PGIMER BSc Nursing Chemistry

Sample Paper – 12

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 number of moles of glucose present in 250 mL of a 0.4 M aqueous glucose solution is:

(A) 0.4 mol

(B) 0.1 mol

(C) 0.04 mol

(D) 1.0 mol

Q2. The energy of a photon of light of frequency 5×10^{14} Hz is (take Planck's constant $h = 6.63 \times 10^{-34}$ J s):

(A) 1.3×10^{-19} J

(B) 3.3×10^{-19} J

(C) 6.6×10^{-19} J

(D) 5.0×10^{-19} J

Q3. The correct order of *increasing* atomic size for the period-2 elements C, N, O and F is:

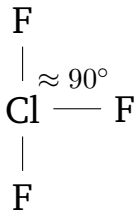
(A) $F < O < N < C$

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

(C) $N < O < F < C$

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

Q4. The molecule chlorine trifluoride (ClF_3), whose structure is shown, has three bond pairs and two lone pairs on chlorine. Its molecular shape is:



(A) trigonal planar

(B) T-shaped

(C) trigonal pyramidal

(D) see-saw

Q5. Which of the following pairs consists of two isoelectronic species that also have the *same* bond order?

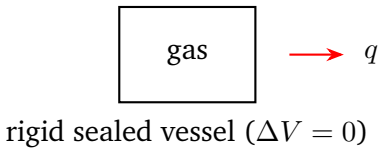
(A) O_2 and NO

(B) CO and O_2

(C) N_2 and O_2

(D) CO and N_2

Q6. A gas enclosed in the rigid, sealed vessel shown absorbs 250 J of heat. Since the vessel is rigid, no work is done. The change in internal energy ΔU of the gas is:



rigid sealed vessel ($\Delta V = 0$)

(A) 0 J

(B) 250 J

(C) -250 J

(D) 500 J

Q7. An aqueous solution of sodium acetate (CH_3COONa), the salt of a weak acid and a strong base, will be:

(A) acidic, with pH < 7

(B) exactly neutral, with pH $= 7$

(C) basic, with pH > 7

(D) strongly acidic, with pH close to 1

Q8. In acidic medium the permanganate ion is reduced to the manganese(II) ion, $MnO_4^- \rightarrow Mn^{2+}$. The number of electrons involved in this half-reaction is:

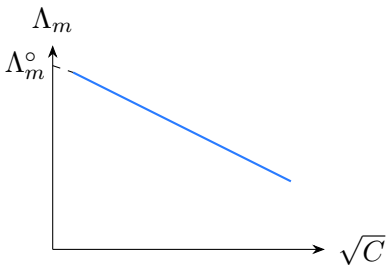
(A) 3

(B) 5

(C) 1

(D) 7

Q9. The graph shows how the molar conductivity Λ_m of a *strong* electrolyte varies with $\sqrt{C}$. As the solution is diluted, the molar conductivity of the strong electrolyte:



(A) decreases continuously

(B) remains exactly constant

(C) increases and approaches a limiting value Λ_m°

(D) first decreases and then increases

Q10. The rate constant of a reaction *doubles* when the temperature is raised from 300 K to 310 K. The activation energy E_a of the reaction is approximately (take $R = 8.314$ J K^{-1} mol^{-1}, $\ln 2 = 0.693$):

(A) 26.8 kJ mol^{-1}

(B) 107 kJ mol^{-1}

(C) 5.8 kJ mol^{-1}

(D) 53.6 kJ mol^{-1}

Q11. An ideal solution contains benzene and toluene in *equimolar* amounts (mole fraction 0.5 each). If the vapour pressures of pure benzene and pure toluene are 120 torr and 40 torr respectively, the total vapour pressure of the solution is:

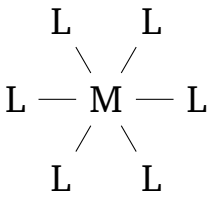
(A) 80 torr

(B) 160 torr

(C) 40 torr

(D) 120 torr

Q12. In an octahedral complex $[ML_6]$ of the type shown, the ligands are arranged in the spectrochemical series by field strength. Among the ligands below, the *strongest* field ligand is:



(A) H_2O

(B) Cl^-

(C) CN^-

(D) F^-

Q13. Which of the following is the most powerful dehydrating (drying) agent, capable of removing even chemically combined water?

(A) phosphorus pentoxide (P_4O_{10})

(B) anhydrous calcium chloride ($CaCl_2$)

(C) silica gel

(D) quicklime (CaO)

Q14. When potassium dichromate ($K_2Cr_2O_7$) acts as an oxidising agent in acidic medium, the dichromate ion is itself reduced to:

(A) chromium metal (Cr)

(B) the chromate ion (CrO_4^{2-})

(C) the chromium(III) ion (Cr^{3+})

(D) the chromium(II) ion (Cr^{2+})

Q15. When burnt in excess of oxygen (air), lithium behaves anomalously among the alkali metals and forms mainly:

(A) the normal oxide, lithium oxide (Li_2O)

(B) the peroxide, lithium peroxide (Li_2O_2)

(C) the superoxide (LiO_2)

(D) a mixture of peroxide and superoxide

Q16. The number of equivalent resonance (canonical) structures that can be drawn for the carbonate ion, CO_3^{2-}, is:

(A) 3

(B) 2

(C) 4

(D) 1

Q17. Catalytic hydrogenation (H_2 in the presence of finely divided nickel) of propene, shown below, gives:

$$CH_2{=}CH{-}CH_3 \xrightarrow{+\ H_2\ (Ni)}$$

(A) propyne

(B) propane

(C) propan-1-ol

(D) propene (no reaction)

Q18. When 2-bromopropane is heated with *alcoholic* potassium hydroxide (KOH), the major organic product is:

(A) propan-2-ol

(B) propan-1-ol

(C) propane

(D) propene

Q19. The reaction of methylmagnesium bromide (CH_3MgBr) with formaldehyde (HCHO), followed by acidic hydrolysis, gives:

(A) ethanol (a primary alcohol)

(B) methanol

(C) propan-2-ol (a secondary alcohol)

(D) 2-methylpropan-2-ol (a tertiary alcohol)

Q20. Clemmensen reduction (zinc amalgam and concentrated HCl) of propan-2-one (acetone) converts the carbonyl group to a CH_2 group, giving:

(A) propan-2-ol

(B) propene

(C) propan-1-ol

(D) propane

Q21. Acid hydrolysis of ethanenitrile (methyl cyanide, CH_3CN) gives:

(A) methanoic acid (HCOOH)

(B) ethanol

(C) methylamine

(D) ethanoic acid (CH_3COOH)

Q22. In the Hinsberg test, a secondary amine reacts with benzenesulphonyl chloride to give a product that is:

(A) an N,N-disubstituted sulphonamide, insoluble in alkali (KOH)

(B) a sulphonamide that is readily soluble in alkali (KOH)

(C) no product at all (secondary amines do not react)

(D) a water-soluble ammonium salt

Q23. In the disaccharide sucrose, the glycosidic linkage is formed between:

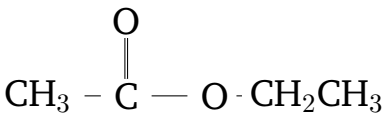
(A) C1 of one glucose unit and C4 of another glucose unit

(B) C1 of glucose and C6 of fructose

(C) C2 of glucose and C1 of fructose

(D) C1 of α-glucose and C2 of β-fructose

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



(A) methyl propanoate

(B) ethyl methanoate

(C) ethyl ethanoate

(D) propyl methanoate

Q25. Which of the following artificial sweeteners is a methyl ester of a dipeptide and loses its sweetness (becomes unstable) at cooking temperatures?

(A) saccharin

(B) sucralose

(C) aspartame

(D) alitame

Detailed Solutions

Q1.

Solution

Concept — Molarity and moles: Molarity is moles of solute per litre of solution, so the number of moles equals molarity multiplied by the volume in litres, $n = M \times V(\text{L})$.

Step 1 — List the data: Molarity $M = 0.4$ mol L^{-1}.

Volume $= 250$ mL.

Step 2 — Convert the volume to litres:

$$V = 250 \text{ mL} = 0.250 \text{ L}.$$

Step 3 — Apply the formula:

$$n = M \times V = 0.4 \times 0.250 = 0.1 \text{ mol}.$$

Why other options are wrong:

- Option A (0.4 mol): uses 1 L instead of 0.25 L.
- Option C (0.04 mol): divides by an extra factor of ten.
- Option D (1.0 mol): ignores both the molarity and the volume.

Final Answer: Number of moles $= 0.1$ mol $\Rightarrow$ B

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Planck's equation: The energy of a single photon is $E = h\nu$, where h is Planck's constant and ν is the frequency of the radiation.

Step 1 — List the values: $h = 6.63 \times 10^{-34}$ J s.

$\nu = 5 \times 10^{14}$ Hz $= 5 \times 10^{14}$ s^{-1}.

Step 2 — Substitute into $E = h\nu$:

$$E = (6.63 \times 10^{-34}) \times (5 \times 10^{14}).$$

Step 3 — Multiply:

$$E = (6.63 \times 5) \times 10^{-34+14} = 33.15 \times 10^{-20}.$$

$$E = 3.315 \times 10^{-19} \approx 3.3 \times 10^{-19}\ \text{J}.$$

Why other options are wrong:

- Option A (1.3×10^{-19} J): too small; uses a wrong frequency.
- Option C (6.6×10^{-19} J): doubles the correct value.
- Option D (5.0×10^{-19} J): confuses the numerical value of ν with the answer.

Final Answer: $E \approx 3.3 \times 10^{-19}$ J $\Rightarrow$ B

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Atomic size across a period: Moving left to right across a period, the nuclear charge increases while electrons enter the same shell, so the atomic radius *decreases*. Thus the leftmost element is the largest.

Step 1 — Place the elements in period 2: The order along the period is C, N, O, F (left to right).

Step 2 — Apply the size trend: Size decreases from C to F, so C is largest and F is smallest: C $>$ N $>$ O $>$ F.

Step 3 — Write the *increasing* order: Reversing gives F $<$ O $<$ N $<$ C.

Why other options are wrong:

- Option B (C $<$ N $<$ O $<$ F): this is the exact reverse (decreasing) of the true order.
- Option C and Option D: place O or F larger than N, which contradicts the periodic trend.

Final Answer: Increasing size is F $<$ O $<$ N $<$ C $\Rightarrow$ A

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — VSEPR shape: The shape is decided by the total number of bond pairs and lone pairs on the central atom. Three bond pairs and two lone pairs give an sp^3d (trigonal bipyramidal) electron arrangement with a T-shaped molecular geometry.

Step 1 — Count the electron pairs on chlorine in ClF_3: Three Cl–F bond pairs and two lone pairs give a total of five electron pairs.

Step 2 — Place the lone pairs: The five pairs adopt a trigonal bipyramidal arrangement; the two lone pairs occupy equatorial positions to minimise repulsion.

Step 3 — Read off the molecular shape: The three fluorine atoms then form a T-shape with bond angles close to $90°$, exactly as drawn.

Why other options are wrong:

- Option A (trigonal planar): needs three bond pairs and *no* lone pairs (as in BF_3).
- Option C (trigonal pyramidal): needs three bond pairs and *one* lone pair (as in NH_3).
- Option D (see-saw): needs four bond pairs and one lone pair (as in SF_4).

Final Answer: ClF_3 is T-shaped $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Isoelectronic species and bond order: Two species are isoelectronic if they have the same total number of electrons; if they also fill their molecular orbitals identically, they have the same bond order.

Step 1 — Count electrons in each species: N_2 has 14 electrons; CO has $6+8=14$ electrons.

Step 2 — Compare bond orders: Both fill the same molecular orbitals, giving bond order $= \frac{1}{2}(10-4) = 3$ for each. They are isoelectronic *and* have equal bond order.

Step 3 — Confirm the choice: The pair CO and N_2 satisfies both conditions.

Why other options are wrong:

- Option A (O_2, NO): O_2 has 16 and NO has 15 electrons; not isoelectronic.
- Option B (CO, O_2): 14 vs 16 electrons and bond orders 3 vs 2.
- Option C (N_2, O_2): 14 vs 16 electrons; bond orders 3 vs 2.

Final Answer: CO and N_2 (both 14 e^-, bond order 3) $\Rightarrow$ D

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — First law at constant volume: The first law is $\Delta U = q + w$, with $w = -P\Delta V$. When the vessel is rigid, $\Delta V = 0$, so $w = 0$ and $\Delta U = q_v$ (the heat absorbed at constant volume).

Step 1 — Evaluate the work term: Rigid vessel $\Rightarrow \Delta V = 0 \Rightarrow w = -P\Delta V = 0$.

Step 2 — Apply the first law:

$$\Delta U = q + w = q + 0 = q.$$

Step 3 — Substitute the heat: Heat absorbed $q = +250$ J (heat flows *into* the gas), so $\Delta U = +250$ J.

Why other options are wrong:

- Option A (0 J): would require no heat exchange.
- Option C (-250 J): wrong sign; heat is absorbed, not released.
- Option D (500 J): wrongly adds a non-existent work term.

Final Answer: $\Delta U = +250$ J $\Rightarrow$ B

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Salt hydrolysis: A salt of a weak acid and a strong base hydrolyses in water; the anion of the weak acid reacts with water to release OH^-, making the solution basic.

Step 1 — Identify the parent acid and base: CH_3COONa comes from acetic acid (weak) and sodium hydroxide (strong).

Step 2 — Write the hydrolysis: The acetate ion accepts a proton from water:

$$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-.$$

Step 3 — Decide the nature: The released OH^- makes $[OH^-] > [H^+]$, so the solution is basic with pH > 7.

Why other options are wrong:

- Option A (acidic): would apply to a salt of a strong acid and weak base such as NH_4Cl.
- Option B (neutral): applies to a salt of a strong acid and strong base such as NaCl.
- Option D (strongly acidic): incorrect direction entirely.

Final Answer: The solution is basic, pH $> 7 \Rightarrow$ C

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Electrons in a half-reaction: The number of electrons transferred equals the total change in oxidation number of the element being reduced (or oxidised).

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

Step 2 — Find the change: Mn goes from $+7$ to $+2$, a decrease of 5 units.

Step 3 — Write the balanced half-reaction:

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

Five electrons are gained.

Why other options are wrong:

- Option A (3): would apply to a change of three units (as $+6 \rightarrow +3$).
- Option C (1): a single-electron change, not the case here.
- Option D (7): mistakes the initial oxidation state ($+7$) for the electron count.

Final Answer: Five electrons are involved $\Rightarrow$ B

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Molar conductivity and dilution: Molar conductivity Λ_m increases on dilution because more ions become free to move. For a *strong* electrolyte the increase is small and Λ_m approaches a limiting value Λ_m° at infinite dilution.

Step 1 — Read the trend on the graph: As the solution is diluted, $\sqrt{C}$ falls towards zero (moving left on the axis).

Step 2 — Follow the line: As $\sqrt{C} \to 0$, the plotted line rises and meets the intercept Λ_m°.

Step 3 — State the behaviour: So on dilution Λ_m increases and approaches the limiting molar conductivity Λ_m°.

Why other options are wrong:

- Option A (decreases): it is the *conductivity* κ, not Λ_m, that falls on dilution.
- Option B (constant): Λ_m clearly changes with concentration.
- Option D (decreases then increases): the variation is monotonic, not U-shaped.

Final Answer: Λ_m increases and approaches $\Lambda_m^\circ \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Arrhenius equation (two temperatures): $\ln \dfrac{k_2}{k_1} = \dfrac{E_a}{R}\left(\dfrac{1}{T_1} - \dfrac{1}{T_2}\right)$, which lets us find E_a from the ratio of rate constants at two temperatures.

Step 1 — List the data: $\dfrac{k_2}{k_1} = 2$, $T_1 = 300$ K, $T_2 = 310$ K, $R = 8.314$ J K^{-1} mol^{-1}.

Step 2 — Evaluate the temperature term:

$$\frac{1}{T_1} - \frac{1}{T_2} = \frac{1}{300} - \frac{1}{310} = \frac{310 - 300}{300 \times 310} = \frac{10}{93000} = 1.075 \times 10^{-4}\ \text{K}^{-1}.$$

Step 3 — Rearrange and substitute:

$$E_a = \frac{R\,\ln(k_2/k_1)}{\left(\frac{1}{T_1} - \frac{1}{T_2}\right)} = \frac{8.314 \times 0.693}{1.075 \times 10^{-4}}.$$

$$E_a = \frac{5.762}{1.075 \times 10^{-4}} = 5.36 \times 10^4 \text{ J mol}^{-1} \approx 53.6 \text{ kJ mol}^{-1}.$$

Why other options are wrong:

- Option A (26.8 kJ): exactly half the correct value.
- Option B (107 kJ): double the correct value.
- Option C (5.8 kJ): stops at the numerator and forgets to divide.

Final Answer: $E_a \approx 53.6$ kJ mol$^{-1} \Rightarrow$ D

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Raoult's law for an ideal solution: The total vapour pressure is the sum of the partial pressures, $P = x_A P_A^\circ + x_B P_B^\circ$, where x is the mole fraction in the liquid and P° is the pure-component vapour pressure.

Step 1 — List the data: $x_{\text{benzene}} = 0.5$, $x_{\text{toluene}} = 0.5$; $P^\circ_{\text{benzene}} = 120$ torr, $P^\circ_{\text{toluene}} = 40$ torr.

Step 2 — Compute each partial pressure:

$$p_{\text{benzene}} = 0.5 \times 120 = 60 \text{ torr}.$$

$$p_{\text{toluene}} = 0.5 \times 40 = 20 \text{ torr}.$$

Step 3 — Add them:

$$P = 60 + 20 = 80 \text{ torr}.$$

Why other options are wrong:

- Option B (160 torr): simply adds the two pure vapour pressures without weighting.
- Option C (40 torr): uses only toluene.
- Option D (120 torr): uses only benzene.

Final Answer: Total vapour pressure $= 80$ torr $\Rightarrow$ A

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Spectrochemical series: Ligands can be ranked by the crystal-field splitting they cause. A common order of increasing field strength is $I^- < Br^- < Cl^- < F^- < H_2O < NH_3 <$ en $< CN^-$.

Step 1 — Locate each option in the series: Cl^- and F^- are weak-field; H_2O is intermediate; CN^- lies at the strong-field end.

Step 2 — Pick the strongest: CN^- produces the largest splitting, so it is the strongest field ligand of the four.

Why other options are wrong:

- Option A (H_2O): only a moderate-field ligand.
- Option B (Cl^-) and Option D (F^-): both are weak-field halide ligands.

Final Answer: CN^- is the strongest field ligand $\Rightarrow$ C

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Dehydrating agents: A dehydrating agent removes water; phosphorus pentoxide, P_4O_{10}, is one of the most powerful, able to abstract chemically combined water (for example converting HNO_3 to N_2O_5).

Step 1 — Rank the drying power: P_4O_{10} is a far stronger dehydrating agent than $CaCl_2$, silica gel or CaO, which merely absorb moisture.

Step 2 — Choose the strongest: Only P_4O_{10} can strip water that is chemically bound, making it the most powerful dehydrating agent listed.

Why other options are wrong:

- Option B ($CaCl_2$): a common but ordinary drying agent; cannot remove combined water.
- Option C (silica gel): a mild desiccant for atmospheric moisture only.
- Option D (CaO): dries gases and alcohols but is weaker than P_4O_{10}.

Final Answer: P_4O_{10} is the most powerful dehydrating agent $\Rightarrow$ A

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Oxidising action of dichromate: In acidic medium $Cr_2O_7^{2-}$ is a strong oxidant; chromium is reduced from the $+6$ state to the $+3$ state, appearing as green Cr^{3+} ions.

Step 1 — Note the oxidation states: In $Cr_2O_7^{2-}$ each Cr is $+6$; the reduced product has Cr in the $+3$ state.

Step 2 — Write the half-reaction:

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O.$$

So the dichromate ion is reduced to Cr^{3+}.

Why other options are wrong:

- Option A (Cr metal): would require reduction all the way to the 0 state, which does not happen here.
- Option B (CrO_4^{2-}): still $+6$; this is only the alkaline form of chromium(VI), not a reduction.
- Option D (Cr^{2+}): over-reduction; the stable product in acid is Cr^{3+}.

Final Answer: Dichromate is reduced to Cr^{3+} $\Rightarrow$ C

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Oxides of alkali metals: Alkali metals form different oxides on burning: lithium forms only the normal oxide, sodium forms mainly the peroxide, and potassium, rubidium and caesium form superoxides. This is part of lithium's anomalous behaviour.

Step 1 — Recall lithium's product: Lithium, because of its small size and high charge density, stabilises only the small oxide ion:

$$4Li + O_2 \rightarrow 2Li_2O.$$

Step 2 — Contrast with the others: Sodium gives Na_2O_2 (peroxide) and potassium gives KO_2 (superoxide), but lithium stops at Li_2O.

Why other options are wrong:

- Option B (Li_2O_2): the large peroxide ion is not stabilised by the tiny Li^+.
- Option C (LiO_2): superoxides form only with the larger, heavier alkali metals.
- Option D (mixture): lithium gives essentially only the normal oxide.

Final Answer: Lithium forms mainly $Li_2O \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Resonance in the carbonate ion: In CO_3^{2-} the negative charge and the double bond are delocalised equally over the three oxygen atoms, giving several equivalent canonical structures.

Step 1 — Draw the delocalisation: The carbon is bonded to three equivalent oxygens; the C=O double bond can be placed on any one of the three.

Step 2 — Count the structures: Because the double bond can sit on oxygen 1, oxygen 2 or oxygen 3, there are exactly 3 equivalent resonance structures.

Why other options are wrong:

- Option B (2): under-counts; three oxygens give three positions.
- Option C (4): over-counts; only three equivalent forms exist.
- Option D (1): ignores delocalisation entirely.

Final Answer: The carbonate ion has 3 resonance structures $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept — Catalytic hydrogenation: In the presence of a finely divided metal catalyst (Ni, Pt or Pd), hydrogen adds across a carbon-carbon double bond, converting an alkene into the corresponding alkane.

Step 1 — Identify the alkene: The structure shown, $CH_2 = CH - CH_3$, is propene (three carbons, one double bond).

Step 2 — Add hydrogen across the double bond:

$$CH_2 = CH - CH_3 + H_2 \xrightarrow{Ni} CH_3 - CH_2 - CH_3.$$

Step 3 — Name the product: The saturated three-carbon product is propane.

Why other options are wrong:

- Option A (propyne): would require removal, not addition, of hydrogen.
- Option C (propan-1-ol): needs water/oxidation, not H_2.
- Option D (propene unchanged): the double bond is reduced under H_2/Ni.

Final Answer: Hydrogenation of propene gives propane $\Rightarrow$ B

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Aqueous vs alcoholic KOH: With an alkyl halide, *aqueous* KOH favours substitution (giving an alcohol), whereas *alcoholic* KOH favours elimination of HX (giving an alkene).

Step 1 — Note the reagent: The reagent here is alcoholic KOH, which acts as a base and removes HBr.

Step 2 — Carry out the elimination:

$$(CH_3)_2CHBr \xrightarrow[\text{alcoholic}]{KOH} CH_3 - CH = CH_2 + KBr + H_2O.$$

Step 3 — Name the product: Loss of HBr from 2-bromopropane gives propene.

Why other options are wrong:

- Option A (propan-2-ol): the substitution product, formed with *aqueous* KOH,

not alcoholic.

- Option B (propan-1-ol): wrong position and wrong reaction type.
- Option C (propane): would require reduction, not elimination.

Final Answer: Alcoholic KOH gives propene by elimination $\Rightarrow$ D

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Grignard synthesis of alcohols: A Grignard reagent adds to the carbonyl carbon; formaldehyde (HCHO) gives a *primary* alcohol, aldehydes give secondary alcohols, and ketones give tertiary alcohols.

Step 1 — Add the Grignard to formaldehyde: CH_3MgBr adds its methyl group to the carbonyl carbon of HCHO.

Step 2 — Hydrolyse the adduct:

$$CH_3MgBr + HCHO \rightarrow CH_3CH_2OMgBr \xrightarrow{H_3O^+} CH_3CH_2OH.$$

Step 3 — Identify the product: The product is ethanol, a primary alcohol (formaldehyde always gives a primary alcohol).

Why other options are wrong:

- Option B (methanol): would need HCHO to react with H, not with a methyl Grignard.
- Option C (propan-2-ol): a secondary alcohol, produced from an aldehyde such as acetaldehyde.
- Option D (tert-butyl alcohol): a tertiary alcohol, produced from a ketone.

Final Answer: The product is ethanol (a primary alcohol) $\Rightarrow$ A

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Clemmensen reduction: Zinc amalgam with concentrated HCl reduces the carbonyl group (>C=O) of an aldehyde or ketone all the way to a methylene group (>CH_2), i.e. to a hydrocarbon.

Step 1 — Identify the carbonyl: Propan-2-one (acetone) is $CH_3 - CO - CH_3$.

Step 2 — Reduce C=O to CH_2:

$$CH_3 - CO - CH_3 \xrightarrow[\text{conc. HCl}]{\text{Zn(Hg)}} CH_3 - CH_2 - CH_3.$$

Step 3 — Name the product: The carbonyl becomes a CH_2 group, giving propane.

Why other options are wrong:

- Option A (propan-2-ol): only a partial reduction to an alcohol (as with $NaBH_4$), not Clemmensen.
- Option B (propene): no double bond is formed in this reduction.
- Option C (propan-1-ol): wrong position and wrong reaction.

Final Answer: Clemmensen reduction of acetone gives propane $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Hydrolysis of nitriles: On acid (or base) hydrolysis, a nitrile R-CN is converted through an amide to a carboxylic acid R-COOH having the same number of carbon atoms.

Step 1 — Identify the nitrile: Ethanenitrile is $CH_3 - C \equiv N$ (two carbons: one methyl, one nitrile carbon).

Step 2 — Hydrolyse to the acid:

$$CH_3CN + 2H_2O \xrightarrow{H^+} CH_3COOH + NH_3.$$

Step 3 — Name the product: The nitrile carbon becomes the -COOH carbon, giving ethanoic (acetic) acid, which keeps both carbons.

Why other options are wrong:

- Option A (methanoic acid): has only one carbon; a carbon would be lost.
- Option B (ethanol): reduction, not hydrolysis, would be needed.
- Option C (methylamine): forms on *reduction* of the nitrile, not on hydrolysis.

Final Answer: CH_3CN hydrolyses to ethanoic acid $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Hinsberg test: Benzenesulphonyl chloride distinguishes amine classes. A primary amine gives a sulphonamide with an acidic N–H, soluble in KOH; a secondary amine gives a sulphonamide with *no* N–H, insoluble in KOH; a tertiary amine does not react.

Step 1 — React the secondary amine: A secondary amine R_2NH reacts to give $R_2N\text{-}SO_2C_6H_5$.

Step 2 — Test for the N–H: This product has no hydrogen on nitrogen, so it cannot lose a proton to KOH and is therefore insoluble in alkali.

Step 3 — Conclude: The secondary amine gives an N,N-disubstituted sulphonamide that is insoluble in alkali.

Why other options are wrong:

- Option B (soluble in alkali): this describes the *primary*-amine product, which retains an acidic N–H.
- Option C (no reaction): tertiary amines, not secondary, fail to react.
- Option D (ammonium salt): not the outcome of the Hinsberg reaction.

Final Answer: The product is an alkali-insoluble sulphonamide $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Glycosidic linkage in sucrose: Sucrose is formed from α-D-glucose and β-D-fructose joined through their two anomeric (reducing) carbons, so both reducing groups are locked and sucrose is non-reducing.

Step 1 — Identify the linked carbons: The anomeric carbon of glucose is C1; the anomeric carbon of fructose is C2.

Step 2 — Form the linkage: The glycosidic bond joins C1 of α-glucose to C2 of β-fructose (an α, β-1,2 linkage).

Step 3 — Note the consequence: Because both anomeric carbons are used in the bond, sucrose has no free reducing group.

Why other options are wrong:

- Option A (C1-glucose to C4-glucose): this is the linkage in maltose, not sucrose.
- Option B (C1-glucose to C6-fructose): wrong carbons; the fructose anomeric carbon is C2.
- Option C (C2-glucose to C1-fructose): reverses the anomeric carbons of the two sugars.

Final Answer: Sucrose links C1 of α-glucose to C2 of β-fructose $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Naming esters: An ester R-COO-R′ is named as "alkyl (from R′) alkanoate (from the acyl part R-COO)." The acyl part gives the acid-derived name, the group on oxygen gives the alkyl name.

Step 1 — Break the structure into parts: The structure is $CH_3-CO-O-CH_2CH_3$: an acetyl group (CH_3CO-) linked through oxygen to an ethyl group.

Step 2 — Name the acyl part: CH_3COO- comes from ethanoic (acetic) acid $\Rightarrow$ "ethanoate."

Step 3 — Name the alkyl part and assemble: The -OCH_2CH_3 group is "ethyl," so the ester is *ethyl ethanoate* (ethyl acetate).

Why other options are wrong:

- Option A (methyl propanoate): would be $CH_3CH_2COO\text{-}CH_3$, a different structure.
- Option B (ethyl methanoate): would have H-COO- (formate), not the acetyl group shown.
- Option D (propyl methanoate): wrong acid part and wrong alkyl group.

Final Answer: The ester is ethyl ethanoate $\Rightarrow$ C

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Artificial sweeteners: Aspartame is the methyl ester of a dipeptide (aspartic acid and phenylalanine). It is roughly 100 times sweeter than sugar but breaks down and loses sweetness on heating, so it is limited to cold foods and drinks.

Step 1 — Match the description: The clue "methyl ester of a dipeptide, unstable on cooking" points directly to aspartame.

Step 2 — Confirm the identity: Aspartame is the only listed sweetener built from two amino acids as a methyl ester and known for heat instability.

Why other options are wrong:

- Option A (saccharin): an ortho-sulphobenzimide; it is stable to heat and is not a peptide.
- Option B (sucralose): a chlorinated sugar derivative, stable at cooking temperatures.
- Option D (alitame): a high-potency sweetener, more stable than aspartame and not the standard NCERT example.

Final Answer: The dipeptide-ester sweetener is aspartame $\Rightarrow$ C

Answer: (C) Go Back to Q25

Answer Key

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