BITSAT 2025 June 26 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.

1. A particle moves with a constant speed of 4 m/s in a circular path of radius 2 m. What is its centripetal acceleration?
(A) 8 m/s^2
(B) 4 m/s^2
(C) 16 m/s^2
(D) 2 m/s^2

Correct Answer: (A) 8 m/s^2

Solution: Step 1: Identify the formula for centripetal acceleration.
The centripetal acceleration a_c for an object moving in a circular path with constant speed is given by:

$$a_c = \frac{v^2}{r},$$

where v is the speed of the particle and r is the radius of the circular path.
Step 2: Substitute the given values into the formula.
The problem provides:
- Speed $v = 4\,\text{m/s}$,
- Radius $r = 2\,\text{m}$.

$$a_c = \frac{(4)^2}{2}.$$

Step 3: Perform the calculation step-by-step. First, compute the square of the speed:

$$(4)^2 = 16.$$

Then divide by the radius:

$$a_c = \frac{16}{2} = 8\,\text{m/s}^2.$$

Step 4: Verify the result.
The units are consistent ($\text{m}^2/\text{s}^2 \div \text{m} = \text{m/s}^2$), and the value 8 m/s^2 aligns with the options provided, confirming the calculation.

Quick Tip

Centripetal acceleration always points toward the center of the circular path and depends on the square of the speed and inversely on the radius. Double-check units to ensure correctness.

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2. A capacitor of capacitance 5 μF is charged to 100 V and then connected to an uncharged capacitor of 2 μF. What is the final potential difference across the capacitors?
(A) 71.43 V
(B) 50 V
(C) 28.57 V
(D) 100 V

Correct Answer: (A) 71.43 V

Solution: Step 1: Identify the initial conditions. The first capacitor ($C_1 = 5\,\mu\text{F}$) is charged to a potential difference of 100 V. The second capacitor ($C_2 = 2\,\mu\text{F}$) is uncharged, so its initial charge is 0.
Step 2: Calculate the initial charge on the first capacitor. The charge Q on a capacitor is given by $Q = C \cdot V$:

$$Q_1 = C_1 \cdot V_1 = 5 \cdot 10^{-6} \cdot 100 = 5 \cdot 10^{-4}\,\text{C}.$$

Step 3: Determine the total capacitance when connected in parallel. Since the capacitors are connected together, they share the same final potential difference, and their capacitances add up:

$$C_{\text{total}} = C_1 + C_2 = 5\,\mu\text{F} + 2\,\mu\text{F} = 7\,\mu\text{F}.$$

Step 4: Apply the conservation of charge. When connected, the charge from the first capacitor redistributes between both capacitors. The total initial charge $Q_{\text{total}} = Q_1$ is conserved:

$$Q_{\text{total}} = C_{\text{total}} \cdot V_f,$$

where V_f is the final potential difference. Substitute the values:

$$5 \cdot 10^{-4} = 7 \cdot 10^{-6} \cdot V_f.$$

Step 5: Solve for the final potential difference:

$$V_f = \frac{5 \cdot 10^{-4}}{7 \cdot 10^{-6}} = \frac{5}{7} \cdot 10^2 = \frac{500}{7} \approx 71.43\,\text{V}.$$

Step 6: Verify the result. The final potential difference should be less than the initial 100 V due to charge sharing, and the calculated value 71.43 V is consistent with the options.

Quick Tip

When capacitors are connected in parallel after one is charged, the final potential difference can be found using charge conservation. The total charge divides inversely proportional to the capacitances.

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3. Which of the following gases has the highest rate of diffusion?
(A) O_2
(B) CO_2
(C) H_2
(D) N_2

Correct Answer: (C) H_2

Solution: Step 1: Recall Graham's law of diffusion, which states that the rate of diffusion of a gas is inversely proportional to the square root of its molar mass:

$$\text{Rate} \propto \frac{1}{\sqrt{M}},$$

where M is the molar mass of the gas.
Step 2: Compare the molar masses of the given gases:
- O_2: 32 g/mol,
- CO_2: 44 g/mol,
- H_2: 2 g/mol,
- N_2: 28 g/mol.

Step 3: Determine the gas with the lowest molar mass.
H_2 has the smallest molar mass (2 g/mol), so it will have the highest rate of diffusion.

Quick Tip

The lighter the gas, the faster it diffuses. Use molar mass to compare diffusion rates effectively.

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4. What is the pH of a 0.01 M solution of HCl?
(A) 1
(B) 2

(C) 3
(D) 4

Correct Answer: (B) 2

Solution: Step 1: Recognize that HCl is a strong acid that dissociates completely in water:

$$\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-.$$

Thus, the concentration of H^+ ions equals the concentration of HCl, which is 0.01 M.
Step 2: Calculate the pH using the formula $\text{pH} = -\log_{10}[\text{H}^+]$. Substitute the H^+ concentration:

$$\text{pH} = -\log_{10}(0.01) = -\log_{10}(10^{-2}) = -(-2) = 2.$$

Step 3: Verify the result. For a 0.01 M solution of a strong acid, the pH should be 2, which matches the calculation.

Quick Tip

For strong acids, pH is simply the negative logarithm of the molar concentration. Ensure the concentration is in the correct units (moles per liter).

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5. If the roots of the quadratic equation $x^2 - 6x + k = 0$ are real and distinct, what is the range of values for k?
(A) $k > 9$
(B) $k < 9$
(C) $k > 0$
(D) $k < 0$

Correct Answer: (B) $k < 9$

Solution: Step 1: For a quadratic equation $ax^2 + bx + c = 0$, the condition for real and distinct roots is that the discriminant $\Delta > 0$, where $\Delta = b^2 - 4ac$.

Step 2: Identify the coefficients for $x^2 - 6x + k = 0$:
- $a = 1$,
- $b = -6$,
- $c = k$.

Step 3: Compute the discriminant:

$$\Delta = (-6)^2 - 4 \cdot 1 \cdot k = 36 - 4k.$$

Step 4: Set the condition for real and distinct roots:

$$36 - 4k > 0.$$

Step 5: Solve for k:

$$36 > 4k \quad \Rightarrow \quad k < \frac{36}{4} \quad \Rightarrow \quad k < 9.$$

Quick Tip

The discriminant determines the nature of roots. For distinct real roots, ensure $\Delta > 0$ by comparing it with zero.

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6. What is the value of $\int_0^{\pi/2} \sin x \cos x \, dx$?
(A) 0
(B) 1/2
(C) 1
(D) 1/4

Correct Answer: (B) 1/2

Solution: Step 1: Use the trigonometric identity $\sin x \cos x = \frac{1}{2} \sin 2x$ to simplify the integrand:

$$\int \sin x \cos x \, dx = \int \frac{1}{2} \sin 2x \, dx.$$

Step 2: Factor out the constant and set up the definite integral:

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

Step 3: Compute the integral. The antiderivative of $\sin 2x$ is $-\frac{1}{2} \cos 2x$:

$$\int \sin 2x \, dx = -\frac{1}{2} \cos 2x + C.$$

Step 4: Evaluate the definite integral from 0 to $\pi/2$:

$$\frac{1}{2} \left[-\frac{1}{2} \cos 2x \right]_0^{\pi/2}.$$

Step 5: Substitute the limits: - At $x = \pi/2$, $2x = \pi$, so $\cos \pi = -1$:

$$-\frac{1}{2} \cos(\pi) = -\frac{1}{2}(-1) = \frac{1}{2}.$$

- At $x = 0$, $2x = 0$, so $\cos 0 = 1$:

$$-\frac{1}{2} \cos(0) = -\frac{1}{2}(1) = -\frac{1}{2}.$$

- Difference:

$$\frac{1}{2} \left[\frac{1}{2} - \left(-\frac{1}{2} \right) \right] = \frac{1}{2} \left[\frac{1}{2} + \frac{1}{2} \right] = \frac{1}{2} \cdot 1 = \frac{1}{2}.$$

Quick Tip

Use the identity $\sin x \cos x = \frac{1}{2} \sin 2x$ to simplify integrals involving products of sine and cosine.

7. A body of mass 2 kg is moving with a velocity of 10 m/s. What is its kinetic energy?
(A) 100 J
(B) 200 J
(C) 50 J
(D) 400 J

Correct Answer: (A) 100 J

Solution: Step 1: Recall the formula for kinetic energy (KE) of a moving body:

$$KE = \frac{1}{2}mv^2,$$

where m is the mass and v is the velocity.
Step 2: Substitute the given values: - Mass $m = 2\,\text{kg}$, - Velocity $v = 10\,\text{m/s}$.

$$KE = \frac{1}{2} \cdot 2 \cdot (10)^2.$$

Step 3: Perform the calculation step-by-step: - First, compute the square of the velocity:

$$(10)^2 = 100.$$

- Then multiply by the mass and divide by 2:

$$KE = \frac{1}{2} \cdot 2 \cdot 100 = 1 \cdot 100 = 100\,\text{J}.$$

Step 4: Verify the result.
The units are consistent ($\text{kg} \cdot (\text{m/s})^2 = \text{J}$), and the value 100 J matches the expected kinetic energy for the given mass and velocity.

Quick Tip

Kinetic energy depends on the square of the velocity, so doubling the speed quadruples the kinetic energy. Always check unit consistency.

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8. Which of the following elements has the highest electronegativity?
(A) Sodium
(B) Chlorine
(C) Oxygen
(D) Fluorine

Correct Answer: (D) Fluorine

Solution: Electronegativity refers to the ability of an atom to attract electrons in a chemical bond. It generally increases across a period (left to right) and decreases down a group (top to bottom) in the periodic table.

- Sodium (Na) is an alkali metal with a low electronegativity.
- Chlorine (Cl) is a halogen, and it has high electronegativity but not the highest.
- Oxygen (O) has a high electronegativity but is still lower than that of fluorine.
- Fluorine (F) has the highest electronegativity of all elements, with a value of 3.98 on the Pauling scale.

Therefore, the element with the highest electronegativity is Fluorine.

Quick Tip

Fluorine is the most electronegative element in the periodic table, followed by oxygen, chlorine, and others. When unsure, check the position of elements in the periodic table to determine their relative electronegativities.

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9. If $\sin\theta + \cos\theta = \sqrt{2}$, what is the value of $\sin\theta\cos\theta$?
(A) $\frac{1}{2}$
(B) $\frac{1}{4}$
(C) 1
(D) 0

Correct Answer: (A) $\frac{1}{2}$

Solution: Step 1: We are given that $\sin\theta + \cos\theta = \sqrt{2}$. Squaring both sides, we get:

$$(\sin\theta + \cos\theta)^2 = (\sqrt{2})^2$$

$$\sin^2\theta + 2\sin\theta\cos\theta + \cos^2\theta = 2$$

Since $\sin^2\theta + \cos^2\theta = 1$ (Pythagorean identity), we can substitute this into the equation:

$$1 + 2\sin\theta\cos\theta = 2$$

$$2\sin\theta\cos\theta = 1$$

$$\sin\theta\cos\theta = \frac{1}{2}$$

Quick Tip

For problems involving trigonometric identities, remember to use the Pythagorean identity $\sin^2\theta + \cos^2\theta = 1$ to simplify expressions and solve for unknown values.

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10. A simple pendulum of length 1 m is oscillating with an amplitude of 0.1 m. What is the maximum tension in the string if the mass of the bob is 0.2 kg? (Assume $g = 10\,\mathrm{m/s^2}$)
(A) 2.2 N
(B) 2.4 N

(C) 2.0 N
(D) 2.6 N

Correct Answer: (B) 2.4 N

Solution: Step 1: The maximum tension in the string occurs when the bob is at the lowest point of the swing. At this point, the tension is the sum of the gravitational force and the centripetal force. The formula for tension is:

$$T = mg + \frac{mv^2}{L}$$

where:
- $m = 0.2\,\text{kg}$ (mass of the bob),
- $g = 10\,\text{m/s}^2$ (acceleration due to gravity),
- $L = 1\,\text{m}$ (length of the pendulum),
- v is the speed at the lowest point, which can be found using conservation of mechanical energy.

Step 2: The total mechanical energy in the system is conserved. At the highest point (amplitude), the potential energy is maximum and the kinetic energy is zero. At the lowest point, all potential energy has been converted into kinetic energy.
The potential energy at the amplitude is:

$$U = mgh$$

where $h = L - L\cos(\theta) \approx L$ for small oscillations, and θ is the angle at maximum displacement. The velocity at the lowest point can be calculated by setting the total energy equal to the potential energy:

$$\frac{1}{2}mv^2 = mgh$$

Thus, solving for v, we get:

$$v = \sqrt{2gh}$$

Substituting $h = 0.1\,\text{m}$ (the amplitude), we get:

$$v = \sqrt{2 \times 10 \times 0.1} = \sqrt{2} \approx 1.414\,\text{m/s}$$

Step 3: Now we can find the maximum tension:

$$T = mg + \frac{mv^2}{L} = (0.2 \times 10) + \frac{0.2 \times (1.414)^2}{1} = 2 + \frac{0.2 \times 2}{1} = 2 + 0.4 = 2.4\,\text{N}$$

Quick Tip

For simple pendulums, remember that the maximum tension occurs at the lowest point, where the speed is highest. Use conservation of energy to relate potential and kinetic energy and find the speed at the lowest point.

11. In the reaction $2SO_2 + O_2 \rightarrow 2SO_3$, if 64 g of SO_2 reacts completely, how many grams of SO_3 are produced? (Molar mass of $SO_2 = 64\,\text{g/mol}, SO_3 = 80\,\text{g/mol}$)
(A) 80 g
(B) 64 g
(C) 100 g
(D) 128 g

Correct Answer: (A) 80 g

Solution: Step 1: Determine the number of moles of SO_2. The molar mass of SO_2 is 64 g/mol, and 64 g is given:

$$\text{Moles of } SO_2 = \frac{\text{mass}}{\text{molar mass}} = \frac{64}{64} = 1\,\text{mol}.$$

Step 2: Use the stoichiometry of the reaction. The balanced equation is $2SO_2 + O_2 \rightarrow 2SO_3$, showing a 2:2 (1:1) mole ratio between SO_2 and SO_3.
Step 3: Calculate the moles of SO_3 produced. Since 1 mole of SO_2 produces 1 mole of SO_3:

$$\text{Moles of } SO_3 = 1\,\text{mol}.$$

Step 4: Compute the mass of SO_3. The molar mass of SO_3 is 80 g/mol:

$$\text{Mass of } SO_3 = \text{moles} \cdot \text{molar mass} = 1 \cdot 80 = 80\,\text{g}.$$

Step 5: Verify the result. The 1:1 mole ratio and consistent molar masses confirm the calculation.

Quick Tip

Use the mole ratio from the balanced equation and convert moles to mass using the molar mass for stoichiometry problems.

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12. What is the sum of the first 10 terms of the arithmetic progression with first term 3 and common difference 2?
(A) 120
(B) 105
(C) 75
(D) 90

Correct Answer: (A) 120

Solution: Step 1: Identify the formula for the sum of the first n terms of an arithmetic progression (A.P.):

$$S_n = \frac{n}{2}[2a + (n-1)d],$$

where n is the number of terms, a is the first term, and d is the common difference.
Step 2: Substitute the given values:
- $n = 10$,

- $a = 3$,
- $d = 2$.

$$S_{10} = \frac{10}{2}[2 \cdot 3 + (10 - 1) \cdot 2].$$

Step 3: Perform the calculation step-by-step:
- Compute the number of terms and factor:

$$S_{10} = 5[6 + 9 \cdot 2].$$

- Calculate the expression inside the brackets:

$$9 \cdot 2 = 18, \quad 6 + 18 = 24.$$

- Multiply by 5:

$$S_{10} = 5 \cdot 24 = 120.$$

Step 4: Verify the result.
The sequence is 3, 5, 7, ..., up to the 10th term.
The 10th term is $a+(n-1)d = 3+9\cdot 2 = 21$, and the sum of an A.P. can also be $S_n = \frac{n}{2}(a+l)$, where l is the last term:

$$S_{10} = \frac{10}{2}(3 + 21) = 5 \cdot 24 = 120.$$

Quick Tip

The sum of an A.P. can be calculated using the first term, common difference, and number of terms, or by averaging the first and last terms multiplied by the number of terms.

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13. Choose the word closest in meaning to 'Candid'.
(A) Secretive
(B) Honest
(C) Reserved
(D) Deceptive

Correct Answer: (B) Honest

Solution: Step 1: Understand the meaning of 'Candid'.
The word 'Candid' means being open, frank, or honest, especially in expressing one's thoughts or feelings.

Step 2: Compare with the options:
- (A) Secretive: Means keeping things hidden, opposite to candid.
- (B) Honest: Means truthful and open, closely aligned with candid.
- (C) Reserved: Means restrained or shy, not closely related.
- (D) Deceptive: Means misleading, opposite to candid.

Step 3: Select the best match.
'Honest' is the word closest in meaning to 'Candid'.

Quick Tip

Look for synonyms that match the context of openness and truthfulness when choosing words closest in meaning.

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14. A sequence is defined as follows: $a_1 = 1, a_2 = 2$**, and** $a_n = a_{n-1} + a_{n-2}$ **for** $n \geq 3$**. What is the 6th term of the sequence?**
(A) 5
(B) 8
(C) 13
(D) 21

Correct Answer: (C) 13

Solution: Step 1: Identify the sequence by computing the terms step-by-step using the given recurrence relation $a_n = a_{n-1} + a_{n-2}$ with initial terms $a_1 = 1$ and $a_2 = 2$.

Step 2: Calculate the terms:
- $a_3 = a_2 + a_1 = 2 + 1 = 3$,
- $a_4 = a_3 + a_2 = 3 + 2 = 5$,
- $a_5 = a_4 + a_3 = 5 + 3 = 8$,
- $a_6 = a_5 + a_4 = 8 + 5 = 13$.

Step 3: Identify the 6th term. The 6th term is $a_6 = 13$.

Step 4: Verify the sequence.
The sequence is 1, 2, 3, 5, 8, 13, which matches the Fibonacci-like pattern, confirming the calculation.

Quick Tip

For recursive sequences, compute each term iteratively using the given relation and initial conditions. Double-check the term number.
