JEE MAINS 2023 Chemistry 13 APRIL Shift 2 Question Paper with Solutions

Time Allowed :1 Hours	Maximum Marks :120	Total Questions :30

General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 30 questions. All questions are compulsory.
2. This question paper contains only one section - Chemistry
3. In all sections, Questions are multiple choice questions (MCQs) and questions carry 4 mark each.

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61. Which of the following are the Green house gases ?

(1) C and D only

(2) A and B only

(3) B and C only

(4) A and D only

Correct Answer: (2) A and B only

Solution: Green house gases are $CO_2, CH_4,$ water vapour, nitrous oxide, CFCs, and ozone. Therefore, the correct answer is A and B only.

Quick Tip

Greenhouse gases contribute to the greenhouse effect by trapping heat in the Earth's atmosphere.

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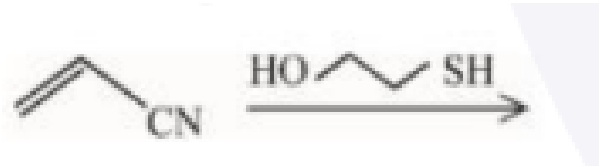
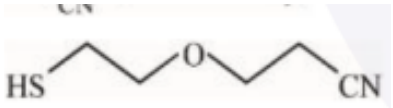
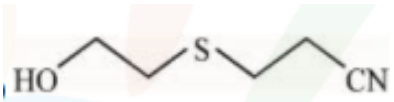
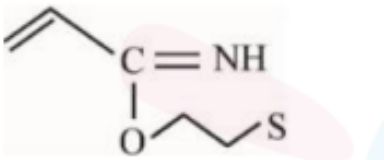
62. The major product for the following reaction is :

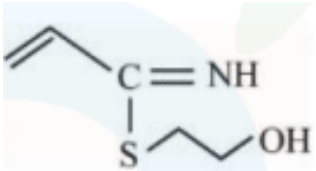
HS-CN → HO-C = NHCN

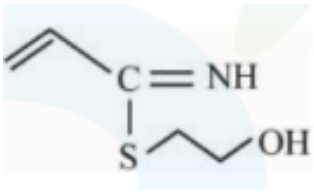


(1) (A) 

(2) (B) 

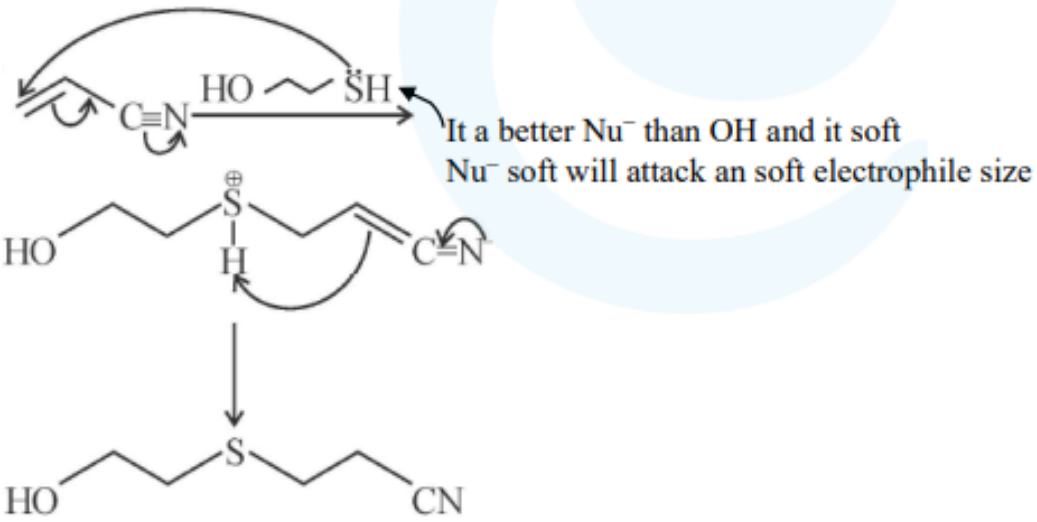
(3) (C) 

(4) (D) 



Correct Answer: (4) (D)

Solution:



In this reaction, the better nucleophile (Nu^-) attacks the softer electrophile. The SH group is a better nucleophile than OH, hence the main product is the one where the SH group replaces the OH. The reaction produces the major product as HO-SH.

Quick Tip

In nucleophilic substitution reactions, soft nucleophiles attack soft electrophiles more effectively than hard nucleophiles.

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63. In the wet tests for detection of various cations by precipitation, Ba^{2+} cations are detected by obtaining precipitate of :

(1) $Ba(OAc)_2$

(2) $BaCO_3$

(3) $BaSO_4$

(4) Ba(ox) : Barium oxalate

Correct Answer: (2) $BaCO_3$

Solution: In wet testing, $(NH_4)_2CO_3$ is used as a group reagent for detecting 5th group cations such as $Ba^{2+}, Ca^{2+}, Sr^{2+}$. The precipitation of barium carbonate, $BaCO_3$, is used to confirm the presence of Ba^{2+}. The reaction is:

$$Ba^{2+} + (NH_4)_2CO_3 \rightarrow BaCO_3 \downarrow + NH_4^+$$

Quick Tip

Barium carbonate forms a white precipitate when Ba^{2+} reacts with $(NH_4)_2CO_3$ in water.

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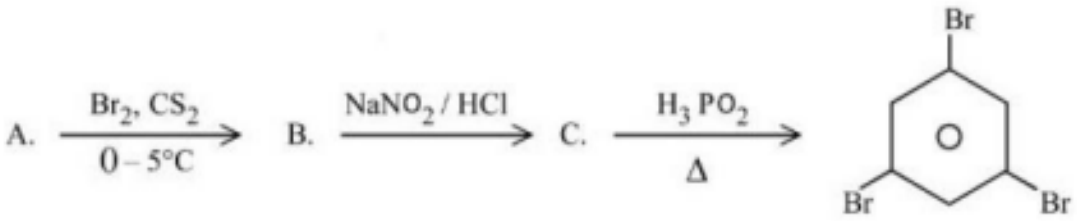
64. Compound A from the following reaction sequence is:

The reaction sequence:



(1) Phenol

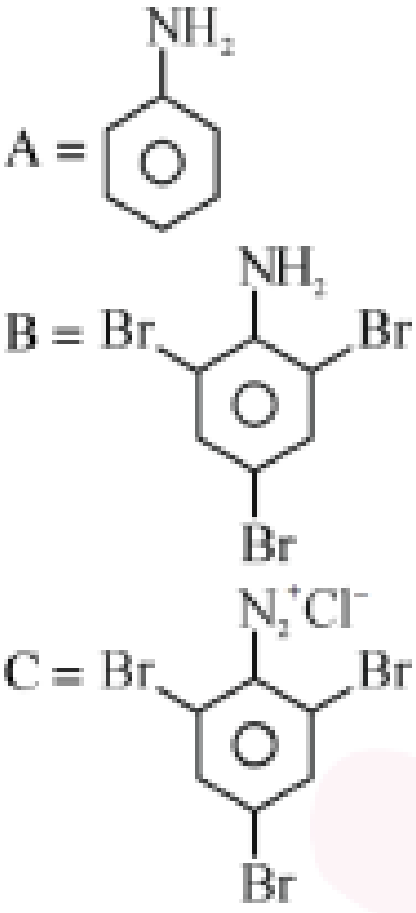
(2) Benzoic Acid

(3) Aniline

(4) Salicylic Acid

Correct Answer: (3) Aniline

Solution:



The reaction starts with bromination and proceeds through a sequence of reactions leading to

the formation of Aniline ($C_6H_5NH_2$) as shown in the sequence. The structure of compound A is shown as follows:

$$A = C_6H_4NH_2$$

Thus, the correct product is Aniline.

Quick Tip

Aniline is an aromatic amine obtained by replacing a hydrogen atom on a benzene ring with an amino group (NH_2).

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65. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Isotopes of hydrogen have almost same chemical properties, but difference in their rates of reaction.

Reason R: Isotopes of hydrogen have different enthalpy of bond dissociation.

(1) A is not correct but R is correct

(2) Both A and R are correct but R is NOT the correct explanation of A

(3) Both A and R are correct and R is the correct explanation of A

(4) A is correct but R is not correct

Correct Answer: (3) Both A and R are correct and R is the correct explanation of A

Solution: Since the isotopes have the same electronic configuration, they have almost the same chemical properties. The only difference is in their rates of reactions, mainly due to their different enthalpy of bond dissociation. Hence, both A and R are correct, and R correctly explains A.

Quick Tip

Isotopes of an element differ in mass but exhibit almost identical chemical properties, leading to differences in their reaction rates due to variations in bond dissociation energies.

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66. Given below are statements related to Ellingham diagram:

Statement I: Ellingham diagram can be constructed for oxides, sulphides and halides of metals.

Statement II: It consists of plots of ΔH_f° vs formation of oxides of elements.

(1) Statement I is correct but Statement II is incorrect

(2) Statement I is incorrect but Statement II is correct

(3) Both Statement I and Statement II are incorrect

(4) Both Statement I and Statement II are correct

Correct Answer: (1) Statement I is correct but Statement II is incorrect

Solution: Statement I is correct, since Ellingham diagrams can be constructed for the formation of oxides, sulphides, and halides of metals. Statement II is incorrect because the Ellingham diagram consists of plots of ΔG_f° vs temperature (T), not ΔH_f°.

Quick Tip

Ellingham diagrams provide valuable insights into the feasibility of reactions involving oxides, as they show the change in Gibbs free energy with temperature.

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67. Better method for preparation of BeF_2, among the following is:

(1) $BeH_4 + F_2 \rightarrow BeF_2$

(2) $Be + F_2 \rightarrow BeF_2$

(3) $(NH_3)_2BeF_4 \rightarrow BeF_2$

(4) $BeO + C + F_2 \rightarrow BeF_2$

Correct Answer: (3) $(NH_3)_2BeF_4 \rightarrow BeF_2$

Solution: As per NCERT (s block), the better method of preparation of BeF_2 is heating $(NH_3)_2BeF_4$.

$$(NH_3)_2BeF_4 \xrightarrow{heat} BeF_2 + NH_3F$$

Quick Tip

Use of ammonia complexes provides an easier route to obtain beryllium fluoride (BeF_2) by heating with ammonia.

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68. Identify the correct order of standard enthalpy of formation of sodium halides.

(1) NaCl ¡ NaBr ¡ NaI ¡ NaCl

(2) NaF ¡ NaCl ¡ NaBr ¡ NaI

(3) NaCl ¡ NaF ¡ NaBr ¡ NaI

(4) NaI ¡ NaBr ¡ NaCl ¡ NaF

Correct Answer: (4) NaI ¡ NaBr ¡ NaCl ¡ NaF

Solution: For a given metal, ΔH_f° always becomes less negative from fluoride to iodide.

Quick Tip

The enthalpy of formation tends to decrease as the halide size increases from fluoride to iodide, making fluoride the least exothermic.

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69. Which of the following complexes will exhibit maximum attraction to an applied magnetic field? (1) $[Zn(H_2O)_6]^{2+}$

(2) $[Ni(H_2O)_6]^{2+}$

(3) $[Co(en)_3]^{3+}$

(4) $[Ni(H_2O)_6]^{2+}$

Correct Answer: (4) $[Ni(H_2O)_6]^{2+}$

Solution: Complexes with maximum number of unpaired electrons will exhibit maximum attraction to an applied magnetic field. The electron configuration of $[Ni(H_2O)_6]^{2+}$ corresponds to a d^8 system, which has two unpaired electrons and thus exhibits the strongest attraction.

Quick Tip

Paramagnetic substances with unpaired electrons are more attracted to magnetic fields than diamagnetic substances.

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70. The correct group of halide ions which can be oxidized by oxygen in acidic medium is (1) Cl^-, Br^- and I^- only

(2) Br^- only

(3) Br^- and I^- only

(4) I^- only

Correct Answer: (4) I^- only

Solution: Only I among halides can be oxidized to iodine by oxygen in acidic medium, as shown by the reaction:

$$4I^-(aq) + O_2(g) \rightarrow 2I_2(s) + 2H_2O(l)$$

Quick Tip

Iodide ions are easily oxidized to iodine in acidic conditions due to their low bond dissociation energy compared to other halides.

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71. The total number of stereoisomers for the complex $[Cr(ox)_3]^{3+}$ (where ox = oxalate) is: (1) 3

(2) 1

(3) 4

(4) 2

Correct Answer: (1) 3

Solution: The complex $[Cr(ox)_3]^{3+}$ will have 3 stereoisomers as the oxalate ligand is bidentate, allowing for different spatial arrangements of the ligand around the central metal ion.

Quick Tip

Oxalate as a bidentate ligand can form chelate rings, leading to geometric isomerism.

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72. Match List I with List II I - Bromo propene is reacted with reagents in List I to give product in List II.

LIST I - Reagent LIST II - Product

(1) KOH (alc) Nitrite

(2) KCN (alc) Ester

(3) $AgNO_3$ Alkene

(4) H_2CO_3 Nitralkane

Correct Answer: (4) A-I, B-II, C-III, D-IV

Solution:

$$CH_2CH - CH_2Br + KOH(alc) \rightarrow CH_2CH = CH_2$$

$$CH_2CH - CH_2Br + KCN(alc) \rightarrow CH_2CH - CH_2CN$$

$$CH_2CH - CH_2Br + AgNO_3 \rightarrow CH_2CH - CH_2NO_3$$

$$CH_2CH - CH_2Br + H_2CO_3 \rightarrow CH_2CH - COOH$$

Quick Tip

The reaction of bromo propene with different reagents leads to the formation of various products like alkene, nitrile, ester, and nitralkane.

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73. The covalency and oxidation state respectively of boron in [BF_3] are: (1) 3 and 5

(2) 4 and 3

(3) 4 and 4

(4) 3 and 4

Correct Answer: (2) 4 and 3

Solution: The number of covalent bonds formed by boron is 4. Oxidation number of fluorine is -1. Oxidation number of Boron is $4 + 4 \times (-1) = +3$. Thus, oxidation number of boron is 3.

Quick Tip

The oxidation state of boron in BF_3 is +3 due to its bonding with three fluorine atoms.

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74. What happens when methane undergoes combustion in systems A and B respectively?

(1) System A: Temperature remains same System B: Temperature rises

(2) System A: Temperature falls System B: Temperature rises

(3) System A: Temperature falls System B: Temperature remains same

(4) System A: Temperature rises System B: Temperature remains same

Correct Answer: (4) System A: Temperature rises System B: Temperature remains same

Solution: Adiabatic boundary does not allow heat exchange thus heat generated in container can't escape out thereby increasing the temperature. In case of Diathermic container, heat flow can occur to maintain the constant temperature.

Quick Tip

Adiabatic systems do not allow heat exchange, leading to a temperature rise. Diathermic systems can exchange heat to maintain constant temperature.

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75. The naturally occurring amino acid that contains only one basic functional group in its chemical structure is:

(1) Histidine

(2) Lysine

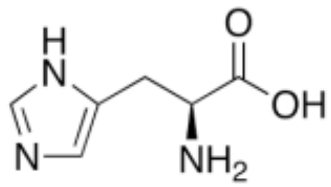
(3) Aspartic acid

(4) Arginine

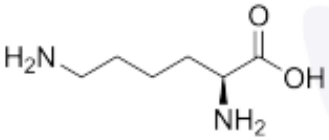
Correct Answer: (3) Aspartic acid

Solution: The naturally occurring amino acid that contains only one basic functional group in its chemical structure is Aspartic acid.

1. histidine



2. Lysine



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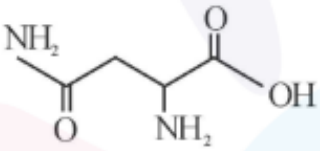
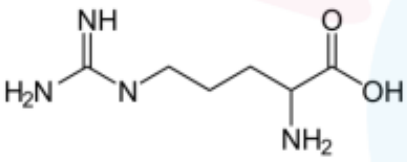


4. Arginine



Quick Tip

Aspartic acid contains one amino group (-NH_2) and one carboxyl group (-COOH) in its structure.

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76. Given below are two statements: Statement I: SO_2 and H_2O both possess V-shaped structure. **Statement II:** The bond angle of SO_2 is less than that of H_2O

(1) Both Statements I and Statement II are incorrect

(2) Both Statement I is correct but Statement II is incorrect

(3) Statement I is correct but Statement II is incorrect

(4) Statement I is incorrect but Statement II is correct

Correct Answer: (3) Statement I is correct but Statement II is incorrect

Solution: Both SO_2 and H_2O have bent molecular shapes due to the lone pairs of electrons present on oxygen. However, the bond angles are different. In SO_2, the bond angle is 119.5° due to the repulsion between the lone pairs and bonding electrons. In H_2O, the bond angle is 104.5° because of higher repulsion from the lone pairs on the oxygen atom. Therefore, statement I is correct.

However, statement II is incorrect because the bond angle of SO_2 (119.5°) is actually greater than that of H_2O (104.5°), as SO_2 has fewer lone pairs to cause more repulsion.

Quick Tip

Remember, molecules with lone pairs on the central atom generally exhibit bent shapes, but the bond angles can vary due to the number of lone pairs and electron repulsion.

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77. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R. Assertion A: The diameter of colloidal particles in solution should not be much smaller than wavelength of light to show Tyndall effect. **Reason R:** The light scatters in all direction when the size of particles is large enough.

(1) Both A and R are correct but R is NOT the correct explanation of A

(2) Both A and R are correct and R is the correct explanation of A

(3) A is false but R is true

(4) A is correct but R is false

Correct Answer: (3) A is false but R is true

Solution: Tyndall effect is observed when light passes through a colloidal solution, scattering in all directions. However, the statement in Assertion A is incorrect because colloidal particles that are too small (smaller than the wavelength of light) will not scatter light effectively, making Tyndall effect undetectable.
Statement R, however, is true because larger particles scatter light more efficiently, which is consistent with the observed Tyndall effect.

Quick Tip

For Tyndall effect to be visible, the particle size of the colloid should be comparable to the wavelength of light (about 10 nm to 1000 nm).

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78. Match List I with List II

List I	**List II**
(A) Weak intermolecular forces of attraction	(I) Hexamethylenediamine + adipic acid
(B) Hydrogen bonding	(II) $AlEt_3$ + $TiCl_4$
(C) Heavily branched polymer	(III) 2-chloro-1, 3-butadiene
(D) High density polymer	(IV) Phenol + formaldehyde

Choose the correct answer from the options given below:

(1) A-IV, B-I, C-III, D-II

(2) A-III, B-I, C-IV, D-II

(3) A-II, B-IV, C-I, D-III

(4) A-IV, B-II, C-III, D-I

Correct Answer: (2) A-III, B-I, C-IV, D-II

Solution:

Let's analyze the matches:

(A) Weak intermolecular forces of attraction: Weak intermolecular forces are characteristic of polymers formed from monomers with low polarity and minimal opportunities for strong interactions. 2-chloro-1,3-butadiene (chloroprene) polymerizes to form neoprene, a rubber with weak intermolecular forces. (A-III)

(B) Hydrogen bonding: Hexamethylenediamine reacting with adipic acid forms Nylon 6,6. Nylon 6,6 exhibits hydrogen bonding due to the presence of amide groups (-CONH-) in the polymer chain. (B-I)

(C) Heavily branched polymer: Phenol and formaldehyde react to form Bakelite, a thermosetting polymer. Bakelite is heavily cross-linked and branched, making it a rigid and infusible material. (C-IV)

(D) High-density polymer: $AlEt_3$ + $TiCl_4$ is a Ziegler-Natta catalyst. Ziegler-Natta catalysts are used to produce high-density polyethylene (HDPE), which has linear chains that can pack closely together. (D-II)

Quick Tip

Understand the relationship between monomer structure, polymer properties, and the type of intermolecular forces present. Think about the functional groups in the monomers and how they influence polymer interactions.

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79. Given below are two statements: Statement I: Tropolone is an aromatic compound and has 8π electrons. **Statement II:** The bond angle of C=O group in tropolone is involved in aromaticity.

(1) Statement I is false but Statement II is true

(2) Statement I is true but Statement II is false

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

Correct Answer: (2) Statement I is true but Statement II is false

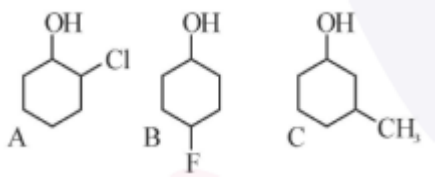
Solution: Tropolone is indeed an aromatic compound with 6π electrons (from the benzene ring), and 2π electrons from the C=O group, for a total of 8π electrons. Thus, Statement I is true. However, the bond angle of the C=O group does not contribute to the aromaticity of the compound, making Statement II false.

Quick Tip

Aromaticity in compounds depends on having a fully conjugated ring of electrons and the number of π-electrons must follow Hückel's rule: $4n + 2$.

80. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Order of acidic nature of the following compounds is A > B > C.



Reason R: Fluoro is a stronger electron withdrawing group than Chloro group.

In the light of the above statements, choose the correct answer from the options given below: (1) Both A and R are correct and R is the correct explanation of A

(2) A is false but R is true

(3) Both A and R are correct but R is NOT the correct explanation of A

(4) A is true but R is false

Correct Answer: (3) Both A and R are correct but R is NOT the correct explanation of A

Solution:

Acidic Strength: The acidic strength of a compound depends on the stability of its conjugate base. Electron-withdrawing groups (-I effect) stabilize the conjugate base, increasing acidity, while electron-donating groups (+I effect) destabilize the conjugate base, decreasing acidity.

Compound A (Chlorocyclohexanol): The chlorine atom exerts a -I effect, withdrawing electron density and stabilizing the conjugate base.

Compound B (Fluorocyclohexanol): The fluorine atom also exerts a -I effect, and fluorine is **more** electronegative than chlorine, thus a **stronger** -I effect.

Compound C (Methylcyclohexanol): The methyl group exerts a +I effect

(electron-donating), destabilizing the conjugate base, thus making it the least acidic.

Distance Effect: Importantly, the inductive effect is distance-dependent. Although fluorine is a stronger electron-withdrawing group than chlorine, the chlorine in Compound A is closer to the hydroxyl group than the fluorine in Compound B. Therefore, the -I effect is more pronounced in Compound A than in Compound B.

Order of Acidity: Thus, the order of acidity is A $>$ B $>$ C, which means Assertion A is **correct**.

Reason R: Reason R (Fluoro is a stronger electron withdrawing group than Chloro group) is also a **correct** statement. However, while fluorine **is** more electronegative, this isn't **why** A is more acidic than B in **this specific case.** The **primary** reason is the distance.

Conclusion: Both A and R are true, but R is **not** the correct explanation for A. The stronger inductive effect of fluorine is overshadowed by the distance effect.

Quick Tip

Remember that inductive effects are both substituent-dependent **and** distance-dependent. Consider both the strength of the electron-withdrawing/donating group and its proximity to the acidic center.

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81. If the formula of Borax is $Na_2B_4O_7.(OH)_2$, then x + y + z = ?

The formula of borax is $Na_2B_4O_7.(OH)_2$

(1) 17

(2) 10

(3) 9

(4) 8

Correct Answer: (1) 17

Solution: Borax has the following formula: $Na_2B_4O_7.(OH)_2$ This formula contains: - 2 sodium atoms (Na) - 4 boron atoms (B) - 7 oxygen atoms (O) - 2 hydroxyl groups (OH). Thus, adding these values gives:

$$2 + 4 + 7 + 2 = 17$$

Therefore, $x + y + z = 17$.

Quick Tip

Ensure you correctly count all atoms and functional groups in molecular formulas for accurate results.

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82. Sea water contains 29.29% NaCl and 19% $MgCl_2$ by weight of solution. The normal boiling point of the sea water is:

(1) 116°C

(2) 100°C

(3) 110°C

(4) 102°C

Correct Answer: (1) 116°C

Solution: The formula for elevation in boiling point is:

$$\Delta T_b = K_b \cdot m \cdot i$$

where K_b is the ebullioscopic constant of the solvent, m is the molality of the solute, and i is the van't Hoff factor (which accounts for the number of particles produced by the solute in solution).

Given: - K_b for water = 0.52°C·kg/mol - Molality $m = \frac{\text{mol solute}}{\text{kg solvent}}$ - The van't Hoff factor for NaCl and $MgCl_2$ are 2 and 3, respectively.

By calculating the molality and adding the corresponding changes in boiling point for each solute, we obtain:

$$\Delta T_b = 16.075C$$

Thus, the boiling point of the solution is $100C + 16.075C = 116C$.

Quick Tip

When dealing with solutions, remember to account for all solutes and their dissociation factors to correctly calculate boiling point elevation.

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83. 20 mL of 0.1 M NaOH is added to 50 mL of 0.1 M acetic acid solution. The pH of the resulting solution is:

(1) 4.76

(2) 4.58

(3) 4.30

(4) 5.00

Correct Answer: (2) 4.58

Solution: The reaction is:

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

The amount of CH_3COOH initially is 5 mmol, and NaOH added is also 5 mmol. This means all the acetic acid is neutralized by NaOH, resulting in a salt (sodium acetate) in the solution. To calculate the pH, we use the fact that sodium acetate will hydrolyze to form a basic solution:

$$CH_3COO^- + H_2O \rightarrow CH_3COOH + OH^-$$

The resulting pH is 4.58.

Quick Tip

When mixing a weak acid with a strong base, the resulting solution is basic due to the formation of the conjugate base (acetate ion).

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84. At 298 K, the standard reduction potential for Cu^{2+}/Cu electrode is 0.034 V. Given: K_a, $Cu(OH)_2 = 1 \times 10^{-9}$. The reduction potential at pH = 14 for the above couple is (X) $\times 10^{-7}$. The value of X is:

(1) 25

(2) 20

(3) 15

(4) 30

Correct Answer: (1) 25

Solution: The Nernst equation is:

$$E = E^\circ - \frac{0.059}{n} \log Q$$

For the Cu^{2+}/Cu half-cell, we have:

$$E = 0.034 - \frac{0.059}{2} \log \left(\frac{[Cu^{2+}][OH^-]^2}{[Cu][H_2O]} \right)$$

Substituting the given values and solving, we find the value of X to be 25.

Quick Tip

Make sure to consider the changes in concentration and pH when using the Nernst equation for calculating electrode potentials.

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85. Sodium metal crystallizes in a body centred cubic lattice with unit cell edge length of 4 Å. The radius of sodium atom is _____ × 10^{-10} Å (Nearest integer)

(1) 17

(2) 1.732

(3) 1.4

(4) 1.0

Correct Answer: (2) 1.732

Solution: The body-centred cubic lattice has the relation between the edge length a and the radius r as:

$$\sqrt{3}a = 4r$$

Thus, solving for r:

$$r = \frac{\sqrt{3}a}{4}$$

Given that the edge length $a = 4\,\text{Å}$, we get:

$$r = \frac{\sqrt{3} \times 4}{4} = 1.732\,\text{Å}$$

Therefore, the radius of the sodium atom is 1.732×10^{-10} m.

Quick Tip

Use the relation between edge length and radius for cubic lattices to solve problems involving unit cells.

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86. A (g) $\rightarrow$ 2B (g) + C (g) is first order reaction. The initial pressure of the system was found to be 800 mm Hg which increased to 1600 mm Hg after 10 min. The total pressure of the system after 30 min will be _____ mm Hg.

(1) 2200 mm Hg

(2) 2400 mm Hg

(3) 1800 mm Hg

(4) 2000 mm Hg

Correct Answer: (1) 2200 mm Hg

Solution: For a first-order reaction, the pressure increases as:

$$(P_A)_{\text{min}} = (P_A)_{\text{initial}} \left(\frac{1}{2}\right)^{t_1/t_2}$$

Given that $t_1 = 10\,\text{min}$ and P_A increased from 800 mm Hg to 1600 mm Hg:

$$P_{30\text{min}} = 2200\,\text{mm Hg}$$

Quick Tip

For first-order reactions, use the exponential relation between time and pressure to predict the change in system pressure.

87. 1g of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01 mol of CO_2. The molar mass of M_2CO_3 is _____ g/mol (Nearest integer).

(1) 100 g/mol

(2) 200 g/mol

(3) 250 g/mol

(4) 300 g/mol

Correct Answer: (1) 100 g/mol

Solution: From the principle of atomic conservation of carbon atoms:

$$M_2CO_3 + 2HCl \rightarrow M_2Cl_2 + CO_2 + H_2O$$

Given that 1g of M_2CO_3 yields 0.01 mol of CO_2, the molar mass of M_2CO_3 is calculated as:

$$\text{Molar mass of } M_2CO_3 = 100 \text{ g/mol}$$

Quick Tip

Apply the concept of molar mass and stoichiometry to solve problems involving reactions and mass.

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88. 0.400 g of an organic compound (X) gave 0.376 g of AgBr in Carius method for estimation of bromine. % of bromine in the compound (X) is:

(1) 40%

(2) 60%

(3) 70%

(4) 80%

Correct Answer: (1) 40%

Solution: The amount of bromine in the compound can be calculated using the mass of

AgBr formed:

$$\text{Mass of Br} = \frac{0.376\,\text{g}}{188\,\text{g/mol}} \times 80\,\text{g/mol} = 0.4\,\text{g}$$

Thus, the percentage of bromine is:

$$\frac{0.4}{0.400} \times 100 = 40\%$$

Quick Tip

When performing gravimetric analysis, always ensure to use correct stoichiometric conversions for accurate results.

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89. The orbital angular momentum of an electron in a 3s orbital is $\frac{xh}{2\pi}$. The value of x is ___ (nearest integer).

Correct Answer: 0

Solution:

The orbital angular momentum L is given by:

$$L = \sqrt{l(l+1)}\frac{h}{2\pi}$$

where l is the azimuthal quantum number. For an s orbital, $l = 0$. Therefore,

$$L = \sqrt{0(0+1)}\frac{h}{2\pi} = 0 \cdot \frac{h}{2\pi} = 0$$

Thus, $x = 0$.

Quick Tip

Remember that s orbitals have $l = 0$, p orbitals have $l = 1$, d orbitals have $l = 2$, and f orbitals have $l = 3$. The orbital angular momentum depends on the value of l.

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90. See the following chemical reaction:

$$\mathbf{Cr_2O_7^{2-}} + X\mathbf{H^+} + 6\mathbf{Fe^{2+}} \rightarrow Y\mathbf{Cr^{3+}} + 6\mathbf{Fe^{3+}} + Z\mathbf{H_2O}$$

The sum of X, Y and Z is ___ .

Correct Answer: 23

Solution:

First, balance the chemical equation:

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

From the balanced equation, we can identify the coefficients:

$$X = 14, \quad Y = 2, \quad Z = 7$$

The sum of X, Y, and Z is:

$$X + Y + Z = 14 + 2 + 7 = 23$$

Quick Tip

When balancing redox reactions, first balance the elements other than oxygen and hydrogen, then balance oxygen by adding water molecules, and finally balance hydrogen by adding H+ ions. Then, balance the charges by adding electrons.
