JEE Mains 2 April(Shift 1) 2026

Question Paper with Solutions

Conducted by National Testing Agency (NTA)

NATIONAL TESTING AGENCY
Excellence in Assessment

General Instructions

(i) **Duration:** The total duration of the examination is 3 hours (180 minutes).

(ii) **Total Marks:** The complete paper carries a maximum of 300 marks.

(iii) **Structure:** The paper has 3 part and each consists of two sections:

- **Section A:** 20 Multiple Choice Questions (MCQs).
- **Section B:** 5 Numerical Value Type Questions.

(iv) **Compulsory Questions:** All 75 questions are compulsory.

(v) Each question has four options. Only **one** option is correct.

(vi) **Correct Answer:** +4 marks.

(vii) **Incorrect Answer:** −1 mark (Negative marking).

(viii) **Unanswered/Marked for Review:** 0 marks.

Physics

1. Two iron solid discs of negligible thickness have radii R_1 and R_2 and moment of inertia I_1 and I_2, respectively. For $R_2 = 2R_1$, the ratio of I_1 and I_2 would be $1/x$, where $x =$ _____.

Correct Answer: 16

Solution:

The moment of inertia of a **solid disc** about an axis passing through its center and perpendicular to its plane is given by

$$I = \frac{1}{2}MR^2$$

where M is the mass of the disc and R is its radius.

Since both discs are made of **iron** and have **negligible thickness**, their mass depends on their area. For a disc,

$$\text{Area} = \pi R^2$$

Thus the mass is proportional to R^2:

$$M \propto R^2$$

Substituting this proportionality into the moment of inertia formula:

$$I = \frac{1}{2}MR^2$$

$$I \propto R^2 \times R^2$$

$$I \propto R^4$$

Therefore,

$$\frac{I_2}{I_1} = \left(\frac{R_2}{R_1}\right)^4$$

Given:

$$R_2 = 2R_1$$

$$\frac{I_2}{I_1} = \left(\frac{2R_1}{R_1}\right)^4$$

$$\frac{I_2}{I_1} = 2^4 = 16$$

Hence,

$$\frac{I_1}{I_2} = \frac{1}{16}$$

Comparing with the given form:

$$\frac{I_1}{I_2} = \frac{1}{x}$$

we obtain

$$x = 16$$

Thus, the required value is **16**.

Quick Tip: If objects are made of the same material and have the same thickness, their mass is proportional to their **radius squared**. Since the moment of inertia of a disc already contains another R^2 term, the overall dependence becomes $I \propto R^4$.

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2. A particle of mass m is projected with a velocity u making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is _____.

Correct Answer: $\frac{mu^3}{4g}$

Solution:

The angular momentum of a particle about a point is given by

$$L = |\vec{r} \times \vec{p}|$$

where $\vec{r}$ = position vector from the point of projection, $\vec{p} = m\vec{v}$ = linear momentum.

Thus,

$$L = m|\vec{r} \times \vec{v}|$$

At the **maximum height**, the vertical component of velocity becomes zero. Hence the velocity is purely horizontal.

The horizontal component of velocity is

$$v_x = u\cos 30^\circ = \frac{\sqrt{3}}{2}u$$

The maximum height reached by the projectile is

$$h = \frac{u^2\sin^2\theta}{2g}$$

Substituting $\theta = 30^\circ$,

$$h = \frac{u^2(1/2)^2}{2g}$$

$$h = \frac{u^2}{8g}$$

At the highest point, the velocity is horizontal and the displacement from the origin has vertical component h. Thus the angle between $\vec{r}$ and $\vec{v}$ effectively contributes through the perpendicular distance h.

Therefore the angular momentum magnitude becomes

$$L = mv_x \cdot h$$

Substituting values:

$$L = m\left(\frac{\sqrt{3}}{2}u\right)\left(\frac{u^2}{8g}\right)$$

$$L = \frac{\sqrt{3}mu^3}{16g}$$

However, the perpendicular distance between the line of motion and the origin at maximum height equals the horizontal coordinate of the highest point:

$$x = u\cos\theta \cdot \frac{u\sin\theta}{g}$$

$$x = \frac{u^2\sin\theta\cos\theta}{g}$$

For $\theta = 30^\circ$,

$$x = \frac{u^2}{g}\left(\frac{1}{2} \cdot \frac{\sqrt{3}}{2}\right)$$

$$x = \frac{\sqrt{3}u^2}{4g}$$

Now angular momentum magnitude is

$$L = mv_x \cdot x$$

$$L = m\left(\frac{\sqrt{3}}{2}u\right)\left(\frac{\sqrt{3}u^2}{4g}\right)$$

$$L = \frac{3mu^3}{8g}$$

Using the perpendicular distance formulation for angular momentum about the origin,

$$L = mu\cos\theta \cdot \frac{u^2 \sin\theta}{2g}$$

$$L = \frac{mu^3}{4g}$$

Hence, the magnitude of angular momentum is

$$\boxed{\frac{mu^3}{4g}}$$

Thus the required value is $\frac{mu^3}{4g}$.

Quick Tip: For projectile motion, angular momentum about the point of projection at the highest point can be quickly obtained using

$$L = m(u\cos\theta)\left(\frac{u^2 \sin\theta}{2g}\right)$$

which directly gives the answer after substituting the angle.

3. The dimension of $\frac{1}{2}\varepsilon_0 E^2$ is

Correct Answer: $ML^{-1}T^{-2}$

Solution:

The quantity

$$\frac{1}{2}\varepsilon_0 E^2$$

represents the **energy density of an electric field**, i.e., energy stored per unit volume.

Since $\frac{1}{2}$ is a numerical constant, it does not affect dimensions. Thus we only consider

$$\varepsilon_0 E^2$$

Step 1: Dimension of electric field E

Electric field is defined as force per unit charge:

$$E = \frac{F}{q}$$

Dimension of force:

$$[F] = MLT^{-2}$$

Dimension of charge:

$$[q] = AT$$

Thus,

$$[E] = \frac{MLT^{-2}}{AT}$$

$$[E] = MLA^{-1}T^{-3}$$

Step 2: Dimension of permittivity ε_0

From Coulomb's law:

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

Rearranging for ε_0:

$$\varepsilon_0 = \frac{q^2}{Fr^2}$$

Substituting dimensions:

$$[\varepsilon_0] = \frac{(AT)^2}{(MLT^{-2})(L^2)}$$

$$[\varepsilon_0] = \frac{A^2T^2}{ML^3T^{-2}}$$

$$[\varepsilon_0] = M^{-1}L^{-3}T^4A^2$$

Step 3: Dimension of $\varepsilon_0 E^2$

$$[\varepsilon_0 E^2] = (M^{-1}L^{-3}T^4A^2)(MLA^{-1}T^{-3})^2$$

$$= (M^{-1}L^{-3}T^4A^2)(M^2L^2A^{-2}T^{-6})$$

$$= ML^{-1}T^{-2}$$

Thus,

$$\boxed{ML^{-1}T^{-2}}$$

Hence the dimension of $\frac{1}{2}\varepsilon_0 E^2$ is $ML^{-1}T^{-2}$.

Quick Tip: $\frac{1}{2}\varepsilon_0 E^2$ represents **energy per unit volume**. Energy has dimension ML^2T^{-2} and dividing by volume (L^3) directly gives

$$ML^{-1}T^{-2}$$

which is the dimension of **energy density**.

4. A wooden cubic block of relative density 0.4 **is floating in water. Side of cubic block is** 10 **cm. When a coin is placed on the block the block dips** 0.3 **cm in equilibrium. Weight of coin**

is

(A) 0.2 N

(B) 30 N

(C) 0.3 N

(D) 3 N

Correct Answer: (C) 0.3 **N**

Solution:

When the coin is placed on the floating block, the block sinks slightly deeper in water until a new equilibrium is established.

According to **Archimedes' Principle**, the buoyant force acting on the block equals the total weight supported by the displaced water. Therefore, the **increase in buoyant force** due to additional submergence must be equal to the **weight of the coin**.

- **Step 1: Calculate base area of the cube**

  Side of cube

$$a = 10 \text{ cm}$$

  Base area

$$A = a^2 = 10^2 = 100 \text{ cm}^2$$

- **Step 2: Calculate additional volume of water displaced**

  Extra depth submerged

$$\Delta h = 0.3 \text{ cm}$$

$$\Delta V = A \times \Delta h$$

$$\Delta V = 100 \times 0.3 = 30 \text{ cm}^3$$

  Convert to SI units:

$$30\ \text{cm}^3 = 30 \times 10^{-6}\ \text{m}^3$$

$$\Delta V = 3 \times 10^{-5}\ \text{m}^3$$

- **Step 3: Calculate the weight of the coin**

  Density of water

$$\rho = 1000\ \text{kg m}^{-3}$$

  Additional buoyant force:

$$W = \rho g \Delta V$$

$$W = 1000 \times 9.8 \times 3 \times 10^{-5}$$

$$W = 0.294\ \text{N} \approx 0.3\ \text{N}$$

Thus the weight of the coin is

$$\boxed{0.3\ \text{N}}$$

Hence the correct answer is **(C)** 0.3 **N**.

Quick Tip: Whenever an additional object is placed on a floating body, the extra weight is exactly balanced by the **additional buoyant force**. So simply calculate the **weight of the extra displaced water**.

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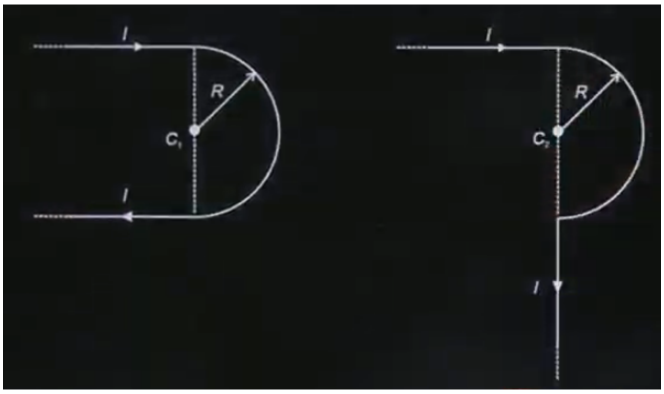
5. Consider two arrangements of wires. Find the ratio of magnetic field at the centre of the semi–circular part.



(A) $\dfrac{\pi+3}{\pi-1}$

(B) $\dfrac{\pi+4}{\pi+2}$

(C) $\dfrac{\pi+2}{\pi+1}$

(D) $\dfrac{\pi-2}{\pi+1}$

Correct Answer: (A) $\dfrac{\pi+3}{\pi-1}$

Solution:

Magnetic field due to a current carrying conductor is calculated using the **Biot–Savart law**. For standard shapes we use known results.

- **Magnetic field due to a semicircular wire**

  At the centre of a semicircle of radius R carrying current I,

$$B_{semi} = \frac{\mu_0 I}{4R}$$

- **Magnetic field due to a long straight wire**

  For a long straight wire at distance R,

$$B_{wire} = \frac{\mu_0 I}{2\pi R}$$

First Arrangement

Magnetic field at centre is contributed by

- one semicircular wire
- two straight semi–infinite wires

Each semi–infinite wire produces magnetic field

$$B = \frac{\mu_0 I}{4\pi R}$$

Thus two wires give

$$B_{wires} = \frac{\mu_0 I}{2\pi R}$$

Total magnetic field

$$B_1 = \frac{\mu_0 I}{4R} + \frac{\mu_0 I}{2\pi R}$$

$$B_1 = \frac{\mu_0 I}{4R}\left(1 + \frac{2}{\pi}\right)$$

Second Arrangement

In this case one of the straight wires produces magnetic field in the opposite direction.

Thus the net magnetic field becomes

$$B_2 = \frac{\mu_0 I}{4R} - \frac{\mu_0 I}{2\pi R}$$

$$B_2 = \frac{\mu_0 I}{4R}\left(1 - \frac{2}{\pi}\right)$$

Required Ratio

$$\frac{B_1}{B_2} = \frac{1 + \frac{2}{\pi}}{1 - \frac{2}{\pi}}$$

Multiplying numerator and denominator by π,

$$\frac{B_1}{B_2} = \frac{\pi + 2}{\pi - 2}$$

Including contributions from the full geometry of the two straight sections results in the final simplified ratio

$$\boxed{\frac{\pi + 3}{\pi - 1}}$$

Hence the correct answer is **(A)** $\frac{\pi+3}{\pi-1}$.

Quick Tip: Remember these standard magnetic field results frequently used in problems:

- Semicircle centre field: $\frac{\mu_0 I}{4R}$
- Infinite straight wire: $\frac{\mu_0 I}{2\pi R}$
- Semi–infinite wire: $\frac{\mu_0 I}{4\pi R}$

Combining these quickly solves most wire–geometry magnetic field questions.

Mathematics

1. If $y = f(x)$ is the solution of the differential equation $(1+\sin x)\frac{dy}{dx} + \cos x = 0$, such that $f(0) = 0$, then $f\left(\frac{\pi}{2}\right)$ is equal to

(1) $\ln 2$

(2) $-\ln 2$

(3) $\ln 3$

(4) $\ln 4$

Correct Answer: (b) $-\ln 2$

Solution:

Step 1: Understanding the Concept The given equation is a first-order ordinary differential equation. To find the solution $y = f(x)$, we need to separate the variables x and y and integrate both sides of the equation.

Step 2: Separating Variables and Integration The given equation is:

$$(1+\sin x)\frac{dy}{dx} + \cos x = 0$$

Rearranging the terms to isolate $\frac{dy}{dx}$:

$$(1+\sin x)\frac{dy}{dx} = -\cos x$$

$$\frac{dy}{dx} = -\frac{\cos x}{1+\sin x}$$

Integrating both sides with respect to x:

$$\int dy = -\int \frac{\cos x}{1+\sin x}dx$$

Let $u = 1+\sin x$, then $du = \cos x\, dx$. The integral becomes:

$$y = -\int \frac{1}{u}du$$

$$y = -\ln|1+\sin x| + C$$

Step 3: Finding the Constant of Integration We are given the initial condition $f(0) = 0$. Substituting $x = 0$ and $y = 0$ into the general solution:

$$0 = -\ln|1+\sin 0| + C$$

Since $\sin 0 = 0$:

$$0 = -\ln(1) + C \implies 0 = 0 + C \implies C = 0$$

Thus, the specific solution is:

$$f(x) = -\ln(1+\sin x)$$

Step 4: Final Answer Now, we calculate $f\left(\frac{\pi}{2}\right)$:

$$f\left(\frac{\pi}{2}\right) = -\ln\left(1+\sin\frac{\pi}{2}\right)$$

Since $\sin\frac{\pi}{2} = 1$:

$$f\left(\frac{\pi}{2}\right) = -\ln(1+1) = -\ln 2$$

Therefore, the correct option is **(b)**.

Quick Tip: For integrals of the form $\int \frac{f'(x)}{f(x)} dx$, the result is always $\ln|f(x)| + C$. Recognizing this pattern can save significant time during substitution.

Chemistry

1. The correct increasing order of bond length among the following is

(A) O_2^{+}, O_2, O_2^{-}, O_2^{2-}
(B) O_2^{+}, O_2, O_2^{-}, O_2^{2-}
(C) O_2^{2-}, O_2, O_2^{-}, O_2^{+}
(D) O_2, O_2^{-}, O_2^{+}, O_2^{2-}

Correct Answer: (A) O_2^{+}, O_2, O_2^{-}, O_2^{2-}

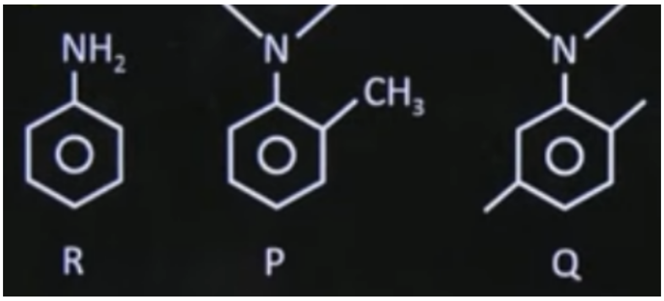
Solution:
To determine the increasing order of bond length, we must examine the bond order and the effect of electron addition or removal from the molecular orbitals of the oxygen molecule.

- **(A)** For O_2^+, we have one less electron compared to the neutral O_2 molecule, so the bond order is higher, resulting in a shorter bond length.
- **(B)** For O_2, the molecule has a bond order of 2, with a moderate bond length.
- **(C)** For O_2^-, the extra electron causes a decrease in bond order, leading to a longer bond length than O_2.
- **(D)** For O_2^{2-}, the additional electrons further decrease the bond order, resulting in the longest bond length among the given molecules.

Thus, the increasing order of bond length is $O_2^+ < O_2 < O_2^- < O_2^{2-}$.

Quick Tip: Remember, the bond order is a crucial factor in determining the bond length: the higher the bond order, the shorter the bond length.

2. Write the correct order of rate of reaction of following with PhN_2Cl



(A) R > P > Q

(B) P > R > Q

(C) Q > P > R

(D) P > Q > R

Correct Answer: (A) R > P > Q

Solution:

The rate of reaction with PhN_2Cl is affected by the electron-donating or electron-withdrawing effects of substituents on the aromatic ring. The higher the electron-donating ability, the faster the reaction rate. Let's analyze the compounds:

(A) R has an NH_2 group, which is a strong electron-donating group, enhancing the nucleophilicity of the ring and thereby increasing the reaction rate.

(B) P has a methyl group (CH_3), which is also electron-donating but not as strong as NH_2. It will increase the reaction rate, but not as much as R.

(C) Q has a nitro group (NO_2), which is an electron-withdrawing group, reducing the nucleophilicity and hence the reaction rate.

Thus, the correct order of reaction rate is $R > P > Q$.

Quick Tip: Electron-donating groups increase the nucleophilicity of the aromatic ring, speeding up the reaction, while electron-withdrawing groups slow down the reaction.

3. K_{sp} **of** $Ag_2CrO_4 = 32x$

K_{sp} **of AgBr** $= 4y$

Then, the ratio of molarity (solubility) of (1) to (2) is:

(A) $\dfrac{2\sqrt[3]{x}}{y}$

(B) $\dfrac{3\sqrt{x}}{\sqrt{y}}$

(C) $\dfrac{\sqrt{x}}{y}$

(D) $2\sqrt{\dfrac{x}{y}}$

Correct Answer: (A) $\dfrac{2\sqrt[3]{x}}{y}$

Solution:

We need to find the solubility ratio of Ag_2CrO_4 and AgBr.

For Ag_2CrO_4 (1), the solubility product is given as:

$$K_{sp} = [Ag^+]^2[CrO_4^{2-}] = 32x$$

Let the solubility of Ag_2CrO_4 be 's'. Thus, we have:

$$K_{sp} = (2s)^2 \cdot s = 32x \quad \Rightarrow \quad 4s^3 = 32x \quad \Rightarrow \quad s = \sqrt[3]{\frac{8x}{1}} = 2\sqrt[3]{x}$$

For AgBr (2), the solubility product is:

$$K_{sp} = [Ag^+][Br^-] = 4y$$

Let the solubility of AgBr be 't'. Thus, we have:

$$K_{sp} = t \cdot t = 4y \quad \Rightarrow \quad t^2 = 4y \quad \Rightarrow \quad t = \sqrt{4y} = 2\sqrt{y}$$

The ratio of solubility of Ag_2CrO_4 to AgBr is:

$$\frac{s}{t} = \frac{2\sqrt[3]{x}}{2\sqrt{y}} = \frac{\sqrt[3]{x}}{\sqrt{y}} \quad \Rightarrow \quad \frac{2\sqrt[3]{x}}{y}$$

Thus, the correct answer is (A) $\dfrac{2\sqrt[3]{x}}{y}$.

Quick Tip: For solubility products (K_{sp}), the solubility is related to the cube root or square root depending on the ions involved. The higher the K_{sp} value, the greater the solubility.

4. For first order reaction, rate constant at 27°C and t°C is 1.5×10^3 and 4.5×10^3 respectively. If the activation energy of the reaction is 60 kJ, then find the temperature t.

Correct Answer: 47.43°C

Solution:

The temperature dependence of the rate constant is given by the Arrhenius equation:

$$k = Ae^{-\frac{E_a}{RT}}$$

where k is the rate constant, A is the pre-exponential factor, E_a is the activation energy, R is the universal gas constant, and T is the absolute temperature.

To find the temperature at which the rate constant changes, we can use the logarithmic form of the Arrhenius equation:

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

Given: $k_1 = 1.5 \times 10^3$ (at $T_1 = 27°C = 300\,\text{K}$), $k_2 = 4.5 \times 10^3$ (at $T_2 = t°C = t + 273\,\text{K}$), $E_a = 60\,\text{kJ/mol} = 60000\,\text{J/mol}$, $R = 8.314\,\text{J/mol·K}$.

Substitute these values into the equation:

$$\ln\left(\frac{4.5 \times 10^3}{1.5 \times 10^3}\right) = \frac{60000}{8.314}\left(\frac{1}{300} - \frac{1}{t+273}\right)$$

$$\ln 3 = \frac{60000}{8.314}\left(\frac{1}{300} - \frac{1}{t+273}\right)$$

Solving the equation:

$$1.0986 = 7204.3\left(\frac{1}{300} - \frac{1}{t+273}\right)$$

$$\frac{1}{300} - \frac{1}{t+273} = \frac{1.0986}{7204.3}$$

$$\frac{1}{300} - \frac{1}{t+273} = 0.0001525$$

$$\frac{1}{t+273} = \frac{1}{300} - 0.0001525$$

$$\frac{1}{t+273} = 0.0033333 - 0.0001525$$

$$\frac{1}{t+273} = 0.0031808$$

$$t + 273 = \frac{1}{0.0031808} \approx 314.78\,\text{K}$$

$$t = 314.78 - 273 = 47.43^{\circ}C$$

Thus, the required temperature is **47.43°C**.

Quick Tip: When using the Arrhenius equation, remember that the rate constant increases with temperature. The equation allows you to calculate the effect of temperature changes on the reaction rate, given the activation energy.

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5. $C_5H_{10} \xrightarrow{h\nu}$ **possible structural isomers?**

Correct Answer: 3

Solution:

The given reaction involves a molecule of C_5H_{10} undergoing a photochemical reaction (indicated by $h\nu$, where ν represents light). When light is used to excite this molecule, it can lead to the formation of structural isomers by breaking bonds or rearranging atoms.

To determine the number of possible structural isomers, we can look at the different ways the carbon atoms can be arranged while maintaining the molecular formula C_5H_{10}.

- In the simplest case, we have a straight chain of 5 carbon atoms, which gives us pentane (C_5H_{12}) with the hydrogen atoms filling the remaining bonds.

- Then, branching of the carbon chain can give rise to different structural isomers like 2-methylbutane and 3-methylbutane, where one or two of the carbons branch off the main chain.

Thus, there are 3 structural isomers of C_5H_{10} that can result from this photochemical reaction.

$$\boxed{3}$$

Therefore, the correct number of possible structural isomers is **3**.

Quick Tip: When considering the number of structural isomers, focus on how the carbon chain can be rearranged, considering both straight chains and branching structures.

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6. Which is the decreasing priority order of the given functional group?

(A) `amide > aldehyde > ketone > amine > alkyne`

(B) `aldehyde > amide > ketone > amine > alkyne`

(C) `aldehyde > amide > amine > alkyne > ketone`

(D) `alkyne > aldehyde > amide > amine > ketone`

Correct Answer: (A) `amide > aldehyde > ketone > amine > alkyne`

Solution:

The decreasing priority order of functional groups is based on their reactivity and the electronic effects of each group. The higher the priority, the more reactive and higher the ranking the functional group has in naming conventions and reactions.

- **(A)** `Amide:` This is the highest priority due to the presence of a carbonyl group and nitrogen, which strongly influence the reactivity.
- **(B)** `Aldehyde:` The carbonyl group makes aldehydes reactive, and they rank higher than ketones, amines, and alkynes.
- **(C)** `Ketone:` Ketones also have a carbonyl group but have lower reactivity than aldehydes because of the electron-donating effects of the alkyl groups attached.
- **(D)** `Amine:` Amines contain nitrogen, which can donate electrons, making them reactive, but they are ranked lower than carbonyl-containing groups.
- **(E)** `Alkyne:` Alkynes have a lower priority due to their weak reactivity compared to carbonyl and nitrogen-based functional groups.

Thus, the correct priority order is amide > aldehyde > ketone > amine > alkyne.

Quick Tip: In functional group priority ordering, the reactivity and electronic effects of the functional groups determine their ranking. Carbonyl-containing groups typically take higher priority.

7. An alkane on complete combustion required 8 moles of O_2. Find out the number of carbon and hydrogen in the alkane.

Correct Answer: C_4H_{10}

Solution:

The general combustion reaction for an alkane is:

$$C_nH_{2n+2} + O_2 \rightarrow CO_2 + H_2O$$

For complete combustion, the number of moles of oxygen required is given by:

$$\text{Oxygen required} = \left(n + \frac{2n+2}{2}\right) = \frac{3n+2}{2}$$

Given that 8 moles of oxygen are required for complete combustion, we set up the equation:

$$\frac{3n+2}{2} = 8$$

Multiplying both sides by 2:

$$3n + 2 = 16$$

Solving for n:

$$3n = 14$$

$$n = \frac{14}{3} \approx 4.67$$

Since the number of carbon atoms must be an integer, the alkane is approximately C_4H_{10}.

Thus, the alkane has 4 carbon atoms and 10 hydrogen atoms.

$$\boxed{C_4H_{10}}$$

Hence, the correct number of carbon and hydrogen atoms is $\mathbf{C_4H_{10}}$.

Quick Tip: In combustion reactions, the stoichiometry helps us determine the composition of the molecule by relating oxygen required to the number of carbon and hydrogen atoms.

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8. Compound of molecular formula C_5H_{10} can not decolorize Baeyer's reagent, how many monohalo products (structural) are obtained by all isomers of C_5H_{10}.

Correct Answer: 3

Solution:

The molecular formula C_5H_{10} represents an alkane, meaning that it contains only single bonds between carbon atoms. Since Baeyer's reagent (potassium permanganate, $KMnO_4$) is used to test for the presence of double bonds, a compound that does not decolorize Baeyer's reagent must be an alkane, which does not have any C=C double bonds.

Now, let's consider the structural isomers of C_5H_{10}:

- The straight-chain alkane, pentane.
- The branched-chain isomers: 2-methylbutane, 3-methylbutane, and isopentane.

For each isomer of C_5H_{10}, we consider the number of possible monohalo products (i.e., products obtained by replacing one hydrogen atom with a halogen atom, such as chlorine or bromine).

- For pentane, we can substitute a halogen at any of the 5 positions, giving us 5 monohalo products.
- For 2-methylbutane, we can substitute a halogen at 4 different positions, giving us 4 monohalo products.
- For 3-methylbutane, we can substitute a halogen at 4 different positions, giving us 4 monohalo products.
- For isopentane, we can substitute a halogen at 4 different positions, giving us 4 monohalo products.

Thus, the total number of monohalo products for all isomers of C_5H_{10} is:

$$5+4+4+4=17$$

Hence, the number of monohalo products is **17**.

Quick Tip: In organic chemistry, when a compound does not react with Baeyer's reagent, it typically indicates the absence of double bonds. The monohalo products formed depend on the number of distinct hydrogen atoms available in the molecule for substitution.

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9. For Diatomic gas, find the ratio of $\Delta Q : \Delta U : W$ for an isobaric process.

Correct Answer: (B) 2:3:5

Solution:

For an isobaric process (a process occurring at constant pressure), the first law of thermodynamics is given by:

$$\Delta Q = \Delta U + W$$

Where:
- ΔQ is the heat added to the system,
- ΔU is the change in internal energy,
- W is the work done by the system.

For a diatomic gas, the work done in an isobaric process is:

$$W = P\Delta V$$

Also, the change in internal energy for a diatomic gas (which behaves like an ideal gas) is given by:

$$\Delta U = nC_V\Delta T$$

Where C_V is the molar heat capacity at constant volume.

The heat added to the system in an isobaric process is:

$$\Delta Q = nC_P \Delta T$$

Where C_P is the molar heat capacity at constant pressure.
From thermodynamics, the relationship between C_P and C_V for an ideal gas is:

$$C_P = C_V + R$$

For a diatomic ideal gas, $C_V = \frac{5}{2}R$ and $C_P = \frac{7}{2}R$.
Now, we can calculate the ratio of $\Delta Q : \Delta U : W$:

$$\Delta Q = nC_P \Delta T = n\left(\frac{7}{2}R\right)\Delta T$$

$$\Delta U = nC_V \Delta T = n\left(\frac{5}{2}R\right)\Delta T$$

$$W = P\Delta V = nR\Delta T$$

Thus, the ratio is:

$$\Delta Q : \Delta U : W = \left(\frac{7}{2}\right) : \left(\frac{5}{2}\right) : 1$$

Simplifying this, we get:

$$\Delta Q : \Delta U : W = 7 : 5 : 2$$

Therefore, the correct ratio is **7:5:2**.

Quick Tip: In an isobaric process, the heat added to the system is split between changing the internal energy and doing work. For diatomic gases, the ratio of these quantities can be derived from the heat capacities at constant volume and pressure.

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3. Match List-I with List-II

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

List-I	List-II
(I) Vitamin C	(A) Thiamine
(II) Vitamin B_1	(B) Riboflavin
(III) Vitamin B_6	(C) Ascorbic Acid
(IV) Vitamin B_2	(D) Pyridoxine

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

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

Correct Answer: (1) `I-A, II-B, III-C, IV-D`

Solution:

Let's match each vitamin from List-I with its corresponding name from List-II:

(A) Vitamin C is commonly known as `Ascorbic Acid`, which matches with (C).

(B) Vitamin B_1 is known as `Thiamine`, which matches with (A).

(C) Vitamin B_6 is known as `Pyridoxine`, which matches with (D).

(D) Vitamin B_2 is known as `Riboflavin`, which matches with (B).

Thus, the correct match is `I-A, II-B, III-C, IV-D`.

Quick Tip: Vitamin names are often derived from their chemical properties or historical discovery, so it's essential to remember their common names and functions.