JEE Main 2023 Jan 30 Shift 2 Chemistry Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**300	**Total Questions :**90

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 90 questions, out of which 75 are to attempted. The maximum marks are 300.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage.
4. Each part (subject) has two sections.
   (i) Section-A: This section contains 20 multiple choice questions which have only one correct answer. Each question carries 4 marks for correct answer and –1 mark for wrong answer.
   (ii) Section-B: This section contains 10 questions. In Section-B, attempt any five questions out of 10. The answer to each of the questions is a numerical value. Each question carries 4 marks for correct answer and –1 mark for wrong answer. For Section-B, the answer should be rounded off to the nearest integer

Chemistry

Section-A

31. Which of the following reactions is correct?

(1) $2LiNO_3 \xrightarrow{\Delta} 2LiNO_2 + O_2$

(2) $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 2N_2O_4 + O_2$

(3) $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$

(4) $2LiNO_3 \xrightarrow{\Delta} 2Li + 2NO_2 + O_2$

Correct Answer: (3)

Solution:

The correct reaction for the decomposition of lithium nitrate is:

$$4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$$

This is the correct decomposition reaction of lithium nitrate. The product lithium oxide (Li_2O) and nitrogen dioxide (NO_2) are formed, along with oxygen (O_2) as a byproduct. Thus, the correct answer is:

$$\boxed{(3)}$$

Quick Tip

Remember that the decomposition of metal nitrates often leads to the formation of metal oxides, nitrogen oxides, and oxygen.

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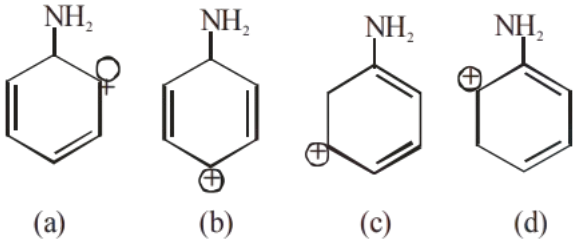
32. The most stable carbocation for the following is:



(1) c

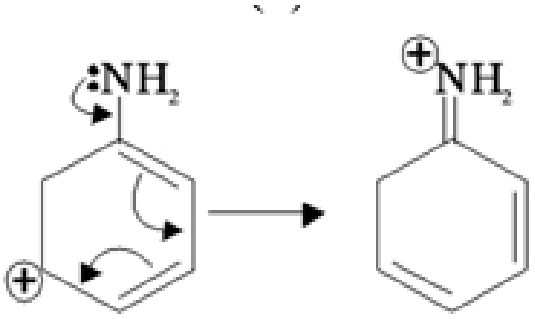
(2) d

(3) b

(4) a

Correct Answer: (1) c

Solution:



The most stable carbocation is **(c)**. The stability of the carbocation is enhanced by the +M (mesomeric) effect of the NH_2 group, which donates electron density into the ring, stabilizing the positive charge on the carbocation. In this case, the resonance structures show that the positive charge is delocalized, making this carbocation the most stable.

Thus, the correct answer is:

$$\boxed{(1)\ c.}$$

Quick Tip

When identifying the most stable carbocation, look for groups that donate electron density through resonance (+M effect), as these stabilize the positive charge.

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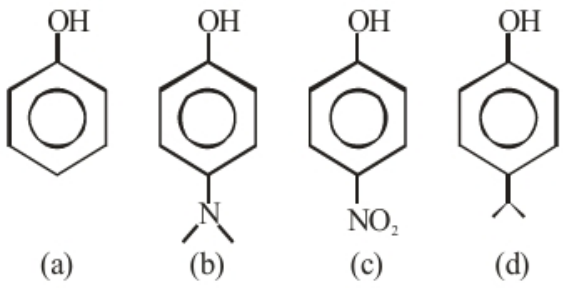
33. The correct order of pK_a values for the following compounds is:



(1) c > a > d > b

(2) b > d > a > c

(3) b > a > d > c

(4) a > b > c > d

Correct Answer: (2) b > d > a > c

Solution:

The pK_a values of compounds are influenced by the electron-donating or electron-withdrawing effects of substituents on the phenyl ring. The nitro group (NO_2) is an electron-withdrawing group and decreases the electron density on the ring, stabilizing the conjugate base and decreasing the pK_a. The amino group (NH_2) is an electron-donating group, which increases the electron density on the ring, destabilizing the conjugate base and increasing the pK_a. Therefore, the correct order of pK_a values is:

$$\boxed{b > d > a > c.}$$

Quick Tip

In aromatic compounds, electron-donating groups (like NH_2) increase the pK_a value, while electron-withdrawing groups (like NO_2) decrease the pK_a value.

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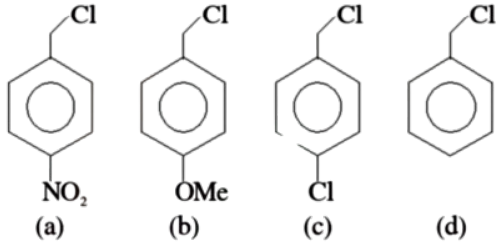
34. Decreasing order towards SN_1 reaction for the following compounds is:



(1) a > c > d > b

(2) a > b > c > d

(3) b > d > c > a

(4) d > b > c > a

Correct Answer: (3) b > d > c > a

Solution:

The rate of SN_1 reaction depends on the stability of the carbocation formed during the reaction. The stability of the carbocation follows the order:

$$OMe > Cl > NO_2.$$

This means that the compound with the methoxy group (OMe) will form the most stable carbocation, while the compound with the nitro group (NO_2) will form the least stable carbocation.

Thus, the reactivity order towards SN_1 reaction is:

$$\boxed{b > d > c > a}.$$

Quick Tip

In SN_1 reactions, the rate is primarily determined by the stability of the carbocation intermediate. The more stabilized the carbocation, the faster the reaction.

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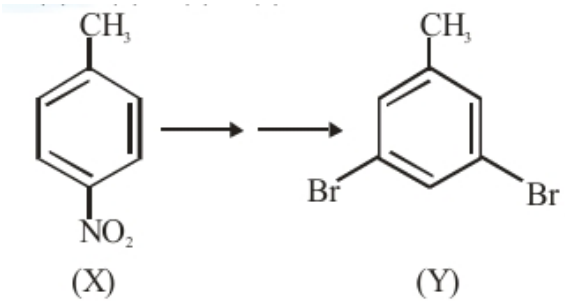
35. In the above conversion of compound (X) to product (Y), the sequence of reagents to be used will be:



(X) (Y)

(1) (i) Br_2, Fe (ii) H^+ (iii) $LiAlH_4$

(2) (i) Br_2, Fe (ii) $LiAlH_4$ (iii) H_3O^+

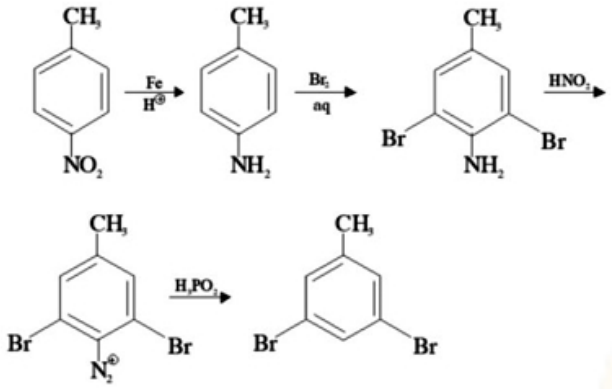
(3) (i) Fe, H^+ (ii) Br_2 (iii) HNO_2, CuBr

(4) (i) Fe, H^+ (ii) Br_2 (iii) HNO_2, H_3PO_2

Correct Answer: (4) (i) Fe, H^+ (ii) Br_2 (iii) HNO_2, H_3PO_2

Solution:

To convert compound X to Y, we need to perform a series of reactions. The first step involves the reduction of the nitro group ($-NO_2$) to a bromine atom ($-Br$).



- Step 1: The nitro group is reduced to a bromine atom using a combination of iron (Fe) and hydrochloric acid (H^+) to form a nitroso intermediate.
- Step 2: Bromination using Br_2 converts the nitroso group into a bromine atom at the position para to the existing substituent.
- Step 3: The final step involves the reduction of the intermediate using HNO_2 and H_3PO_2 to complete the formation of product Y.

Thus, the correct sequence of reagents is:

$$\boxed{(i)Fe, H^+ \quad (ii)Br_2 \quad (iii)HNO_2, H_3PO_2}$$

Quick Tip

In organic chemistry reactions, carefully consider the sequence of reagents needed for each transformation. Reductions and halogenations often require specific reagents and conditions.

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36. Maximum number of electrons that can be accommodated in shell with $n = 4$ are:

(1) 16

(2) 32

(3) 50

(4) 72

Correct Answer: (2) 32

Solution:

The maximum number of electrons that can be accommodated in a shell with principal quantum number $n = 4$ is determined by the sum of electrons in all sub-shells (s, p, d, and f) associated with that shell.

- $4s$ sub-shell can hold 2 electrons.
- $4p$ sub-shell can hold 6 electrons.
- $4d$ sub-shell can hold 10 electrons.
- $4f$ sub-shell can hold 14 electrons.

The total number of electrons that can be accommodated in shell $n = 4$ is:

$$2 + 6 + 10 + 14 = 32$$

Thus, the correct answer is:

$$\boxed{32}$$

Quick Tip

Remember that the number of electrons in each sub-shell is determined by the formula $2l + 1$ for each orbital, and the total number of electrons in the shell is the sum of the maximum electrons in all sub-shells.

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37. Match List I with List II:

	List I (Complexes)		List II (Hybridisation)
(A)	$[Ni(CO)_4]$	I	sp^3
(B)	$[Cu(NH_3)_4]^{2+}$	II	dsp^2
(C)	$[Fe(NH_3)_6]^{2+}$	III	sp^3d^2
(D)	$[Fe(H_2O)_6]^{2+}$	IV	d^2sp^3

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

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

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

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

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

Solution:

For $[Fe(NH_3)_6]^{2+}$, $\Delta_0 < P$, hence the pairing of electrons does not occur in t_{2g}. Therefore, the complex is outer orbital and its hybridisation is sp^3d^2.

List I (Complexes)	List II (Hybridisation)
(A) $[Ni(CO)_4]$	sp^3
(B) $[Cu(NH_3)_4]^{2+}$	dsp^2
(C) $[Fe(NH_3)_6]^{2+}$	sp^3d^2
(D) $[Fe(H_2O)_6]^{2+}$	sp^3d^2

Thus, the correct match is:

A - I, B - II, C - IV, D - III.

Quick Tip

In coordination chemistry, hybridisation can be determined by the electron pairing and the nature of the metal's orbitals. Outer orbital complexes typically have sp^3d^2 hybridisation.

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38. The Cl - Co - Cl bond angle values in a fac $-$ $[Co(NH_3)_3Cl_3]$ complex is/are:

(1) 90° & 180°

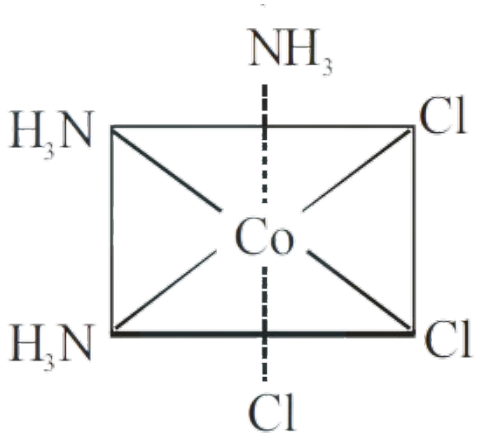
(2) 90°

(3) 180°

(4) 90° & 120°

Correct Answer: (2) 90°

Solution:



The Cl - Co - Cl bond angle in the given octahedral complex is 90°. This is because in a fac – $[Co(NH_3)_3Cl_3]$ complex, the ligands are arranged in a way that the bond angle between the Cl atoms is 90°, which is typical for octahedral coordination complexes.

Thus, the correct answer is:

(2) 90°.

Quick Tip

In octahedral complexes, the bond angle between ligands on the same face is typically 90°.

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39. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: $CH3COOH$ can be easily reduced using Zn-Hg/HCl to $CH3CH2OH$.

Reason R: Zn-Hg/HCl is used to reduce carbonyl group to $-CH2-$ group.

In the light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true

(2) A is true but R is false

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

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

Correct Answer: (2) A is true but R is false

Solution:

Assertion A is correct: Acetic acid ($CH3COOH$) can indeed be reduced to ethanol ($CH3CH2OH$) using Zn-Hg/HCl, a process known as Clemmensen reduction.
Reason R is incorrect: While it is true that Zn-Hg/HCl is used to reduce a carbonyl group, it specifically reduces the carbonyl group in aldehydes and ketones, not esters or carboxylic acids like acetic acid.
Thus, the correct answer is:

(2) A is true but R is false.

Quick Tip

Zn-Hg/HCl reduces carbonyl groups in aldehydes and ketones but does not work well for carboxylic acids or esters.

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40. Chlorides of which metal are soluble in organic solvents:

(1) Ca

(2) Mg

(3) K

(4) Be

Correct Answer: (4) Be

Solution:

Beryllium chloride ($BeCl_2$) is soluble in organic solvents because it has a covalent nature. Unlike other alkaline earth metal chlorides, $BeCl_2$ forms a covalent bond that is readily soluble in organic solvents.
Thus, the correct answer is:

(4) Be.

Quick Tip

Metal chlorides that exhibit covalent bonding tend to be soluble in organic solvents.

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41. Given below are two statements: One is labelled as Assertion A and the other labelled as Reason R.

Assertion A: Antihistamines do not affect the secretion of acid in stomach. Reason R: Antiallergic and antacid drugs work on different receptors.

In the light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true

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

(3) A is true but R is false

(4) Both A and R are true but R is not the correct explanation of A

Correct Answer: (2) Both A and R are true and R is the correct explanation of A

Solution:

- Assertion A is true because antihistamines primarily block histamine receptors and do not directly affect acid secretion in the stomach. - Reason R is also true, as antihistamines and antacids work on different receptors. Antihistamines block histamine receptors, while antacids neutralize stomach acid by altering the pH.

Thus, the correct answer is:

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

Quick Tip

Antihistamines and antacids work on different receptors, with antihistamines blocking histamine receptors and antacids affecting the stomach's acidity.

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42. The wave function (Ψ) of 2s is given by

$$\Psi_{2s} = \frac{1}{2\sqrt{2\pi}} \left(\frac{1}{a_0}\right)^{1/2} \left(2 - \frac{r}{a_0}\right) e^{-r/2a_0}$$

At $r = r_0$, a radial node is formed. Thus, r_0 in terms of a_0 is:

(1) $r_0 = a_0$

(2) $r_0 = 4a_0$

(3) $r_0 = \frac{a_0}{2}$

(4) $r_0 = 2a_0$

Correct Answer: (4) $r_0 = 2a_0$

Solution:

At the node, the wave function $\Psi_{2s} = 0$. Thus,

$$2 - \frac{r_0}{a_0} = 0$$
$$\Rightarrow \frac{r_0}{a_0} = 2$$
$$\Rightarrow r_0 = 2a_0$$

Thus, the correct answer is:

$$\text{(4) } r_0 = 2a_0$$

Quick Tip

The radial node is the point where the wave function $\Psi_{2s} = 0$. At this point, you can solve for r_0 by setting the wave function equal to zero.

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43. $KMnO_4$ oxidises I^- in acidic and neutral/faintly alkaline solution, respectively to:

(1) I_2 & IO_3^-

(2) IO_3^- & I_2

(3) IO_3^- & IO_3^-

(4) I_2 & I_2

Correct Answer: (1) I_2 & IO_3^-

Solution:

In acidic medium:

$$2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$$

In neutral/faintly alkaline solution:

$$2MnO_4^- + I^- + H_2O \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$

Thus, the correct answer is:

$$(1)\ I_2 \& IO_3^-$$

Quick Tip

$KMnO_4$ acts as a strong oxidizing agent and can oxidize iodide ions to iodine (I_2) in acidic solution, while in neutral/alkaline solution, iodide gets oxidized to iodate (IO_3^-).

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44. Bond dissociation energy of E–H bond of the "H_2E" hydrides of group 16 elements (given below), follows order.

(A) O

(B) S

(C) Se

(D) Te

(1) A > B > C > D

(2) A > B > C > D

(3) B > A > C > D

(4) D > C > B > A

Correct Answer: (1) A > B > C > D

Solution:

Bond dissociation energy of E–H bond in hydrides follows the trend:

$$\text{O–H} > \text{S–H} > \text{Se–H} > \text{Te–H}$$

Thus, the correct order is:

$$(1)\ \text{A} > \text{B} > \text{C} > \text{D}$$

Quick Tip

The bond dissociation energy of E–H bond decreases as we move down the group in the periodic table. This is because the atomic size increases and the bond strength decreases.

45. The water quality of a pond was analysed and its BOD was found to be 4. The pond has:

(1) Highly polluted water

(2) Water has high amount of fluoride compounds

(3) Very clean water

(4) Slightly polluted water

Correct Answer: (3) Very clean water

Solution:

BOD (Biochemical Oxygen Demand) is a measure of the amount of oxygen consumed by microorganisms in the breakdown of organic matter.

A BOD value of 0-5 indicates very clean water, as there is little organic matter to decompose.

A BOD of 6-15 indicates moderately polluted water.

A BOD higher than 15 suggests highly polluted water.

Since the BOD is 4, it indicates very clean water.

Thus, the correct answer is:

(3) Very clean water

Quick Tip

A lower BOD value means less pollution in the water, indicating better water quality. BOD is an important parameter for assessing the ecological health of water bodies.

46. Match List I with List II:

	List I (Mixture)		List II (Separation Technique)
(A)	$CHCl_3 + C_6H_5NH_2$	I	Steam distillation
(B)	$C_6H_{14} + C_5H_{12}$	II	Differential extraction
(C)	$C_6H_5NH_2 + H_2O$	III	Distillation
(D)	Organic compound in H_2O	IV	Fractional distillation

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

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

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

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

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

Solution:

- **(A) $CHCl_3$ + $C_6H_5NH_2$:** The mixture consists of chloroform and aniline, which can be separated by **distillation**.
- **(B) C_6H_14 + C_5H_12:** The mixture consists of alkanes, which can be separated by **fractional distillation**.
- **(C) $C_6H_5NH_2$ + H_2O:** Aniline and water can be separated by **steam distillation**.
- **(D) Organic compound in H_2O:** This mixture can be separated by **differential extraction**.

Thus, the correct answer is:

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

Quick Tip

Different separation techniques are used based on the nature of the mixtures such as boiling points or solubility.

47. Boric acid in solid, whereas BF_3 is gas at room temperature because of:

(1) Strong ionic bond in Boric acid

(2) Strong van der Waal's interaction in Boric acid

(3) Strong hydrogen bond in Boric acid

(4) Strong covalent bond in BF_3

Correct Answer: (3) Strong hydrogen bond in Boric acid

Solution:

- Boric acid (B_2O_3) has strong hydrogen bonding between its molecules, which makes it a solid at room temperature.
- BF_3, on the other hand, has covalent bonds and does not exhibit strong hydrogen bonding, which makes it a gas at room temperature.

Thus, the correct answer is:

(3) Strong hydrogen bond in Boric acid.

Quick Tip

In substances like boric acid, hydrogen bonding plays a key role in determining whether the substance is a solid or a gas at room temperature.

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48. Given below are two statements:

Statement I: During Electrolytic refining, the pure metal is made to act as anode and its impure metallic form is used as cathode.

Statement II: During the Hall-Heroult electrolysis process, purified Al_2O_3 is mixed with Na_3AlF_6 to lower the melting point of the mixture.

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

(2) Both Statement I and Statement II are incorrect

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

(4) Both Statement I and Statement II are correct

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

Solution:

In Electrolytic refining, the pure metal is used as cathode and impure metal is used as anode. Na_3AlF_6 is added during electrolysis of Al_2O_3 to lower the melting point and increase conductivity.

Quick Tip

In electrolytic refining, the pure metal acts as cathode, while the impure metal is used as anode.

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49. Formulae for Nessler's reagent is:

(1) $KHgI_2$

(2) $KHgI_3$

(3) K_2HgI_4

(4) HgI_2

Correct Answer: (3) K_2HgI_4

Solution:

Nessler's reagent is K_2HgI_4.

Quick Tip

Nessler's reagent is a solution of potassium tetraiodomercurate(II), used in analytical chemistry.

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50. 1 L, 0.02 M solution of $[Co(NH_3)_5SO_4]Br$ is mixed with 1 L, 0.02 M solution of $[Co(NH_3)_5Br]SO_4$. The resulting solution is divided into two equal parts (X) and treated with excess $AgNO_3$ solution and $BaCl_2$ solution respectively as shown below:

1 L Solution (X) + $AgNO_3$ solution (excess) $\rightarrow Y$

1 L Solution (X) + $BaCl_2$ solution (excess) $\rightarrow Z$ The number of moles of Y and Z respectively are:

(1) 0.02, 0.02

(2) 0.01, 0.01

(3) 0.02, 0.01

(4) 0.01, 0.02

Correct Answer: (2) 0.01, 0.01

Solution:

$$[\text{Co}(NH_3)_5SO_4]\,Br + \text{AgNO}_3 \rightarrow \text{AgBr}\downarrow$$

$$0.01 \text{ mol} \quad \text{excess} \quad 0.01 \text{ Mol}$$

$$[\text{Co}(NH_3)_5Br]\,SO_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4\downarrow$$

$$0.01 \text{ mol} \quad \text{excess} \quad 0.01 \text{ Mol}$$

Thus, the correct answer is 0.01 moles for both Y and Z.

Quick Tip

When mixing solutions with different compounds, stoichiometry can be used to calculate the number of moles of the resulting products formed.

SECTION-B

51. 1 mole of ideal gas is allowed to expand reversibly and adiabatically from a temperature of 27°C. The work done is 3 kJ mol^{-1}. The final temperature of the gas is ..... K (Nearest integer). Given $C_v = 20$ J mol^{-1} K^{-1}.

Correct Answer: (1) 150

Solution:

For an adiabatic process, $q = 0$, so $\Delta U = w$.

The equation for work done:

$$w = C_v \Delta T$$

Where $C_v = 20\,\text{J mol}^{-1}\,\text{K}^{-1}$.

$$w = 3\,\text{kJ mol}^{-1} = 3000\,\text{J mol}^{-1}$$

$$\Delta U = w = 3000\,\text{J mol}^{-1}$$

Using the equation for change in temperature:

$$1 \times 20 \times [T_2 - 300] = -3000$$

$$T_2 - 300 = -150$$

$$T_2 = 150\,\text{K}$$

Thus, the final temperature of the gas is 150 K.

Quick Tip

In adiabatic processes, the work done is equal to the change in internal energy, and you can use this to calculate the final temperature of a gas.

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52. Iron oxide FeO, crystallises in a cubic lattice with a unit cell edge length of 5.0Å. If density of the FeO in the crystal is 4.0 g cm^{-3}, then the number of FeO units present per unit cell is ..... (Nearest integer)

Correct Answer: (4) 8

Solution:

We can use the formula to calculate the number of units per unit cell:

$$d = \frac{Z \times M}{N_0 \times a^3}$$

Where:

$d = 4.0\,\text{g cm}^{-3}$ (density)

M = molar mass of FeO $= 56 + 16 = 72\,\text{g mol}^{-1}$

$N_0 = 6.022 \times 10^{23}\,\text{mol}^{-1}$ (Avogadro's number)

$a = 5.0\,\text{Å} = 5.0 \times 10^{-8}\,\text{cm}$ (edge length)

Substituting into the formula:

$$4.0 = \frac{Z \times 72}{6.022 \times 10^{23} \times (5.0 \times 10^{-8})^3}$$

Solving this:

$$Z \approx 8$$

Thus, the number of FeO units per unit cell is 8.

Quick Tip

For cubic lattice structures, use the density formula along with the edge length of the unit cell and molar mass to calculate the number of units per unit cell.

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53. An organic compound undergoes first order decomposition. If the time taken for the 60% decomposition is 540 s, then the time required for 90% decomposition will be ..... s. (Nearest integer).

Correct Answer: (1350)

Solution:

The formula for first-order decomposition is:

$$\frac{t_1}{t_2} = \frac{\ln \frac{a_0}{0.4a_0}}{\ln \frac{a_0}{0.1a_0}}$$

Given that time taken for 60

$$540 \div t_2 = \frac{\ln \frac{10}{4}}{\ln 10}$$

Simplifying the logarithmic expressions:

$$540 \div t_2 = \frac{\log 10 - \log 4}{\log 10} = 1 - 0.6 = 0.4$$

Thus:

$$t_2 = \frac{540}{0.4} = 1350\,\text{sec}$$

Quick Tip

For first-order reactions, the time required for a specific percentage of decomposition can be calculated using the logarithmic relation between concentrations at different times.

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54. Lead storage battery contains 38% by weight solution of H_2SO_4. The van't Hoff factor is 2.67 at this concentration. The temperature in Kelvin at which the solution in the battery will freeze is ..... (Nearest integer).

Correct Answer: (243)

Solution:

The formula for freezing point depression is:

$$\Delta T_f = iK_f m$$

Given that:

$$i = 2.67, \quad K_f = 1.8\,\text{K kg mol}^{-1}, \quad \text{weight fraction of } H_2SO_4 = 38\%$$

$$m = \frac{\text{weight}}{\text{molar mass}} = \frac{38}{98} \times \frac{1000}{62}$$

Thus:

$$\Delta T_f = 2.67 \times 1.8 \times \frac{38 \times 1000}{98 \times 62} = 30.05$$

Therefore, the freezing point is:

$$\text{F.P.} = 273 - 30.05 = 243\,\text{K}$$

Quick Tip

For calculating freezing point depression, remember to use the molality of the solution and the van't Hoff factor.

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55. Consider the following equation: $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$, $\Delta H = -190$ kJ The number of factors which will increase the yield of SO_3 at equilibrium from the following is .....

Correct Answer: (3)

Solution:

The yield of SO_3 at equilibrium will increase by:

- **B. Increasing pressure** – According to Le Chatelier's principle, increasing the pressure will shift the equilibrium towards the side with fewer moles of gas (the right side in this case).
- **C. Adding more SO_2** – Adding more reactant shifts the equilibrium towards the product side.
- **D. Adding more O_2** – Similarly, adding more O_2 will also shift the equilibrium to produce more SO_3.

Thus, the correct answer is:

(3) B, C, D

Quick Tip

In equilibrium problems, use Le Chatelier's principle to predict how changing conditions like temperature, pressure, or concentration affect the position of equilibrium.

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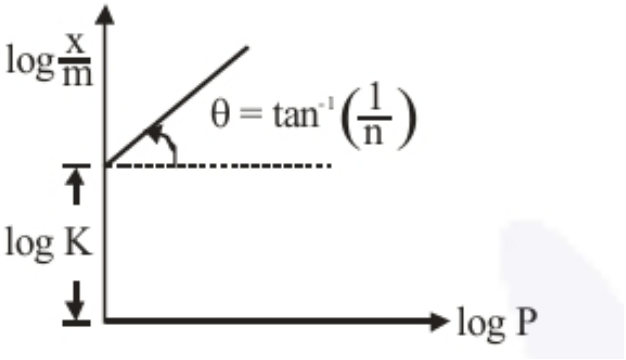
56. The graph of $\log \frac{x}{m}$ vs $\log p$ for an adsorption process is a straight line inclined at an angle of 45° with intercept equal to 0.6020. The mass of gas adsorbed per unit mass of adsorbent at the pressure of 0.4 atm is ..... $\times 10^{-1}$ (Nearest integer).

Correct Answer: (16)

Solution:



The equation for the adsorption process is given by:

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log P$$

Where:

- $\theta = \tan^{-1}\left(\frac{1}{n}\right)$
- $\log k = 0.6020$ which gives $\log k = \log 4$
- $n = \tan 45^\circ = 1$
- $\log K = 0.6020 = \log 4$

Thus, we have:

$$K = 4$$

The equation becomes:

$$\frac{x}{m} = K \cdot P^{1/n}$$

Substituting the values:

$$\frac{x}{m} = 4 \cdot (0.4) = 1.6$$

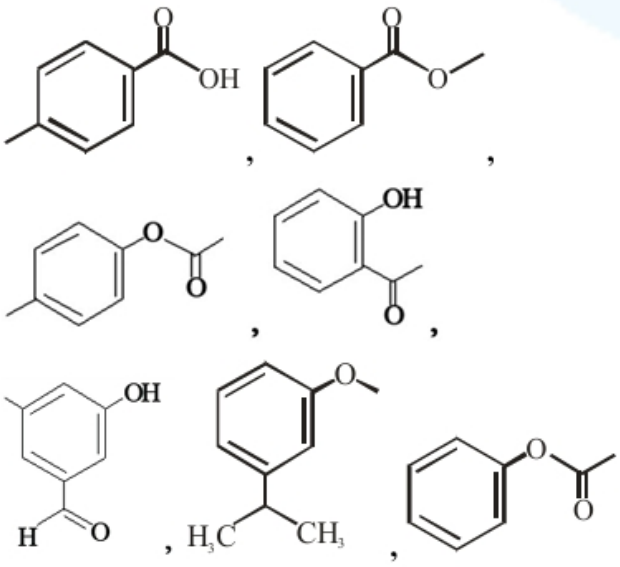
Therefore, the mass of gas adsorbed is:

$$\frac{x}{m} = 1.6 \times 10^{-1}$$

Quick Tip

In adsorption problems, remember that the relationship between $\log \frac{x}{m}$ and $\log P$ is linear, and use the given intercept and slope to find the constants.

57. Number of compounds from the following which will not dissolve in cold $NaHCO_3$ and NaOH solutions but will dissolve in hot NaOH solution is .....



Correct Answer: (3)

Solution: The compounds that will not dissolve in cold $NaHCO_3$ and NaOH solutions but will dissolve in hot NaOH solution are:

- Compound 2, 3, and 7.

Thus, the correct number of compounds is 3.

Quick Tip

In acid-base reactions, phenolic compounds and carboxylic acids may dissolve in NaOH only when the solution is hot. This is due to the increased solubility of the conjugate base in hot NaOH.

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58. A short peptide on complete hydrolysis produces 3 moles of glycine (G), two moles of leucine (L) and two moles of valine (V) per mole of peptide. The number of peptide linkages in it are .....

Correct Answer: (6)

Solution: Number of peptide linkage = (amino acid - 1)

$$= 7 - 1 = 6$$

Quick Tip

To calculate the number of peptide linkages, subtract 1 from the number of amino acids in the peptide chain.

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59. The strength of 50 volume solution of hydrogen peroxide is ..... g/L (Nearest integer). Given: Molar mass of H_2O_2 is 34 g mol^{-1} Molar volume of gas at STP = 22.7 L

Correct Answer: (150)

Solution: Molarity = $\frac{50}{11.35}$

$$\text{Strength in gm/L} = \frac{50}{11.35} \times 34 = 150\,\text{g/L}$$

Quick Tip

The strength of a volume solution of hydrogen peroxide can be calculated using its molarity and molar mass.

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60. The electrode potential of the following half cell at 298 K.

$$X|X^{2+}(0.001M) \parallel Y^{2+}(0.01M)|Y$$

is ..... $\times 10^{-2}$V (Nearest integer).

Given: $E^0_{X^{2+}|X} = -2.36\,\text{V}$ $E^0_{Y^{2+}|Y} = +0.36\,\text{V}$

$$\frac{2.303RT}{F} = 0.06\,\text{V}$$

Correct Answer: (275)

Solution:

$$X + Y^{2+} \rightarrow Y + X^{2+}$$

$$E^0_{cell} = 0.36 - (-2.36) = 2.72\,\text{V}$$

Now, applying the Nernst equation:

$$E_{cell} = 2.72 - \frac{0.06}{2} \log \frac{0.001}{0.01}$$

$$E_{cell} = 2.72 + 0.03 = 2.75\,\text{V}$$

Thus, the electrode potential is:

$$= 275 \times 10^{-2}\,\text{V}$$

Quick Tip

To calculate the electrode potential, use the Nernst equation, considering the concentrations of ions and their standard electrode potentials.
