AIIMS B.Sc Nursing Chemistry

Sample Paper – 11

Duration: 36 Minutes **Maximum Marks: 30**

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry section of the **AIIMS B.Sc Nursing (Hons)** entrance.
- Each correct answer carries **+1 mark**. **1/3 mark** is deducted per incorrect answer. Unattempted questions carry **no penalty**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11–12 (NCERT)** Chemistry.
- The actual exam is conducted in **Computer Based Test (CBT)** mode.
- Use of mobile phones, calculators, or other electronic gadgets is strictly prohibited.

Q1. The number of moles present in **9.8 g** of H_2SO_4 (molar mass $= 98$ g mol^{-1}) is:

(A) 0.05 mol

(B) 0.10 mol

(C) 0.20 mol

(D) 1.00 mol

Q2. The total number of atoms present in **0.5 mol** of CO_2 is (Avogadro number $= 6.022 \times 10^{23}$):

(A) 3.011×10^{23}

(B) 6.022×10^{23}

(C) 9.033×10^{23}

(D) 1.806×10^{24}

Q3. For an electron in the **3p** orbital, the possible value of the azimuthal quantum number l is:

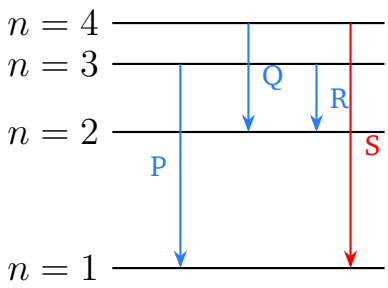
(A) 1

(B) 0

(C) 2

(D) 3

Q4. The energy-level diagram below shows electronic transitions in a hydrogen atom. The transition that emits a photon of the **highest** energy is:



(A) Transition P

(B) Transition Q

(C) Transition R

(D) Transition S

Q5. Across a period from left to right, the atomic radius of the elements generally:

(A) increases

(B) remains constant

(C) decreases

(D) first increases then decreases

Q6. The hybridisation of the carbon atom in methane (CH_4) is:

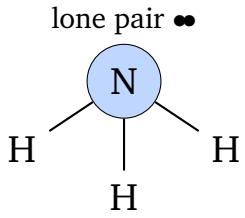
(A) sp^3

(B) sp^2

(C) sp

(D) dsp^2

Q7. The molecular shape shown below, with a central atom and three bonded atoms plus one lone pair, corresponds to the molecule:



(A) BF_3 (trigonal planar)

(B) NH_3 (trigonal pyramidal)

(C) CH_4 (tetrahedral)

(D) H_2O (bent)

Q8. Which of the following molecules is **non-polar** despite having polar bonds?

(A) H_2O

(B) NH_3

(C) HCl

(D) CO_2

Q9. At constant temperature, a gas occupies **2 L** at **1 atm**. If the pressure is increased to **4 atm**, the new volume (Boyle's law) is:

(A) 8 L

(B) 1 L

(C) 0.5 L

(D) 2 L

Q10. For a reaction to be spontaneous at all temperatures, the signs of ΔH and ΔS must respectively be:

(A) $\Delta H < 0$, $\Delta S > 0$

(B) $\Delta H > 0$, $\Delta S < 0$

(C) $\Delta H > 0$, $\Delta S > 0$

(D) $\Delta H < 0$, $\Delta S < 0$

Q11. The pH of a **0.001 M** HCl solution (a strong, fully dissociated acid) is:

(A) 2

(B) 3

(C) 4

(D) 11

Q12. For the exothermic reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$, the yield of ammonia is increased by:

(A) increasing temperature

(B) decreasing pressure

(C) adding a catalyst only

(D) increasing pressure and lowering temperature

Q13. The oxidation number of manganese in potassium permanganate, $KMnO_4$, is:

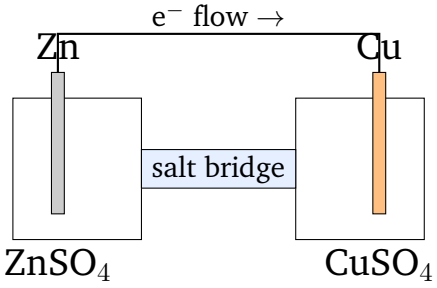
(A) $+2$

(B) $+4$

(C) $+7$

(D) $+6$

Q14. In the galvanic (Daniell) cell shown below, the electrode at which **oxidation** occurs (the anode) is:



(A) Zn electrode

(B) Cu electrode

(C) Salt bridge

(D) Both electrodes equally

Q15. For a **first-order** reaction, the half-life ($t_{1/2}$) depends on:

(A) the initial concentration only

(B) the rate constant only

(C) both rate constant and initial concentration

(D) neither

Q16. Which of the following is the most electronegative element of group 17 (halogens)?

(A) Iodine

(B) Bromine

(C) Chlorine

(D) Fluorine

Q17. Transition metals show variable oxidation states mainly because of the participation of:

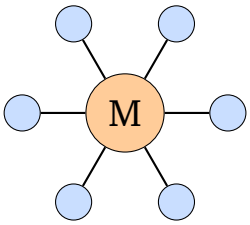
(A) only s electrons

(B) only p electrons

(C) both $(n-1)d$ and ns electrons

(D) only f electrons

Q18. The complex ion shown below, with six ligands around a central metal, has the geometry and coordination number:



6 ligands

(A) Octahedral, coordination number 6

(B) Tetrahedral, coordination number 4

(C) Square planar, coordination number 4

(D) Linear, coordination number 2

Q19. Which oxide of nitrogen is commonly known as “laughing gas”?

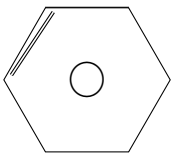
(A) NO

(B) N_2O

(C) NO_2

(D) N_2O_5

Q20. In the benzene ring shown below, the hybridisation of each carbon atom is:



benzene C_6H_6

(A) sp^3

(B) sp

(C) sp^2

(D) dsp^2

Q21. The number of structural (chain) isomers possible for butane, C_4H_{10}, is:

(A) 4

(B) 3

(C) 1

(D) 2

Q22. The addition of HBr to propene ($CH_3CH{=}CH_2$) follows Markovnikov's rule and gives mainly:

(A) 2-bromopropane

(B) 1-bromopropane

(C) 1,2-dibromopropane

(D) propane

Q23. The **+I (inductive) effect** of an alkyl group results in:

(A) withdrawal of electron density

(B) donation (release) of electron density

(C) no change in electron density

(D) formation of a double bond

Q24. Which functional group is present in ethanol, CH_3CH_2OH?

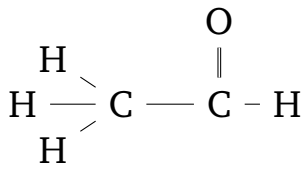
(A) Aldehyde ($-CHO$)

(B) Carboxylic acid ($-COOH$)

(C) Hydroxyl ($-OH$)

(D) Ketone ($>C{=}O$)

Q25. The compound whose structural formula is shown below is:



(A) Acetaldehyde (ethanal, CH_3CHO)

(B) Acetone (propanone)

(C) Acetic acid

(D) Ethanol

Q26. Which of the following is a **secondary** amine?

(A) CH_3NH_2

(B) $(CH_3)_3N$

(C) $C_6H_5NH_2$

(D) $(CH_3)_2NH$

Q27. The reaction of a haloalkane (R−X) with aqueous KOH gives mainly:

(A) an alkene (elimination)

(B) an alcohol (substitution)

(C) an ether

(D) an amine

Q28. Glucose and fructose are examples of:

(A) polysaccharides

(B) disaccharides

(C) monosaccharides

(D) proteins

Q29. Which of the following is a **natural** polymer?

(A) Cellulose

(B) Polythene

(C) Nylon-6,6

(D) PVC

Q30. Aspirin, a common drug, acts mainly as a(n):

(A) antibiotic

(B) antacid

(C) antiseptic

(D) analgesic (pain reliever) and antipyretic

Detailed Solutions

Q1.

Solution

Concept — Mole Concept: Number of moles = given mass ÷ molar mass.

Step 1 — Substitute the values:

$$n = \frac{9.8 \text{ g}}{98 \text{ g mol}^{-1}}$$

Step 2 — Compute:

$$n = 0.10 \text{ mol}$$

Why other options are wrong:

- 0.05, 0.20 and 1.00 mol come from dividing by the wrong factor.

Final Answer: $n = 0.10$ mol $\Rightarrow$ B

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Counting Atoms: One molecule of CO_2 contains 3 atoms (1 C + 2 O). Atoms = moles $\times N_A \times$ (atoms per molecule).

Step 1 — Molecules in 0.5 mol:

$$0.5 \times 6.022 \times 10^{23} = 3.011 \times 10^{23} \text{ molecules}$$

Step 2 — Multiply by 3 atoms each:

$$3.011 \times 10^{23} \times 3 = 9.033 \times 10^{23} \text{ atoms}$$

Why other options are wrong:

- 3.011×10^{23} counts molecules, not atoms; the others use a wrong multiplier.

Final Answer: 9.033×10^{23} atoms $\Rightarrow$ C

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Quantum Numbers: The azimuthal quantum number l defines the subshell: $s \to l = 0$, $p \to l = 1$, $d \to l = 2$, $f \to l = 3$.

Explanation: A 3p orbital is a p subshell, so $l = \mathbf{1}$. (The principal quantum number $n = 3$ does not affect l here.)

Why other options are wrong:

- $l = 0$ is for s, $l = 2$ is for d, and $l = 3$ is for f orbitals.

Final Answer: For 3p, $l = 1 \Rightarrow$ A

Answer: (A) Go Back to Q3

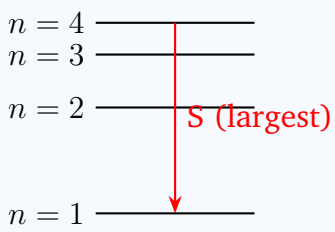
Q4.

Solution

Concept — Energy of Emission: The energy of an emitted photon equals the energy gap between the levels. The bigger the drop (and the lower the final level), the higher the photon energy.

Step 1 — Compare the transitions: P ($n = 3 \to 1$), Q ($n = 4 \to 2$), R ($n = 3 \to 2$) and S ($n = 4 \to 1$). The largest energy gap is the one that ends at $n = 1$ and starts highest.

Step 2 — Identify the largest: S is $n = 4 \to 1$, the biggest drop of all, so it emits the highest-energy photon.



Why other options are wrong:

- P, Q and R have smaller energy gaps than the full $4 \to 1$ drop.

Final Answer: Transition S ($4 \to 1$) $\Rightarrow$ D

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Periodic Trend (Atomic Radius): Across a period the nuclear charge increases while electrons fill the same shell, pulling them closer.

Explanation: The stronger nuclear pull on the same shell shrinks the atom, so atomic radius **decreases** across a period.

Why other options are wrong:

- It does not increase or stay constant; the decrease is steady, not up-then-down.

Final Answer: Atomic radius decreases across a period $\Rightarrow$ C

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Hybridisation: Count the regions of electron density (bonds + lone pairs) around the central atom.

Explanation: Carbon in CH_4 has 4 bond pairs and no lone pairs, giving 4 electron domains, which corresponds to sp^3 hybridisation (tetrahedral, $109.5°$).

Why other options are wrong:

- sp^2 is for 3 domains, sp for 2; dsp^2 is for square-planar complexes.

Final Answer: Carbon in CH_4 is $sp^3 \Rightarrow$ A

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — VSEPR Shapes: Three bond pairs + one lone pair on the central atom give a trigonal pyramidal shape.

Explanation: The figure shows a central N with three N−H bonds and one lone pair. That is **NH_3**, which is trigonal pyramidal (bond angle $\approx 107°$).

Why other options are wrong:

- BF_3 has no lone pair (trigonal planar); CH_4 has four bonds (tetrahedral); H_2O has two bonds and two lone pairs (bent).

Final Answer: The shape is that of $NH_3 \Rightarrow$ B

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Molecular Polarity: A molecule is non-polar if its bond dipoles cancel due to symmetry.

Explanation: CO_2 is linear (O=C=O); the two equal C=O dipoles point in opposite directions and cancel, so CO_2 is **non-polar**.

Why other options are wrong:

- H_2O and NH_3 are bent/pyramidal so dipoles do not cancel; HCl has a single polar bond.

Final Answer: CO_2 is non-polar $\Rightarrow$ D

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Boyle's Law: At constant temperature, $P_1V_1 = P_2V_2$.

Step 1 — Substitute:

$$(1 \text{ atm})(2 \text{ L}) = (4 \text{ atm})\, V_2$$

Step 2 — Solve:

$$V_2 = \frac{2}{4} = 0.5 \text{ L}$$

Why other options are wrong:

- 8 L would need pressure to fall; 1 L and 2 L do not satisfy $P_1V_1 = P_2V_2$.

Final Answer: $V_2 = 0.5$ L $\Rightarrow$ C

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Gibbs Free Energy: A process is spontaneous when $\Delta G = \Delta H - T\Delta S < 0$.

Explanation: If $\Delta H < 0$ (exothermic) and $\Delta S > 0$ (entropy increases), then ΔG is negative at **all** temperatures, so the reaction is always spontaneous.

Why other options are wrong:

- The other sign combinations make ΔG temperature-dependent or always positive.

Final Answer: $\Delta H < 0, \Delta S > 0 \Rightarrow$ A

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — pH of a Strong Acid: For a fully dissociated strong acid, $[\text{H}^+]$ = acid concentration, and $\text{pH} = -\log[\text{H}^+]$.

Step 1 — Hydrogen-ion concentration:

$$[\text{H}^+] = 0.001 \text{ M} = 10^{-3} \text{ M}$$

Step 2 — Compute pH:

$$\text{pH} = -\log(10^{-3}) = 3$$

Why other options are wrong:

- pH 2 and 4 use a wrong concentration; pH 11 is basic, not acidic.

Final Answer: pH $= 3 \Rightarrow$ B

Answer: (B) Go Back to Q11

Q12.

Solution

Concept — Le Chatelier's Principle: The equilibrium shifts to oppose any imposed change. The forward reaction is exothermic and reduces the number of gas molecules (4 mol $\rightarrow$ 2 mol).

Explanation: **Increasing pressure** shifts towards fewer gas moles (products), and **lowering temperature** favours the exothermic forward reaction. Both raise the ammonia yield.

Why other options are wrong:

- Increasing temperature and decreasing pressure both shift backward; a catalyst only speeds up equilibrium, it does not change yield.

Final Answer: Increase pressure, lower temperature $\Rightarrow$ D

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Oxidation Number: The sum of oxidation numbers in a neutral compound is zero. K is $+1$, O is -2.

Step 1 — Set up the equation: Let Mn $= x$.

$$(+1) + x + 4(-2) = 0$$

Step 2 — Solve:

$$x - 7 = 0 \;\Rightarrow\; x = +7$$

Why other options are wrong:

- $+2$, $+4$ and $+6$ do not balance the charges in $KMnO_4$.

Final Answer: Mn is $+7$ in $KMnO_4 \Rightarrow$ C

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Galvanic Cell: In a Daniell cell, the more reactive metal is oxidised (loses electrons) at the anode; the less reactive metal is the cathode.

Explanation: Zinc is more reactive than copper, so **Zn** is oxidised ($Zn \rightarrow Zn^{2+} + 2e^-$) and is the anode. Electrons flow from Zn to Cu through the wire, as the arrow shows.

Why other options are wrong:

- Cu is the cathode (reduction); the salt bridge only carries ions; the electrodes are not equal.

Final Answer: The Zn electrode is the anode $\Rightarrow$ A

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — First-Order Kinetics: For a first-order reaction, $t_{1/2} = \dfrac{0.693}{k}$.

Explanation: The half-life contains only the rate constant k and not the initial concentration, so it depends on **the rate constant only**.

Why other options are wrong:

- Dependence on initial concentration applies to zero- or second-order, not first-order.

Final Answer: $t_{1/2}$ depends on k only $\Rightarrow$ B

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Electronegativity Trend: Electronegativity decreases down a group. Fluorine is at the top of group 17.

Explanation: **Fluorine** is the most electronegative halogen (and the most electronegative element overall).

Why other options are wrong:

- Chlorine, bromine and iodine lie below fluorine and are less electronegative.

Final Answer: Fluorine is most electronegative $\Rightarrow$ D

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Variable Oxidation States: In transition metals the $(n-1)d$ and ns orbitals are close in energy, so electrons from both can be lost.

Explanation: Because **both** $(n-1)d$ **and** ns **electrons** take part, transition metals show several oxidation states (e.g. Fe^{2+}, Fe^{3+}).

Why other options are wrong:

- Using only s, only p, or only f electrons does not explain the variety in d-block metals.

Final Answer: Both $(n-1)d$ and ns electrons $\Rightarrow$ C

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — Coordination Geometry: The number of ligands directly bonded to the metal is the coordination number; six ligands arranged symmetrically give an octahedron.

Explanation: The figure shows six ligands around the metal, so the coordination number is **6** and the geometry is **octahedral** (e.g. $[Co(NH_3)_6]^{3+}$).

Why other options are wrong:

- Tetrahedral and square planar are coordination number 4; linear is coordination number 2.

Final Answer: Octahedral, CN $= 6 \Rightarrow$ A

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Oxides of Nitrogen: Dinitrogen oxide, N_2O, has mild anaesthetic and exhilarating effects.

Explanation: **N_2O** (nitrous oxide) is called "laughing gas" and is used as a mild anaesthetic.

Why other options are wrong:

- NO and NO_2 are toxic pollutants; N_2O_5 is an acidic anhydride of nitric acid.

Final Answer: Laughing gas is $N_2O \Rightarrow$ B

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Hybridisation in Benzene: Each carbon in benzene forms three sigma bonds (two C−C and one C−H) and contributes one electron to the de-localised π system.

Explanation: Three sigma bonds means three electron domains, so each carbon is sp^2 hybridised; the ring is planar with 120° angles.

Why other options are wrong:

- sp^3 is for four single bonds; sp for two; dsp^2 for square-planar complexes.

Final Answer: Each benzene carbon is $sp^2 \Rightarrow$ C

Answer: (C) Go Back to Q20

Q21.

Solution

Concept — Chain Isomerism: Isomers have the same molecular formula but a different arrangement of carbon atoms.

Explanation: C_4H_{10} exists as **n-butane** (straight chain) and **isobutane** (branched), so there are **2** structural isomers.

Why other options are wrong:

- 4 and 3 overcount; 1 ignores the branched form.

Final Answer: Butane has 2 isomers $\Rightarrow$ D

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Markovnikov's Rule: In the addition of HX to an unsymmetrical alkene, the H adds to the carbon already bearing more hydrogens.

Explanation: In $CH_3CH{=}CH_2$, H adds to the terminal CH_2 and Br to the middle carbon, giving **2-bromopropane** ($CH_3CHBrCH_3$).

Why other options are wrong:

- 1-bromopropane is the anti-Markovnikov product; the dibromide and propane are not formed by HBr addition.

Final Answer: The product is 2-bromopropane $\Rightarrow$ A

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Inductive Effect: The $+$I effect is the tendency of a group to push (release) electron density through sigma bonds.

Explanation: Alkyl groups are electron-releasing, so they show a $+$I effect, meaning **donation of electron density**.

Why other options are wrong:

- Electron withdrawal is the $-$I effect; the effect does change electron density and does not form double bonds.

Final Answer: $+$I effect donates electron density $\Rightarrow$ B

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Functional Groups: The functional group decides the chemical family of an organic compound.

Explanation: Ethanol, CH_3CH_2OH, contains the **hydroxyl ($-$OH)** group, so it is an alcohol.

Why other options are wrong:

- $-$CHO is aldehyde, $-$COOH is acid, $>$C=O is ketone; none of these is in ethanol.

Final Answer: Ethanol has the $-$OH group $\Rightarrow$ C

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Reading a Structure: A terminal carbon double-bonded to O and also bonded to one H is an aldehyde ($-CHO$).

Explanation: The structure is CH_3-CHO: a methyl group attached to a $-CHO$ group. That is **acetaldehyde (ethanal)**.

Why other options are wrong:

- Acetone has C=O between two carbons; acetic acid has $-COOH$; ethanol has $-OH$, not C=O.

Final Answer: The compound is acetaldehyde $\Rightarrow$ A

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Classifying Amines: A secondary amine has **two** carbon (alkyl/aryl) groups attached to the nitrogen.

Explanation: $(CH_3)_2NH$ has two methyl groups on N, so it is a **secondary** amine.

Why other options are wrong:

- CH_3NH_2 and $C_6H_5NH_2$ are primary (one group); $(CH_3)_3N$ is tertiary (three groups).

Final Answer: $(CH_3)_2NH$ is a secondary amine $\Rightarrow$ D

Answer: (D) Go Back to Q26

Q27.

Solution

Concept — Haloalkane Reactions: Aqueous KOH provides OH^- ions, which act as nucleophiles and substitute the halogen.

Explanation: $R-X + KOH(aq) \rightarrow R-OH + KX$. The product is an **alcohol** (nucleophilic substitution).

Why other options are wrong:

- Alcoholic KOH gives an alkene (elimination); ethers and amines need different reagents.

Final Answer: Aqueous KOH gives an alcohol $\Rightarrow$ B

Answer: (B) Go Back to Q27

Q28.

Solution

Concept — Classifying Carbohydrates: Monosaccharides are the simplest sugars that cannot be hydrolysed to smaller sugars.

Explanation: Glucose and fructose each have the formula $C_6H_{12}O_6$ and cannot be broken down further, so they are **monosaccharides**.

Why other options are wrong:

- Disaccharides (e.g. sucrose) hydrolyse into two units; polysaccharides are large; proteins are not sugars.

Final Answer: Both are monosaccharides $\Rightarrow$ C

Answer: (C) Go Back to Q28

Q29.

Solution

Concept — Natural vs Synthetic Polymers: Natural polymers occur in nature; synthetic polymers are made in industry.

Explanation: Cellulose is a natural polymer of glucose found in plants.

Why other options are wrong:

- Polythene, Nylon-6,6 and PVC are all man-made synthetic polymers.

Final Answer: Cellulose is a natural polymer $\Rightarrow$ A

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Drugs in Everyday Life: Drugs are classified by their action (analgesic, antibiotic, antacid, etc.).

Explanation: Aspirin (acetylsalicylic acid) relieves pain and reduces fever, so it is an **analgesic and antipyretic** (it is also an anti-inflammatory).

Why other options are wrong:

- It is not an antibiotic, an antacid, or an antiseptic.

Final Answer: Aspirin is an analgesic/antipyretic $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q30

Answer Key

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