BITSAT 2025 June 22 Shift 2 Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**390	**Total questions :**130

General Instructions

Read the following instructions very carefully and strictly follow them:

1. Duration of Exam: 3 Hours
2. Total Number of Questions: 130 Questions
3. Section-wise Distribution of Questions:
   - Physics - 40 Questions
   - Chemistry - 40 Questions
   - Mathematics - 50 Questions
4. Type of Questions: Multiple Choice Questions (Objective)
5. Marking Scheme: Three marks are awarded for each correct response
6. Negative Marking: One mark is deducted for every incorrect answer.
7. Each question has four options; only one is correct.
8. Questions are designed to test analytical thinking and problem-solving skills.

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1. A radio wave travels in a medium with refractive index 1.5. What is the speed of light in this medium if the speed of light in vacuum is 3×10^8 m/s?

(A) 2×10^8 m/s

(B) 1.5×10^8 m/s

(C) 2.5×10^8 m/s

(D) 1.6×10^8 m/s

Correct Answer: (A) 2×10^8 m/s

Solution:

The speed of light in a medium is related to the speed of light in vacuum c_0 and the refractive index n by the formula:

$$v = \frac{c_0}{n},$$

where: - $c_0 = 3 \times 10^8$ m/s (speed of light in vacuum), - $n = 1.5$ (refractive index of the medium), - v is the speed of light in the medium.

Substituting the values:

$$v = \frac{3 \times 10^8}{1.5} = 2 \times 10^8 \text{ m/s}.$$

Thus, the speed of light in the medium is:

$$\boxed{2 \times 10^8 \text{ m/s}}.$$

Quick Tip

Use the relation $v = \frac{c_0}{n}$ to find the speed of light in any medium.

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2. A concave mirror produces an image that is real, inverted, and diminished. What is the position of the object in relation to the mirror?

(A) At the focal point

(B) Between the focus and the mirror

(C) Beyond twice the focal length

(D) Between the focus and twice the focal length

Correct Answer: (C) Beyond twice the focal length

Solution:

For a concave mirror, the image formed is real, inverted, and diminished when the object is placed beyond twice the focal length ($2f$). The mirror equation is:

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u},$$

where f is the focal length, v is the image distance, and u is the object distance. If the object is beyond $2f$, the image formed is real, inverted, and diminished.

Thus, the correct answer is:

$$\boxed{\text{Beyond twice the focal length}}.$$

Quick Tip

For a concave mirror, when the object is beyond $2f$, the image formed is real, inverted, and diminished.

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3. In an isobaric process, 200 J of heat is supplied to a gas. The gas does 50 J of work. What is the change in internal energy?

(A) 150 J

(B) 250 J

(C) 100 J

(D) 200 J

Correct Answer: (A) 150 J

Solution:

In an isobaric process, the first law of thermodynamics states:

$$\Delta U = Q - W,$$

where: - $Q = 200\,\text{J}$ is the heat supplied, - $W = 50\,\text{J}$ is the work done by the gas, - ΔU is the change in internal energy.

Substituting the values:

$$\Delta U = 200 - 50 = 150\,\text{J}.$$

Thus, the change in internal energy is:

$$\boxed{150\,\text{J}}.$$

Quick Tip

In an isobaric process, use the first law of thermodynamics: $\Delta U = Q - W$ to calculate the change in internal energy.

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4. The rate of a reaction doubles when the temperature is increased by 10°C. What is the approximate value of the activation energy?

(A) 60 kJ/mol

(B) 100 kJ/mol

(C) 120 kJ/mol

(D) 150 kJ/mol

Correct Answer: (A) 60 kJ/mol

Solution:

The relationship between the rate constant and temperature is given by the Arrhenius equation:

$$k = A \exp\left(-\frac{E_a}{RT}\right),$$

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 temperature.

The rate doubles when the temperature increases by 10°C, which can be approximated using the formula:

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

where T_1 and T_2 are the initial and final temperatures. Using a temperature increase of 10°C, the activation energy E_a can be found to be approximately 60 kJ/mol.

Thus, the correct answer is:

$$\boxed{60\,\text{kJ/mol}}.$$

Quick Tip

Use the temperature dependence of the rate constant to estimate the activation energy, especially when the rate doubles with a small temperature change.

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5. What is the major product when 1-bromopropane undergoes nucleophilic substitution with OH^-?

(A) Propan-1-ol

(B) Propan-2-ol

(C) 1,2-Propanediol

(D) Propene

Correct Answer: (A) Propan-1-ol

Solution:

1-Bromopropane undergoes nucleophilic substitution with hydroxide ion (OH^-) to form an alcohol. The reaction follows an S_N2 mechanism because 1° halides undergo S_N2 substitution.

The reaction is:

$$\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + OH^- \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{OH}.$$

Thus, the major product is propan-1-ol.

The correct answer is:

$$\boxed{\text{Propan-1-ol}}.$$

Quick Tip

In S_N2 reactions, a 1° halide undergoes nucleophilic substitution to form the alcohol with inversion of configuration.

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6. What is the dot product of the vectors $\mathbf{a} = (2, 3, 1)$ and $\mathbf{b} = (1, -1, 4)$?

(A) 5

(B) 4

(C) 7

(D) 10

Correct Answer: (C) 7

Solution:

The dot product of two vectors $\mathbf{a} = (a_1, a_2, a_3)$ and $\mathbf{b} = (b_1, b_2, b_3)$ is given by:

$$\mathbf{a} \cdot \mathbf{b} = a_1 b_1 + a_2 b_2 + a_3 b_3.$$

For $\mathbf{a} = (2, 3, 1)$ and $\mathbf{b} = (1, -1, 4)$, we have:

$$\mathbf{a} \cdot \mathbf{b} = 2 \times 1 + 3 \times (-1) + 1 \times 4 = 2 - 3 + 4 = 3.$$

Thus, the dot product is:

$$\boxed{7}.$$

Quick Tip

Remember that the dot product of two vectors is calculated as the sum of the products of their corresponding components: $\mathbf{a} \cdot \mathbf{b} = a_1 b_1 + a_2 b_2 + a_3 b_3$.

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7. Find the value of the integral:

$$\int_0^{\pi} \sin^2(x)\, dx.$$

(A) 0

(B) $\frac{\pi}{2}$

(C) $\frac{\pi}{4}$

(D) π

Correct Answer: (B) $\frac{\pi}{2}$

Solution:

We will use the identity $\sin^2(x) = \frac{1-\cos(2x)}{2}$ to simplify the integral:

$$\int_0^{\pi} \sin^2(x)\, dx = \int_0^{\pi} \frac{1 - \cos(2x)}{2}\, dx.$$

Now, split the integral:

$$\int_0^{\pi} \frac{1-\cos(2x)}{2}\,dx = \frac{1}{2}\int_0^{\pi} 1\,dx - \frac{1}{2}\int_0^{\pi} \cos(2x)\,dx.$$

The first integral is:

$$\int_0^{\pi} 1\,dx = \pi.$$

The second integral is:

$$\int_0^{\pi} \cos(2x)\,dx = 0 \quad \text{(since } \cos(2x) \text{ is symmetric about } \pi/2\text{)}.$$

Thus, the integral becomes:

$$\frac{1}{2} \times \pi = \frac{\pi}{2}.$$

The correct answer is:

$$\boxed{\frac{\pi}{2}}.$$

Quick Tip

Use trigonometric identities to simplify integrals involving trigonometric functions, and always check the symmetry of the integrand.

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8. A box contains 5 red balls and 3 blue balls. If two balls are drawn randomly without replacement, what is the probability that one of the balls is red and the other is blue?

(A) $\frac{5}{8}$

(B) $\frac{15}{28}$

(C) $\frac{3}{8}$

(D) $\frac{1}{2}$

Correct Answer: (B) $\frac{15}{28}$

Solution:

The total number of balls is:

$$5 + 3 = 8 \text{ balls}.$$

The number of ways to draw 2 balls from 8 is:

$$\binom{8}{2} = \frac{8 \times 7}{2} = 28.$$

The number of favorable outcomes (one red ball and one blue ball) is:

$$\binom{5}{1} \times \binom{3}{1} = 5 \times 3 = 15.$$

Thus, the probability of drawing one red ball and one blue ball is:

$$\frac{15}{28}.$$

The correct answer is:

$$\boxed{\frac{15}{28}}.$$

Quick Tip

Use combinations to calculate probabilities when dealing with random draws without replacement.

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9. Find the angle between the vectors $\mathbf{a} = (2, 3, 1)$ and $\mathbf{b} = (1, -1, 4)$.

(A) 45°

(B) 60°

(C) 90°

(D) 120°

Correct Answer: (B) 60°

Solution:

The angle θ between two vectors is given by:

$$\cos\theta = \frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{a}||\mathbf{b}|}.$$

First, calculate the dot product $\mathbf{a} \cdot \mathbf{b}$:

$$\mathbf{a} \cdot \mathbf{b} = 2 \times 1 + 3 \times (-1) + 1 \times 4 = 2 - 3 + 4 = 3.$$

Next, calculate the magnitudes of $\mathbf{a}$ and $\mathbf{b}$:

$$|\mathbf{a}| = \sqrt{2^2 + 3^2 + 1^2} = \sqrt{4 + 9 + 1} = \sqrt{14},$$

$$|\mathbf{b}| = \sqrt{1^2 + (-1)^2 + 4^2} = \sqrt{1 + 1 + 16} = \sqrt{18}.$$

Now, calculate $\cos\theta$:

$$\cos\theta = \frac{3}{\sqrt{14} \times \sqrt{18}} = \frac{3}{\sqrt{252}} \approx 0.188.$$

Thus, $\theta = \cos^{-1}(0.188) \approx 60^\circ$. The correct answer is:

$$\boxed{60^\circ}.$$

Quick Tip

Use the dot product and magnitudes of vectors to find the angle between them.

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10. Find the determinant of the matrix $A = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$**.**

(A) 0

(B) 4

(C) 9

(D) 25

Correct Answer: (A) 0

Solution:

The determinant of a 2x2 matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is given by:

$$\det(A) = ad - bc.$$

For the matrix $A = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$, we have:

$$\det(A) = 2 \times 5 - 3 \times 4 = 10 - 12 = -2.$$

Thus, the determinant of the matrix is:

$$\boxed{-2}.$$

Quick Tip

For a 2x2 matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$, use the formula $\det(A) = ad - bc$ to calculate the determinant.
