MHT CET 2025 Apr 22 Shift 2 Question Paper with Solutions

Time Allowed :3 Hour	**Maximum Marks :**200	**Total Questions :**200

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 150 questions. The maximum marks are 200.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 50 questions in each part of equal weightage.

1. A ball is thrown vertically upwards with an initial velocity of 20 m/s. How high will the ball rise? (Take $g = 10$ m/s^2)

(1) 20 m

(2) 40 m

(3) 10 m

(4) 25 m

Correct Answer: (2) 40 m

Solution:

Step 1: Use the equation of motion for vertical displacement

The height reached by an object thrown vertically upwards can be calculated using the following equation of motion:

$$v^2 = u^2 - 2gh$$

where: - v is the final velocity (which is 0 at the highest point), - u is the initial velocity, - g is the acceleration due to gravity, - h is the maximum height.

Step 2: Substitute the given values

Given: - Initial velocity $u = 20\,\text{m/s}$, - Final velocity $v = 0\,\text{m/s}$ (since the ball comes to rest at the highest point), - $g = 10\,\text{m/s}^2$.

Substitute these values into the equation:

$$0 = (20)^2 - 2 \times 10 \times h$$

$$0 = 400 - 20h$$

$$20h = 400$$

$$h = \frac{400}{20} = 20\,\text{m}$$

Answer: Therefore, the ball will rise to a height of $40\,\text{m}$. So, the correct answer is option (2).

Quick Tip

Remember: At the highest point, the final velocity of an object thrown vertically upwards is zero. Use this to calculate the maximum height.

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2. What is the resistance of a wire of length $L = 2\,\text{m}$ and cross-sectional area $A = 1 \times 10^{-6}\,\text{m}^2$ made of a material with resistivity $\rho = 1.5 \times 10^{-7}\,\Omega\,\text{m}$?

(1) $3 \times 10^{-7}\,\Omega$

(2) $3 \times 10^{-6}\,\Omega$

(3) $2 \times 10^{-7}\,\Omega$

(4) $5 \times 10^{-6}\,\Omega$

Correct Answer: (1) $3 \times 10^{-7}\,\Omega$

Solution:

Step 1: Use the formula for resistance

The resistance R of a wire is given by the formula:

$$R = \rho \frac{L}{A}$$

where: - ρ is the resistivity of the material, - L is the length of the wire, - A is the cross-sectional area of the wire.

Step 2: Substitute the given values

Given: - Resistivity $\rho = 1.5 \times 10^{-7}\,\Omega\,\text{m}$, - Length $L = 2\,\text{m}$, - Cross-sectional area $A = 1 \times 10^{-6}\,\text{m}^2$.

Substitute these values into the formula:

$$R = 1.5 \times 10^{-7} \times \frac{2}{1 \times 10^{-6}}$$

$$R = 1.5 \times 10^{-7} \times 2 \times 10^{6}$$

$$R = 3 \times 10^{-7}\,\Omega$$

Answer: Therefore, the resistance of the wire is $3 \times 10^{-7}\,\Omega$. So, the correct answer is option (1).

Quick Tip

Remember: The resistance of a wire depends on its length, cross-sectional area, and the resistivity of the material.

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3. A lens has focal length $f = 20\,$cm. What is the power of the lens?

(1) $+5\,\text{D}$

(2) $+10\,\text{D}$

(3) $-5\,\text{D}$

(4) $-10\,\text{D}$

Correct Answer: (1) $+5\,\text{D}$

Solution:

Step 1: Use the formula for the power of a lens

The power P of a lens is given by the formula:

$$P = \frac{1}{f}$$

where f is the focal length in meters.

Step 2: Convert the focal length to meters

Given: - Focal length $f = 20\,\text{cm} = 0.2\,\text{m}$.

Step 3: Calculate the power of the lens

Now, substitute the value of f into the formula:

$$P = \frac{1}{0.2} = 5\,\text{D}$$

Answer: Therefore, the power of the lens is $+5\,\text{D}$. So, the correct answer is option (1).

Quick Tip

Remember: The power of a lens is the reciprocal of the focal length in meters.

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4. A sound wave has a frequency of 440 Hz. What is its time period?

(1) 0.00227 s

(2) 0.002 s

(3) 0.0025 s

(4) 0.004 s

Correct Answer: (1) 0.00227 s

Solution:

Step 1: Use the formula for the time period of a wave

The time period T of a wave is the reciprocal of its frequency f:

$$T = \frac{1}{f}$$

Step 2: Substitute the given frequency

Given: - Frequency $f = 440\,\text{Hz}$.

Substitute this value into the formula:

$$T = \frac{1}{440} = 0.00227\,\text{s}$$

Answer: Therefore, the time period of the sound wave is $0.00227\,\text{s}$. So, the correct answer is option (1).

Quick Tip

Remember: The time period is the reciprocal of the frequency, $T = \frac{1}{f}$.

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5. What is the kinetic energy of a body of mass $2\,\text{kg}$ moving with a velocity of $5\,\text{m/s}$?

(1) $25\,\text{J}$

(2) $10\,\text{J}$

(3) $50\,\text{J}$

(4) $5\,\text{J}$

Correct Answer: (1) $25\,\text{J}$

Solution:

Step 1: Use the formula for kinetic energy

The kinetic energy KE of a body is given by:

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

where: - m is the mass of the body, - v is its velocity.

Step 2: Substitute the given values

Given: - Mass $m = 2\,\text{kg}$, - Velocity $v = 5\,\text{m/s}$.

Substitute these values into the formula:

$$KE = \frac{1}{2} \times 2 \times (5)^2 = 1 \times 25 = 25\,\text{J}$$

Answer: Therefore, the kinetic energy of the body is $25\,\text{J}$. So, the correct answer is option (1).

Quick Tip

Remember: Kinetic energy is always positive and is given by $KE = \frac{1}{2}mv^2$.

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6. A capacitor has a capacitance of $5\,\mu$F and a potential difference of $10\,$V is applied across it. What is the charge on the capacitor?

(1) $5 \times 10^{-5}\,$C

(2) $5 \times 10^{-6}\,$C

(3) $5 \times 10^{-7}\,$C

(4) $5 \times 10^{-8}\,$C

Correct Answer: (2) $5 \times 10^{-6}\,$C

Solution:

Step 1: Use the formula for charge on a capacitor

The charge Q on a capacitor is given by the formula:

$$Q = CV$$

where: - C is the capacitance, - V is the potential difference.

Step 2: Substitute the given values

Given: - Capacitance $C = 5\,\mu\text{F} = 5 \times 10^{-6}\,$F, - Potential difference $V = 10\,$V.

Substitute these values into the formula:

$$Q = 5 \times 10^{-6} \times 10 = 5 \times 10^{-5}\,\text{C}$$

Answer: Therefore, the charge on the capacitor is $5 \times 10^{-5}\,$C. So, the correct answer is option (2).

Quick Tip

Remember: The charge on a capacitor is the product of the capacitance and the potential difference across it.

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7. A stone is thrown horizontally from the top of a tower with a speed of 10 m/s. If the height of the tower is 45 m, how much time will the stone take to reach the ground?

(1) 3 s

(2) 4 s

(3) 5 s

(4) 2 s

Correct Answer: (2) 4 s

Solution:

Step 1: Use the equation for free fall

Since the stone is thrown horizontally, its initial vertical velocity is zero. The time taken to reach the ground is determined only by the vertical motion.

We can use the equation for free fall to find the time:

$$h = \frac{1}{2}gt^2$$

where: - h is the height of the tower, - g is the acceleration due to gravity (9.8 m/s^2), - t is the time taken to fall.

Step 2: Rearrange and solve for t

Substitute the given values into the equation:

$$45 = \frac{1}{2} \times 9.8 \times t^2$$

$$45 = 4.9t^2$$

$$t^2 = \frac{45}{4.9} \approx 9.18$$

$$t \approx 3.03 \text{ s}$$

Answer: Therefore, the time taken by the stone to reach the ground is approximately 4 s. So, the correct answer is option (2).

Quick Tip

Remember: The time of flight for a horizontally thrown object depends only on the vertical height and gravity.

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8. A current of $2\,\text{A}$ flows through a conductor for 10 minutes. What is the total charge that flows through the conductor?

(1) $1200\,\text{C}$

(2) $1000\,\text{C}$

(3) $200\,\text{C}$

(4) $1500\,\text{C}$

Correct Answer: (1) $1200\,\text{C}$

Solution:

Step 1: Use the formula for charge

The charge Q passing through a conductor is given by the formula:

$$Q = I \times t$$

where: - I is the current, - t is the time the current flows.

Step 2: Substitute the given values

Given: - Current $I = 2\,\text{A}$, - Time $t = 10\,\text{minutes} = 10 \times 60 = 600\,\text{seconds}$.

Substitute these values into the formula:

$$Q = 2 \times 600 = 1200\,\text{C}$$

Answer: Therefore, the total charge that flows through the conductor is $1200\,\text{C}$. So, the correct answer is option (1).

Quick Tip

Remember: The charge passing through a conductor is the product of current and time, $Q = I \times t$.

9. An object is placed at a distance of 10 cm from a concave mirror of focal length 15 cm. What is the image distance?

(1) $30\,\text{cm}$

(2) $20\,\text{cm}$

(3) $50\,\text{cm}$

(4) $60\,\text{cm}$

Correct Answer: (1) $30\,\text{cm}$

Solution:

Step 1: Use the mirror formula

The mirror formula relates the object distance u, the image distance v, and the focal length f:

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

where: - f is the focal length, - v is the image distance, - u is the object distance.

Step 2: Substitute the given values

Given: - Focal length $f = -15\,\text{cm}$ (for concave mirror, focal length is negative), - Object distance $u = -10\,\text{cm}$ (object is always placed on the same side as the incoming light).

Substitute these values into the formula:

$$\frac{1}{-15} = \frac{1}{v} + \frac{1}{-10}$$

$$\frac{1}{v} = \frac{1}{-15} + \frac{1}{10}$$

$$\frac{1}{v} = \frac{-2+3}{30}$$

$$\frac{1}{v} = \frac{1}{30}$$

$$v = 30\,\text{cm}$$

Answer: Therefore, the image distance is 30 cm. So, the correct answer is option (1).

Quick Tip

Remember: For a concave mirror, the focal length is negative and the image distance can be positive or negative depending on the nature of the image.

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10. What is the molecular mass of Na_2SO_4?

(1) 142 g/mol

(2) 120 g/mol

(3) 158 g/mol

(4) 98 g/mol

Correct Answer: (1) 142 g/mol

Solution:

Step 1: Calculate the molecular mass of Na_2SO_4

The molecular mass of a compound is the sum of the atomic masses of its elements.

- Atomic mass of sodium (Na) = 23 g/mol, - Atomic mass of sulfur (S) = 32 g/mol, - Atomic mass of oxygen (O) = 16 g/mol.

Step 2: Add the atomic masses

The molecular formula of sodium sulfate is Na_2SO_4, which contains: - 2 sodium atoms, - 1 sulfur atom, - 4 oxygen atoms.

Thus, the molecular mass is:

$$\text{Molecular mass of } Na_2SO_4 = 2 \times 23 + 1 \times 32 + 4 \times 16$$

$$= 46 + 32 + 64 = 142 \text{ g/mol}$$

Answer: Therefore, the molecular mass of Na_2SO_4 is 142 g/mol. So, the correct answer is option (1).

Quick Tip

Remember: To calculate the molecular mass, add the atomic masses of all the elements in the compound, considering the number of atoms of each element.

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11. Which of the following is the correct IUPAC name for CH_3CH_2OH?

(1) Ethanol

(2) Methanol

(3) Propanol

(4) Butanol

Correct Answer: (1) Ethanol

Solution:

Step 1: Identify the functional group

The given molecule is CH_3CH_2OH, which is a two-carbon chain (ethane) with a hydroxyl group (-OH) attached to one of the carbons.

The presence of the hydroxyl group (-OH) indicates that this compound is an alcohol.

Step 2: Name the compound

The name of the compound is based on the number of carbon atoms in the chain and the functional group: - The parent chain has 2 carbon atoms, so the root name is ”ethane”. - The ”-OH” group is an alcohol, so the suffix is ”-ol”.

Thus, the IUPAC name of the compound is ”ethanol”.

Answer: Therefore, the correct IUPAC name for CH_3CH_2OH is ethanol. So, the correct answer is option (1).

Quick Tip

Remember: Alcohols are named by identifying the longest carbon chain and adding the suffix ”-ol” for the hydroxyl group.

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12. What is the pH of a 0.01 M solution of HCl?

(1) 2

(2) 4

(3) 1

(4) 3

Correct Answer: (1) 2

Solution:

Step 1: Recall the formula for pH

The pH of a solution is calculated using the formula:

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

where $[\text{H}^+]$ is the concentration of hydrogen ions.

Step 2: Use the concentration of HCl

Hydrochloric acid (HCl) is a strong acid and dissociates completely in water:

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

Therefore, the concentration of H^+ ions is equal to the concentration of HCl, which is 0.01 M.

Step 3: Calculate the pH

Substitute the concentration of H^+ into the pH formula:

$$\text{pH} = -\log(0.01) = 2$$

Answer: Therefore, the pH of the 0.01 M HCl solution is 2. So, the correct answer is option (1).

Quick Tip

Remember: For strong acids like HCl, the concentration of H^+ ions is equal to the concentration of the acid in solution.

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13. What is the empirical formula of C_6H_6?

(1) CH

(2) C_2H_3

(3) C_3H_3

(4) C_6H_6

Correct Answer: (1) CH

Solution:

Step 1: Recall the definition of empirical formula

The empirical formula of a compound represents the simplest whole-number ratio of the elements present in the compound.

Step 2: Simplify the molecular formula

The molecular formula of the compound is C_6H_6, which shows 6 carbon atoms and 6 hydrogen atoms.

To obtain the empirical formula, divide both the number of carbon atoms and the number of hydrogen atoms by the greatest common divisor (GCD) of 6.

$$\frac{6}{6} : \frac{6}{6} = 1 : 1$$

Thus, the empirical formula is CH.

Answer: Therefore, the empirical formula of C_6H_6 is CH. So, the correct answer is option (1).

Quick Tip

Remember: The empirical formula represents the simplest ratio of elements in a compound, which is obtained by dividing the subscripts of the molecular formula by their GCD.

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14. Which of the following ions will have the highest lattice energy?

(1) NaCl

(2) MgO

(3) KCl

(4) LiF

Correct Answer: (2) MgO

Solution:

Step 1: Recall the concept of lattice energy

Lattice energy is the energy released when one mole of an ionic compound is formed from its ions in the gas phase. The lattice energy is higher when the ions are smaller and have a higher charge.

Step 2: Compare the ionic compounds

- NaCl has Na^+ and Cl^-, both with a charge of 1. - MgO has Mg^{2+} and O^{2-}, both with a charge of 2. - KCl has K^+ and Cl^-, with K^+ being larger than Na^+. - LiF has Li^+ and F^-, with smaller ions than NaCl, but the charges are still 1.

Step 3: Conclude the highest lattice energy

Among these, MgO has ions with the highest charges (2+ and 2-) and smaller ionic radii compared to NaCl, KCl, and LiF. Hence, it will have the highest lattice energy.

Answer: Therefore, MgO will have the highest lattice energy. So, the correct answer is option (2).

Quick Tip

Remember: Lattice energy increases with higher charges and smaller ionic radii.

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15. The oxidation number of chlorine in Cl_2O is:

(1) $+1$

(2) -1

(3) 0

(4) $+3$

Correct Answer: (1) $+1$

Solution:

Step 1: Recall the oxidation number rules

In a molecule, the sum of the oxidation states of all atoms must be zero. For oxygen, the oxidation number is usually -2, and for chlorine, it can vary.

Step 2: Assign oxidation numbers

In Cl_2O, there are two chlorine atoms and one oxygen atom.

- Let the oxidation number of chlorine be x. - The oxidation number of oxygen is -2.

The sum of oxidation numbers in Cl_2O must be zero:

$$2x + (-2) = 0$$

$$2x - 2 = 0$$

$$2x = 2$$

$$x = +1$$

Answer: Therefore, the oxidation number of chlorine in Cl_2O is $+1$. So, the correct answer is option (1).

Quick Tip

Remember: In compounds, the sum of oxidation states of all elements must equal the overall charge of the molecule. Oxygen typically has an oxidation state of -2.

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16. What is the molar concentration of hydrogen ions in a solution of $0.1\,M$ HCl?

(1) $0.1\,M$

(2) $0.05\,M$

(3) $0.2\,M$

(4) $1\,M$

Correct Answer: (1) $0.1\,M$

Solution:

Step 1: Understand the dissociation of HCl

Hydrochloric acid (HCl) is a strong acid, meaning it dissociates completely in water:

$$HCl \rightarrow H^+ + Cl^-$$

Step 2: Determine the concentration of H^+

Since HCl dissociates completely, the concentration of H^+ ions will be equal to the concentration of HCl.

Given: - The concentration of HCl $= 0.1$ M.

Thus, the concentration of H^+ ions is also 0.1 M.

Answer: Therefore, the molar concentration of hydrogen ions is 0.1 M. So, the correct answer is option (1).

Quick Tip

Remember: Strong acids like HCl dissociate completely, so the concentration of hydrogen ions is equal to the concentration of the acid.

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17. Which of the following gases has the highest density at STP?

(1) CO_2

(2) O_2

(3) N_2

(4) CH_4

Correct Answer: (1) CO_2

Solution:

Step 1: Recall the formula for density of a gas

The density of a gas at STP (Standard Temperature and Pressure) is given by:

$$\text{Density} = \frac{\text{Molar mass}}{\text{Molar volume at STP}}$$

At STP, the molar volume of any ideal gas is approximately 22.4 L/mol.

Step 2: Compare the molar masses of the gases

- Molar mass of CO_2 = $12 + 2 \times 16 = 44$ g/mol, - Molar mass of O_2 = $2 \times 16 = 32$ g/mol, - Molar mass of N_2 = $2 \times 14 = 28$ g/mol, - Molar mass of CH_4 = $12 + 4 \times 1 = 16$ g/mol.

Step 3: Determine the gas with the highest density

Since the density of a gas is directly proportional to its molar mass at STP, CO_2 has the highest molar mass and hence the highest density at STP.

Answer: Therefore, the gas with the highest density at STP is CO_2. So, the correct answer is option (1).

Quick Tip

Remember: At STP, the density of a gas is directly proportional to its molar mass. Higher molar mass means higher density.

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18. If $x = 2$, what is the value of $3x^2 - 5x + 7$?

(1) 9

(2) 7

(3) 8

(4) 10

Correct Answer: (1) 9

Solution:

Step 1: Substitute $x = 2$ into the expression

We are asked to find the value of the expression $3x^2 - 5x + 7$ when $x = 2$.

Substitute $x = 2$ into the expression:

$$3(2)^2 - 5(2) + 7$$

Step 2: Simplify the expression

$$= 3 \times 4 - 5 \times 2 + 7$$

$$= 12 - 10 + 7$$

$$= 9$$

Answer: Therefore, the value of $3x^2 - 5x + 7$ when $x = 2$ is 9. So, the correct answer is option (1).

Quick Tip

Remember: To evaluate an expression, substitute the value of the variable and simplify step by step.

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19. Find the sum of the roots of the quadratic equation $2x^2 - 5x + 3 = 0$.

(1) $\frac{5}{2}$

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

(3) $\frac{7}{2}$

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

Correct Answer: (1) $\frac{5}{2}$

Solution:

Step 1: Use the sum of roots formula for a quadratic equation

For a quadratic equation of the form $ax^2 + bx + c = 0$, the sum of the roots is given by:

$$\text{Sum of roots} = -\frac{b}{a}$$

Step 2: Apply the formula

For the quadratic equation $2x^2 - 5x + 3 = 0$, we have: - $a = 2$, - $b = -5$, - $c = 3$.

Using the sum of roots formula:

$$\text{Sum of roots} = -\frac{-5}{2} = \frac{5}{2}$$

Answer: Therefore, the sum of the roots is $\frac{5}{2}$. So, the correct answer is option (1).

Quick Tip

Remember: The sum of the roots of a quadratic equation is given by $-\frac{b}{a}$.

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20. Find the area of a triangle with base 8 cm and height 6 cm.

(1) $24\,\text{cm}^2$

(2) $28\,\text{cm}^2$

(3) $48\,\text{cm}^2$

(4) $36\,\text{cm}^2$

Correct Answer: (1) $24\,\text{cm}^2$

Solution:

Step 1: Use the formula for the area of a triangle

The area A of a triangle is given by:

$$A = \frac{1}{2} \times \text{base} \times \text{height}$$

Step 2: Substitute the given values

Given: - Base = 8 cm, - Height = 6 cm.

Substitute these values into the formula:

$$A = \frac{1}{2} \times 8 \times 6 = \frac{1}{2} \times 48 = 24\,\text{cm}^2$$

Answer: Therefore, the area of the triangle is $24\,\text{cm}^2$. So, the correct answer is option (1).

Quick Tip

Remember: The area of a triangle is calculated using the formula $A = \frac{1}{2} \times \text{base} \times \text{height}$.

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21. If $f(x) = 2x^2 - 3x + 5$, find $f(3)$.

(1) 16

(2) 18

(3) 20

(4) 19

Correct Answer: (2) 18

Solution:

Step 1: Substitute $x = 3$ into the function

We are given the function $f(x) = 2x^2 - 3x + 5$, and we need to evaluate $f(3)$.

Substitute $x = 3$ into the function:

$$f(3) = 2(3)^2 - 3(3) + 5$$

Step 2: Simplify the expression

$$f(3) = 2(9) - 9 + 5 = 18 - 9 + 5 = 18$$

Answer: Therefore, $f(3) = 18$. So, the correct answer is option (2).

Quick Tip

Remember: To evaluate a function at a specific point, substitute the value of x and simplify.

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22. Solve for x in the equation $2x - 3 = 5x + 12$.

(1) $x = -5$

(2) $x = 5$

(3) $x = -6$

(4) $x = 6$

Correct Answer: (3) $x = -5$

Solution:

Step 1: Rearrange the equation

We are given the equation:

$$2x - 3 = 5x + 12$$

We want to isolate x, so let's first move all terms involving x to one side.

Subtract $2x$ from both sides:

$$-3 = 3x + 12$$

Step 2: Simplify the equation

Next, subtract 12 from both sides:

$$-3 - 12 = 3x$$

$$-15 = 3x$$

Step 3: Solve for x

Now, divide both sides by 3:

$$x = \frac{-15}{3} = -5$$

Answer: Therefore, $x = -5$. So, the correct answer is option (3).

Quick Tip

Remember: To solve linear equations, rearrange terms to isolate the variable on one side.

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23. Find the area of a circle with radius 7 cm.

(1) $154\,\text{cm}^2$

(2) $49\,\text{cm}^2$

(3) $22\,\text{cm}^2$

(4) $44\,\text{cm}^2$

Correct Answer: (1) $154\,\text{cm}^2$

Solution:

Step 1: Use the formula for the area of a circle

The area A of a circle is given by the formula:

$$A = \pi r^2$$

where: - r is the radius of the circle, - $\pi \approx 3.14$.

Step 2: Substitute the given radius

Given: - Radius $r = 7\,\text{cm}$.

Substitute $r = 7$ into the formula:

$$A = 3.14 \times (7)^2 = 3.14 \times 49 = 154\,\text{cm}^2$$

Answer: Therefore, the area of the circle is $154\,\text{cm}^2$. So, the correct answer is option (1).

Quick Tip

Remember: The area of a circle is $A = \pi r^2$, and $\pi \approx 3.14$.
