AIIMS Paramedical Chemistry

Sample Paper – 7

Duration: 30 Minutes **Maximum Marks: 30**

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry portion of **AIIMS Paramedical** entrance.
- Each correct answer carries **+1 mark**. Each incorrect answer carries **a penalty of $-\frac{1}{3}$ mark**; unattempted questions carry **0** marks.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 & 12 NCERT Chemistry**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. What volume (in litres) is occupied by 0.25 mol of an ideal gas at STP (molar volume $= 22.4$ L mol^{-1})?

(A) 2.24 L

(B) 4.48 L

(C) 5.60 L

(D) 11.2 L

Q2. According to the Heisenberg uncertainty principle, the product of the uncertainties in position (Δx) and momentum (Δp) of a particle is at least:

(A) $\dfrac{h}{2\pi}$

(B) $\dfrac{h}{4\pi}$

(C) $\dfrac{h}{\pi}$

(D) h

Q3. In the van der Waals equation $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$, the constant a accounts for:

(A) Intermolecular attractive forces

(B) The finite volume of the molecules

(C) The kinetic energy of the molecules

(D) The collision frequency with the walls

Q4. For the isothermal reversible expansion of an ideal gas, the work done by the gas is given by:

(A) $w = P\,\Delta V$

(B) $w = nRT(V_2 - V_1)$

(C) $w = nR(T_2 - T_1)$

(D) $w = nRT \ln \frac{V_2}{V_1}$

Q5. For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, the relation between K_p and K_c is:

(A) $K_p = K_c(RT)^2$

(B) $K_p = K_c(RT)^{-2}$

(C) $K_p = K_c(RT)^{-1}$

(D) $K_p = K_c$

Q6. A weak acid has dissociation constant $K_a = 1.0 \times 10^{-5}$. Its degree of ionisation in a 0.1 M solution (using Ostwald's dilution law, $\alpha = \sqrt{K_a/C}$) is:

(A) 1.0×10^{-3}

(B) 1.0×10^{-4}

(C) 1.0×10^{-2}

(D) 1.0×10^{-1}

Q7. The oxidation number of oxygen in hydrogen peroxide (H_2O_2) is:

(A) -1

(B) -2

(C) $-\frac{1}{2}$

(D) $+1$

Q8. The equilibrium constant K of a cell reaction is related to its standard cell potential E°_{cell} (with n electrons) by:

(A) $\ln K = \dfrac{nE^\circ_{\text{cell}}}{RT}$

(B) $E^\circ_{\text{cell}} = -\dfrac{RT}{nF} \ln K$

(C) $\log K = -\dfrac{nFE^\circ_{\text{cell}}}{2.303RT}$

(D) $\log K = \dfrac{nE^\circ_{\text{cell}}}{0.0591}$

Q9. The rate of a reaction doubles for every 10°C rise in temperature. By approximately what factor does the rate increase when the temperature is raised by 30°C?

(A) 4

(B) 8

(C) 6

(D) 16

Q10. According to Henry's law, the solubility of a gas in a liquid at constant temperature is:

(A) Inversely proportional to its partial pressure

(B) Independent of its partial pressure

(C) Directly proportional to its partial pressure

(D) Proportional to the square of its partial pressure

Q11. Unlike the other elements of group 15, nitrogen does NOT form pentahalides such as NX_5. The main reason is that nitrogen:

(A) Has no d-orbitals in its valence shell to expand its octet

(B) Has a very large atomic radius

(C) Is a metal

(D) Has the lowest electronegativity in the group

Q12. The greater stability of the $+1$ oxidation state of thallium compared with its $+3$ state is explained by the:

(A) Diagonal relationship

(B) Inert pair effect

(C) Lanthanoid contraction

(D) Screening by p-electrons

Q13. According to molecular orbital theory, the O_2 molecule is paramagnetic because it has:

(A) No unpaired electrons

(B) One unpaired electron

(C) Three unpaired electrons

(D) Two unpaired electrons (one each in $\pi^*_{2p_x}$ and $\pi^*_{2p_y}$)

Q14. The hybridisation of the carbon atom in carbon dioxide (O=C=O) is:

(A) sp^3

(B) sp^2

(C) sp

(D) sp^3d

Q15. Sodium hydroxide (NaOH) is manufactured industrially by the electrolysis of brine. This process is known as the:

(A) Chlor-alkali process

(B) Solvay process

(C) Haber process

(D) Ostwald process

Q16. Which of the following is an interhalogen compound?

(A) HCl

(B) ClF_3

(C) Cl_2O

(D) NaCl

Q17. In the molecule XeF_4, the number of lone pairs of electrons on the central xenon atom is:

(A) 0

(B) 1

(C) 3

(D) 2

Q18. Finely divided iron is used as a catalyst in the Haber process for the synthesis of ammonia. The catalytic activity of transition metals is largely attributed to their:

(A) Variable oxidation states and ability to provide a surface

(B) Low melting points

(C) Diamagnetic character

(D) Colourless ions

Q19. The spin-only magnetic moment of a complex ion having three unpaired electrons is (in Bohr magnetons, $\mu = \sqrt{n(n+2)}$):

(A) 1.73 BM

(B) 2.83 BM

(C) 3.87 BM

(D) 4.90 BM

Q20. In the laboratory, dihydrogen (H_2) is usually prepared by the reaction of:

(A) Copper with dilute HCl

(B) Granulated zinc with dilute HCl

(C) Sodium with cold water (collected easily)

(D) Carbon with steam

Q21. According to Hückel's rule, a planar cyclic conjugated system is aromatic if it contains a number of π electrons equal to:

(A) $4n$

(B) $2n$

(C) $n + 2$

(D) $4n + 2$ (where $n = 0, 1, 2, \dots$)

Q22. The number of structural (chain) isomers possible for the molecular formula C_4H_{10} is:

(A) 2

(B) 3

(C) 4

(D) 1

Q23. In electrophilic aromatic substitution, the nitro group ($-NO_2$) attached to benzene is:

(A) An ortho/para-directing activator

(B) A meta-directing deactivator

(C) An ortho/para-directing deactivator

(D) A meta-directing activator

Q24. Kolbe's electrolysis of an aqueous solution of sodium acetate (CH_3COONa) gives, as the major hydrocarbon product:

(A) Methane

(B) Propane

(C) Ethane

(D) Butane

Q25. Aryl halides (haloarenes) are much less reactive than alkyl halides towards nucleophilic substitution mainly because of:

(A) Greater bond length of the C–X bond

(B) The presence of a β-hydrogen

(C) Higher polarity of the C–X bond

(D) Partial double-bond character of the C–X bond due to resonance

Q26. When phenol is treated with chloroform and aqueous NaOH followed by acidification (Reimer–Tiemann reaction), the major product formed is:

(A) Salicylaldehyde (2-hydroxybenzaldehyde)

(B) Benzoic acid

(C) Anisole

(D) Picric acid

Q27. On oxidation, an aldehyde (RCHO) is converted into:

(A) A primary alcohol (RCH_2OH)

(B) A carboxylic acid (RCOOH)

(C) A ketone

(D) An ester

Q28. Reduction of acetone (CH_3COCH_3) with $NaBH_4$ gives:

(A) Propanoic acid

(B) Propanal

(C) Propan-2-ol (isopropyl alcohol)

(D) Propan-1-ol

Q29. A primary aromatic amine (e.g. aniline) reacts with nitrous acid (HNO_2) at 0–5°C to give:

(A) A secondary amine

(B) A nitroalkane

(C) An amide

(D) A diazonium salt

Q30. Which nitrogenous base is present in RNA but NOT in DNA?

(A) Uracil

(B) Thymine

(C) Adenine

(D) Guanine

Detailed Solutions

Q1.

Solution

Concept — Molar volume at STP: At standard temperature and pressure, one mole of any ideal gas occupies a fixed volume of 22.4 litres.

Step 1 — Write the relation: Volume $=$ (number of moles) $\times$ (molar volume).

Step 2 — Substitute the values:

$$V = 0.25 \times 22.4 \text{ L}.$$

Step 3 — Compute:

$$V = 5.60 \text{ L}.$$

Why other options are wrong:

- 2.24 L corresponds to 0.1 mol.
- 4.48 L corresponds to 0.2 mol.
- 11.2 L corresponds to 0.5 mol.

Final Answer: 0.25 mol occupies 5.60 L $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 1

Q2.

Solution

Concept — Heisenberg uncertainty principle: It is impossible to determine simultaneously the exact position and exact momentum of a microscopic particle.

Step 1 — State the inequality:

$$\Delta x \cdot \Delta p \geq \frac{h}{4\pi}.$$

Step 2 — Interpret: The minimum value of the product of the two uncertainties equals $h/4\pi$.

Why other options are wrong:

- $h/2\pi$, h/π and h are not the correct lower bound; the accepted form has the factor 4π in the denominator.

Final Answer: $\Delta x \cdot \Delta p \geq \frac{h}{4\pi} \Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q 2**

Q3.

Solution

Concept — van der Waals corrections: Real gases deviate from ideal behaviour because molecules attract one another and occupy a finite volume. The van der Waals equation introduces two constants to correct for these.

Step 1 — Identify the pressure correction: The term $\frac{an^2}{V^2}$ is added to the measured pressure to account for the inward pull of attractive forces, which lowers the wall pressure. Hence a measures intermolecular attraction.

Step 2 — Identify the volume correction: The constant b (in $V - nb$) accounts for the finite molecular volume.

Why other options are wrong:

- Finite molecular volume is described by b, not a.
- Kinetic energy and collision frequency are not what the constants correct for.

Final Answer: a accounts for intermolecular attractive forces $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q 3**

Q4.

Solution

Concept — Work in isothermal reversible expansion: For an ideal gas at constant temperature, the reversible work involves integrating $P\,dV$ with $P = nRT/V$.

Step 1 — Set up the integral:

$$w = \int_{V_1}^{V_2} \frac{nRT}{V}\,dV.$$

Step 2 — Integrate (T constant):

$$w = nRT \ln \frac{V_2}{V_1}.$$

Why other options are wrong:

- $P\Delta V$ applies to constant external pressure, not reversible isothermal change.
- $nRT(V_2 - V_1)$ and $nR(T_2 - T_1)$ are dimensionally and conceptually incorrect for this case.

Final Answer: $w = nRT\ln\frac{V_2}{V_1} \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q 4**

Q5.

Solution

Concept — Relation between K_p and K_c: They are linked by $K_p = K_c(RT)^{\Delta n_g}$, where Δn_g is moles of gaseous products minus moles of gaseous reactants.

Step 1 — Count gaseous moles: Products $= 2$ (NH_3); reactants $= 1+3 = 4$ (N_2+ $3H_2$).

Step 2 — Compute Δn_g:

$$\Delta n_g = 2 - 4 = -2.$$

Step 3 — Write the relation:

$$K_p = K_c(RT)^{-2}.$$

Why other options are wrong:

- $(RT)^2$ uses the wrong sign of Δn_g.
- $(RT)^{-1}$ and $(RT)^0$ use incorrect values of Δn_g.

Final Answer: $K_p = K_c(RT)^{-2} \Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q 5**

Q6.

Solution

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

Step 1 — Substitute the data:

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

Step 2 — Simplify the ratio:

$$\frac{1.0 \times 10^{-5}}{0.1} = 1.0 \times 10^{-4}.$$

Step 3 — Take the square root:

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

Why other options are wrong:

- 10^{-3} and 10^{-4} come from arithmetic slips in the root.
- 10^{-1} ignores the square root entirely.

Final Answer: $\alpha = 1.0 \times 10^{-2} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 6

Q7.

Solution

Concept — Oxidation number in peroxides: In ordinary oxides oxygen is -2, but in peroxides (which contain the O–O linkage) each oxygen has an oxidation number of -1.

Step 1 — Assign hydrogen: In H_2O_2, each H is $+1$, so the two H atoms contribute $+2$.

Step 2 — Balance the neutral molecule: Let oxygen be x. Then $2(+1)+2(x) = 0$, giving $2x = -2$, so $x = -1$.

Why other options are wrong:

- -2 is the value in normal oxides, not peroxides.

- $-\frac{1}{2}$ applies to superoxides (e.g. KO_2), and $+1$ has the wrong sign.

Final Answer: Oxygen is -1 in $H_2O_2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 7

Q8.

Solution

Concept — Nernst equation at equilibrium: The standard cell potential is related to the equilibrium constant through $\Delta G^\circ = -nFE^\circ_{\text{cell}} = -RT\ln K$.

Step 1 — Equate the two expressions:

$$nFE^\circ_{\text{cell}} = RT\ln K = 2.303\,RT\log K.$$

Step 2 — Solve for $\log K$ and insert constants:

$$\log K = \frac{nFE^\circ_{\text{cell}}}{2.303RT} = \frac{nE^\circ_{\text{cell}}}{0.0591} \quad (\text{at } 298 \text{ K}).$$

Why other options are wrong:

- The first option omits the factor F and uses $\ln$ inconsistently.
- The second and third options carry the wrong sign.

Final Answer: $\log K = \frac{nE^\circ_{\text{cell}}}{0.0591} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 8

Q9.

Solution

Concept — Temperature coefficient: If the rate doubles for each 10°C rise, then a rise of ΔT multiplies the rate by $2^{\Delta T/10}$.

Step 1 — Find the number of 10°C steps:

$$\frac{\Delta T}{10} = \frac{30}{10} = 3.$$

Step 2 — Apply the doubling factor:

$$\text{factor} = 2^3 = 8.$$

Why other options are wrong:

- 4 corresponds to a $20°$C rise (2^2).
- 16 corresponds to a $40°$C rise (2^4); 6 is not a power of 2.

Final Answer: The rate increases by a factor of $8 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 9

Q10.

Solution

Concept — Henry's law: At a constant temperature, the solubility of a gas (or its mole fraction in solution) is directly proportional to the partial pressure of the gas above the liquid.

Step 1 — Write the law:

$$p = K_H\, x,$$

where p is partial pressure and x is the mole fraction (solubility) of the gas.

Step 2 — Interpret: Solubility x rises in direct proportion to p; higher pressure forces more gas into solution.

Why other options are wrong:

- Inverse proportionality and independence contradict the law.
- Solubility is not proportional to the square of pressure.

Final Answer: Solubility is directly proportional to partial pressure $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 10

Q11.

Solution

Concept — Anomalous behaviour of nitrogen: The first element of a group often differs from the rest. Nitrogen's valence shell is the second shell ($n = 2$), which has only s and p orbitals.

Step 1 — Maximum covalency: Without accessible d-orbitals, nitrogen cannot expand its octet beyond four bonds, so it cannot form NX_5.

Step 2 — Compare with phosphorus: Phosphorus ($n = 3$) has empty $3d$ orbitals and readily forms PCl_5.

Why other options are wrong:

- Nitrogen has a small (not large) atomic radius.
- Nitrogen is a non-metal and is the most electronegative member of the group.

Final Answer: Absence of valence d-orbitals prevents octet expansion $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 11

Q12.

Solution

Concept — Inert pair effect: On moving down groups 13–15, the ns^2 valence electrons become reluctant to participate in bonding, making the lower oxidation state (two units less than the group state) more stable.

Step 1 — Apply to thallium: For Tl (group 13), the $+1$ state retains the $6s^2$ pair and is more stable than the $+3$ state.

Step 2 — Conclusion: This stabilisation is the inert pair effect.

Why other options are wrong:

- The diagonal relationship and lanthanoid contraction describe different periodic trends.
- Simple p-electron screening does not by itself explain the preference for $+1$.

Final Answer: Stability of Tl^+ is due to the inert pair effect $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 12

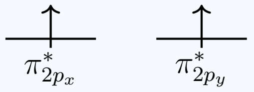
Q13.

Solution

Concept — MOT of O_2: Filling the molecular orbitals for 16 electrons places the last two electrons singly in the two degenerate antibonding π^*_{2p} orbitals (Hund's rule), giving two unpaired electrons and hence paramagnetism.

Step 1 — Antibonding π^* filling: The two π^*_{2p} orbitals each receive one electron with parallel spins.

Two unpaired electrons (parallel spins)



Step 2 — Magnetic nature: Unpaired electrons make O_2 paramagnetic.

Why other options are wrong:

- Zero unpaired electrons would make it diamagnetic.
- One or three unpaired electrons do not match the MOT filling for 16 electrons.

Final Answer: O_2 has two unpaired electrons in $\pi^*_{2p} \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q 13**

Q14.

Solution

Concept — Hybridisation from geometry: The hybridisation of a central atom is decided by its steric number (sigma bonds + lone pairs).

Step 1 — Examine CO_2: Carbon forms two sigma bonds (one to each oxygen) and has no lone pairs.

$$\mathrm{O} = \mathrm{C} = \mathrm{O}$$

linear, 180°

Step 2 — Determine hybridisation: Steric number $= 2 \Rightarrow sp$ hybridisation, consistent with the linear shape.

Why other options are wrong:

- sp^3 and sp^2 correspond to steric numbers 4 and 3.
- sp^3d corresponds to steric number 5.

Final Answer: Carbon in CO_2 is sp hybridised $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q 14**

Q15.

Solution

Concept — Industrial NaOH: Sodium hydroxide is produced by the electrolysis of aqueous sodium chloride (brine), a process called the chlor-alkali process.

Step 1 — Products of electrolysis: At the cathode H_2 is liberated and OH^- accumulates, giving NaOH; at the anode Cl_2 is evolved.

Step 2 — Name the process: Because both chlorine and alkali (NaOH) are obtained, it is named the chlor-alkali process.

Why other options are wrong:

- Solvay process makes Na_2CO_3.
- Haber process makes NH_3; Ostwald process makes HNO_3.

Final Answer: NaOH from brine electrolysis is the chlor-alkali process $\Rightarrow \boxed{A}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q 15

Q16.

Solution

Concept — Interhalogen compounds: These are formed between two different halogen atoms, with general formulae XX', XX'_3, XX'_5, XX'_7.

Step 1 — Test each option: ClF_3 contains two different halogens (Cl and F), so it is an interhalogen.

Step 2 — Eliminate the rest: HCl and NaCl contain non-halogen partners; Cl_2O contains oxygen, not a second halogen.

Why other options are wrong:

- HCl is a hydrogen halide.
- Cl_2O is a chlorine oxide; NaCl is a metal halide.

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

$\boxed{\text{Answer: (B)}}$ Go Back to Q 16

Q17.

Solution

Concept — Lone pairs in XeF_4: Use VSEPR. Xenon has 8 valence electrons; four are used to bond four fluorine atoms.

Step 1 — Count bonding electrons: Four Xe–F bonds use 4 of Xe's electrons.

Step 2 — Count remaining lone pairs: The remaining $8 - 4 = 4$ electrons form 2 lone pairs, giving a square-planar shape.

Why other options are wrong:

- 0 or 1 lone pairs would not produce the observed square-planar geometry.
- 3 lone pairs would over-count xenon's available electrons.

Final Answer: XeF_4 has 2 lone pairs on Xe $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 17

Q18.

Solution

Concept — Catalytic activity of transition metals: Transition metals and their compounds act as good catalysts because they show variable oxidation states (allowing them to form intermediate compounds) and provide a large surface for adsorption of reactants.

Step 1 — Apply to iron in Haber process: Iron can shift between oxidation states and adsorb N_2 and H_2, weakening their bonds and speeding the reaction.

Step 2 — Conclusion: Variable oxidation states plus a reactive surface explain the activity.

Why other options are wrong:

- Transition metals generally have high (not low) melting points.
- Catalytic activity is not due to being diamagnetic or having colourless ions.

Final Answer: Variable oxidation states and surface provision $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 18

Q19.

Solution

Concept — Spin-only magnetic moment: It is calculated from the number of unpaired electrons n using $\mu = \sqrt{n(n+2)}$ Bohr magnetons.

Step 1 — Insert $n = 3$:

$$\mu = \sqrt{3(3+2)} = \sqrt{3 \times 5}.$$

Step 2 — Evaluate:

$$\mu = \sqrt{15} \approx 3.87 \text{ BM}.$$

Why other options are wrong:

- 1.73 BM is for 1 unpaired electron.
- 2.83 BM is for 2 and 4.90 BM is for 4 unpaired electrons.

Final Answer: $\mu \approx 3.87$ BM $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 19

Q20.

Solution

Concept — Laboratory preparation of H_2: Dihydrogen is conveniently prepared by reacting a moderately reactive metal with a dilute mineral acid.

Step 1 — Choose the right metal: Granulated zinc reacts smoothly with dilute HCl:

$$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2 \uparrow.$$

Step 2 — Reject unsuitable options: Copper lies below hydrogen in the activity series and does not displace H_2 from dilute HCl.

Why other options are wrong:

- Copper does not react with dilute HCl.
- Sodium reacts violently with water (unsafe and not the standard method); carbon with steam gives water gas industrially, not the lab method.

Final Answer: Granulated zinc with dilute HCl $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 20

Q21.

Solution

Concept — Hückel's rule: A planar, cyclic, fully conjugated ring is aromatic when its delocalised system contains $(4n+2)$ π electrons, where $n = 0, 1, 2, \ldots$

Step 1 — Check benzene: With $n = 1$, $4n + 2 = 6$, matching benzene's six π electrons, which is aromatic.

Step 2 — Conclusion: The aromaticity criterion is the $(4n+2)$ count.

Why other options are wrong:

- $4n$ π electrons correspond to antiaromatic systems.
- $2n$ and $n + 2$ are not the Hückel condition.

Final Answer: Aromatic if π electrons $= 4n + 2 \Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ **Go Back to Q 21**

Q22.

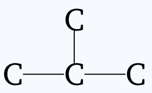
Solution

Concept — Chain isomerism: Structural isomers differ in the connectivity (carbon skeleton) of atoms for the same molecular formula.

Step 1 — Draw the possibilities for C_4H_{10}: A straight chain (n-butane) and a branched chain (isobutane / 2-methylpropane).

C—C—C—C

n-butane



$$\begin{array}{c} \mathrm{C} \\ | \\ \mathrm{C{-}C{-}C} \end{array}$$

isobutane

Step 2 — Count: Exactly 2 distinct skeletons exist.

Why other options are wrong:

- 3 and 4 over-count; no further distinct skeleton exists for four carbons.
- 1 ignores the branched isomer.

Final Answer: C_4H_{10} has 2 structural isomers $\Rightarrow \boxed{\text{A}}$

$\boxed{\textbf{Answer: (A)}}$ **Go Back to Q 22**

Q23.

Solution

Concept — Directive influence of substituents: Electron-withdrawing groups deactivate the ring and direct incoming electrophiles to the meta position; electron-donating groups activate and direct to ortho/para.

Step 1 — Classify –NO_2: The nitro group strongly withdraws electron density (by resonance and induction), so it deactivates the ring.

Step 2 — Predict the position: A deactivating group of this type directs the next substituent to the meta position.

Why other options are wrong:

- It is not ortho/para-directing.
- It is a deactivator, not an activator.

Final Answer: –NO_2 is a meta-directing deactivator $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q 23**

Q24.

Solution

Concept — Kolbe's electrolysis: Electrolysis of the sodium (or potassium) salt of a carboxylic acid gives a hydrocarbon formed by coupling of two alkyl radicals, plus CO_2.

Step 1 — Form the radical: The acetate ion loses CO_2 at the anode to give a methyl radical $CH_3^\bullet$.

Step 2 — Couple the radicals: Two methyl radicals combine:

$$CH_3^\bullet + {}^\bullet CH_3 \rightarrow CH_3\text{–}CH_3 \text{ (ethane)}.$$

Why other options are wrong:

- Methane would require no coupling, which does not occur here.
- Propane and butane would need larger or unequal radicals.

Final Answer: Sodium acetate gives ethane $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ **Go Back to Q 24**

Q25.

Solution

Concept — Low reactivity of haloarenes: In aryl halides the lone pair on the halogen overlaps with the aromatic ring, delocalising electron density into the C–X bond.

Step 1 — Resonance effect: This delocalisation gives the C–X bond partial double-bond character, making it shorter and stronger.

Step 2 — Consequence: The stronger, shorter bond resists cleavage by nucleophiles, so haloarenes are far less reactive than haloalkanes.

Why other options are wrong:

- The C–X bond in haloarenes is shorter, not longer.
- There is no β-hydrogen issue here, and the bond is less (not more) polar/reactive.

Final Answer: Partial double-bond character due to resonance $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 25

Q26.

Solution

Concept — Reimer–Tiemann reaction: Phenol reacts with chloroform in the presence of aqueous NaOH to introduce a –CHO group at the ortho position, giving salicylaldehyde after acidification.

Step 1 — Generate the reactive species: $CHCl_3$ with NaOH produces dichlorocarbene (:CCl_2), the electrophile.

Step 2 — Form the product: The carbene attacks the ortho carbon of the phenoxide; hydrolysis and acidification give 2-hydroxybenzaldehyde (salicylaldehyde).

Why other options are wrong:

- Benzoic acid and anisole are not formed in this reaction.
- Picric acid results from nitration, not from the Reimer–Tiemann conditions.

Final Answer: Phenol gives salicylaldehyde $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 26

Q27.

Solution

Concept — Oxidation of aldehydes: Aldehydes are easily oxidised because the carbonyl carbon still bears a hydrogen atom; oxidation converts –CHO into –COOH.

Step 1 — Write the change:

$$\text{RCHO} \xrightarrow{[O]} \text{RCOOH}.$$

Step 2 — Note the ease: Even mild oxidants (e.g. Tollens' or Fehling's) accomplish this, which distinguishes aldehydes from ketones.

Why other options are wrong:

- A primary alcohol is the reduction (not oxidation) product.
- A ketone or ester is not formed by simple oxidation of an aldehyde.

Final Answer: RCHO is oxidised to RCOOH $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 27

Q28.

Solution

Concept — Reduction of carbonyl compounds: Reducing agents such as $NaBH_4$ or $LiAlH_4$ add hydrogen across the C=O bond. Ketones give secondary alcohols.

Step 1 — Write the change:

$$CH_3COCH_3 \xrightarrow{NaBH_4} CH_3CH(OH)CH_3.$$

Step 2 — Name the product: The product is propan-2-ol (isopropyl alcohol), a secondary alcohol.

Why other options are wrong:

- Propanoic acid and propanal are not reduction products of acetone.
- Propan-1-ol would require a different carbon skeleton/position.

Final Answer: Acetone is reduced to propan-2-ol $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 28

Q29.

Solution

Concept — Diazotisation: A primary aromatic amine reacts with nitrous acid (generated in situ from $NaNO_2$ and HCl) at 0–$5°$C to form an aromatic diazonium salt.

Step 1 — Write the reaction:

$$C_6H_5NH_2 + HNO_2 + HCl \to C_6H_5N_2^+Cl^- + 2H_2O.$$

Step 2 — Note the conditions: The low temperature stabilises the otherwise unstable diazonium ion.

Why other options are wrong:

- A secondary amine or amide is not the product of this reaction.
- Nitroalkane formation is not the outcome for an aromatic primary amine here.

Final Answer: Aniline with HNO_2 gives a diazonium salt $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q 29

Q30.

Solution

Concept — Bases of nucleic acids: DNA contains adenine, guanine, cytosine and thymine; RNA contains adenine, guanine, cytosine and uracil. Thymine is replaced by uracil in RNA.

Step 1 — Compare the base sets: Uracil is unique to RNA; thymine is unique to DNA.

Step 2 — Conclusion: The base present in RNA but absent in DNA is uracil.

Why other options are wrong:

- Thymine is found in DNA, not RNA.
- Adenine and guanine occur in both DNA and RNA.

Final Answer: Uracil is present in RNA but not DNA $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q 30

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	B	3	A	4	D	5	B
6	C	7	A	8	D	9	B	10	C
11	A	12	B	13	D	14	C	15	A
16	B	17	D	18	A	19	C	20	B
21	D	22	A	23	B	24	C	25	D
26	A	27	B	28	C	29	D	30	A