PGIMER BSc Nursing Chemistry

Sample Paper – 4

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 percentage by mass of nitrogen in urea, $(NH_2)_2CO$ (molar mass $= 60$ g mol^{-1}, atomic mass of N $= 14$), is approximately:

(A) 23.3%

(B) 46.7%

(C) 60.0%

(D) 18.7%

Q2. The de Broglie wavelength of an electron (mass $= 9.1 \times 10^{-31}$ kg) moving with a velocity of 7.25×10^6 m s^{-1} is (take $h = 6.6 \times 10^{-34}$ J s):

(A) 1.0×10^{-9} m

(B) 7.25×10^{-10} m

(C) 1.0×10^{-10} m

(D) 6.6×10^{-34} m

Q3. Among the following halogens, the element with the highest (most negative) electron gain enthalpy is:

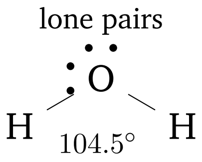
(A) Cl

(B) F

(C) Br

(D) I

Q4. The number of lone pairs of electrons on the central oxygen atom in a water molecule (H_2O), shown below, is:



(A) 1

(B) 2

(C) 0

(D) 3

Q5. According to Fajans' rules, which of the following compounds has the greatest covalent character?

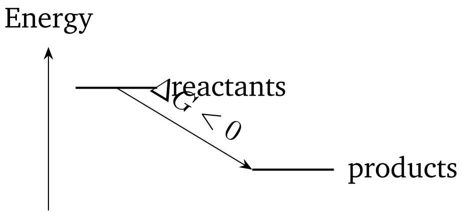
(A) $AlCl_3$

(B) NaCl

(C) KCl

(D) CsCl

Q6. For a reaction at 300 K, $\Delta H = -50$ kJ and $\Delta S = -100$ J K^{-1}. Using $\Delta G = \Delta H - T\Delta S$, the value of ΔG is:



(A) $+20$ kJ

(B) -80 kJ

(C) -20 kJ

(D) $+80$ kJ

Q7. The solubility product of silver chloride (AgCl) is 4×10^{-10} at 25°C. Its molar solubility s (in mol L^{-1}) is:

(A) 2×10^{-5}

(B) 4×10^{-10}

(C) 1.6×10^{-19}

(D) 2×10^{-10}

Q8. The equivalent weight of potassium permanganate ($KMnO_4$, molar mass $= 158$ g mol^{-1}) when it acts as an oxidising agent in acidic medium (n-factor $= 5$) is:

(A) 158

(B) 79

(C) 52.7

(D) 31.6

Q9. A current of 9.65 A is passed through a solution of silver nitrate for 1000 s. The mass of silver deposited (atomic mass of Ag $= 108$, 1 F $= 96500$ C) is:

(A) 10.8 g

(B) 1.08 g

(C) 108 g

(D) 21.6 g

Q10. According to the Arrhenius equation $k = A\, e^{-E_a/RT}$, at constant temperature, as the activation energy E_a of a reaction increases, the rate constant k:

(A) increases

(B) decreases

(C) remains unchanged

(D) becomes zero

Q11. When 18 g of glucose (molar mass $= 180$ g mol^{-1}) is dissolved in 178.2 g of water (molar mass $= 18$ g mol^{-1}), the relative lowering of vapour pressure of the solution is:

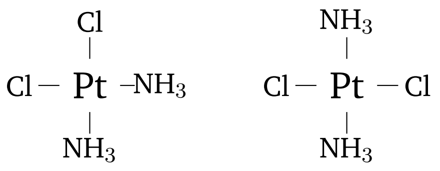
(A) 0.1

(B) 1.0

(C) 0.5

(D) 0.01

Q12. The square planar complex $[\mathrm{Pt(NH_3)_2Cl_2}]$, whose two possible arrangements are shown, exhibits which type of isomerism?



$$\begin{array}{ccc} & \mathrm{Cl} & \\ & | & \\ \mathrm{Cl}- & \mathrm{Pt} & -\mathrm{NH_3} \\ & | & \\ & \mathrm{NH_3} & \end{array} \qquad \begin{array}{ccc} & \mathrm{NH_3} & \\ & | & \\ \mathrm{Cl}- & \mathrm{Pt} & -\mathrm{Cl} \\ & | & \\ & \mathrm{NH_3} & \end{array}$$

cis trans

(A) ionisation isomerism

(B) linkage isomerism

(C) optical isomerism

(D) geometrical (cis–trans) isomerism

Q13. The gas evolved when ammonium chloride is heated with sodium hydroxide is:

(A) HCl

(B) NH_3

(C) Cl_2

(D) H_2

Q14. The lanthanide contraction (the steady decrease in atomic and ionic radii across the lanthanide series) is caused mainly by:

(A) an increase in the number of electron shells

(B) expansion of the d-orbitals

(C) the poor shielding effect of the $4f$ electrons

(D) a decrease in nuclear charge

Q15. The number of neutrons present in one atom of tritium (^3_1H) is:

(A) 2

(B) 1

(C) 0

(D) 3

Q16. The pair of compounds dimethyl ether (CH_3-O-CH_3) and ethanol (CH_3CH_2OH) is an example of:

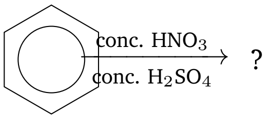
(A) geometrical isomerism

(B) optical isomerism

(C) chain isomerism

(D) functional isomerism

Q17. The product formed when benzene is treated with a mixture of concentrated nitric acid and concentrated sulphuric acid is:



(A) benzoic acid

(B) nitrobenzene

(C) aniline

(D) chlorobenzene

Q18. According to Saytzeff's rule, the dehydrohalogenation of 2-bromobutane with alcoholic KOH gives, as the major product:

(A) but-1-ene

(B) butane

(C) buta-1,3-diene

(D) but-2-ene

Q19. In the Williamson ether synthesis, diethyl ether is best prepared by the reaction of:

(A) ethanol with ethanol in the presence of conc. H_2SO_4

(B) ethene with water

(C) sodium ethoxide with bromoethane

(D) ethanol with metallic sodium

Q20. Which of the following compounds gives a positive Fehling's test (a brick-red precipitate of Cu_2O)?

(A) acetone (CH_3COCH_3)

(B) benzaldehyde (C_6H_5CHO)

(C) acetaldehyde (CH_3CHO)

(D) tert-butyl alcohol

Q21. The functional derivative of a carboxylic acid that is formed when the acid reacts with an alcohol (in the presence of acid) is:

(A) an acid chloride

(B) an ester

(C) an amide

(D) an acid anhydride

Q22. Benzene diazonium chloride couples with phenol in mildly alkaline medium to give an orange-coloured dye, which is:

(A) nitrobenzene

(B) p-hydroxyazobenzene (an azo dye)

(C) aniline

(D) chlorobenzene

Q23. The pentose sugar present in the nucleotide units of DNA is:

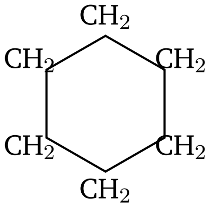
(A) ribose

(B) glucose

(C) 2-deoxyribose

(D) fructose

Q24. The IUPAC name of the saturated cyclic hydrocarbon whose carbon skeleton is shown below is:



(A) cyclohexane

(B) hexane

(C) benzene

(D) cyclopentane

Q25. In the qualitative analysis of an organic compound, the presence of sulphur is confirmed when the sodium fusion extract, on addition of sodium nitroprusside, gives:

(A) a white precipitate

(B) a deep blue colour

(C) a brick-red precipitate

(D) a violet (purple) colouration

Detailed Solutions

Q1.

Solution

Concept — Percentage composition by mass: The mass percentage of an element equals the total mass of that element in one mole of the compound divided by the molar mass, multiplied by 100.

Step 1 — Find the mass of nitrogen in one mole of urea: Urea $(\mathrm{NH_2})_2\mathrm{CO}$ contains two nitrogen atoms.

Mass of N $= 2 \times 14 = 28$ g.

Step 2 — Write the molar mass: Molar mass of urea $= 60$ g mol^{-1}.

Step 3 — Apply the formula:

$$\%\,\mathrm{N} = \frac{28}{60} \times 100.$$

Step 4 — Simplify:

$$\%\,\mathrm{N} = 46.7\%.$$

Why other options are wrong:

- Option A (23.3%): counts only one nitrogen atom $(14/60)$.
- Option C (60.0%): uses the molar mass as if it were the nitrogen mass.
- Option D (18.7%): corresponds to the mass percentage of carbon, not nitrogen.

Final Answer: Nitrogen content $= 46.7\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — de Broglie wavelength: A moving particle has an associated wavelength $\lambda = \dfrac{h}{mv}$, where h is Planck's constant, m the mass and v the velocity.

Step 1 — List the values: $h = 6.6 \times 10^{-34}$ J s, $m = 9.1 \times 10^{-31}$ kg, $v = 7.25 \times 10^{6}$ m s^{-1}.

Step 2 — Compute the denominator mv:

$$mv = (9.1 \times 10^{-31})(7.25 \times 10^{6}) = 6.6 \times 10^{-24}\ \text{kg m s}^{-1}.$$

Step 3 — Substitute into the formula:

$$\lambda = \frac{6.6 \times 10^{-34}}{6.6 \times 10^{-24}}.$$

Step 4 — Simplify:

$$\lambda = 1.0 \times 10^{-10}\ \text{m}.$$

Why other options are wrong:

- Option A (1.0×10^{-9} m): off by a factor of ten in the exponent.
- Option B (7.25×10^{-10} m): mixes the velocity value into the answer.
- Option D (6.6×10^{-34} m): just quotes Planck's constant, ignoring mv.

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

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Electron gain enthalpy: This is the energy released when an electron is added to a neutral gaseous atom; the more negative the value, the greater the tendency to accept an electron.

Step 1 — Recall the halogen trend: Electron gain enthalpy generally becomes less negative down group 17, but the very small size of fluorine causes extra electron–electron repulsion.

Step 2 — Compare fluorine and chlorine: Because of its compact $2p$ subshell, fluorine releases less energy than expected, so chlorine has the most negative electron gain enthalpy of all halogens.

Step 3 — Conclude: Chlorine (Cl) has the highest (most negative) electron gain enthalpy.

Why other options are wrong:

- Option B (F): smaller value than Cl due to inter-electronic repulsion in the small $2p$ orbital.

- Option C (Br) and Option D (I): values become less negative on moving down the group.

Final Answer: Chlorine has the highest electron gain enthalpy $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q3**

Q4.

Solution

Concept — Lone pairs on the central atom: The lone pairs equal the valence electrons of the central atom that are not used in forming sigma bonds, counted in pairs.

Step 1 — Count the valence electrons of oxygen: Oxygen has six valence electrons.

Step 2 — Subtract the bonding electrons: Oxygen forms two O–H bonds, using two of its electrons.

The remaining four electrons form two lone pairs.

Step 3 — Confirm with the shape: Two bond pairs and two lone pairs give a bent shape with a bond angle of 104.5°, as shown.

Why other options are wrong:

- Option A (1): would correspond to nitrogen in NH_3, not oxygen in water.
- Option C (0): would mean no lone pairs, giving a linear molecule.
- Option D (3): exceeds the electrons available on oxygen.

Final Answer: Water has 2 lone pairs on oxygen $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q4**

Q5.

Solution

Concept — Fajans' rules: Covalent character increases with a small, highly charged cation and a large, easily polarised anion; greater polarisation of the anion means more covalent character.

Step 1 — Compare the cations: Al^{3+} is very small and carries a high charge of $+3$.

Na^+, K^+ and Cs^+ are larger and carry only a $+1$ charge.

Step 2 — Apply the polarising power: The high charge density of Al^{3+} polarises the chloride ion strongly, distorting its electron cloud the most.

Step 3 — Conclude: $AlCl_3$ has the greatest covalent character of the four chlorides.

Why other options are wrong:

- Option B (NaCl) and Option C (KCl): singly charged cations with low polarising power, predominantly ionic.
- Option D (CsCl): the large Cs^+ has the lowest polarising power, so it is the most ionic.

Final Answer: $AlCl_3$ is the most covalent $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Gibbs energy change: The spontaneity of a process is governed by $\Delta G = \Delta H - T\Delta S$; a negative ΔG means the process is spontaneous.

Step 1 — Convert the entropy to kJ: $\Delta S = -100 \text{ J K}^{-1} = -0.100 \text{ kJ K}^{-1}$.

Step 2 — Compute the $T\Delta S$ term:

$$T\Delta S = 300 \times (-0.100) = -30 \text{ kJ}.$$

Step 3 — Substitute into the equation:

$$\Delta G = \Delta H - T\Delta S = (-50) - (-30).$$

Step 4 — Simplify:

$$\Delta G = -50 + 30 = -20 \text{ kJ}.$$

Since ΔG is negative, the reaction is spontaneous, as the diagram indicates.

Why other options are wrong:

- Option A ($+20$ kJ): wrong sign from mishandling the double negative.
- Option B (-80 kJ): adds the $T\Delta S$ term instead of subtracting it.

- Option D ($+80$ kJ): wrong sign and wrong operation.

Final Answer: $\Delta G = -20$ kJ $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — K_{sp} and molar solubility: For a salt AB that dissolves as AB $\rightarrow$ $\text{A}^+ + \text{B}^-$, if s is the molar solubility, then $K_{sp} = [\text{A}^+][\text{B}^-] = s \times s = s^2$.

Step 1 — Write the relation for AgCl:

$$K_{sp} = s^2.$$

Step 2 — Rearrange for s:

$$s = \sqrt{K_{sp}}.$$

Step 3 — Substitute the value:

$$s = \sqrt{4 \times 10^{-10}}.$$

Step 4 — Simplify:

$$s = 2 \times 10^{-5} \text{ mol L}^{-1}.$$

Why other options are wrong:

- Option B (4×10^{-10}): this is K_{sp} itself, not the solubility.
- Option C (1.6×10^{-19}): this is K_{sp}^2, an incorrect operation.
- Option D (2×10^{-10}): wrong exponent from not taking the square root properly.

Final Answer: Molar solubility $= 2 \times 10^{-5}$ mol $\text{L}^{-1} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Equivalent weight: The equivalent weight of an oxidising or reducing agent equals its molar mass divided by the n-factor (the number of electrons exchanged per formula unit).

Step 1 — Identify the n-factor: In acidic medium, MnO_4^- is reduced from Mn$(+7)$ to Mn$(+2)$, a gain of 5 electrons, so $n = 5$.

Step 2 — Write the molar mass: Molar mass of $KMnO_4 = 158$ g mol^{-1}.

Step 3 — Apply the formula:

$$\text{Equivalent weight} = \frac{158}{5}.$$

Step 4 — Simplify:

$$\text{Equivalent weight} = 31.6.$$

Why other options are wrong:

- Option A (158): uses $n = 1$, ignoring the redox change.
- Option B (79): uses $n = 2$.
- Option C (52.7): uses $n = 3$ (the value in neutral/faintly alkaline medium).

Final Answer: Equivalent weight $= 31.6 \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q8**

Q9.

Solution

Concept — Faraday's laws of electrolysis: The amount of substance deposited is proportional to the charge passed; the charge is $Q = It$, and one mole of electrons (one Faraday) deposits one equivalent of the metal.

Step 1 — Find the charge passed:

$$Q = It = 9.65 \times 1000 = 9650 \text{ C}.$$

Step 2 — Find the moles of electrons:

$$n_e = \frac{9650}{96500} = 0.1 \text{ mol}.$$

Step 3 — Relate electrons to silver: $\text{Ag}^+ + e^- \rightarrow \text{Ag}$, so 0.1 mol of electrons deposits 0.1 mol of silver.

Step 4 — Convert to mass:

$$m = 0.1 \times 108 = 10.8 \text{ g}.$$

Why other options are wrong:

- Option B (1.08 g): off by a factor of ten in the moles.
- Option C (108 g): assumes one full mole of silver.
- Option D (21.6 g): incorrectly treats silver as requiring two electrons.

Final Answer: Mass of silver deposited $= 10.8 \text{ g} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Arrhenius equation: The rate constant is $k = A\,e^{-E_a/RT}$; the exponential term controls how k responds to changes in activation energy E_a.

Step 1 — Look at the exponent: The term is $-E_a/RT$, which becomes more negative as E_a increases.

Step 2 — Interpret the exponential: A more negative exponent makes $e^{-E_a/RT}$ smaller.

Step 3 — Conclude: A smaller exponential factor gives a smaller k, so the rate constant decreases as E_a increases.

Why other options are wrong:

- Option A (increases): a higher barrier slows the reaction, it does not speed it up.
- Option C (remains unchanged): k depends directly on E_a through the exponential.
- Option D (becomes zero): k becomes very small but never exactly zero for finite E_a.

Final Answer: The rate constant decreases $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Relative lowering of vapour pressure: By Raoult's law for a non-volatile solute, the relative lowering of vapour pressure equals the mole fraction of the solute.

Step 1 — Find the moles of solute (glucose):

$$n_{\text{glucose}} = \frac{18}{180} = 0.1 \text{ mol.}$$

Step 2 — Find the moles of solvent (water):

$$n_{\text{water}} = \frac{178.2}{18} = 9.9 \text{ mol.}$$

Step 3 — Compute the mole fraction of solute:

$$x_{\text{solute}} = \frac{0.1}{0.1 + 9.9} = \frac{0.1}{10}.$$

Step 4 — Simplify:

$$x_{\text{solute}} = 0.01.$$

Why other options are wrong:

- Option A (0.1): uses moles of solute without dividing by total moles.
- Option B (1.0): would mean pure solute, which is impossible here.
- Option C (0.5): not supported by the mole calculation.

Final Answer: Relative lowering of vapour pressure $= 0.01 \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q11**

Q12.

Solution

Concept — Geometrical isomerism in complexes: A square planar complex of the type MA_2B_2 can have the two identical ligands either adjacent (cis) or opposite (trans), giving geometrical isomers.

Step 1 — Identify the geometry: $[Pt(NH_3)_2Cl_2]$ is a square planar MA_2B_2 complex.

Step 2 — Apply the cis–trans possibility: The two NH_3 ligands can lie next to each other (cis) or across the square (trans), giving two distinct isomers.

Step 3 — Conclude: The complex shows geometrical (cis–trans) isomerism.

Why other options are wrong:

- Option A (ionisation): needs an exchangeable counter-ion, which this neutral complex lacks.
- Option B (linkage): needs an ambidentate ligand such as NO_2^- or SCN^-.
- Option C (optical): this square planar complex has a plane of symmetry and is not chiral.

Final Answer: The complex shows geometrical isomerism $\Rightarrow \boxed{D}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q12

Q13.

Solution

Concept — Preparation of ammonia: An ammonium salt reacts with a strong base on heating to liberate ammonia gas.

Step 1 — Write the reaction:

$$NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3 \uparrow .$$

Step 2 — Identify the gas: The gas evolved is ammonia (NH_3), which has a pungent smell and turns moist red litmus blue.

Why other options are wrong:

- Option A (HCl): not formed; chlorine remains as sodium chloride in solution.
- Option C (Cl_2): no oxidising agent is present to release chlorine.
- Option D (H_2): hydrogen is not liberated in this acid–base type reaction.

Final Answer: The gas evolved is $NH_3 \Rightarrow \boxed{B}$

$\boxed{\text{Answer: (B)}}$ Go Back to Q13

Q14.

Solution

Concept — Lanthanide contraction: As we move across the lanthanide series, electrons enter the inner $4f$ subshell, which shields the nucleus poorly, so the effective nuclear charge felt by outer electrons rises steadily.

Step 1 — Examine the added electrons: Each new electron goes into a $4f$ orbital, which is diffuse and shields the outer electrons inefficiently.

Step 2 — Effect on nuclear pull: Because shielding is poor, the increasing nuclear charge pulls the electron cloud inward, so radii decrease slowly across the series.

Step 3 — Conclude: The contraction is caused by the poor shielding effect of the $4f$ electrons.

Why other options are wrong:

- Option A (more shells): the number of shells stays the same across the series.
- Option B (d-orbital expansion): irrelevant; the $4f$ subshell is being filled.
- Option D (decrease in nuclear charge): nuclear charge actually increases across the series.

Final Answer: Poor shielding by $4f$ electrons causes the contraction $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ Go Back to Q14

Q15.

Solution

Concept — Subatomic particles in isotopes: The number of neutrons equals the mass number minus the atomic number, neutrons $= A - Z$.

Step 1 — Read the isotope symbol: Tritium is ${}^{3}_{1}\text{H}$, so the mass number $A = 3$ and the atomic number $Z = 1$.

Step 2 — Apply the relation:

$$\text{neutrons} = A - Z = 3 - 1.$$

Step 3 — Simplify:

$$\text{neutrons} = 2.$$

Why other options are wrong:

- Option B (1): this is the number of neutrons in deuterium, not tritium.
- Option C (0): this is the case for protium ($^1_1$H).
- Option D (3): this is the mass number, not the neutron count.

Final Answer: Tritium has 2 neutrons $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q15**

Q16.

Solution

Concept — Functional isomerism: Compounds with the same molecular formula but different functional groups are functional isomers.

Step 1 — Find the molecular formula of each: Dimethyl ether CH_3-O-CH_3 has the formula C_2H_6O.

Ethanol CH_3CH_2OH also has the formula C_2H_6O.

Step 2 — Compare the functional groups: One is an ether ($-O-$) and the other is an alcohol ($-OH$); the functional groups differ.

Step 3 — Conclude: Same formula but different functional groups means they are functional isomers.

Why other options are wrong:

- Option A (geometrical) and Option B (optical): these are types of stereoisomerism, requiring restricted rotation or chirality, which are absent here.
- Option C (chain): chain isomers differ in carbon skeleton with the same functional group, which is not the case here.

Final Answer: The pair shows functional isomerism $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q16**

Q17.

Solution

Concept — Electrophilic aromatic substitution (nitration): A mixture of concentrated HNO_3 and concentrated H_2SO_4 generates the nitronium ion NO_2^+, which substitutes a ring hydrogen of benzene.

Step 1 — Generate the electrophile: H_2SO_4 protonates HNO_3, which loses water to give the nitronium ion NO_2^+.

Step 2 — Substitution on benzene: NO_2^+ attacks the aromatic ring and replaces one hydrogen atom, restoring aromaticity.

Step 3 — Name the product: The product is nitrobenzene, $C_6H_5NO_2$.

Why other options are wrong:

- Option A (benzoic acid): would require oxidation of a side chain, not nitration.
- Option C (aniline): is obtained by reduction of nitrobenzene, a later step.
- Option D (chlorobenzene): is the product of halogenation, not nitration.

Final Answer: Nitration of benzene gives nitrobenzene $\Rightarrow \boxed{B}$

Answer: (B) **Go Back to Q17**

Q18.

Solution

Concept — Saytzeff's rule: In an elimination reaction, the major alkene is the more highly substituted (more stable) one, formed by removing the hydrogen from the carbon with fewer hydrogen atoms.

Step 1 — Identify the substrate: 2-bromobutane is CH_3-$CHBr$-CH_2-CH_3.

Step 2 — Find the possible alkenes: Removing H from C-1 gives but-1-ene; removing H from C-3 gives but-2-ene.

Step 3 — Apply Saytzeff's rule: But-2-ene is more substituted (a disubstituted alkene) and therefore more stable, so it is the major product.

Why other options are wrong:

- Option A (but-1-ene): the less substituted, minor (Hofmann) product.
- Option B (butane): a reduction product, not an elimination product.

- Option C (buta-1,3-diene): would require loss of two HBr units, not available here.

Final Answer: The major product is but-2-ene $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Williamson ether synthesis: An ether is prepared by the S_N2 reaction of a sodium alkoxide with a primary alkyl halide.

Step 1 — Write the general reaction:

$$\text{R-O}^-\text{Na}^+ + \text{R}'\text{-X} \rightarrow \text{R-O-R}' + \text{NaX}.$$

Step 2 — Apply it to diethyl ether: Sodium ethoxide (C_2H_5ONa) reacts with bromoethane (C_2H_5Br) to give diethyl ether.

Step 3 — Conclude: The correct reagents are sodium ethoxide and bromoethane.

Why other options are wrong:

- Option A (ethanol with conc. H_2SO_4): this is acid dehydration, not the Williamson synthesis.
- Option B (ethene with water): this gives ethanol, not an ether.
- Option D (ethanol with sodium): this only produces sodium ethoxide and hydrogen, not the ether.

Final Answer: Sodium ethoxide + bromoethane is the Williamson route $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Fehling's test: Fehling's solution is reduced by aliphatic aldehydes to give a red precipitate of Cu_2O; ketones and aromatic aldehydes do not respond.

Step 1 — Identify which class reacts: Only an aliphatic aldehyde reduces Fehling's solution.

Step 2 — Examine the options: Acetaldehyde (CH_3CHO) is an aliphatic aldehyde, so it gives the test.

Step 3 — Conclude: Acetaldehyde produces the brick-red precipitate of cuprous oxide.

Why other options are wrong:

- Option A (acetone): a ketone, which does not reduce Fehling's solution.
- Option B (benzaldehyde): an aromatic aldehyde, which gives a negative Fehling's test.
- Option D (tert-butyl alcohol): an alcohol with no carbonyl group, so it does not respond.

Final Answer: Acetaldehyde gives a positive Fehling's test $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept — Functional derivatives of carboxylic acids: Replacing the $-$OH of a carboxylic acid with another group gives a derivative; reaction with an alcohol (esterification) replaces $-$OH by $-$OR to form an ester.

Step 1 — Write the esterification:

$$\text{R-COOH} + \text{R}'\text{-OH} \xrightarrow{\text{H}^+} \text{R-COOR}' + \text{H}_2\text{O}.$$

Step 2 — Identify the product type: The product R-COOR$'$ is an ester.

Step 3 — Conclude: A carboxylic acid reacting with an alcohol forms an ester.

Why other options are wrong:

- Option A (acid chloride): formed by treating the acid with PCl_5, PCl_3 or $SOCl_2$, not an alcohol.
- Option C (amide): formed by reaction with ammonia or an amine.
- Option D (acid anhydride): formed by loss of water between two acid molecules.

Final Answer: The product is an ester $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Diazo coupling: A diazonium salt acts as an electrophile and couples with electron-rich aromatic compounds such as phenol to form coloured azo compounds containing the $-N=N-$ linkage.

Step 1 — Identify the coupling partners: Benzene diazonium chloride ($C_6H_5N_2^+Cl^-$) is the electrophile; phenol is the electron-rich coupling partner.

Step 2 — Site of attack: Coupling occurs at the para position of phenol, giving an azo compound.

Step 3 — Name the product: The product is p-hydroxyazobenzene, an orange azo dye.

Why other options are wrong:

- Option A (nitrobenzene): contains no azo linkage and is unrelated to coupling.
- Option C (aniline): is the precursor that is diazotised, not the coupling product.
- Option D (chlorobenzene): is formed in the Sandmeyer/Gattermann reaction, not in coupling.

Final Answer: The dye is p-hydroxyazobenzene $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q22**

Q23.

Solution

Concept — Components of nucleic acids: A nucleotide is made of a nitrogenous base, a pentose sugar and a phosphate group; the sugar differs between DNA and RNA.

Step 1 — Recall the sugar in DNA: DNA contains the sugar 2-deoxyribose, which lacks the $-OH$ at the C-2 position.

Step 2 — Contrast with RNA: RNA contains ribose, which has the C-2 hydroxyl group.

Step 3 — Conclude: The pentose sugar in DNA is 2-deoxyribose.

Why other options are wrong:

- Option A (ribose): is the sugar of RNA, not DNA.
- Option B (glucose): is a metabolic sugar, not a nucleic acid component.
- Option D (fructose): is a ketohexose, not part of nucleic acids.

Final Answer: DNA contains 2-deoxyribose $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q23**

Q24.

Solution

Concept — Naming cyclic hydrocarbons: A saturated ring of carbon atoms is named by adding the prefix "cyclo" to the alkane name corresponding to the number of carbons in the ring.

Step 1 — Count the ring carbons: The skeleton shown has six CH_2 groups joined in a closed ring, so there are six carbon atoms.

Step 2 — Identify the alkane stem: Six carbons correspond to the stem "hex".

Step 3 — Add the cyclic prefix: A saturated six-membered ring is cyclohexane.

Why other options are wrong:

- Option B (hexane): is the open-chain (non-cyclic) six-carbon alkane.
- Option C (benzene): is an unsaturated aromatic ring, not a saturated one.
- Option D (cyclopentane): would have only five carbons in the ring.

Final Answer: The compound is cyclohexane $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q24**

Q25.

Solution

Concept — Detection of sulphur (Lassaigne's test): Sulphur in an organic compound is converted to sodium sulphide on fusion with sodium; sulphide ions then react with sodium nitroprusside to give a characteristic violet colour.

Step 1 — Formation of sulphide: Fusion with sodium converts organic sulphur to Na_2S, giving S^{2-} ions in the extract.

Step 2 — Reaction with sodium nitroprusside:

$$S^{2-} + [Fe(CN)_5NO]^{2-} \rightarrow [Fe(CN)_5NOS]^{4-}.$$

Step 3 — Observation: The complex formed is violet (purple), confirming the presence of sulphur.

Why other options are wrong:

- Option A (white precipitate): a halide gives a white precipitate with silver nitrate, not sulphur.
- Option B (deep blue colour): the Prussian blue colour indicates nitrogen, not sulphur.
- Option C (brick-red precipitate): not the test for sulphur; brick red is seen in other reactions.

Final Answer: Sulphur gives a violet colour with sodium nitroprusside $\Rightarrow \boxed{\text{D}}$

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