BITSAT 2025 June 25 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 coil of resistance 10 Ω is connected to a battery of 12 V. If the current flowing through the coil is 2 A, what is the power dissipated in the coil?

(A) 40 W

(B) 10 W

(C) 24 W

(D) 30 W

Correct Answer: (A) 40 W

Solution: The power dissipated in a coil is given by the formula:

$$P = I^2 R$$

Where: - P is the power dissipated,

- I is the current,

- R is the resistance.

Given: - $I = 2\,\text{A}$,

- $R = 10\,\Omega$.

Substitute these values into the formula:

$$P = (2)^2 \times 10 = 4 \times 10 = 40\,\text{W}$$

Thus, the power dissipated in the coil is $40\,\text{W}$.

Quick Tip

To find the power dissipated in a resistor, use the formula $P = I^2 R$. If you know the voltage and resistance, you can also use $P = \frac{V^2}{R}$ for easier calculation.

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2. Two identical bodies of mass 1 kg each are moving towards each other with velocities of 5 m/s and 3 m/s, respectively. They collide elastically. What will be the velocity of the body initially moving at 5 m/s after the collision?

(a) -3 m/s

(b) 3 m/s

(c) -5 m/s

(d) 5 m/s

Correct Answer: (a) -3 m/s

Solution:

To find the velocity of the body initially moving at 5 m/s after an elastic collision with an identical body moving at 3 m/s, we use the principles of conservation of momentum and kinetic energy, since the collision is elastic.

Step 1: Define variables

- Mass of both bodies $m_1 = m_2 = 1\,\text{kg}$
- Initial velocity of the first body $u_1 = 5\,\text{m/s}$ (moving right)
- Initial velocity of the second body $u_2 = -3\,\text{m/s}$ (moving left, opposite direction)
- Final velocities are v_1 (for the first body) and v_2 (for the second body)

Step 2: Conservation of momentum

For an elastic collision, momentum is conserved:

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

Since $m_1 = m_2 = 1\,\text{kg}$:

$$u_1 + u_2 = v_1 + v_2$$

Substitute the initial velocities:

$$5 + (-3) = v_1 + v_2$$

$$2 = v_1 + v_2 \quad \cdots (1)$$

Step 3: Conservation of kinetic energy

For an elastic collision, kinetic energy is also conserved:

$$\frac{1}{2} m_1 u_1^2 + \frac{1}{2} m_2 u_2^2 = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$$

Since $m_1 = m_2 = 1\,\text{kg}$, cancel $\frac{1}{2}$ and m:

$$u_1^2 + u_2^2 = v_1^2 + v_2^2$$

Substitute the initial velocities:

$$5^2 + (-3)^2 = v_1^2 + v_2^2$$

$$25 + 9 = v_1^2 + v_2^2$$

$$34 = v_1^2 + v_2^2 \quad \cdots (2)$$

Step 4: Solve the equations

From equation (1):

$$v_2 = 2 - v_1$$

Substitute into equation (2):

$$v_1^2 + (2 - v_1)^2 = 34$$

Expand:

$$v_1^2 + (4 - 4v_1 + v_1^2) = 34$$

$$2v_1^2 - 4v_1 + 4 = 34$$

$$2v_1^2 - 4v_1 - 30 = 0$$

Divide by 2:

$$v_1^2 - 2v_1 - 15 = 0$$

Solve this quadratic equation using the quadratic formula $v_1 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, where $a = 1$, $b = -2$, $c = -15$:

$$\text{Discriminant} = (-2)^2 - 4 \cdot 1 \cdot (-15) = 4 + 60 = 64$$

$$v_1 = \frac{2 \pm \sqrt{64}}{2} = \frac{2 \pm 8}{2}$$

$$v_1 = \frac{2 + 8}{2} = 5 \quad \text{or} \quad v_1 = \frac{2 - 8}{2} = -3$$

Step 5: Determine corresponding v_2

- If $v_1 = 5$:

$$v_2 = 2 - 5 = -3$$

- If $v_1 = -3$:

$$v_2 = 2 - (-3) = 5$$

Step 6: Interpret the results

The two solutions represent the possible exchanges of velocities due to the elastic collision of identical masses. Since the bodies are identical and moving toward each other, they exchange velocities:

- The body initially at 5 m/s will move at -3 m/s (reversing direction to the left).

- The body initially at -3 m/s will move at 5 m/s (reversing direction to the right).

Step 7: Answer the question

The velocity of the body initially moving at 5 m/s after the collision is $-3\,\text{m/s}$.

Step 8: Verify

- Momentum: $5 \cdot 1 + (-3) \cdot 1 = 2$, $(-3) \cdot 1 + 5 \cdot 1 = 2$ (conserved).

- Kinetic energy: $\frac{1}{2} \cdot 1 \cdot 5^2 + \frac{1}{2} \cdot 1 \cdot (-3)^2 = 12.5 + 4.5 = 17$,

$\frac{1}{2} \cdot 1 \cdot (-3)^2 + \frac{1}{2} \cdot 1 \cdot 5^2 = 4.5 + 12.5 = 17$ (conserved).

Step 9: Conclusion

The velocity is $-3\,\text{m/s}$, matching option (a).

Quick Tip

For elastic collisions of identical masses, the bodies exchange velocities. Use conservation of momentum and energy to solve.

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3. Which of the following compounds has the highest boiling point?

(a) Methanol (CH_3OH)

(b) Ethanol (C_2H_5OH)

(c) Water (H_2O)

(d) Propanol (C_3H_7OH)

Correct Answer: (c) Water (H_2O)

Solution:

To determine which compound has the highest boiling point,

we need to consider the intermolecular forces that affect boiling points,

such as hydrogen bonding, molecular weight, and molecular structure.

Step 1: Identify intermolecular forces

- All the given compounds (methanol, ethanol, propanol, and water)

are capable of forming hydrogen bonds because they have an -OH group,

which allows hydrogen bonding between molecules.

- Boiling point increases with stronger intermolecular forces
and higher molecular weight, but hydrogen bonding strength depends
on the molecule's structure.

Step 2: Compare molecular weights and hydrogen bonding

- Methanol (CH_3OH): Molecular weight $\approx$ 32 g/mol, 1 carbon.
- Ethanol (C_2H_5OH): Molecular weight $\approx$ 46 g/mol, 2 carbons.
- Propanol (C_3H_7OH): Molecular weight $\approx$ 60 g/mol, 3 carbons.
- Water (H_2O): Molecular weight $\approx$ 18 g/mol, no carbon,
but two hydrogen atoms available for hydrogen bonding per molecule.

Step 3: Analyze hydrogen bonding

- Water has a unique structure with two hydrogen atoms
and two lone pairs on oxygen, allowing it to form an extensive network of hydrogen bonds.
This results in a higher boiling point despite its lower molecular weight.
- Alcohols (methanol, ethanol, propanol) also form hydrogen bonds,
but the effect is less extensive due to the presence of the alkyl group,
which reduces the hydrogen bonding efficiency per molecule as the carbon chain length
increases.

Step 4: Compare boiling points

- Methanol: Boiling point $\approx$ 64.7°C
- Ethanol: Boiling point $\approx$ 78.4°C
- Propanol: Boiling point $\approx$ 97.4°C
- Water: Boiling point $\approx$ 100°C

The boiling point increases with molecular weight among alcohols
due to stronger van der Waals forces, but water's extensive hydrogen bonding network
gives it the highest boiling point.

Step 5: Conclusion

Despite having a lower molecular weight, water has the highest boiling point (100°C)
due to its strong and extensive hydrogen bonding network,
making (c) Water (H_2O) the correct answer.

Quick Tip

Boiling point depends on intermolecular forces.

Hydrogen bonding in water is exceptionally strong due to its structure,

often leading to a higher boiling point than alcohols of similar or higher molecular weight.

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4. The pH of a solution is 3. What is the concentration of hydrogen ions in this solution?

(a) 1×10^{-3} M

(b) 3×10^{-4} M

(c) 10^{-3} M

(d) 10^{-3} M

Correct Answer: (c) 10^{-3} M

Solution:

To find the concentration of hydrogen ions $[H^+]$ given the pH of the solution,

we use the pH formula:

$$\text{pH} = -\log_{10}[H^+]$$

Step 1: Use the pH formula

The pH is given as 3. Rearrange the formula to solve for $[H^+]$:

$$[H^+] = 10^{-\text{pH}}$$

Step 2: Substitute the pH value

Substitute pH = 3 into the equation:

$$[H^+] = 10^{-3}\,\text{M}$$

Step 3: Interpret the result

The concentration of hydrogen ions is 10^{-3} M,

which is equivalent to 0.001 moles per liter.

Step 4: Compare with options

- (a) 1×10^{-3} M is the same as 10^{-3} M.

- (b) 3×10^{-4} M is different.

- (c) 10^{-3} M matches the calculated value.

- (d) 10^{-3} M is a duplicate of (c).

Since (a) and (c) are equivalent, either is correct, but (c) aligns with standard notation.

Step 5: Conclusion

The concentration of hydrogen ions is 10^{-3} M,

making (c) 10^{-3} M the correct answer.

Quick Tip

pH is a logarithmic scale where pH = $-\log_{10}[H^+]$.

A pH of 3 corresponds to $[H^+] = 10^{-3}$ M.

Always check the exponent and coefficient in options.

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5. If the roots of the quadratic equation $2x^2 - 5x + k = 0$ are real and distinct, what is the range of values for k?

(A) $k > \frac{25}{8}$

(B) $k < \frac{25}{8}$

(C) $k > 0$

(D) $k < 0$

Correct Answer: (B) $k < \frac{25}{8}$

Solution: For the roots of a quadratic equation to be real and distinct, the discriminant must be positive. The discriminant Δ of the quadratic equation $ax^2 + bx + c = 0$ is given by:

$$\Delta = b^2 - 4ac$$

For the given equation $2x^2 - 5x + k = 0$, we have: - $a = 2$, - $b = -5$, - $c = k$.

Substitute these values into the discriminant formula:

$$\Delta = (-5)^2 - 4(2)(k) = 25 - 8k$$

For the roots to be real and distinct, we require $\Delta > 0$:

$$25 - 8k > 0$$

$$25 > 8k$$

$$k < \frac{25}{8}$$

Thus, the value of k must be less than $\frac{25}{8}$.

Quick Tip

For real and distinct roots, the discriminant must be positive. If the discriminant is zero, the roots are real and equal. If the discriminant is negative, the roots are imaginary.

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6. If $\log_{10}(x + 1) = 2$, what is the value of x?

(a) 99

(b) 100

(c) 101

(d) 99.9

Correct Answer: (a) 99

Solution:

To find the value of x given the equation $\log_{10}(x + 1) = 2$,

we use the definition of logarithms.

Step 1: Apply the logarithm definition

The equation $\log_{10}(x + 1) = 2$ means that 10 raised to the power of 2

equals x + 1:

$$x + 1 = 10^2$$

Step 2: Solve for x

Calculate 10^2 :

$$x + 1 = 100$$

$$x = 100 - 1$$

$$x = 99$$

Step 3: Verify the solution

Substitute x = 99 back into the original equation:

$$\log_{10}(99 + 1) = \log_{10}(100)$$

Since $100 = 10^2$,

$$\log_{10}(100) = 2$$

The equation holds true.

Step 4: Compare with options

- (a) 99 matches the calculated value.
- (b) 100 would give $\log_{10}(100 + 1) = \log_{10}(101) \neq 2$.
- (c) 101 would give $\log_{10}(101 + 1) = \log_{10}(102) \neq 2$.
- (d) 99.9 would give $\log_{10}(99.9 + 1) = \log_{10}(100.9) \neq 2$.

Step 5: Conclusion

The value of x is 99, making (a) 99 the correct answer.

Quick Tip

To solve $\log_{10}(a) = b$, use $a = 10^b$.

Always verify by substituting the value back into the original equation.

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7. A particle moves in a circle of radius 2 m with a speed of 6 m/s. What is the centripetal acceleration of the particle?

(1) 9 m/s^2

(2) 18 m/s^2

(3) 3 m/s^2

(4) 36 m/s^2

Correct Answer: (2) 18 m/s^2

Solution:

The formula for centripetal acceleration is:

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

where: - $v = 6\,\text{m/s}$ (velocity) - $r = 2\,\text{m}$ (radius)

Substituting the given values:

$$a_c = \frac{6^2}{2} = \frac{36}{2} = 18\,\text{m/s}^2$$

Thus, the centripetal acceleration is **18 m/s^2**.

Quick Tip

The centripetal acceleration is always directed towards the center of the circular path and is proportional to the square of the velocity and inversely proportional to the radius.

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8. A convex lens has focal length 20 cm. An object is placed at a distance of 40 cm from the lens. What is the position of the image formed?

(1) 40 cm on the opposite side

(2) 20 cm on the same side

(3) 20 cm on the opposite side

(4) 40 cm on the same side

Correct Answer: (4) 40 cm on the same side

Solution:

The lens formula is given by:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

where: - $f = 20\,\text{cm}$ (focal length of the lens) - $u = -40\,\text{cm}$ (object distance; negative because the object is on the same side as the incoming light)

We need to find the image distance v. Rearranging the lens formula:

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

Substituting the values:

$$\frac{1}{v} = \frac{1}{20} + \frac{1}{-40} = \frac{1}{20} - \frac{1}{40} = \frac{2-1}{40} = \frac{1}{40}$$

Thus,

$$v = 40\,\text{cm}$$

Since v is positive, the image is formed on the opposite side of the object. The position of the image is **40 cm** on the opposite side.

Quick Tip

For a convex lens, if the object is placed beyond the focal length, the image formed is real, inverted, and on the opposite side of the object.

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9. Which of the following substances does not undergo hydrolysis in aqueous solution?

(A) Sodium acetate

(B) Ammonium chloride

(C) Sodium carbonate

(D) Sodium chloride

Correct Answer: (D) Sodium chloride

Solution: Hydrolysis occurs when a salt reacts with water to form either acidic or basic solutions. - Sodium acetate (CH_3COONa) is a basic salt formed from a strong base (NaOH) and a weak acid (acetic acid). It undergoes hydrolysis to form a basic solution. - Ammonium chloride (NH_4Cl) is an acidic salt formed from a weak base (NH_3) and a strong acid (HCl). It undergoes hydrolysis to form an acidic solution.

- Sodium carbonate (Na_2CO_3) is a basic salt formed from a strong base (NaOH) and a weak acid (carbonic acid). It undergoes hydrolysis to form a basic solution.

- Sodium chloride (NaCl) is a neutral salt formed from a strong base ($NaOH$) and a strong acid (HCl). It does not undergo hydrolysis because both ions (Na^+ and Cl) do not react with water.

Quick Tip

For hydrolysis of salts: - Salts formed from a strong acid and a strong base do not undergo hydrolysis. - Salts formed from a weak acid and a strong base undergo hydrolysis to give a basic solution. - Salts formed from a strong acid and a weak base undergo hydrolysis to give an acidic solution.

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10. In the reaction $2\mathbf{NaOH} + \mathbf{Cl_2} \rightarrow \mathbf{NaCl} + \mathbf{NaOCl} + \mathbf{H_2O}$, what is the oxidation state of chlorine in sodium hypochlorite (NaOCl)?

(A) +1

(B) +2

(C) -1

(D) 0

Correct Answer: (A) +1

Solution: In the given reaction, chlorine (Cl_2) reacts with sodium hydroxide (NaOH) to form sodium chloride (NaCl) and sodium hypochlorite (NaOCl).

To determine the oxidation state of chlorine in sodium hypochlorite, we follow these steps:

- In sodium chloride (NaCl), chlorine has an oxidation state of -1, as sodium (Na) has an oxidation state of +1. - In sodium hypochlorite (NaOCl), sodium (Na) has an oxidation state of +1, oxygen (O) generally has an oxidation state of -2.

Let the oxidation state of chlorine in sodium hypochlorite be x. The sum of the oxidation states in NaOCl should be zero, as it is a neutral compound. Therefore:

$$+1 + (-2) + x = 0 \quad \Rightarrow \quad x = +1.$$

Thus, the oxidation state of chlorine in sodium hypochlorite is +1.

Quick Tip

To determine the oxidation state of an element in a compound, consider the oxidation states of other elements and apply the rule that the sum of the oxidation states in a neutral molecule must be zero.

11. The sum of the first 30 terms of an arithmetic progression is 930. If the first term is 2, what is the common difference of the progression?

(A) 1

(B) 2

(C) 3

(D) 4

Correct Answer: (B) 2

Solution:

We are given that the sum of the first 30 terms of an arithmetic progression (AP) is 930, and the first term is 2. We need to find the common difference d.

The formula for the sum of the first n terms of an arithmetic progression is:

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

where: - S_n is the sum of the first n terms, - a is the first term, - d is the common difference, - n is the number of terms.

Substituting the known values:

$$S_{30} = \frac{30}{2} [2(2) + (30-1) \cdot d]$$

$$930 = 15 [4 + 29d]$$

$$930 = 15(4 + 29d)$$

$$930 = 60 + 435d$$

$$930 - 60 = 435d$$

$$870 = 435d$$

$$d = \frac{870}{435}$$

$$d = 2$$

Thus, the common difference is $d = 2$.

Quick Tip

Use the formula for the sum of an arithmetic progression to solve for the common difference when the sum and first term are known. Ensure the correct substitution of values in the equation.

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12. If $\sin\theta + \cos\theta = 1$, what is the value of $\sin^2\theta + \cos^2\theta$?

(A) 0

(B) 1

(C) 2

(D) -1

Correct Answer: (B) 1

Solution: We are given the equation $\sin\theta + \cos\theta = 1$. We need to find $\sin^2\theta + \cos^2\theta$.

Using the Pythagorean identity:

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

This identity is always true for any angle θ, so regardless of the given equation, we know that:

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

Thus, the value of $\sin^2\theta + \cos^2\theta$ is 1.

Quick Tip

The identity $\sin^2\theta + \cos^2\theta = 1$ holds true for all angles. This is fundamental to trigonometry and is useful when simplifying expressions involving trigonometric functions.