VITEEE 2025 Apr 21 Question Paper with Solutions

Time Allowed :2 Hours 30 minutes	**Maximum Marks :**125	**Total Questions :**125

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 2 hours and 30 minutes duration.
2. The question paper consists of 125 questions. The maximum marks are 200.
3. There are three parts in the question paper consisting of Physics, Chemistry, Biology/Mathematics, Aptitude and English e.

1. A block of mass $2\,$kg is placed on a smooth horizontal surface. A force of $10\,$N is applied horizontally on the block. What is the acceleration of the block?

(1) $2.5\,\text{m/s}^2$

(2) $5\,\text{m/s}^2$

(3) $10\,\text{m/s}^2$

(4) $20\,\text{m/s}^2$

Correct Answer: (2) $5\,\text{m/s}^2$

Solution:

We are given: - Mass of the block $m = 2\,$kg - Force applied $F = 10\,$N - The surface is smooth, i.e., there is no friction.

Step 1: Use Newton's Second Law of Motion

According to Newton's Second Law,

$$F = m \cdot a$$

Solving for acceleration a:

$$a = \frac{F}{m}$$

$$a = \frac{10}{2} = 5\,\text{m/s}^2$$

Step 2: Final Answer

Thus, the acceleration of the block is $5\,\text{m/s}^2$.

Answer: The correct answer is option (2) $5\,\text{m/s}^2$.

Quick Tip

When the surface is smooth (frictionless), you can directly apply $F = ma$ without accounting for frictional forces.

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2. A ray of light strikes a plane mirror at an angle of incidence 30°. What is the angle between the incident ray and the reflected ray?

(1) 30°

(2) 60°

(3) 90°

(4) 120°

Correct Answer: (2) 60°

Solution:

Step 1: Understand the law of reflection The law of reflection states that:

$$\text{Angle of incidence } i = \text{Angle of reflection } r$$

Given: $i = 30^\circ \Rightarrow r = 30^\circ$

Step 2: Find the angle between the incident and reflected ray

The incident ray and the reflected ray are on opposite sides of the normal, and each makes a 30° angle with the normal. So the angle between them is:

$$\text{Angle between incident and reflected ray} = i + r = 30^\circ + 30^\circ = 60^\circ$$

Answer: The correct answer is option (2) 60°.

Quick Tip

For a plane mirror, the angle between the incident and reflected ray is always $2i$, where i is the angle of incidence.

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3. Two point charges $+2\,\mu$C and $-2\,\mu$C are placed 0.1 m apart in air. What is the electrostatic force between them?

(1) $3.6\,\text{N}$

(2) $1.8\,\text{N}$

(3) $4.2\,\text{N}$

(4) $0.72\,\text{N}$

Correct Answer: (1) $3.6\,\text{N}$

Solution:

We are given: - $q_1 = +2\,\mu\text{C} = 2 \times 10^{-6}\,\text{C}$ - $q_2 = -2\,\mu\text{C} = -2 \times 10^{-6}\,\text{C}$ - Distance $r = 0.1\,\text{m}$ - Coulomb's constant $k = 9 \times 10^9\,\text{Nm}^2/\text{C}^2$

Step 1: Use Coulomb's Law

$$F = \frac{k|q_1 q_2|}{r^2}$$

$$F = \frac{9 \times 10^9 \cdot (2 \times 10^{-6})^2}{(0.1)^2}$$

$$F = \frac{9 \times 10^9 \cdot 4 \times 10^{-12}}{0.01} = \frac{36 \times 10^{-3}}{0.01} = 3.6\,\text{N}$$

Step 2: Direction of force

Since the charges are opposite in sign, the force is attractive.

Answer: The electrostatic force between the charges is $3.6\,\text{N}$. So, the correct answer is option (1).

Quick Tip

Always convert microcoulombs (μC) to coulombs (C) before using Coulomb's Law.

4. The energy of a photon is 6.6×10^{-19} J. What is the frequency of the photon? (Take Planck's constant $h = 6.6 \times 10^{-34}$ Js)

(1) 1×10^{15} Hz

(2) 5×10^{14} Hz

(3) 2×10^{15} Hz

(4) 1×10^{14} Hz

Correct Answer: (1) 1×10^{15} Hz

Solution:

Step 1: Use the relation between energy and frequency

The energy of a photon is given by:

$$E = h\nu$$

Where: - $E = 6.6 \times 10^{-19}$ J - $h = 6.6 \times 10^{-34}$ Js

Step 2: Rearrange to find frequency ν

$$\nu = \frac{E}{h} = \frac{6.6 \times 10^{-19}}{6.6 \times 10^{-34}} = 1 \times 10^{15} \text{ Hz}$$

Answer: The frequency of the photon is 1×10^{15} Hz. Hence, the correct answer is option (1).

Quick Tip

Remember: $E = h\nu$ is a fundamental relation in quantum physics used to calculate photon frequency from its energy.

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5. A gas expands from volume V to $2V$ at constant pressure P. What is the work done by the gas?

(1) PV

(2) $2PV$

(3) $\frac{PV}{2}$

(4) Zero

Correct Answer: (1) PV

Solution:

Step 1: Use the formula for work done at constant pressure (isobaric process)

Work done by a gas during isobaric expansion:

$$W = P(V_2 - V_1)$$

Given: - $V_1 = V$ - $V_2 = 2V$ - $P = P$ (constant)

$$W = P(2V - V) = P \cdot V$$

Step 2: Final Answer

The work done by the gas is PV.

Answer: Hence, the correct answer is option (1) PV.

Quick Tip

In an isobaric process, the area under the P-V graph (a rectangle) gives the work: $W = P\Delta V$.

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6. How many moles are present in 44 g of CO_2?

(Molar mass of $CO_2 = 44$ g/mol)

(1) 1 mol

(2) 2 mol

(3) 0.5 mol

(4) 4 mol

Correct Answer: (1) 1 mol

Solution:

Step 1: Use the formula for number of moles

$$\text{Number of moles} = \frac{\text{Given mass}}{\text{Molar mass}}$$

Given: - Mass of $CO_2 = 44$ g - Molar mass of $CO_2 = 44$ g/mol

$$\text{Moles} = \frac{44}{44} = 1\,\text{mol}$$

Answer: Therefore, the number of moles in 44 g of CO_2 is 1 mol. So, the correct answer is option (1).

Quick Tip

Always remember: Moles $= \frac{\text{Mass}}{\text{Molar Mass}}$. Keep units consistent when using this formula.

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7. Which of the following elements has the smallest atomic radius?

(1) Na

(2) Mg

(3) Al

(4) Si

Correct Answer: (4) Si

Solution:

The elements Na, Mg, Al, and Si all belong to Period 3 of the periodic table. As we move left to right across a period:

- Atomic number increases - Effective nuclear charge increases - Electrons are added to the same shell, so the attraction between the nucleus and outer electrons increases.

Hence, atomic radius decreases across a period.

Order of atomic radius:

$$\text{Na} > \text{Mg} > \text{Al} > \text{Si}$$

Answer: Therefore, Si has the smallest atomic radius among the options. Correct answer is option (4).

Quick Tip

Across a period in the periodic table, atomic radius decreases due to increasing nuclear charge.

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8. Which of the following is the major product of the reaction between 1-bromobutane and potassium hydroxide in ethanol?

(1) Butan-1-ol

(2) But-2-ene

(3) Butan-2-ol

(4) Butane

Correct Answer: (2) But-2-ene

Solution:

The reaction involves 1-bromobutane (an alkyl halide) with potassium hydroxide (KOH) in ethanol. This is a typical example of an elimination reaction (E2 mechanism), where the hydroxide ion (OH) removes a proton from the carbon adjacent to the carbon that is bonded to the leaving group (Br), leading to the formation of a double bond.

Step 1: Identify the type of reaction

Since the reaction is occurring in ethanol, which is a polar protic solvent, the elimination occurs via the E2 mechanism.

Step 2: Identify the product

- The E2 mechanism will lead to the formation of an alkene. - The hydrogen is removed from the carbon next to the carbon bearing the bromine (the -carbon), leading to the formation of But-2-ene.

Answer: The major product of the reaction is But-2-ene, and thus the correct answer is option (2).

Quick Tip

In a reaction with KOH in ethanol, the elimination (E2) mechanism typically leads to the formation of an alkene.

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9. For a first-order reaction, the rate constant is $k = 0.01\,\mathrm{s}^{-1}$. What is the half-life of the reaction?

(1) 69.3 s

(2) 100 s

(3) 10 s

(4) 7 s

Correct Answer: (1) 69.3 s

Solution:

For a first-order reaction, the half-life ($t_{1/2}$) is given by the formula:

$$t_{1/2} = \frac{0.693}{k}$$

Given: - Rate constant $k = 0.01\,\text{s}^{-1}$

Step 1: Calculate the half-life

$$t_{1/2} = \frac{0.693}{0.01} = 69.3\,\text{s}$$

Answer: Therefore, the half-life of the reaction is $69.3\,\text{s}$, and the correct answer is option (1).

Quick Tip

For a first-order reaction, the half-life is independent of the initial concentration and only depends on the rate constant.

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10. Which of the following is a characteristic of a coordination compound?

(1) It has a definite molecular formula.

(2) It has a high melting point and is a good conductor of electricity in solid state.

(3) It contains a central metal atom/ion bonded to a number of ligands.

(4) It is always insoluble in water.

Correct Answer: (3) It contains a central metal atom/ion bonded to a number of ligands.

Solution:

A coordination compound is formed when a central metal ion or atom is surrounded by a number of ligands, which are molecules or ions that can donate electron pairs to the metal ion.

Step 1: Review the options - Option 1: While coordination compounds can have a definite molecular formula, this is not their most distinguishing feature. - Option 2: Coordination compounds do not necessarily have high melting points or conduct electricity in the solid state. This is more typical of ionic compounds. - Option 3: The hallmark of a coordination compound is the bonding of a central metal atom/ion with ligands. This option is correct. - Option 4: Coordination compounds can be soluble in water, especially if they form ions in solution.

Answer: The correct characteristic of a coordination compound is option (3) — it contains a central metal atom/ion bonded to a number of ligands.

Quick Tip

Coordination compounds typically involve metal-ligand coordination bonds, and the ligands donate electron pairs to the central metal.

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11. What is the standard electrode potential of a half-reaction in which electrons are transferred from Ag^+ to Ag?

(1) $+0.80\,\text{V}$

(2) $+0.34\,\text{V}$

(3) $0\,\text{V}$

(4) $-0.76\,\text{V}$

Correct Answer: (1) $+0.80\,\text{V}$

Solution:

The standard electrode potential of a half-reaction is defined as the potential difference when the half-reaction occurs under standard conditions (1 M concentration, 1 atm pressure, and 25°C).

Step 1: Review the given half-reaction

The given half-reaction is:

$$Ag^+ + e^- \rightarrow Ag(s)$$

The standard electrode potential for this half-reaction is a well-known value in electrochemistry and is given as:

$$E^\circ = +0.80\,\text{V}$$

Answer: Therefore, the standard electrode potential for the reduction of Ag^+ to Ag is $+0.80\,\text{V}$. The correct answer is option (1).

Quick Tip

The standard electrode potential for the reduction of Ag^+ to Ag is $+0.80\,\text{V}$, which indicates that silver ions are easily reduced to silver metal.
