PGIMER BSc Nursing Chemistry

Sample Paper – 14

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. The mass (in grams) of a single molecule of carbon dioxide (CO_2, molar mass $= 44$ g mol^{-1}, $N_A = 6.022 \times 10^{23}$ mol^{-1}) is approximately:

(A) 4.4×10^{-23} g

(B) 7.31×10^{-23} g

(C) 2.66×10^{22} g

(D) 44 g

Q2. The total number of orbitals present in the third shell ($n = 3$) of an atom is:

(A) 3

(B) 6

(C) 9

(D) 18

Q3. Among the following elements, the one with the most electropositive (metallic) character is:

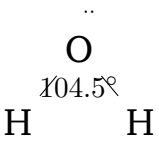
(A) Cs

(B) Na

(C) Li

(D) K

Q4. The H–O–H bond angle in a water molecule (shown below) is:



(A) 104.5°

(B) 109.5°

(C) 120°

(D) 90°

Q5. Boron trifluoride (BF_3) is a weaker Lewis acid than expected because boron partly completes its octet through $p\pi$–$p\pi$ back bonding. The orbitals involved in this back donation are:

(A) empty $2p$ of F donating into filled $2p$ of B

(B) filled $2s$ of B donating into empty $2p$ of F

(C) empty $2p$ of B overlapping with empty $2p$ of F

(D) filled $2p$ of F donating into empty $2p$ of B

Q6. Using the three combustion/formation data below and Hess's law, the standard enthalpy of formation of methane, $C(s) + 2H_2(g) \rightarrow CH_4(g)$, is:

(1) $C(s) + O_2(g) \rightarrow CO_2(g)$, $\Delta H_1 = -393$ kJ

(2) $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$, $\Delta H_2 = -286$ kJ

(3) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$, $\Delta H_3 = -890$ kJ

$$\begin{array}{ccc} \mathrm{C} + 2\mathrm{H_2} + 2\mathrm{O_2} & \xrightarrow{\Delta H_f = ?} & \mathrm{CH_4} + 2\mathrm{O_2} \\ & \searrow^{\Delta H_1 + 2\Delta H_2} \quad \swarrow_{\Delta H_3} & \\ & \mathrm{CO_2} + 2\mathrm{H_2O} & \end{array}$$

(A) -965 kJ

(B) $+75$ kJ

(C) -1569 kJ

(D) -75 kJ

Q7. For the equilibrium $\mathrm{N_2}(g) + 3\mathrm{H_2}(g) \rightleftharpoons 2\mathrm{NH_3}(g)$, the correct relationship between K_p and K_c is:

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

(B) $K_p = K_c$

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

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

Q8. The oxidation number of sulphur in sulphurous acid ($\mathrm{H_2SO_3}$) is:

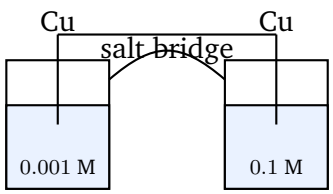
(A) $+4$

(B) $+6$

(C) $+2$

(D) -2

Q9. For the copper concentration cell shown, $\mathrm{Cu} \,|\, \mathrm{Cu}^{2+}(0.001\ \mathrm{M}) \,\|\, \mathrm{Cu}^{2+}(0.1\ \mathrm{M}) \,|\, \mathrm{Cu}$ at 25°C, the EMF (take $\frac{0.059}{n}\log$ form) is:



(A) 0.118 V

(B) 0 V

(C) 0.059 V

(D) 0.0295 V

Q10. A first-order reaction has a rate constant $k = 2.303 \times 10^{-2}$ min^{-1}. The time required for the reaction to reach 99% completion is:

(A) 100 min

(B) 300 min

(C) 200 min

(D) 400 min

Q11. The normality of a 0.5 M solution of sulphuric acid (H_2SO_4, basicity $= 2$) is:

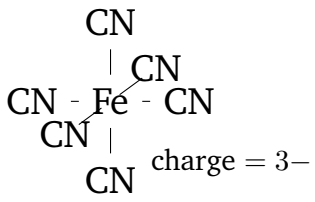
(A) 1 N

(B) 0.5 N

(C) 2 N

(D) 0.25 N

Q12. The IUPAC name of the coordination compound $K_3[Fe(CN)_6]$, whose octahedral anion is shown, is:



(A) potassium hexacyanidoferrate(III)

(B) potassium hexacyanidoferrate(II)

(C) potassium hexacyanidoiron(III)

(D) tripotassium hexacyanoferrate

Q13. Which of the following is a crystalline allotrope of carbon?

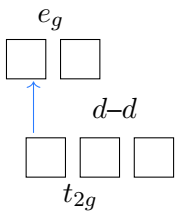
(A) charcoal

(B) coke

(C) lampblack

(D) graphite

Q14. The aqueous Cu^{2+} ion ($3d^9$, whose split d-levels are shown) is blue. This colour arises because the ion:



(A) has a completely filled d subshell

(B) absorbs visible light, promoting a d-electron between split d-levels (d–d transition)

(C) undergoes charge transfer with water only in ultraviolet light

(D) has no unpaired electrons at all

Q15. The chemical formula of Plaster of Paris is:

(A) $CaSO_4 \cdot 2H_2O$

(B) $CaSO_4 \cdot \frac{1}{2}H_2O$

(C) $CaSO_4$ (anhydrous)

(D) $Ca(OH)_2$

Q16. Which of the following substituents exerts the strongest electron-withdrawing mesomeric ($-M$) effect?

(A) $-NO_2$

(B) $-COOH$

(C) $-CHO$

(D) $-OCH_3$

Q17. The main hydrocarbon obtained at the anode during the Kolbe electrolysis of an aqueous solution of sodium acetate (shown) is:

$$2\,CH_3COO^- \xrightarrow{-2e^-\ (anode)} CH_3\text{-}CH_3 + 2\,CO_2$$

(A) ethane

(B) methane

(C) ethene

(D) ethanol

Q18. Which of the following halides is the most reactive towards an S_N1 reaction?

(A) vinyl chloride (CH_2=CH-Cl)

(B) benzyl chloride ($C_6H_5CH_2$-Cl)

(C) chlorobenzene (C_6H_5-Cl)

(D) ethyl chloride (CH_3CH_2-Cl)

Q19. When a primary alcohol is oxidised with a mild oxidising agent such as pyridinium chlorochromate (PCC), the product is:

(A) a carboxylic acid

(B) a ketone

(C) an aldehyde

(D) an ester

Q20. The product formed when acetaldehyde (CH_3CHO) reacts with hydrogen cyanide (HCN) is:

(A) acetonitrile

(B) acetic acid

(C) 2-hydroxypropanenitrile (a cyanohydrin)

(D) ethylamine

Q21. The product obtained when acetic acid (CH_3COOH) is treated with thionyl chloride ($SOCl_2$) is:

(A) acetamide

(B) acetyl chloride

(C) acetic anhydride

(D) ethyl chloride

Q22. The reduction of acetonitrile (CH_3CN) with lithium aluminium hydride ($LiAlH_4$) gives:

(A) methylamine

(B) acetamide

(C) ethanol

(D) ethylamine

Q23. The α-helix and β-pleated sheet arrangements, held together by hydrogen bonds, describe which level of protein structure?

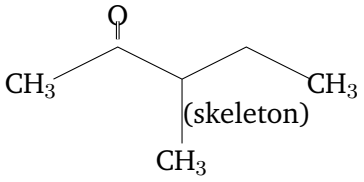
(A) primary structure

(B) secondary structure

(C) tertiary structure

(D) quaternary structure

Q24. The IUPAC name of the ketone whose carbon skeleton is shown below is:



(A) 2-methylpentan-4-one

(B) hexan-2-one

(C) 4-methylpentan-3-one

(D) 4-methylpentan-2-one

Q25. Regarding antiseptics and disinfectants, which of the following statements is correct?

(A) Antiseptics are applied to floors, drains and instruments.

(B) Disinfectants are safely applied to open wounds and living tissue.

(C) A 1% solution of phenol acts as an antiseptic.

(D) A dilute (0.2%) solution of phenol acts as an antiseptic, while a stronger (1%) solution acts as a disinfectant.

Detailed Solutions

Q1.

Solution

Concept — Mass of a single molecule: One mole of any substance contains $N_A = 6.022 \times 10^{23}$ molecules and has a mass equal to the molar mass. So the mass of a single molecule is the molar mass divided by N_A.

Step 1 — List the values: Molar mass of CO_2, $M = 44$ g mol^{-1}.

Avogadro constant, $N_A = 6.022 \times 10^{23}$ mol^{-1}.

Step 2 — Write the formula:

$$\text{mass of one molecule} = \frac{M}{N_A} = \frac{44}{6.022 \times 10^{23}}.$$

Step 3 — Evaluate:

$$= 7.31 \times 10^{-23} \text{ g}.$$

Why other options are wrong:

- Option A (4.4×10^{-23} g): uses 10 instead of 6.022×10^{23} scaling incorrectly.
- Option C (2.66×10^{22} g): this is $M \times N_A$, an enormous nonsensical mass.
- Option D (44 g): this is the mass of a whole mole, not one molecule.

Final Answer: Mass of one CO_2 molecule $= 7.31 \times 10^{-23}$ g $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Orbitals in a shell: For a principal shell with principal quantum number n, the total number of orbitals is n^2 (the sum of 1 s, 3 p, 5 d, ... orbitals of the sub-shells).

Step 1 — List the sub-shells for $n = 3$: $3s$ (1 orbital), $3p$ (3 orbitals), $3d$ (5 orbitals).

Step 2 — Add them up:

$$1 + 3 + 5 = 9.$$

Step 3 — Check with the rule:

$$n^2 = 3^2 = 9 \text{ orbitals.}$$

Why other options are wrong:

- Option A (3): counts only the $3p$ orbitals.
- Option B (6): has no basis in the n^2 rule.
- Option D (18): this is the maximum number of electrons ($2n^2$), not orbitals.

Final Answer: The third shell has 9 orbitals $\Rightarrow$ C

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Electropositive character: Electropositive (metallic) character increases down a group as ionisation energy falls, and decreases across a period. The alkali metal lowest in group 1 loses its electron most easily.

Step 1 — Identify the group: Cs, Na, Li and K are all group 1 alkali metals.

Step 2 — Order them down the group: Li (period 2) $<$ Na (period 3) $<$ K (period 4) $<$ Cs (period 6).

Step 3 — Apply the trend: Caesium is lowest, has the largest atom and the lowest ionisation energy, so it is the most electropositive.

Why other options are wrong:

- Option B (Na) and Option D (K): more electropositive than Li but less than Cs.
- Option C (Li): the smallest alkali metal here, the least electropositive of the four.

Final Answer: Caesium is the most electropositive $\Rightarrow$ A

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — VSEPR and bond angle: The oxygen in water has two bond pairs and two lone pairs (four electron regions, sp^3). Lone pair–lone pair repulsion is stronger than bond pair repulsion, so the H–O–H angle is squeezed below the ideal tetrahedral value.

Step 1 — Count electron regions on oxygen: Two O–H bond pairs and two lone pairs give four regions (sp^3 hybridisation).

Step 2 — Start from the tetrahedral angle: The ideal sp^3 angle is $109.5°$.

Step 3 — Apply lone-pair compression: The two lone pairs repel the bond pairs more strongly, bending the molecule and reducing the angle to about $104.5°$.

Why other options are wrong:

- Option B ($109.5°$): the ideal tetrahedral angle, seen only with no lone pairs (e.g. CH_4).
- Option C ($120°$): a trigonal planar (sp^2) angle.
- Option D ($90°$): far too small for a bent sp^3 molecule.

Final Answer: The H–O–H bond angle is $104.5° \Rightarrow$ A

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — Back bonding in BF_3: Boron in BF_3 is electron deficient (only six electrons). Each fluorine has filled $2p$ orbitals; one of these overlaps sideways with the empty $2p$ orbital on boron, giving $p\pi$–$p\pi$ back donation from F to B.

Step 1 — Identify the donor: Fluorine has completely filled $2p$ orbitals (lone pairs) available to donate.

Step 2 — Identify the acceptor: Boron has a vacant $2p$ orbital perpendicular to the molecular plane, which can accept electron density.

Step 3 — Describe the overlap: The filled $2p$ of F overlaps with the empty $2p$ of B, giving partial double-bond character and making BF_3 a weaker Lewis acid than expected.

Why other options are wrong:

- Option A: reverses donor and acceptor; F's orbital is filled, not empty.
- Option B: boron's $2s$ is not the donor; boron is the electron-poor acceptor.
- Option C: an empty-into-empty overlap transfers no electron density.

Final Answer: Filled $2p$ of F donates into the empty $2p$ of B $\Rightarrow$ D

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Hess's law: The enthalpy of formation can be built by adding and subtracting given reactions so that they sum to the target equation; enthalpies add the same way.

Step 1 — Write the target: $\mathrm{C}(s) + 2\mathrm{H}_2(g) \rightarrow \mathrm{CH}_4(g)$.

Step 2 — Combine the equations: Take equation (1) once, equation (2) twice, and reverse equation (3):

$$\Delta H_f = \Delta H_1 + 2\Delta H_2 - \Delta H_3.$$

Step 3 — Substitute the values:

$$\Delta H_f = (-393) + 2(-286) - (-890).$$

$$\Delta H_f = -393 - 572 + 890.$$

$$\Delta H_f = -75 \text{ kJ}.$$

Why other options are wrong:

- Option A (-965 kJ): forgets to reverse (add) equation (3).
- Option B ($+75$ kJ): correct magnitude but wrong sign.
- Option C (-1569 kJ): adds all three enthalpies directly.

Final Answer: $\Delta H_f(\mathrm{CH}_4) = -75$ kJ $\Rightarrow$ D

Answer: (D) Go Back to Q6

Q7.

Solution

Concept — Relation between K_p and K_c: $K_p = K_c(RT)^{\Delta n}$, where Δn is the change in the number of moles of gas (products minus reactants).

Step 1 — Count the gas moles: Products: 2 mol NH_3. Reactants: 1 mol N_2 + 3 mol H_2 = 4 mol.

Step 2 — Find Δn:

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

Step 3 — Write the relation:

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

Why other options are wrong:

- Option A ($(RT)^2$): uses $\Delta n = +2$, the wrong sign.
- Option B ($K_p = K_c$): would need $\Delta n = 0$.
- Option D ($(RT)^{-1}$): uses $\Delta n = -1$ instead of -2.

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

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Oxidation number: In a neutral molecule the oxidation numbers sum to zero; H is $+1$ and O is -2 in normal compounds.

Step 1 — Assign the known values in H_2SO_3: Two H give $2(+1) = +2$; three O give $3(-2) = -6$.

Step 2 — Set up the equation: Let sulphur be x:

$$(+2) + x + (-6) = 0.$$

Step 3 — Solve:

$$x - 4 = 0 \Rightarrow x = +4.$$

Why other options are wrong:

- Option B ($+6$): the state of S in sulphuric acid H_2SO_4.
- Option C ($+2$): does not balance the charges here.
- Option D (-2): the state of S in sulphides such as H_2S.

Final Answer: Oxidation number of S in H_2SO_3 is $+4 \Rightarrow$ A

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Concentration cell: Both electrodes are identical, so $E^\circ_{\text{cell}} = 0$. The EMF comes only from the concentration difference: $E_{\text{cell}} = \dfrac{0.059}{n} \log \dfrac{C_{\text{cathode}}}{C_{\text{anode}}}$, with the higher concentration as cathode.

Step 1 — Identify cathode and anode: The higher concentration (0.1 M) is the cathode; the lower (0.001 M) is the anode. Here $n = 2$.

Step 2 — Substitute into the Nernst form:

$$E_{\text{cell}} = \frac{0.059}{2} \log \frac{0.1}{0.001}.$$

Step 3 — Simplify:

$$\frac{0.1}{0.001} = 100, \qquad \log 100 = 2.$$

$$E_{\text{cell}} = \frac{0.059}{2} \times 2 = 0.059 \text{ V}.$$

Why other options are wrong:

- Option A (0.118 V): forgets to divide by $n = 2$.
- Option B (0 V): would require equal concentrations.
- Option D (0.0295 V): uses $\log 10 = 1$ instead of $\log 100 = 2$.

Final Answer: $E_{\text{cell}} = 0.059$ V $\Rightarrow$ C

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — First-order kinetics: For a first-order reaction $t = \dfrac{2.303}{k}\log\dfrac{a}{a-x}$, where a is the initial amount and x is the amount reacted.

Step 1 — Set up the ratio for 99% completion: When 99% has reacted, $x = 0.99a$, so

$$\frac{a}{a-x} = \frac{a}{0.01a} = 100.$$

Step 2 — Substitute into the formula:

$$t = \frac{2.303}{k}\log 100 = \frac{2.303}{k} \times 2.$$

Step 3 — Put in $k = 2.303 \times 10^{-2}$ min^{-1}:

$$t = \frac{2.303 \times 2}{2.303 \times 10^{-2}} = \frac{2}{10^{-2}} = 200 \text{ min}.$$

Why other options are wrong:

- Option A (100 min): uses $\log 10 = 1$ (i.e. 90% completion).
- Option B (300 min): uses $\log 1000 = 3$ (99.9%).
- Option D (400 min): doubles the correct value.

Final Answer: Time for 99% completion $= 200$ min $\Rightarrow$ C

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Normality and molarity: Normality $=$ Molarity $\times$ n-factor. For an acid the n-factor is its basicity (number of replaceable H^+).

Step 1 — Find the n-factor of H_2SO_4: Sulphuric acid has two replaceable protons, so basicity $= 2$.

Step 2 — Apply the relation:

$$N = M \times n\text{-factor} = 0.5 \times 2.$$

Step 3 — Evaluate:

$$N = 1 \text{ N}.$$

Why other options are wrong:

- Option B (0.5 N): assumes an n-factor of 1.
- Option C (2 N): uses molarity $= 1$ M, not 0.5 M.
- Option D (0.25 N): divides by the n-factor instead of multiplying.

Final Answer: Normality $= 1$ N $\Rightarrow$ A

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Naming coordination compounds: Name the cation first, then the complex anion: ligands (alphabetical, with counts) followed by the metal with the suffix "-ate" and its oxidation state in Roman numerals.

Step 1 — Split the compound: $K_3[Fe(CN)_6]$: three K^+ ions and the anion $[Fe(CN)_6]^{3-}$.

Step 2 — Find the oxidation state of iron: Each cyanide is -1; the complex charge is -3:

$$x + 6(-1) = -3 \Rightarrow x = +3.$$

Step 3 — Assemble the name: Six cyanido ligands $\Rightarrow$ hexacyanido; iron in an anion $\Rightarrow$ ferrate(III); cation potassium: *potassium hexacyanidoferrate(III)*.

Why other options are wrong:

- Option B: gives iron as $+2$ (that would be $K_4[Fe(CN)_6]$).
- Option C: uses "iron" instead of "ferrate" for an anionic complex.
- Option D: "tripotassium" and "hexacyano" are not the correct IUPAC forms.

Final Answer: potassium hexacyanidoferrate(III) $\Rightarrow$ A

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Allotropes of carbon: Carbon exists in crystalline allotropes (diamond, graphite, fullerenes) with ordered lattices, and amorphous forms (charcoal, coke, lampblack) that lack long-range order.

Step 1 — Classify each option: Charcoal, coke and lampblack are amorphous forms of carbon.

Step 2 — Identify the crystalline one: Graphite has a regular layered lattice of hexagonal carbon sheets, so it is a crystalline allotrope.

Why other options are wrong:

- Option A (charcoal): an amorphous form obtained by heating wood.
- Option B (coke): an amorphous residue from destructive distillation of coal.
- Option C (lampblack): finely divided amorphous carbon (soot).

Final Answer: Graphite is a crystalline allotrope of carbon $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept — Colour of transition-metal ions: In an aqueous complex the d-orbitals split into lower (t_{2g}) and higher (e_g) sets. A partly filled d sub-shell can absorb visible light to promote an electron from t_{2g} to e_g (a d–d transition); the transmitted light gives the colour.

Step 1 — Look at Cu^{2+}: Cu^{2+} is $3d^9$, a partly filled d sub-shell with one unpaired electron and a vacancy in the e_g set.

Step 2 — Explain the colour: It absorbs red/orange light to excite a d-electron from t_{2g} to e_g; the complementary blue light is transmitted, so the ion looks blue.

Why other options are wrong:

- Option A (completely filled d): a full d^{10} shell (e.g. Zn^{2+}) allows no d–d transition and is colourless.
- Option C (UV charge transfer): the Cu^{2+}(aq) colour is a visible d–d transition, not a UV charge-transfer band.
- Option D (no unpaired electrons): Cu^{2+} actually has one unpaired electron.

Final Answer: A d–d transition in the partly filled d shell causes the blue colour

$\Rightarrow$ B

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Plaster of Paris: Plaster of Paris is calcium sulphate hemihydrate, made by heating gypsum ($CaSO_4 \cdot 2H_2O$) to about $120\,^\circ C$, driving off most of the water.

Step 1 — Recall the dehydration:

$$CaSO_4 \cdot 2H_2O \xrightarrow{120\,^\circ C} CaSO_4 \cdot \tfrac{1}{2}H_2O + \tfrac{3}{2}H_2O.$$

Step 2 — Identify the product: The hemihydrate $CaSO_4 \cdot \frac{1}{2}H_2O$ is Plaster of Paris; on adding water it re-sets back to gypsum.

Why other options are wrong:

- Option A ($CaSO_4 \cdot 2H_2O$): this is gypsum, the starting material.
- Option C ($CaSO_4$): the fully anhydrous "dead burnt" plaster, which will not set.
- Option D ($Ca(OH)_2$): slaked lime, a completely different compound.

Final Answer: Plaster of Paris is $CaSO_4 \cdot \frac{1}{2}H_2O \Rightarrow$ B

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Mesomeric ($-M$) effect: A $-M$ group withdraws electron density through resonance. The strength depends on how well the group delocalises the pi electrons; the nitro group is the strongest common $-M$ group.

Step 1 — Classify the groups: $-NO_2$, $-COOH$ and $-CHO$ are $-M$ (electron withdrawing by resonance); $-OCH_3$ is $+M$ (electron donating by resonance).

Step 2 — Rank the $-M$ groups: $-NO_2$ carries two electron-withdrawing oxygens and a formal positive nitrogen, giving the strongest $-M$ effect, greater than $-CHO$ or $-COOH$.

Why other options are wrong:

- Option B ($-$COOH) and Option C ($-$CHO): $-M$ groups, but weaker than the nitro group.
- Option D ($-OCH_3$): actually a $+M$ (electron-donating) group, the opposite effect.

Final Answer: $-NO_2$ has the strongest $-M$ effect $\Rightarrow$ A

Answer: (A) Go Back to Q16

Q17.

Solution

Concept — Kolbe electrolysis: Electrolysis of the concentrated aqueous sodium salt of a carboxylic acid liberates carboxylate ions at the anode, which lose CO_2 to give alkyl radicals that couple into a symmetrical alkane R-R.

Step 1 — Write the anode reaction for acetate:

$$2\,CH_3COO^- \rightarrow 2\,CH_3^\bullet + 2\,CO_2 + 2e^-.$$

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

$$CH_3^\bullet + CH_3^\bullet \rightarrow CH_3\text{-}CH_3.$$

Step 3 — Name the hydrocarbon: CH_3-CH_3 is ethane.

Why other options are wrong:

- Option B (methane): would come from a single CH_3 radical picking up H, not from coupling.
- Option C (ethene): not formed; Kolbe gives the saturated coupled product.
- Option D (ethanol): an oxygen-containing product, not the anodic hydrocarbon.

Final Answer: Kolbe electrolysis of sodium acetate gives ethane $\Rightarrow$ A

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — S_N1 reactivity: An S_N1 reaction proceeds through a carbocation, so it is fastest for the halide that forms the most stable cation. Benzylic and allylic cations are resonance-stabilised; vinyl and aryl halides are almost unreactive because of partial double-bond character and sp^2 C–X bonds.

Step 1 — Classify the halides: Benzyl chloride gives a resonance-stabilised benzyl cation; ethyl chloride gives a primary cation; vinyl chloride and chlorobenzene have C–Cl bonds with double-bond character.

Step 2 — Compare cation stability: Benzyl cation (delocalised over the ring) $>$ primary ethyl cation $\gg$ vinyl/aryl (cannot ionise easily).

Step 3 — Conclude: Benzyl chloride ionises most readily, so it is the fastest by S_N1.

Why other options are wrong:

- Option A (vinyl chloride) and Option C (chlorobenzene): the C–Cl bond has partial double-bond character and resists ionisation.
- Option D (ethyl chloride): a primary halide whose cation is far less stable than benzyl.

Final Answer: Benzyl chloride is most reactive by $S_N1 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Controlled oxidation of alcohols: A primary alcohol is oxidised to an aldehyde by a mild oxidant that stops at that stage, but a strong oxidant carries it further to a carboxylic acid. PCC is a mild reagent that gives the aldehyde.

Step 1 — Identify the reagent type: Pyridinium chlorochromate (PCC) is a mild, anhydrous oxidising agent.

Step 2 — Predict the product: It oxidises a primary alcohol only to the aldehyde and does not over-oxidise:

$$\text{RCH}_2\text{OH} \xrightarrow{\text{PCC}} \text{RCHO}.$$

Why other options are wrong:

- Option A (carboxylic acid): the product with strong oxidants such as $KMnO_4/K_2Cr_2O_7$, not PCC.
- Option B (ketone): would require a secondary alcohol, not a primary one.
- Option D (ester): not an oxidation product of a single alcohol.

Final Answer: PCC oxidises a 1° alcohol to an aldehyde $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Cyanohydrin formation: HCN adds across the polar C=O bond of aldehydes and ketones by nucleophilic addition; the cyanide ion adds to the carbonyl carbon and H to the oxygen, giving a hydroxynitrile (cyanohydrin).

Step 1 — Add CN^- to the carbonyl carbon: CN^- attacks the electrophilic carbonyl carbon of CH_3CHO.

Step 2 — Protonate the alkoxide: The resulting alkoxide picks up H^+ to give the OH group:

$$CH_3CHO + HCN \rightarrow CH_3CH(OH)CN.$$

Step 3 — Name the product: $CH_3CH(OH)CN$ is 2-hydroxypropanenitrile, an α-hydroxynitrile (cyanohydrin).

Why other options are wrong:

- Option A (acetonitrile): CH_3CN has no OH group and is not an addition product.
- Option B (acetic acid): an oxidation product, not from HCN addition.
- Option D (ethylamine): a reduction product, unrelated to cyanohydrin formation.

Final Answer: The product is 2-hydroxypropanenitrile (a cyanohydrin) $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept — Acids to acyl chlorides: Thionyl chloride ($SOCl_2$) converts the $-OH$ of a carboxylic acid into $-Cl$, giving an acyl chloride; the by-products SO_2 and HCl are gases, so the reaction is clean.

Step 1 — Write the reaction:

$$CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 \uparrow + HCl \uparrow .$$

Step 2 — Identify the organic product: The $-OH$ is replaced by $-Cl$, giving acetyl chloride (CH_3COCl).

Why other options are wrong:

- Option A (acetamide): formed with ammonia, not $SOCl_2$.
- Option C (acetic anhydride): formed by dehydration of two acid molecules.
- Option D (ethyl chloride): would need loss of the whole carboxyl group, which does not happen here.

Final Answer: Acetic acid $+SOCl_2$ gives acetyl chloride $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Reduction of nitriles: A strong reducing agent such as $LiAlH_4$ (or H_2/Ni) adds four hydrogens across the C≡N triple bond, converting a nitrile R-CN into a primary amine R-CH_2-NH_2.

Step 1 — Write the reduction:

$$CH_3\text{-}C{\equiv}N \xrightarrow{LiAlH_4} CH_3\text{-}CH_2\text{-}NH_2.$$

Step 2 — Identify the product: The nitrile carbon gains two H and the nitrogen gains two H, giving ethylamine.

Step 3 — Note the carbon count: Acetonitrile (CH_3CN) has two carbons, so the amine also has two carbons (ethylamine), not one.

Why other options are wrong:

- Option A (methylamine): has only one carbon; that would come from reducing HCN, not CH_3CN.
- Option B (acetamide): a partial-oxidation-level product, not a reduction product.
- Option C (ethanol): an oxygen-containing compound, not an amine.

Final Answer: CH_3CN is reduced to ethylamine $\Rightarrow$ D

Answer: (D) Go Back to Q22

Q23.

Solution

Concept — Levels of protein structure: The primary structure is the sequence of amino acids; the secondary structure is the local regular folding of the backbone into α-helix or β-pleated sheets held by hydrogen bonds; tertiary is the overall 3D shape; quaternary is the assembly of subunits.

Step 1 — Match the description: The α-helix and β-pleated sheet are regular local backbone arrangements stabilised by hydrogen bonds.

Step 2 — Assign the level: These are the defining features of the secondary structure.

Why other options are wrong:

- Option A (primary): just the linear amino-acid sequence, no folding.
- Option C (tertiary): the overall folding of the whole chain into a 3D shape.
- Option D (quaternary): the way several folded subunits assemble together.

Final Answer: α-helix and β-sheet describe the secondary structure $\Rightarrow$ B

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — IUPAC naming of ketones: Choose the longest chain containing the carbonyl carbon, number it so the C=O gets the lowest possible locant, and cite substituents with their locants as prefixes.

Step 1 — Read the skeleton: The structure is CH_3-CO-CH_2-CH(CH_3)-CH_3, a five-carbon (pentane) chain with a ketone and a methyl branch.

Step 2 — Number for the lowest carbonyl locant: Numbering from the carbonyl end places C=O on C-2 and the methyl branch on C-4 (the other direction would give the ketone C-4, which is higher).

Step 3 — Assemble the name: Pentan chain, ketone at C-2, methyl at C-4 $\Rightarrow$ 4-methylpentan-2-one.

Why other options are wrong:

- Option A (2-methylpentan-4-one): numbers from the wrong end, giving the carbonyl a higher locant.
- Option B (hexan-2-one): treats it as a straight six-carbon chain, ignoring the branch.
- Option C (4-methylpentan-3-one): wrong carbonyl position for this structure.

Final Answer: The ketone is 4-methylpentan-2-one $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Antiseptics vs disinfectants: Both kill or inhibit micro-organisms, but antiseptics are safe on living tissue (skin, wounds) while disinfectants are used on non-living objects. The same substance can act as either depending on its concentration; phenol is the classic example.

Step 1 — Recall the phenol case: A 0.2% solution of phenol is a mild antiseptic; a 1% solution is a stronger disinfectant.

Step 2 — Match with the options: Only the statement that a dilute (0.2%) phenol solution is an antiseptic while a 1% solution is a disinfectant is correct.

Why other options are wrong:

- Option A: antiseptics are for living tissue, not floors and instruments.
- Option B: disinfectants are too harsh for open wounds and living tissue.
- Option C: a 1% phenol solution acts as a disinfectant, not an antiseptic.

Final Answer: Dilute (0.2%) phenol is an antiseptic, 1% phenol is a disinfectant $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q25

Answer Key

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