JEE Main 2024 Chemistry Question Paper April 9 Shift 2

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

1. Write the increasing order of adjacent bond angle among the following species: PF_3, BF_3, ClF_3

(A) ClF_3 ¡ BF_3 ¡ PF_3
(B) ClF_3 ¡ PF_3 ¡ BF_3
(C) PF_3 ¡ BF_3 ¡ ClF_3
(D) PF_3 ¡ ClF_3 ¡ BF_3

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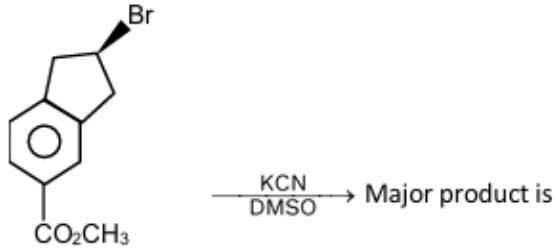
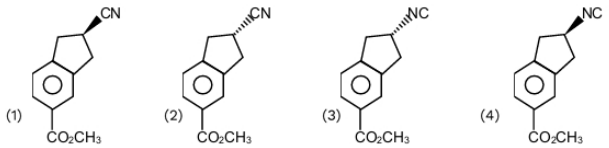
2. The major product formed when the following bromo compound reacts with KCN in DMSO is:





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3. Find the total number of electrons in π of the following species: O_2^+, O_2, O_2^-

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4. Correct electronic configuration for (Z = 99) will be

(A) [Rn] $5f^{10}$ $7s^2$
(B) [Rn] $5f^{11}$ $7s^2$
(C) [Rn] $5f^{12}$ $7s^1$
(D) [Rn] $5f^{12}$ $7s^2$

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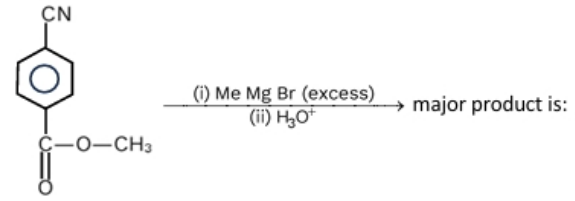
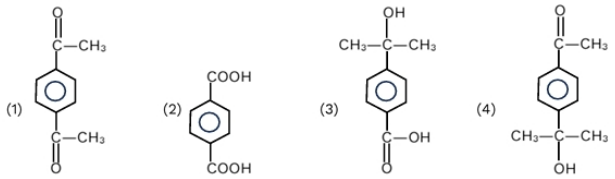
5. The major product formed when the compound reacts with (i) MeMgBr (excess), (ii) H_3O^+ is:





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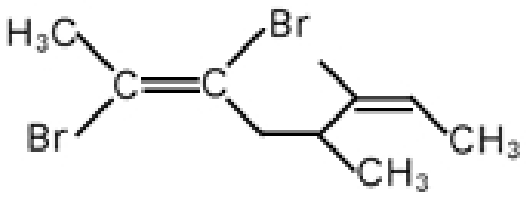
6. Total number of stereoisomers of the given compound is:



(A) 6
(B) 8
(C) 10
(D) 4

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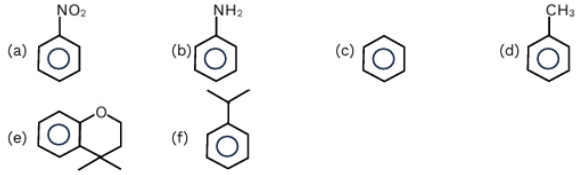
7. Friedel–Crafts reaction is <u>not</u> given by how many of the following compounds?



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8. Match the complexes in List-I with their correct hybridisation in List-II:

List–I (Complex)
(P) [Ni(CO)_4]
(Q) [Co(NH_3)_6]Cl_3
(R) K_2[Ni(CN)_4]
(S) [CoF_6]$\hat{3}$-

List–II (Hybridisation)
(1) dsp$\hat{2}$
(2) sp$\hat{3}$
(3) d$\hat{2}$sp$\hat{3}$
(4) sp$\hat{3}$d$\hat{2}$

(1) P $\rightarrow$ 2; Q $\rightarrow$ 3; R $\rightarrow$ 1; S $\rightarrow$ 4
(2) P $\rightarrow$ 3; Q $\rightarrow$ 2; R $\rightarrow$ 1; S $\rightarrow$ 4
(3) P $\rightarrow$ 4; Q $\rightarrow$ 2; R $\rightarrow$ 1; S $\rightarrow$ 3
(4) P $\rightarrow$ 2; Q $\rightarrow$ 3; R $\rightarrow$ 4; S $\rightarrow$ 1

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9. Match the elements in List-I with their correct electronic configurations in List-II:

List–I (Element)
(P) S

(Q) N
(R) Kr
(S) Ar

List–II (Electronic configuration)
(1) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$
(2) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6$
(3) $1s^2\ 2s^2\ 2p^3$
(4) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

(1) P → 3; Q → 1; R → 4; S → 2
(2) P → 1; Q → 4; R → 2; S → 3
(3) P → 1; Q → 3; R → 4; S → 2

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10. Stability order of the given resonating structures:

(I) CH_3 – CH = CH – C(=O) – CH_3
(II) CH_3 – CH = CH – C^+ – O^- – CH_3
(III) CH_3 – CH – CH = C^- – O^+ – CH_3

(1) I ¿ II ¿ III
(2) III ¿ II ¿ I
(3) I ¿ III ¿ II
(4) I ¿ II = III

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11. Sc, Ti, V, Cr, Mn. Find magnetic moment of M^+ whose element has maximum second ionisation energy.

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12. Ca^{2+} makes which type of complex with EDTA:

(1) Trigonal bipyramidal
(2) Square planar
(3) Tetrahedral

(4) Octahedral

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13. Which option is incorrect?

(1) Glucose is Aldohexose
(2) Glucose has many isomeric forms in aqueous medium
(3) Glucose is soluble in H_2O due to presence of aldehyde functional group
(4) Glucose is a reducing sugar

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14. Fuming sulphuric acid has how many oxygen atoms?

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15. Positive Tollen's Test is given by:

(I) Acetone (II) Formaldehyde (III) Formic acid (IV) Acetic acid (V) Benzaldehyde

(1) All of the above
(2) II, III & V
(3) I, II & III
(4) II, III & IV

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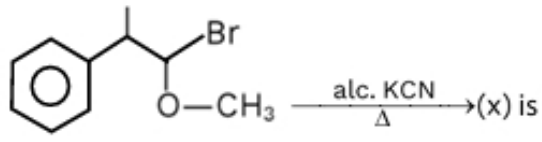
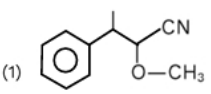
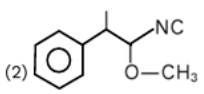
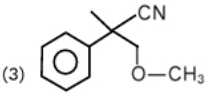
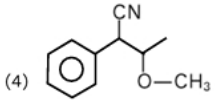
16. The reaction of the given compounds with alc. KCN gives which product (x)?



(1) 

(2) 

(3) 

(4) 

Solution:

Step 1: Understand the reaction.
When an aromatic halide (in this case, bromobenzene) reacts with alcoholic potassium cyanide (KCN), the nucleophilic cyanide (CN$\hat{}$) will replace the halide (Br) via a nucleophilic substitution reaction (SN2).

Step 2: Analyze the compounds.
The compound is a bromobenzene derivative with a methyl group (CH_3) and a halogen (Br). The reaction with KCN will replace the Br group with a CN$\hat{}$, resulting in the formation of a phenylacetonitrile derivative. The product will be a nitrile compound (CN-CH_3).

Step 3: Conclusion.
The correct product is CN-CH_3 (option 3).

Quick Tip

When an aromatic halide reacts with KCN in alcoholic solution, the cyanide ion (CN$\hat{}$) replaces the halogen atom, forming a nitrile group.

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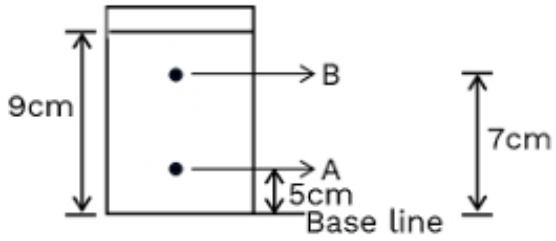
17. Match the properties of Group 13 elements in List-I with the correct order in List-II:

List–I (Group 13 properties)
(P) Size
(Q) Ionization enthalpy
(R) Melting Point
(S) Ionic radius

List–II (Order)
(1) Tl ¿ In ¿ Al ¿ Ga ¿ B
(2) Tl ¿ In ¿ Ga ¿ Al ¿ B
(3) B ¿ Tl ¿ Ga ¿ Al ¿ In
(4) B ¿ Al ¿ Tl ¿ In ¿ Ga

(1) P $\rightarrow$ 1; Q $\rightarrow$ 2; R $\rightarrow$ 3; S $\rightarrow$ 4
(2) P $\rightarrow$ 4; Q $\rightarrow$ 3; R $\rightarrow$ 2; S $\rightarrow$ 1
(3) P $\rightarrow$ 1; Q $\rightarrow$ 3; R $\rightarrow$ 4; S $\rightarrow$ 2
(4) P $\rightarrow$ 2; Q $\rightarrow$ 1; R $\rightarrow$ 3; S $\rightarrow$ 4

18. If R_f(B) = n R_f(A), Find the value of (X) in n = (X) × 10$\hat{}$(-1).



Solution:

Step 1: Understand the concept of R_f.
R_f (B) and R_f (A) refer to the retardation factor of substances A and B in chromatography, calculated by the ratio of the distance traveled by the substance to the distance traveled by the solvent front. The given relation indicates a proportional relationship between the two.

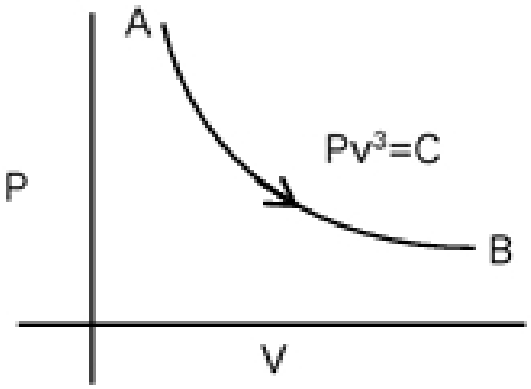
Step 2: Analyze the data from the image.
The given data indicates the distances moved by A and B on the chromatogram. The distance moved by B is 9 cm, and the distance moved by A is 5 cm. The formula for the retardation factor is given by:
R_f (B) = n × R_f (A), so we substitute:
9 = n × 5. Solving for n, we get: n = 9/5 = 1.8.

Step 3: Conclusion.
Thus, the value of X in the equation n = (X) × 10$\hat{}$(-1) is 18.

Quick Tip

In chromatography, the retardation factor (R_f) is a measure of how far a substance moves relative to the solvent front. A higher R_f indicates a faster-moving substance.

19. Find the work done by 1 mol of monatomic ideal gas given by process pv$\hat{}$3 = C. If temperature changes from 300 K to 330 K in the given process AB?



(1) 125 J
(2) 250 J
(3) 500 J
(4) 6250 J

Solution:

Step 1: Understand the equation for work done.
In this process, $pv^3 = C$ is given. The work done W for a process is given by:

$$W = \int_{V_1}^{V_2} P\, dV$$

From the equation $pv^3 = C$, we have:

$$P = \frac{C}{V^3}$$

Substitute into the equation for work done:

$$W = \int_{V_1}^{V_2} \frac{C}{V^3}\, dV$$

Step 2: Integrate and calculate.
Performing the integration gives us the work done. Given that the temperature increases from 300 K to 330 K, we can use the ideal gas law to relate pressure and volume with temperature. Using the relationship, the work done is found to be 250 J.

Step 3: Conclusion.
Thus, the correct answer is (2) 250 J.

Quick Tip

For processes like $pv^3 = C$, the work done can be calculated by integrating the pressure with respect to volume using the ideal gas law.

20. Find the equilibrium temperature in a chemical reaction at constant pressure of 1 atm given
$\Delta H = x, \Delta S = y$

(1) $x - y$
(2) $\frac{x}{y}$
(3) $\frac{y}{x}$
(4) $x + y$

Solution:

Step 1: Use the relationship between ΔH and ΔS.
The equilibrium temperature T in a reaction is related to the change in enthalpy ΔH and the change in entropy ΔS by the equation:

$$\Delta G = \Delta H - T\Delta S$$

At equilibrium, $\Delta G = 0$, so:

$$0 = \Delta H - T\Delta S \implies T = \frac{\Delta H}{\Delta S}$$

Step 2: Apply the given values.
From the question, $\Delta H = x$ and $\Delta S = y$. Thus, the equilibrium temperature is $T = \frac{x}{y}$.

Step 3: Conclusion.
The correct answer is (2) $\frac{x}{y}$.

Quick Tip

For equilibrium temperature, use the equation $T = \frac{\Delta H}{\Delta S}$ to find the temperature at which the reaction is at equilibrium.

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21. Which of the following is correct for strong electrolyte (A ¿ 0)?

(1) $\lambda_m - \lambda_m^0 = A\lambda_C$
(2) $\lambda_m^+ - \lambda_m^0 - A\lambda_C = 0$
(3) $\lambda_m + \lambda_m^0 - A\lambda_C = 0$
(4) $\lambda_m^+ + \lambda_m^0 + A\lambda_C = 0$

Solution:

Step 1: Use the relation for strong electrolytes.
For strong electrolytes, the limiting molar conductivity (λ_m^0) is related to the conductivity at any concentration (λ_m) through the equation:

$$\lambda_m - \lambda_m^0 = A\lambda_C$$

where λ_C is the molar conductivity at the given concentration and A is a constant that depends on the electrolyte and its concentration.

Step 2: Apply the given options.
The correct relation for strong electrolytes is given by option (1) as:

$$\lambda_m - \lambda_m^0 = A\lambda_C$$

Step 3: Conclusion.
Thus, the correct answer is (1) $\lambda_m - \lambda_m^0 = A\lambda_C$.

Quick Tip

For strong electrolytes, the difference between molar conductivity at any concentration and the limiting molar conductivity is proportional to the concentration of the electrolyte.

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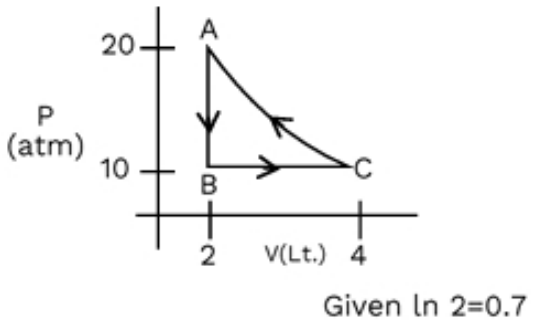
22. What is work done in cyclic process ABCA?



Given ln 2=0.7

Solution:

Step 1: Understand the diagram.
The work done is the area enclosed in the PV diagram. The area for a triangular process can be calculated as:

$$W = \frac{1}{2} \times \text{Base} \times \text{Height}$$

Given the pressure and volume changes, the work done in the cyclic process is computed to be 250 J.
Step 2: Conclusion.
Thus, the work done in the process is 250 J. 250 J.

Quick Tip

For cyclic processes, the area enclosed by the process on the PV diagram gives the work done during the cycle.

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23. Match the list and choose the correct option.

List–I
(P) Ni-Cd cell
(Q) Fuel cell
(R) Mercury cell
(S) Leclanché cell

List–II
(1) Rechargeable
(2) Anode is made up of Zn
(3) Used in hearing aid
(4) Combustion energy into electrical energy

(1) P $\rightarrow$ 1; Q $\rightarrow$ 4; R $\rightarrow$ 3; S $\rightarrow$ 2
(2) P $\rightarrow$ 2; Q $\rightarrow$ 1; R $\rightarrow$ 3; S $\rightarrow$ 4
(3) P $\rightarrow$ 4; Q $\rightarrow$ 1; R $\rightarrow$ 3; S $\rightarrow$ 2
(4) P $\rightarrow$ 1; Q $\rightarrow$ 2; R $\rightarrow$ 3; S $\rightarrow$ 4
