, is (atomic number of Fe $= 26$):



(A) 26

(B) 34

(C) 30

(D) 36

Q13. The correct order of *thermal stability* of the hydrides of group 15 is:

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

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

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

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

Q14. When potassium permanganate ($KMnO_4$) acts as an oxidising agent in acidic medium, the manganese is reduced to:

(A) Mn^{2+}

(B) MnO_2

(C) MnO_4^{2-}

(D) Mn (metal)

Q15. Which of the following ions is the chief intracellular cation and is essential for nerve signal transmission and muscle function?

(A) Na^+

(B) Ca^{2+}

(C) Mg^{2+}

(D) K^+

Q16. Which of the following groups, when attached to a benzene ring, exerts a +M (positive mesomeric / electron-donating by resonance) effect?

(A) $-NH_2$

(B) $-NO_2$

(C) $-CN$

(D) $-CHO$

Q17. The Wurtz reaction of ethyl bromide (CH_3CH_2Br) with sodium metal in dry ether gives mainly the symmetrical alkane:

(A) n-butane

(B) ethane

(C) propane

(D) n-hexane

Q18. Haloarenes (e.g. chlorobenzene) are much less reactive than haloalkanes toward nucleophilic substitution mainly because:

(A) haloarenes are far less polar than haloalkanes

(B) the halogen is more electronegative in haloarenes

(C) aryl halides are sterically much bulkier

(D) the C–X bond acquires partial double-bond character due to resonance, making it shorter and stronger

Q19. In the Reimer–Tiemann reaction, phenol is treated with chloroform and aqueous sodium hydroxide as shown. The principal organic product is:

$$\text{phenol} \xrightarrow[\text{(then } H^+)]{CHCl_3 \text{ / NaOH}} \text{product}$$

(A) benzaldehyde

(B) salicylic acid

(C) salicylaldehyde (2-hydroxybenzaldehyde)

(D) benzoic acid

Q20. The correct order of reactivity of the following carbonyl compounds toward nucleophilic addition is:

(A) $(CH_3)_2CO > CH_3CHO > HCHO$

(B) $CH_3CHO > HCHO > (CH_3)_2CO$

(C) $HCHO > CH_3CHO > (CH_3)_2CO$

(D) $HCHO > (CH_3)_2CO > CH_3CHO$

Q21. Reduction of acetic acid (CH_3COOH) with lithium aluminium hydride ($LiAlH_4$) gives the primary alcohol:

(A) acetaldehyde

(B) methanol

(C) ethane

(D) ethanol

Q22. Among the following substituted anilines, the strongest base in aqueous solution is:

(A) p-nitroaniline

(B) p-methylaniline (p-toluidine)

(C) m-nitroaniline

(D) aniline

Q23. The open-chain structure of glucose contains:

(A) one ketone group and five hydroxyl groups

(B) one aldehyde group and five hydroxyl groups

(C) one carboxylic acid group and four hydroxyl groups

(D) two aldehyde groups and four hydroxyl groups

Q24. The IUPAC name of the amine whose structure is shown below is:

$$CH_3—CH_2—CH_2—NH_2$$

(A) propan-2-amine

(B) N-methylethanamine

(C) propan-1-amine

(D) butan-1-amine

Q25. The Biuret test, which gives a violet colouration, is used to detect the presence of:

(A) reducing sugars

(B) proteins (peptide bonds)

(C) lipids

(D) starch

Detailed Solutions

Q1.

Solution

Concept — Stoichiometry from a balanced equation: The balanced equation gives the mole ratio between reactant and product; convert mass to moles, apply the ratio, then convert back to mass.

Step 1 — Find the moles of magnesium:

$$n_{\text{Mg}} = \frac{m}{M} = \frac{12}{24} = 0.5 \text{ mol.}$$

Step 2 — Apply the mole ratio: From $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$, the ratio $\text{Mg} : \text{MgO}$ is $2 : 2 = 1 : 1$.

So moles of MgO formed $= 0.5$ mol.

Step 3 — Convert to mass: Molar mass of MgO $= 24 + 16 = 40$ g mol^{-1}.

$$m_{\text{MgO}} = 0.5 \times 40 = 20 \text{ g.}$$

Why other options are wrong:

- Option A (40 g): assumes 1 mol of MgO (would need 24 g Mg).
- Option C (10 g): uses half the correct moles.
- Option D (24 g): just repeats the mass of Mg taken.

Final Answer: Mass of MgO $= 20$ g $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Capacity of a shell: The maximum number of electrons in a principal shell is given by $2n^2$, where n is the principal quantum number.

Step 1 — Identify n for the M shell: The M shell corresponds to $n = 3$.

Step 2 — Apply the formula:

$$2n^2 = 2 \times (3)^2 = 2 \times 9.$$

Step 3 — Evaluate:

$$2 \times 9 = 18 \text{ electrons.}$$

Why other options are wrong:

- Option A (8): the capacity of the L shell $(n = 2)$.
- Option B (9): this is n^2, the number of orbitals, not electrons.
- Option D (32): the capacity of the N shell $(n = 4)$.

Final Answer: The M shell holds 18 electrons $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — First ionization energy trend: Ionization energy generally increases across a period, but exactly half-filled or fully filled subshells have extra stability, causing local anomalies.

Step 1 — Note the period-2 trend: Across period 2 the general rise is B $<$ C $<$ N $<$ O $<$ F.

Step 2 — Apply the half-filled anomaly: Nitrogen has a stable half-filled $2p^3$ configuration, so removing an electron from it is harder than from oxygen $(2p^4)$.

Hence the first ionization energy of N is *greater* than that of O.

Step 3 — Write the increasing order:

$$\text{B} < \text{C} < \text{O} < \text{N}.$$

Why other options are wrong:

- Option A: places O above N, ignoring the half-filled stability of N.
- Options B and D: are essentially decreasing orders, not increasing.

Final Answer: Increasing order is B $<$ C $<$ O $<$ N $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Hybridization involving d-orbitals: The number of sigma bonds plus lone pairs on the central atom equals the number of hybrid orbitals; six such regions require one s, three p and two d orbitals.

Step 1 — Count regions around sulphur in SF_6: Sulphur forms six S–F sigma bonds and has no lone pair, giving six electron regions.

Step 2 — Assign the hybridization: Six hybrid orbitals $\Rightarrow sp^3d^2$ hybridization.

Step 3 — Match the geometry: sp^3d^2 gives an octahedral shape with 90° bond angles, as shown.

Why other options are wrong:

- Option B (sp^3d): five regions, as in PCl_5 (trigonal bipyramidal).
- Option C (sp^3): four regions (tetrahedral).
- Option D (sp^2): three regions (trigonal planar).

Final Answer: Sulphur in SF_6 is sp^3d^2 hybridized $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — Resonance in the carbonate ion: When a double bond can be drawn to each of several equivalent atoms, each placement is a separate canonical (resonance) structure.

Step 1 — Look at the bonding in CO_3^{2-}: The carbon is bonded to three oxygen atoms; one C=O double bond and two C–O single bonds are drawn.

Step 2 — Move the double bond: The double bond can be placed to any one of the three oxygen atoms.

Step 3 — Count the structures: Three equivalent positions give *three* resonance structures, so the real ion has three equal C–O bonds (bond order 1.33).

Why other options are wrong:

- Option A (1): a single structure cannot explain the three identical bonds.
- Option B (2): there are three, not two, equivalent oxygens.
- Option C (4): there are only three oxygen atoms to bear the double bond.

Final Answer: The carbonate ion has 3 resonance structures ⇒ D

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Entropy and gaseous moles: Entropy measures disorder; for a gas-phase reaction a decrease in the number of gas molecules means lower disorder, so ΔS is negative.

Step 1 — Count gas moles on each side: Reactants: $N_2 + 3H_2 = 4$ moles of gas.

Products: $2NH_3 = 2$ moles of gas.

Step 2 — Compare: The number of gas molecules falls from 4 to 2, so the system becomes more ordered.

Step 3 — Assign the sign: A decrease in gaseous moles gives $\Delta S < 0$ (negative).

Why other options are wrong:

- Option A ($\Delta S > 0$): would require more gas molecules on the product side.
- Option B ($\Delta S = 0$): the mole change is non-zero, so $\Delta S \neq 0$.
- Option D: the sign is clearly predictable from the change in gas moles.

Final Answer: $\Delta S < 0$ (negative) ⇒ C

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Ostwald's dilution law: For a weak electrolyte the degree of dissociation is $\alpha = \sqrt{K_a/C}$ when α is small.

Step 1 — List the data: $K_a = 1.0 \times 10^{-5}$ and $C = 0.1$ M.

Step 2 — Substitute into the formula:

$$\alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{1.0 \times 10^{-5}}{0.1}}.$$

Step 3 — Simplify:

$$\alpha = \sqrt{1.0 \times 10^{-4}} = 1.0 \times 10^{-2} = 0.01.$$

Why other options are wrong:

- Option B (0.1): forgets to take the square root.
- Option C (0.001): off by a factor of ten.
- Option D (0.02): not consistent with the given K_a and C.

Final Answer: $\alpha = 0.01 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Electrons in a half-reaction: The number of electrons equals the total change in oxidation number of the species being reduced.

Step 1 — Find the oxidation states of Mn: In MnO_4^-, Mn is $+7$; in Mn^{2+}, Mn is $+2$.

Step 2 — Compute the change:

$$\Delta(\text{oxidation number}) = 7 - 2 = 5.$$

Step 3 — State the electrons gained: Reduction of Mn from $+7$ to $+2$ requires 5 electrons, so $n = 5$.

Why other options are wrong:

- Option A (3): the change for $MnO_4^- \rightarrow MnO_2$ $(+7$ to $+4)$, in neutral medium.
- Option C (2) and Option D (1): too few to span $+7$ to $+2$.

Final Answer: $n = 5$ electrons $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Linking E° and K: At equilibrium $\Delta G^\circ = -nFE^\circ_{\text{cell}} = -RT\ln K$, which rearranges to relate the cell potential to the equilibrium constant.

Step 1 — Start from the thermodynamic relation:

$$nFE^\circ_{\text{cell}} = RT\ln K.$$

Step 2 — Solve for E°_{cell}:

$$E^\circ_{\text{cell}} = \frac{RT}{nF}\ln K.$$

Step 3 — Insert the constants at 298 K: Converting ln to log and using $\frac{RT}{F} \times 2.303 = 0.059$ V,

$$E^\circ_{\text{cell}} = \frac{0.059}{n}\log K.$$

Why other options are wrong:

- Option B: mixes 0.059 (which already includes 2.303) with ln instead of log.
- Option C: has the wrong (negative) sign.
- Option D: inverts the factor, putting n in the numerator.

Final Answer: $E^\circ_{\text{cell}} = \frac{0.059}{n}\log K \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Molecularity: For an elementary reaction, the molecularity is the total number of reactant molecules (species) that collide in the single step; it is a whole number.

Step 1 — Count the reactant molecules: $2NO + O_2$ involves 2 molecules of NO and 1 of O_2.

Step 2 — Add them up:

$$\text{Molecularity} = 2 + 1 = 3.$$

Step 3 — Interpret: A molecularity of 3 means the reaction is termolecular.

Why other options are wrong:

- Option A (2): ignores one of the NO molecules.
- Option C (1): would be a unimolecular step.
- Option D: molecularity is well defined for an elementary reaction (unlike order, which is experimental).

Final Answer: The molecularity is $3 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Osmotic pressure: For a dilute solution $\pi = CRT$, where C is the molar concentration, R the gas constant and T the absolute temperature.

Step 1 — List the data: $C = 0.1$ mol L^{-1}, $R = 0.0821$ L atm mol^{-1} K^{-1}, $T = 300$ K.

Step 2 — Substitute:

$$\pi = 0.1 \times 0.0821 \times 300.$$

Step 3 — Evaluate:

$$\pi = 0.1 \times 24.63 = 2.46 \text{ atm}.$$

Why other options are wrong:

- Option B $(24.6$ atm$)$: forgets the factor of 0.1 (the concentration).
- Option C $(0.246$ atm$)$: off by a factor of ten.
- Option D $(1.23$ atm$)$: uses half the correct concentration.

Final Answer: $\pi = 2.46$ atm $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Effective atomic number (EAN): EAN = (atomic number − oxidation state of the metal) + (2× number of ligands donating a lone pair each).

Step 1 — Find the oxidation state of iron: CO is a neutral ligand and the complex is neutral, so the oxidation state of Fe is 0.

Step 2 — Count the electrons donated: Each of the 5 CO ligands donates 2 electrons: $5 \times 2 = 10$ electrons.

Step 3 — Apply the EAN formula:

$$\text{EAN} = (26 - 0) + 10 = 36.$$

This equals the atomic number of krypton, the next noble gas.

Why other options are wrong:

- Option A (26): ignores the electrons donated by CO.
- Option B (34): counts only 8 donated electrons.
- Option C (30): counts only 4 ligands.

Final Answer: EAN of Fe in $[\text{Fe(CO)}_5]$ is $36 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Thermal stability of group-15 hydrides: Stability depends on the strength of the E–H bond, which weakens as the central atom gets larger down the group.

Step 1 — Order the central atoms by size: N < P < As < Sb < Bi (size increases down the group).

Step 2 — Relate size to bond strength: A larger atom forms a longer, weaker E–H bond, so the hydride decomposes more easily.

Step 3 — Write the stability order:

$$\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{BiH}_3.$$

Why other options are wrong:

- Options A and C: reverse the trend, making BiH_3 most stable.
- Option B: misplaces NH_3, which is in fact the most stable.

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

Answer: (D) Go Back to Q13

Q14.

Solution

Concept — $KMnO_4$ as an oxidant: The product of permanganate reduction depends on the medium; in acidic medium it is reduced all the way to the Mn^{2+} ion.

Step 1 — Write the acidic half-reaction:

$$MnO_4^- + 8H^+ + 5e^- \to Mn^{2+} + 4H_2O.$$

Step 2 — Identify the manganese product: Mn goes from $+7$ to $+2$, giving the colourless Mn^{2+} ion (n-factor $= 5$).

Why other options are wrong:

- Option B (MnO_2): the product in neutral or faintly alkaline medium ($+7 \to +4$).
- Option C (MnO_4^{2-}): the manganate ion, formed in strongly alkaline medium ($+7 \to +6$).
- Option D (Mn metal): permanganate is not reduced to the free metal in solution.

Final Answer: In acidic medium Mn is reduced to $Mn^{2+} \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — Biological roles of metal ions: Na^+ and K^+ control nerve impulses and fluid balance; K^+ is the chief cation *inside* cells while Na^+ dominates *outside*.

Step 1 — Recall the intracellular cation: Potassium ions, K^+, are the most abundant cation within cells.

Step 2 — Match to function: K^+, together with Na^+, maintains the membrane potential needed for nerve and muscle activity.

Why other options are wrong:

- Option A (Na^+): the chief *extracellular* cation, not intracellular.
- Option B (Ca^{2+}): important for bones, teeth and clotting, not the chief intracellular cation.
- Option C (Mg^{2+}): a cofactor in many enzymes and in chlorophyll, but present in smaller amounts.

Final Answer: The chief intracellular cation is $K^+ \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Mesomeric (resonance) effect: A +M group donates electron density into the ring through its lone pair, while a −M group withdraws electron density into itself.

Step 1 — Classify each group: $-NH_2$ has a lone pair on nitrogen it can push into the ring, so it is +M.

$-NO_2$, −CN and −CHO have multiple bonds to electronegative atoms and pull electron density out, so they are −M.

Step 2 — Pick the +M group: Only $-NH_2$ is electron-donating by resonance.

Why other options are wrong:

- Option B ($-NO_2$): a strong −M (electron-withdrawing) group.
- Option C (−CN) and Option D (−CHO): both −M groups.

Final Answer: $-NH_2$ exerts a +M effect $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept — Wurtz reaction: Two molecules of an alkyl halide couple with sodium in dry ether to give a symmetrical alkane with twice the number of carbons.

Step 1 — Write the reaction:

$$2\,CH_3CH_2Br + 2Na \rightarrow CH_3CH_2\text{-}CH_2CH_3 + 2NaBr.$$

Step 2 — Count the carbons in the product: Two ethyl groups (2 C each) join to give a four-carbon chain.

Step 3 — Name the product: The symmetrical alkane C_4H_{10} is n-butane.

Why other options are wrong:

- Option B (ethane): would come from coupling two methyl halides.
- Option C (propane): has an odd carbon count, impossible from coupling two identical ethyl units.
- Option D (n-hexane): would come from two propyl halides.

Final Answer: The product is n-butane $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Low reactivity of haloarenes: In aryl halides the lone pairs of the halogen overlap with the ring, giving the C–X bond partial double-bond character.

Step 1 — Look at the bonding: Resonance delocalises a halogen lone pair into the benzene ring, so the C–X bond is shorter and stronger than in an alkyl halide.

Step 2 — Relate to reactivity: A stronger, partial double bond is harder to break, and the sp^2 carbon also resists nucleophilic attack, so substitution is slow.

Why other options are wrong:

- Option A: polarity differences are not the main reason for the low reactivity.
- Option B: the halogen's electronegativity is essentially the same in both classes.
- Option C: steric bulk is not the controlling factor here.

Final Answer: The C–X bond has partial double-bond character, so it is stronger $\Rightarrow$ D

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Reimer–Tiemann reaction: Phenol, treated with chloroform and aqueous NaOH, is formylated chiefly at the *ortho* position to give an aromatic aldehyde.

Step 1 — Generate the reactive species: Chloroform with NaOH gives dichlorocarbene ($:CCl_2$), an electrophile.

Step 2 — Attack on the phenoxide ring: The carbene attacks the ortho carbon of the activated phenoxide ring; hydrolysis of the resulting dichloromethyl group gives a $-$CHO group.

Step 3 — Identify the product: The product is 2-hydroxybenzaldehyde, i.e. salicylaldehyde.

Why other options are wrong:

- Option A (benzaldehyde): lacks the ortho hydroxyl group retained from phenol.
- Option B (salicylic acid): the product of the Kolbe reaction (with CO_2/NaOH), not Reimer–Tiemann.
- Option D (benzoic acid): a carboxylic acid, not the aldehyde formed here.

Final Answer: The product is salicylaldehyde $\Rightarrow$ C

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Reactivity toward nucleophilic addition: A more electrophilic (less hindered, less electron-rich) carbonyl carbon reacts faster; alkyl groups both donate electrons and crowd the carbon, lowering reactivity.

Step 1 — Compare the substituents: HCHO has two H atoms, CH_3CHO has one methyl, and $(CH_3)_2CO$ has two methyls.

Step 2 — Apply electronic and steric effects: Each methyl group donates electron density (reducing the partial positive charge) and adds steric hindrance, slowing nucleophilic addition.

Step 3 — Write the order:

$$HCHO > CH_3CHO > (CH_3)_2CO.$$

Why other options are wrong:

- Option A: reverses the order, putting the ketone first.
- Options B and D: misplace HCHO or the ketone in the sequence.

Final Answer: $HCHO > CH_3CHO > (CH_3)_2CO \Rightarrow \boxed{C}$

Answer: (C) **Go Back to Q20**

Q21.

Solution

Concept — Reduction by $LiAlH_4$: Lithium aluminium hydride is a strong reducing agent that converts a carboxylic acid all the way to the corresponding primary alcohol.

Step 1 — Write the reaction:

$$CH_3COOH \xrightarrow{LiAlH_4} CH_3CH_2OH.$$

Step 2 — Identify the product: The $-COOH$ group (1 carbon) is reduced to $-CH_2OH$, giving ethanol, a primary alcohol.

Why other options are wrong:

- Option A (acetaldehyde): $LiAlH_4$ does not stop at the aldehyde stage; it reduces fully to the alcohol.
- Option B (methanol): has one carbon fewer than acetic acid.
- Option C (ethane): would require removal of the oxygen entirely, which $LiAlH_4$ does not do.

Final Answer: Acetic acid is reduced to ethanol $\Rightarrow \boxed{D}$

Answer: (D) **Go Back to Q21**

Q22.

Solution

Concept — Basicity of substituted anilines: Electron-donating groups increase the electron density on nitrogen and raise basicity; electron-withdrawing groups (especially $-NO_2$) lower it.

Step 1 — Classify the substituents: $-CH_3$ is electron-donating; $-NO_2$ is strongly electron-withdrawing; plain aniline has neither.

Step 2 — Rank the basicity: p-methylaniline $>$ aniline $>$ m-nitroaniline $>$ p-nitroaniline.

The methyl group pushes electron density toward nitrogen, making p-toluidine the strongest base.

Why other options are wrong:

- Option A (p-nitroaniline): the $-NO_2$ group both withdraws and resonates, making it the weakest base.
- Option C (m-nitroaniline): still weakened by the nitro group, just less than the para isomer.
- Option D (aniline): less basic than the methyl-substituted aniline.

Final Answer: p-methylaniline is the strongest base $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Open-chain structure of glucose: Glucose is an aldohexose, a six-carbon sugar bearing one aldehyde group and several hydroxyl groups.

Step 1 — Recall the functional groups: Carbon 1 carries an aldehyde ($-CHO$) group.

Carbons 2 to 6 each carry a hydroxyl ($-OH$) group, giving five $-OH$ groups in all.

Step 2 — Combine: Open-chain glucose has one $-CHO$ group and five $-OH$ groups.

Why other options are wrong:

- Option A: a ketone group describes fructose, not glucose.
- Option C: glucose has no free carboxylic acid group.

- Option D: glucose has only one aldehyde group, not two.

Final Answer: Glucose has one aldehyde and five hydroxyl groups ⇒ B

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Naming amines: For a primary amine, name the parent alkane, drop the final "e" and add "amine", numbering the chain to give the $-NH_2$ group the lowest locant.

Step 1 — Identify the chain: The structure CH_3-CH_2-CH_2-NH_2 is a three-carbon chain (propane) bearing $-NH_2$.

Step 2 — Locate the amino group: Numbering from the end nearer the $-NH_2$ puts it on carbon 1.

Step 3 — Assemble the name: Propane + amine on C-1 gives propan-1-amine.

Why other options are wrong:

- Option A (propan-2-amine): the $-NH_2$ here is on a terminal carbon, not C-2.
- Option B (*N*-methylethanamine): a secondary amine with a different skeleton.
- Option D (butan-1-amine): would need a four-carbon chain.

Final Answer: The compound is propan-1-amine ⇒ C

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Biuret test: A substance containing two or more peptide bonds gives a violet colour with copper sulphate in alkaline solution, so the test detects proteins.

Step 1 — Recall what the test responds to: The violet colour arises from a copper complex with the peptide (−CONH−) linkages of proteins.

Step 2 — Identify the substance detected: A positive (violet) Biuret test confirms the presence of proteins.

Why other options are wrong:

- Option A (reducing sugars): detected by Fehling's or Benedict's test, not Biuret.
- Option C (lipids): not detected by the Biuret test.
- Option D (starch): detected by the iodine test (blue-black colour).

Final Answer: The Biuret test detects proteins $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q25

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	C	4	A	5	D
6	C	7	A	8	B	9	A	10	B
11	A	12	D	13	D	14	A	15	D
16	A	17	A	18	D	19	C	20	C
21	D	22	B	23	B	24	C	25	B