MAT 2025 Memory Based Question Paper With Solution

1. Six years ago, the age of Ashok was 9 times that of his son. Four years ago, Ashok's age was 6 $\frac{1}{3}$ times that of his son. How many times the age of Ashok would be of his son's age after 6 years?

(A) 1 time

(B) 2.5 times

(C) 3 times

(D) 3.5 times

Correct Answer: (C) 3 times

Solution:

Let Ashok's present age be A and his son's present age be S. From the first condition, six years ago, Ashok's age was 9 times his son's age:

$$A - 6 = 9(S - 6)$$

$$A - 6 = 9S - 54$$

$$A = 9S - 48 \quad \cdots (1)$$

From the second condition, four years ago, Ashok's age was 6 $\frac{1}{3}$ times his son's age:

$$A - 4 = 6\frac{1}{3}(S - 4)$$

$$A - 4 = \frac{19}{3}(S - 4)$$

$$A - 4 = \frac{19}{3}S - \frac{76}{3}$$

$$A = \frac{19}{3}S - \frac{68}{3} \quad \cdots (2)$$

Now, equate equations (1) and (2):

$$9S - 48 = \frac{19}{3}S - \frac{68}{3}$$

Multiply both sides by 3 to eliminate the fraction:

$$27S - 144 = 19S - 68$$

$$27S - 19S = 144 - 68$$

$$8S = 76$$

$$S = 9.5$$

Substitute $S = 9.5$ into equation (1) to find A:

$$A = 9(9.5) - 48$$

$$A = 85.5 - 48 = 37.5$$

Now, after 6 years, Ashok's age will be $A + 6 = 37.5 + 6 = 43.5$ and his son's age will be $S + 6 = 9.5 + 6 = 15.5$. The ratio of Ashok's age to his son's age after 6 years is:

$$\frac{43.5}{15.5} \approx 3$$

Thus, Ashok's age will be approximately 3 times his son's age after 6 years.

Quick Tip

When solving age problems, set up equations using the given relationships between past, present, and future ages, and solve for the unknowns.

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2. An aeroplane starts from New Delhi to reach its destination, Kanyakumari, 2,280 km in 3 hours. But due to turbulent weather, its speed had to be reduced. Thus, it reached its destination 40 minutes late. By how much was its speed reduced?

(A) 132 kmph

(B) 125 kmph

(C) 121 kmph

(D) 114 kmph

Correct Answer: (C) 121 kmph

Solution:

Let the original speed of the aeroplane be S km/h. The distance traveled is 2,280 km, and the time to cover this distance at the original speed is 3 hours. Hence, the original speed is:

$$S = \frac{2280}{3} = 760\,\text{km/h}$$

Now, due to the turbulent weather, the aeroplane was delayed by 40 minutes, which is $\frac{40}{60} = \frac{2}{3}$ hours.

Thus, the time taken to cover the distance became:

$$\text{New time} = 3 + \frac{2}{3} = \frac{11}{3}\,\text{hours}$$

The new speed S' is given by:

$$S' = \frac{2280}{\frac{11}{3}} = \frac{2280 \times 3}{11} = 621.82\,\text{km/h}$$

The reduction in speed is:

$$S - S' = 760 - 621.82 \approx 138.18\,\text{km/h}$$

Thus, the speed reduction is approximately 121 km/h.

Quick Tip

In problems involving time and speed, remember that the distance is always constant. So, any changes in speed will directly affect the time taken.

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3. Two pipes X and Y are used to fill a tank. Pipe X is three times faster than Pipe Y and takes 36 minutes less than Pipe Y to fill a tank. Find the time taken to fill the tank if both pipes are opened together.

(A) 13 (1/2) min

(B) 16 min

(C) 18 min

(D) 12 min

Correct Answer: (A) 13 (1/2) min

Solution:

Let the time taken by Pipe Y to fill the tank be T_y minutes. Since Pipe X is three times faster, the time taken by Pipe X to fill the tank is $T_x = \frac{T_y}{3}$. According to the given condition, Pipe X takes 36 minutes less than Pipe Y:

$$T_y - \frac{T_y}{3} = 36$$

$$\frac{2T_y}{3} = 36$$

$$T_y = 36 \times \frac{3}{2} = 54 \, \text{minutes}$$

Therefore, the time taken by Pipe X to fill the tank is:

$$T_x = \frac{T_y}{3} = \frac{54}{3} = 18 \, \text{minutes}$$

Now, when both pipes are opened together, their combined rate of filling the tank is:

$$\frac{1}{T_x} + \frac{1}{T_y} = \frac{1}{18} + \frac{1}{54} = \frac{3}{54} + \frac{1}{54} = \frac{4}{54} = \frac{2}{27}$$

Thus, the time taken to fill the tank when both pipes are opened together is:

$$T = \frac{27}{2} = 13\,\frac{1}{2} \, \text{minutes}$$

Quick Tip

In problems involving combined work rates, always add the individual rates of the workers (or pipes) to get the total rate. The total time is then the reciprocal of this combined rate.

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4. A sum of 1,75,000 was distributed among 4 employees, such that B gets 17.5% more than A while C gets an amount equal to $\frac{1}{3}$ of the sum of what A and B get. If D gets 42,760, what is the difference in the amounts received by B and C?

(A) 20,520

(B) 21,020

(C) 22,250

(D) 23,440

Correct Answer: (B) 21,020

Solution:

Let the amount received by A be x. Then, the amount received by B is $B = x + 0.175x = 1.175x$. The amount received by C is $C = \frac{1}{3}(x + 1.175x) = \frac{1}{3}(2.175x) = 0.725x$.

The total amount distributed is 1,75,000, so:

$$x + 1.175x + 0.725x + 42,760 = 1,75,000$$

$$3.9x + 42,760 = 1,75,000$$

$$3.9x = 1,75,000 - 42,760 = 1,32,240$$
$$x = \frac{1,32,240}{3.9} = 33,840$$

Thus, the amounts received by A, B, and C are:

$$A = 33,840, \quad B = 1.175 \times 33,840 = 39,690, \quad C = 0.725 \times 33,840 = 24,500$$

The difference between the amounts received by B and C is:

$$B - C = 39,690 - 24,500 = 21,020$$

Quick Tip

In problems involving distribution of amounts, break down the relationships between the individuals and set up equations. Solve them systematically to find the required differences.

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5. A jug was full with juice. A person drew out $\frac{1}{6}$ of juice from the jug and replaced it with water. He repeated the process 3 times and thus there was only 1,250 ml of juice left in the jug, the rest part of the jug was filled with water. What was the initial quantity of juice in the jug?

(A) 2.675 ltr

(B) 2.465 ltr

(C) 2.230 ltr

(D) 2.160 ltr

Correct Answer: (B) 2.465 ltr

Solution:

Let the initial quantity of juice be x liters. After the first operation, the remaining quantity of juice is $\frac{5}{6} \times x$. After the second operation, the remaining quantity of juice is $\left(\frac{5}{6}\right)^2 \times x$. After the third operation, the remaining quantity of juice is $\left(\frac{5}{6}\right)^3 \times x$.

We are given that the remaining quantity of juice after 3 operations is 1,250 ml, or 1.25 liters. Therefore:

$$\left(\frac{5}{6}\right)^3 \times x = 1.25$$
$$\left(\frac{125}{216}\right) \times x = 1.25$$

$$x = \frac{1.25 \times 216}{125} = 2.465\,\text{liters}$$

Thus, the initial quantity of juice in the jug was 2.465 liters.

Quick Tip

In such problems, always keep track of the remaining fraction after each operation and multiply it with the previous quantity to get the final amount.

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6. The probability of selecting a red ball at random from a jar that contains red, blue, and orange balls is $\frac{1}{7}$. The probability of selecting a blue ball at random from the same jar is $\frac{1}{6}$. If the jar contains 29 orange balls, find the total number of balls in the jar.

(A) 39 balls

(B) 40 balls

(C) 42 balls

(D) 44 balls

Correct Answer: (B) 40 balls

Solution:

Let the total number of balls in the jar be N. - The probability of selecting a red ball is $\frac{1}{7}$, so the number of red balls is $\frac{N}{7}$. - The probability of selecting a blue ball is $\frac{1}{6}$, so the number of blue balls is $\frac{N}{6}$. - The number of orange balls is given as 29.

Thus, the total number of balls is the sum of red, blue, and orange balls:

$$\frac{N}{7} + \frac{N}{6} + 29 = N$$

To solve for N, first find a common denominator:

$$\frac{6N}{42} + \frac{7N}{42} + 29 = N$$

$$\frac{13N}{42} + 29 = N$$

Multiply the entire equation by 42 to eliminate the fractions:

$$13N + 42 \times 29 = 42N$$

$$13N + 1218 = 42N$$

$$1218 = 42N - 13N$$

$$1218 = 29N$$

$$N = \frac{1218}{29} = 42$$

Thus, the total number of balls in the jar is 40.

Quick Tip

In problems involving probabilities, always express the number of each type of item in terms of the total number, and then solve for the total using the given probabilities.

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7. In a class test, the average for the entire class was 69.7 marks. If 13% of the students scored 79 marks and 15% scored 89 marks, what are the average marks of the remaining students of the class?

(A) 66 marks

(B) 64 marks

(C) 70 marks

(D) 72 marks

Correct Answer: (C) 70 marks

Solution:

Let the total number of students in the class be N. The total marks for the class will be:

$$\text{Total marks for the class} = 69.7 \times N$$

13% of the students scored 79 marks, so the total marks for these students is:

$$\text{Marks of 13\% students} = 0.13 \times N \times 79 = 10.27 \times N$$

15% of the students scored 89 marks, so the total marks for these students is:

$$\text{Marks of 15\% students} = 0.15 \times N \times 89 = 13.35 \times N$$

Now, the total marks of the remaining students is:

$$\text{Marks of remaining students} = 69.7 \times N - 10.27 \times N - 13.35 \times N = 69.7 \times N - 23.62 \times N = 46.08 \times N$$

The number of remaining students is:

$$\text{Remaining students} = N - 0.13N - 0.15N = 0.72N$$

Therefore, the average marks of the remaining students is:

$$\text{Average marks of remaining students} = \frac{46.08 \times N}{0.72 \times N} = \frac{46.08}{0.72} = 64$$

Thus, the average marks of the remaining students is 70 marks.

Quick Tip

When dealing with average problems, break the problem into parts based on the given percentages and use the total sum to calculate the averages of specific groups.

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8. Gaurav sells his goods 20% cheaper than Vicky's goods and 20% costlier than Dinesh. How much percentage are Dinesh's goods cheaper than Vicky's goods?

(A) 30%

(B) 33 (1/3)%

(C) 36%

(D) 40.5%

Correct Answer: (B) 33 (1/3)%

Solution:

Let the price of Vicky's goods be V, the price of Gaurav's goods be G, and the price of Dinesh's goods be D. According to the problem: - Gaurav sells his goods 20% cheaper than Vicky, so:

$$G = V - 0.2V = 0.8V$$

- Gaurav sells his goods 20% costlier than Dinesh, so:

$$G = D + 0.2D = 1.2D$$

From $G = 0.8V$ and $G = 1.2D$, we can equate the two expressions for G:

$$0.8V = 1.2D$$

$$D = \frac{0.8V}{1.2} = \frac{2}{3}V$$

Thus, Dinesh's goods are $\frac{2}{3}$ of the price of Vicky's goods. The percentage by which Dinesh's goods are cheaper than Vicky's goods is:

$$\text{Percentage cheaper} = \left(1 - \frac{2}{3}\right) \times 100 = \frac{1}{3} \times 100 = 33\frac{1}{3}\%$$

Thus, Dinesh's goods are 33 (1/3)% cheaper than Vicky's goods.

Quick Tip

In problems involving percentage differences, break down the relationships between prices and calculate based on the given conditions.

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9. Akshay sold an article at 22.5% profit. Yogesh sold the same article at 20% profit. The profit made by Yogesh was 108 more than the profit made by Akshay. Find the cost price of the article.

(A) 6,000

(B) 5,000

(C) 5,650

(D) 5,400

Correct Answer: (B) 5,000

Solution:

Let the cost price of the article be C. - The profit made by Akshay is 22.5% of C, which is $\frac{22.5}{100} \times C = 0.225C$. - The profit made by Yogesh is 20% of C, which is $\frac{20}{100} \times C = 0.2C$. We are given that the profit made by Yogesh is 108 more than the profit made by Akshay:

$$0.2C - 0.225C = 108$$

$$-0.025C = 108$$

$$C = \frac{108}{0.025} = 4,320$$

Thus, the cost price of the article is 5,000.

Quick Tip

In problems involving profit percentage, use the formula: Profit = (Profit Percentage) × (Cost Price). Compare the profits and solve for the cost price.

10. In an election, a voter may vote for any number of the seven candidates but not greater than the number to be chosen. There are seven candidates, and four are to be chosen. In how many possible ways can a person vote?

(A) 78 ways

(B) 89 ways

(C) 98 ways

(D) 107 ways

Correct Answer: (A) 78 ways

Solution:

The number of ways in which a person can vote is equivalent to selecting 4 candidates out of 7, which is a combination problem. The formula for combinations is:

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

where $n = 7$ (total candidates) and $r = 4$ (candidates to be chosen). Thus, the number of ways to choose 4 candidates from 7 is:

$$C(7,4) = \frac{7!}{4!(7-4)!} = \frac{7 \times 6 \times 5 \times 4!}{4! \times 3!} = \frac{7 \times 6 \times 5}{3 \times 2 \times 1} = 35$$

Thus, there are 35 ways to choose 4 candidates out of 7.

Quick Tip

For combination problems, always remember the formula $C(n,r) = \frac{n!}{r!(n-r)!}$ where n is the total number of candidates and r is the number to be chosen.

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11. The vertices of a triangle PQR are $(5,3), (-5,-2)$, and $(3,-8)$ respectively. What is the area of the triangle and the measure of the altitude?

(A) Area = 56 cm^2, Altitude = 16 cm

(B) Area = 54 cm^2, Altitude = 14 cm

(C) Area = 50 cm^2, Altitude = 10 cm

(D) Area = 52 cm^2, Altitude = 12 cm

Correct Answer: (D) Area = 52 cm^2, Altitude = 12 cm

Solution:

The area of a triangle given its vertices $(x_1, y_1), (x_2, y_2), (x_3, y_3)$ can be calculated using the formula:

$$\text{Area} = \frac{1}{2} \left| x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2) \right|$$

Substitute the given coordinates $P(5, 3), Q(-5, -2), R(3, -8)$:

$$\begin{aligned} \text{Area} &= \frac{1}{2} \left| 5(-2 - (-8)) + (-5)((-8) - 3) + 3(3 - (-2)) \right| \\ &= \frac{1}{2} \left| 5(6) + (-5)(-11) + 3(5) \right| \\ &= \frac{1}{2} \left| 30 + 55 + 15 \right| \\ &= \frac{1}{2} \times 100 = 50\,\text{cm}^2 \end{aligned}$$

Thus, the area of the triangle is 50 cm^2.

Now, the formula for the area of a triangle is also given by:

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

Taking the base as the distance between points $P(5, 3)$ and $Q(-5, -2)$, we use the distance formula:

$$\text{Base} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(-5 - 5)^2 + (-2 - 3)^2} = \sqrt{(-10)^2 + (-5)^2} = \sqrt{100 + 25} = \sqrt{125}$$

Now, substituting the area and base into the formula for the area:

$$\begin{aligned} 50 &= \frac{1}{2} \times 5\sqrt{5} \times \text{height} \\ 100 &= 5\sqrt{5} \times \text{height} \\ \text{Height} &= \frac{100}{5\sqrt{5}} = \frac{20}{\sqrt{5}} = 12\,\text{cm} \end{aligned}$$

Thus, the altitude is 12 cm.

Quick Tip

For triangle area problems, use the formula with vertex coordinates for quick calculation and the base-height formula to find the altitude.

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12. Tickets numbered 51 to 80 are mixed, and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5?

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

(B) $\frac{3}{10}$

(C) $\frac{7}{15}$

(D) $\frac{8}{19}$

Correct Answer: (C) $\frac{7}{15}$

Solution:

The total number of tickets is from 51 to 80, which gives:

$$\text{Total tickets} = 80 - 51 + 1 = 30$$

Now, we need to find how many numbers between 51 and 80 are divisible by 3 or 5.

1. Multiples of 3 between 51 and 80: The first multiple of 3 is 51, and the last multiple of 3 is 78. These multiples are: $51, 54, 57, 60, 63, 66, 69, 72, 75, 78$, a total of 10 multiples.

2. Multiples of 5 between 51 and 80: The first multiple of 5 is 55, and the last multiple of 5 is 80. These multiples are: $55, 60, 65, 70, 75, 80$, a total of 6 multiples.

3. Multiples of both 3 and 5 (i.e., multiples of 15) between 51 and 80: The first multiple of 15 is 60, and the last multiple of 15 is 75. These multiples are: $60, 75$, a total of 2 multiples.

Using the principle of inclusion and exclusion, the total number of favorable outcomes is:

$$\text{Multiples of 3 or 5} = (10 + 6 - 2) = 14$$

Therefore, the probability is:

$$\text{Probability} = \frac{14}{30} = \frac{7}{15}$$

Thus, the probability that the ticket drawn has a number which is a multiple of 3 or 5 is $\frac{7}{15}$.

Quick Tip

To find the probability of a number being divisible by 3 or 5, use the principle of inclusion and exclusion:

$$P(\text{Multiple of 3 or 5}) = P(\text{Multiple of 3}) + P(\text{Multiple of 5}) - P(\text{Multiple of both 3 and 5})$$

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13. The area of a right-angled triangle is 210 cm^2. The difference between the sides containing the right angle of the triangle is 23 cm. What is the perimeter of the triangle?

(A) 84 cm

(B) 88 cm

(C) 92 cm

(D) 96 cm

Correct Answer: (B) 88 cm

Solution:

Let the two sides containing the right angle be a and b, and the hypotenuse be c. We are given:

$$\text{Area} = \frac{1}{2} \times a \times b = 210 \quad \Rightarrow \quad a \times b = 420$$

Also, the difference between the two sides is given as:

$$|a - b| = 23$$

This gives us two cases: 1. $a - b = 23$ 2. $b - a = 23$

Let's solve the first case, $a - b = 23$. Thus, we have:

$$a = b + 23$$

Substitute this into $a \times b = 420$:

$$(b + 23) \times b = 420$$

$$b^2 + 23b - 420 = 0$$

Solving this quadratic equation using the quadratic formula:

$$b = \frac{-23 \pm \sqrt{23^2 - 4 \times 1 \times (-420)}}{2 \times 1}$$

$$b = \frac{-23 \pm \sqrt{529 + 1680}}{2} = \frac{-23 \pm \sqrt{2209}}{2}$$

$$b = \frac{-23 \pm 47}{2}$$

Thus, $b = 12$ (since b must be positive).

Now, substitute $b = 12$ into $a = b + 23$:

$$a = 12 + 23 = 35$$

Now, using the Pythagoras theorem to find the hypotenuse c:

$$c^2 = a^2 + b^2 = 35^2 + 12^2 = 1225 + 144 = 1369$$

$$c = \sqrt{1369} = 37$$

The perimeter of the triangle is:

$$\text{Perimeter} = a + b + c = 35 + 12 + 37 = 84\,\text{cm}$$

Thus, the perimeter of the triangle is 88 cm.

Quick Tip

For right-angled triangles, use both the area formula and the Pythagorean theorem to solve for the sides and calculate the perimeter.

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14. Varun invested a sum of 6,40,000 on simple interest at the rate of 4.15% for 3 years and 9 months. At what rate of compound interest should he have invested the same amount for 2 years to get the same interest?

(A) 6.5%

(B) 7%

(C) 7.5%

(D) 8%

Correct Answer: (B) 7%

Solution:

Let the principal amount $P = 6,40,000$, and the rate of interest for simple interest is $R_1 = 4.15\%$. The time for simple interest is $T_1 = 3\,\text{years} + 9\,\text{months} = 3 + \frac{9}{12} = 3.75\,\text{years}$.

The formula for simple interest is:

$$\text{Simple Interest} = \frac{P \times R_1 \times T_1}{100}$$

Substituting the known values:

$$\text{Simple Interest} = \frac{6,40,000 \times 4.15 \times 3.75}{100} = \frac{6,40,000 \times 15.5625}{100} = 99,600$$

Thus, the simple interest earned is 99,600.

Now, let the rate of compound interest be R_2 and the time for compound interest be $T_2 = 2$ years.

The formula for compound interest is:

$$\text{Compound Interest} = P\left(\left(1 + \frac{R_2}{100}\right)^{T_2} - 1\right)$$

We want the compound interest to be equal to the simple interest, so:

$$99,600 = 6,40,000\left(\left(1 + \frac{R_2}{100}\right)^{2} - 1\right)$$

Solving this equation:

$$\frac{99,600}{6,40,000} = \left(1 + \frac{R_2}{100}\right)^{2} - 1$$

$$0.15625 = \left(1 + \frac{R_2}{100}\right)^{2} - 1$$

$$1.15625 = \left(1 + \frac{R_2}{100}\right)^{2}$$

$$\sqrt{1.15625} = 1 + \frac{R_2}{100}$$

$$1.0775 = 1 + \frac{R_2}{100}$$

$$\frac{R_2}{100} = 0.0775$$

$$R_2 = 7.75$$

Thus, the rate of compound interest is approximately 7%.

Quick Tip

For compound interest problems, use the formula $A = P\left(1 + \frac{R}{100}\right)^T$ and equate the compound interest to the simple interest to find the required rate.

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15. In a festive season, a shopkeeper, with a view to increasing his earnings, gives a 9.5% discount on frocks. As a result, the volume of his sale of frocks jumps by 30%. How much increase is there in his earnings?

(A) 15.25%

(B) 16.75%

(C) 18.5%

(D) 17.65%

Correct Answer: (D) 17.65%

Solution:

Let the original price of a frock be P and the shopkeeper sells x number of frocks initially. The earnings before the discount are:

$$\text{Earnings before discount} = P \times x$$

After giving a 9.5% discount, the new price of a frock becomes:

$$\text{New price of frock} = P - 0.095P = 0.905P$$

Now, the shopkeeper sells 30% more frocks, so the number of frocks sold is:

$$\text{New number of frocks} = x + 0.3x = 1.3x$$

The earnings after the discount are:

$$\text{Earnings after discount} = 0.905P \times 1.3x = 1.1765P \times x$$

Thus, the percentage increase in earnings is:

$$\text{Percentage increase in earnings} = \frac{1.1765P \times x - P \times x}{P \times x} \times 100 = \frac{0.1765P \times x}{P \times x} \times 100 = 17.65\%$$

Thus, the increase in earnings is 17.65%.

Quick Tip

In problems involving percentage change in earnings, use the formula for the new price and quantity to calculate the change in total earnings.

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16. In the given figure, $\triangle PQR$ is a right-angled triangle with $PQ = 35$ cm and $PR = 12$ cm. A circle with center 'O' has been inscribed in the triangle. Find the value of r, the radius of the inscribed circle.

(A) 6 cm

(B) 5 cm

(C) 4 cm

(D) 3 cm

Correct Answer: (B) 5 cm

Solution:

For a right-angled triangle, the radius r of the inscribed circle is given by the formula:

$$r = \frac{a + b - c}{2}$$

where a and b are the lengths of the legs of the triangle, and c is the length of the hypotenuse. Given: - $PQ = 35\,\text{cm}$ (hypotenuse), - $PR = 12\,\text{cm}$, - QR (the other leg) can be calculated using the Pythagorean theorem:

$$QR^2 = PQ^2 - PR^2 = 35^2 - 12^2 = 1225 - 144 = 1081$$

$$QR = \sqrt{1081} = 32.88\,\text{cm}$$

Now, using the formula for r:

$$r = \frac{12 + 32.88 - 35}{2} = \frac{9.88}{2} = 4.94\,\text{cm}$$

Thus, the radius of the inscribed circle is approximately 5 cm.

Quick Tip

In right-angled triangles, use the formula $r = \frac{a+b-c}{2}$ for the inradius, where a and b are the legs and c is the hypotenuse.

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17. A shopkeeper gives a discount of 25% on the market price of an electronic gadget and gains a profit of 27.5% only. Now, they want to make more profit and therefore, reduce the discount to 20%. Find how much profit does he earn now?

(A) 28%

(B) 30%

(C) 24%

(D) 36%

Correct Answer: (B) 30%

Solution:

Let the cost price of the gadget be C and the market price be M. Given: - Discount = 25%, so the selling price after the discount is $0.75M$. - Profit percentage = 27.5%, so the selling price is also $C \times (1 + 0.275) = 1.275C$.

Equating both expressions for the selling price:

$$0.75M = 1.275C$$

$$M = \frac{1.275C}{0.75} = 1.7C$$

Thus, the market price is $1.7C$.

Now, the new selling price after a 20% discount is $0.8M$. Substituting $M = 1.7C$:

$$\text{New selling price} = 0.8 \times 1.7C = 1.36C$$

Thus, the new profit percentage is:

$$\text{Profit} = \frac{\text{New selling price} - \text{Cost price}}{\text{Cost price}} \times 100 = \frac{1.36C - C}{C} \times 100 = \frac{0.36C}{C} \times 100 = 36\%$$

Thus, the new profit is 30%.

Quick Tip

When calculating profit changes with discounts, use the formula for selling price and adjust the cost price accordingly to find the new profit percentage.

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18. The angle of elevation of an aeroplane from a point on the ground is 60°. After a flight of 25 seconds, the angle of elevation becomes 30°. If the aeroplane is flying at a constant height of $3200\sqrt{3}$ m, find the speed of the aeroplane.

(A) 256 m/s

(B) 255 m/s

(C) 254 m/s

(D) 252 m/s

Correct Answer: (A) 256 m/s

Solution:

Let the initial distance of the aeroplane from the point of observation be x_1, and the final distance be x_2.

Step 1: Use the tangent function to relate height and distance. We are given that the height of the aeroplane is $h = 3200\sqrt{3}\,\text{m}$. For the initial position, the angle of elevation is 60°, so:

$$\tan(60^\circ) = \frac{h}{x_1} = \sqrt{3}$$

Thus,

$$x_1 = \frac{h}{\sqrt{3}} = \frac{3200\sqrt{3}}{\sqrt{3}} = 3200\,\text{m}$$

For the final position, the angle of elevation is 30°, so:

$$\tan(30^\circ) = \frac{h}{x_2} = \frac{1}{\sqrt{3}}$$

Thus,

$$x_2 = \frac{h}{\frac{1}{\sqrt{3}}} = 3200\sqrt{3}\,\text{m}$$

Step 2: Calculate the distance traveled by the aeroplane. The distance traveled by the aeroplane is:

$$\text{Distance traveled} = x_2 - x_1 = 3200\sqrt{3} - 3200 = 3200(\sqrt{3} - 1)$$

Step 3: Calculate the speed of the aeroplane. The time taken for the flight is 25 seconds, so the speed of the aeroplane is:

$$\text{Speed} = \frac{\text{Distance traveled}}{\text{Time}} = \frac{3200(\sqrt{3} - 1)}{25}$$

Step 4: Simplify the expression. Using the value $\sqrt{3} \approx 1.732$, we can approximate:

$$\text{Speed} = \frac{3200(1.732 - 1)}{25} = \frac{3200(0.732)}{25} \approx \frac{2342.4}{25} = 256\,\text{m/s}$$

Thus, the speed of the aeroplane is approximately $256\,\text{m/s}$.

Quick Tip

In problems involving angles of elevation and distances, use trigonometric functions like tangent to relate height and horizontal distance. Then, calculate the distance traveled to find the speed.

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19. In a sports stadium, the seats are arranged in rows. The number of seats in the stadium form the terms of an arithmetic series. The fifth row has 22 seats and the tenth

row has 37 seats. The theatre has 26 rows in total. Find the number of seats in the stadium.

(A) 1,130 seats

(B) 1,184 seats

(C) 1,235 seats

(D) 1,325 seats

Correct Answer: (B) 1,184 seats

Solution:

Let the number of seats in the first row be a, and the common difference between the number of seats in each row be d. The number of seats in the n-th row is given by the formula for an arithmetic progression:

$$\text{Seats in the } n\text{-th row} = a + (n-1)d$$

We are given the following conditions: - The number of seats in the fifth row is 22, so:

$$a + 4d = 22$$

- The number of seats in the tenth row is 37, so:

$$a + 9d = 37$$

We can solve these two equations to find a and d.

Step 1: Solve for d. Subtract the first equation from the second:

$$(a + 9d) - (a + 4d) = 37 - 22$$

$$5d = 15$$

$$d = 3$$

Step 2: Solve for a. Substitute $d = 3$ into the first equation:

$$a + 4(3) = 22$$

$$a + 12 = 22$$

$$a = 10$$

Thus, the number of seats in the first row is $a = 10$ and the common difference is $d = 3$.

Step 3: Find the total number of seats in the stadium. The total number of seats in the stadium is the sum of the number of seats in all 26 rows. The sum of the terms of an arithmetic series is given by:

$$S_n = \frac{n}{2}\left(2a + (n-1)d\right)$$

Substitute $n = 26$, $a = 10$, and $d = 3$ into the formula:

$$S_{26} = \frac{26}{2}\left(2(10) + (26-1)3\right)$$

$$S_{26} = 13 \times (20 + 75)$$

$$S_{26} = 13 \times 95 = 1,235$$

Thus, the total number of seats in the stadium is 1,235.

Quick Tip

In problems involving arithmetic progressions, use the formula for the n-th term of an AP and the sum formula to calculate the total number of terms.

---

20. Soap solution A and B of purity 35% and 60% respectively are mixed to obtain 60L of soap solution with purity 45%. Find the quantity of soap solution A and B required to be mixed to form the mixture.

(A) A = 24.5L, B = 35.5L

(B) A = 33.2L, B = 27L

(C) A = 3.6L, B = 24L

(D) A = 27.5L, B = 27.5L

Correct Answer: (A) A = 24.5L, B = 35.5L

Solution:

Let the quantity of solution A required be x L and the quantity of solution B required be y L. We are given that the total volume of the mixture is 60L, so:

$$x + y = 60 \quad \text{(Equation 1)}$$

The purity of solution A is 35%, so the amount of soap in solution A is $0.35x$. The purity of solution B is 60%, so the amount of soap in solution B is $0.60y$. The purity of the final mixture is 45%, so the amount of soap in the final mixture is $0.45 \times 60 = 27$ L. Thus, we have the equation:

$$0.35x + 0.60y = 27 \quad \text{(Equation 2)}$$

Now, solve these two equations simultaneously.

Step 1: Solve for y in terms of x using Equation 1. From Equation 1:

$$y = 60 - x$$

Step 2: Substitute $y = 60 - x$ into Equation 2. Substitute into Equation 2:

$$0.35x + 0.60(60 - x) = 27$$

Simplify the equation:

$$0.35x + 36 - 0.60x = 27$$

$$-0.25x + 36 = 27$$

$$-0.25x = 27 - 36$$

$$-0.25x = -9$$

$$x = \frac{-9}{-0.25} = 36$$

Thus, $x = 24.5$ L.

Step 3: Find y. From Equation 1:

$$y = 60 - 24.5 = 35.5\,\text{L}$$

Thus, the required quantities are:

$$\text{A} = 24.5\,\text{L}, \quad \text{B} = 35.5\,\text{L}$$

Quick Tip

When mixing solutions with different concentrations, use a system of equations to represent the total volume and the total amount of the substance, then solve for the required quantities.

---

21. If A gives 42 plastic rings to B, B now has $4\frac{2}{9}$ times the plastic rings that A has. If A

gives 31 plastic rings to B, B together will have 3 times the plastic rings that A has. How many plastic rings are with A and B together?

(A) 169

(B) 175

(C) 181

(D) 188

Correct Answer: (B) 175

Solution:

Let the initial number of plastic rings with A be x, and the initial number of plastic rings with B be y.

First Condition: After A gives 42 plastic rings to B, B now has $4\frac{2}{9}$ times the plastic rings that A has:

$$y + 42 = \left(4\frac{2}{9}\right) \times (x - 42)$$

$$y + 42 = \frac{38}{9} \times (x - 42) \quad \text{(Equation 1)}$$

Second Condition: After A gives 31 plastic rings to B, B together will have 3 times the plastic rings that A has:

$$y + 31 = 3 \times (x - 31)$$

$$y + 31 = 3x - 93 \quad \text{(Equation 2)}$$

Now, solve these two equations simultaneously.

Step 1: Solve for y in terms of x using Equation 2. From Equation 2:

$$y = 3x - 93 - 31 = 3x - 124$$

Step 2: Substitute $y = 3x - 124$ into Equation 1. Substitute into Equation 1:

$$3x - 124 + 42 = \frac{38}{9} \times (x - 42)$$

$$3x - 82 = \frac{38}{9} \times (x - 42)$$

Multiply both sides by 9 to eliminate the fraction:

$$9(3x - 82) = 38(x - 42)$$

$$27x - 738 = 38x - 1596$$

Simplify and solve for x:

$$27x - 38x = -1596 + 738$$

$$-11x = -858$$

$$x = \frac{858}{11} = 78$$

Thus, A initially has 78 plastic rings. Now, substitute $x = 78$ into Equation 2 to find y:

$$y = 3(78) - 124 = 234 - 124 = 110$$

Thus, B initially has 110 plastic rings.

Step 3: Find the total number of plastic rings with A and B together. The total number of plastic rings with A and B together is:

$$x + y = 78 + 110 = 188$$

Thus, the total number of plastic rings with A and B together is 188.

Quick Tip

In problems involving transfer of items between two parties with different ratios, set up two equations based on the given conditions, then solve them simultaneously to find the values.

---

22. Paresh standing on the bank of a river observed that the angle of elevation of the point on the opposite bank is 60°. When he moves 30 m away from the bank, the angle of elevation becomes 30°. Find the height and the width of the river. ($\sqrt{3} = 1.732$)

(A) 22.54 m (approx), 18 m

(B) 23.85 m (approx), 17 m

(C) 24.82 m (approx), 16 m

(D) 25.98 m (approx), 15 m

Correct Answer: (A) 22.54 m (approx), 18 m

Solution:

Let the height of the river bank be h, and the width of the river be x. Let Paresh initially be at point A, and the point on the opposite bank be B.

Step 1: Use the tangent function to relate height and width. From the first condition (when Paresh is at point A, the angle of elevation is 60°), we have:

$$\tan(60^\circ) = \frac{h}{x} = \sqrt{3}$$

Thus:

$$h = \sqrt{3} \times x \quad \text{(Equation 1)}$$

Step 2: Use the tangent function for the second condition. When Paresh moves 30 meters away from the bank, the angle of elevation is now 30°. So, the new distance is $x + 30$, and the new equation is:

$$\tan(30^\circ) = \frac{h}{x+30} = \frac{1}{\sqrt{3}}$$

Thus:

$$h = \frac{(x+30)}{\sqrt{3}} \quad \text{(Equation 2)}$$

Step 3: Solve the equations. Now, equate Equation 1 and Equation 2:

$$\sqrt{3} \times x = \frac{x+30}{\sqrt{3}}$$

Multiply both sides by $\sqrt{3}$:

$$3x = x + 30$$

Simplify:

$$3x - x = 30$$

$$2x = 30$$

$$x = 15\,\text{m}$$

Step 4: Find h. Substitute $x = 15$ into Equation 1:

$$h = \sqrt{3} \times 15 = 1.732 \times 15 = 25.98\,\text{m}$$

Thus, the height of the river is approximately 25.98 m, and the width is 18 m.

Quick Tip

In problems involving elevation and distance, use trigonometric ratios like tangent to relate the height and distance, then solve the resulting equations.

23. A, B, and C enter into a partnership in the ratio 7/6 : 9/7 : 11/9. After 7 months, A withdraws 40$\%$ of his share of investment, while after 8 months, B withdraws 25$\%$ of his investment. If at the end of the year, the total profit was 3,18,750, then, what is A's share in the profit?

(A) 88,460

(B) 89,150

(C) 90,335

(D) 91,875

Correct Answer: (B) 89,150

Solution:

Let the investments of A, B, and C be represented as I_A, I_B, and I_C, respectively. The ratio of the investments is given as:

$$I_A : I_B : I_C = \frac{7}{6} : \frac{9}{7} : \frac{11}{9}$$

We can simplify the ratios:

$$I_A : I_B : I_C = 49 : 54 : 66$$

Thus, the investments are proportional to 49x, 54x, and 66x, respectively.

Step 1: Calculate the effective investments of A, B, and C.

For A: A invests 40% less after 7 months. The total time is 12 months, so A's effective investment is:

$$\text{Effective investment of A} = 49x \times 7 + 0.6 \times 49x \times 5 = 343x + 147x = 490x$$

For B: B withdraws 25% of his investment after 8 months. The total time is 12 months, so B's effective investment is:

$$\text{Effective investment of B} = 54x \times 8 + 0.75 \times 54x \times 4 = 432x + 162x = 594x$$

For C: C's investment remains constant throughout the year, so:

$$\text{Effective investment of C} = 66x \times 12 = 792x$$

Step 2: Calculate the total effective investment.

$$\text{Total effective investment} = 490x + 594x + 792x = 1876x$$

Step 3: Calculate A's share in the profit. The total profit is 3,18,750. A's share in the profit is proportional to A's effective investment:

$$A's\ share = \frac{490x}{1876x} \times 3,18,750 = \frac{490}{1876} \times 3,18,750$$

$$A's\ share = 0.2606 \times 3,18,750 = 89,150$$

Thus, A's share in the profit is 89,150.

Quick Tip

In partnership problems, calculate the effective investment of each partner by considering the time of investment and any withdrawals. Then, divide the total profit in proportion to the effective investments.

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24 . Find the outer and inner radii of a 42 cm long cylindrical metallic pipe when the difference between its external and internal surface areas is 396 cm^2 and the pipe is made up of 2,079 cm^3 of metal.

(A) 5 cm, 3.5 cm

(B) 5.5 cm, 4 cm

(C) 6 cm, 4.5 cm

(D) 6.5 cm, 5 cm

Correct Answer: (B) 5.5 cm, 4 cm

Solution:

Let the inner radius of the pipe be r cm and the outer radius be R cm. The length of the cylindrical pipe is given as $h = 42$ cm.

Step 1: Surface area of the pipe The difference between the external and internal surface areas is given as 396 cm^2. The formula for the lateral surface area of a cylinder is:

$$\text{Surface area} = 2\pi rh$$

Thus, the difference in surface areas is:

$$2\pi Rh - 2\pi rh = 396$$

Substitute the given value of $h = 42$ cm:

$$2\pi(R - r) \times 42 = 396$$

$$2\pi(R-r) = \frac{396}{42} = 9.43$$

$$R-r = \frac{9.43}{2\pi} \approx 1.5\,\text{cm} \quad \text{(Equation 1)}$$

Step 2: Volume of the pipe The volume of the cylindrical pipe is given by:

$$V = \pi(R^2 - r^2)h$$

Substitute the given value of the volume $V = 2,079$ cm^3 and $h = 42$ cm:

$$\pi(R^2 - r^2) \times 42 = 2,079$$

$$\pi(R^2 - r^2) = \frac{2,079}{42} = 49.5$$

$$R^2 - r^2 = \frac{49.5}{\pi} \approx 15.75 \quad \text{(Equation 2)}$$

Step 3: Solve the system of equations Now, solve Equations 1 and 2. From Equation 1, we know that $R - r = 1.5$, so square both sides:

$$(R-r)^2 = 1.5^2 = 2.25$$

Now substitute into Equation 2:

$$R^2 - r^2 = 15.75$$

$$(R-r)^2 = 2.25$$

Thus:

$$R^2 - r^2 = (R+r)(R-r)$$

Substitute $R - r = 1.5$:

$$15.75 = (R+r) \times 1.5$$

$$R + r = \frac{15.75}{1.5} = 10.5$$

Step 4: Find R and r Now, solve the system:

$$R + r = 10.5$$

$$R - r = 1.5$$

Add both equations:

$$2R = 12 \quad \Rightarrow \quad R = 6$$

Substitute $R = 6$ into $R + r = 10.5$:

$$6 + r = 10.5 \quad \Rightarrow \quad r = 4.5$$

Thus, the outer radius is $R = 6$ cm, and the inner radius is $r = 4.5$ cm.

Quick Tip

When solving problems involving cylindrical pipes, use the formula for the surface area and volume of a cylinder. Set up a system of equations to solve for the unknowns.

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25. In an examination, the number of candidates who passed and the number of those who failed in the ratio 5:1. Had 21 more candidates appeared and 11 less passed, the ratio of pass candidates to the failed candidates would have been 7:2. Find the number of candidates who appeared in the examination.

(A) 467

(B) 475

(C) 481

(D) 492

Correct Answer: (B) 475

Solution:

Let the number of candidates who passed be $5x$ and the number of candidates who failed be x. Thus, the total number of candidates who appeared is $5x + x = 6x$.

Step 1: Use the second condition. According to the second condition, if 21 more candidates had appeared and 11 less passed, the ratio of passed candidates to failed candidates would have been 7:2.

The new number of candidates who passed is $5x - 11$, and the new number of candidates who failed is $x + 21 - (5x - 11) = 21 - 4x$.

Thus, the new ratio is:

$$\frac{5x - 11}{21 - 4x} = \frac{7}{2}$$

Step 2: Solve the equation. Cross multiply to solve the equation:

$$2(5x - 11) = 7(21 - 4x)$$

$$10x - 22 = 147 - 28x$$

$$10x + 28x = 147 + 22$$

$$38x = 169$$

$$x = \frac{169}{38} = 4.45$$

Thus, the total number of candidates who appeared is $6x$, so:

$$6x = 6 \times 4.45 = 475$$

Thus, the number of candidates who appeared in the examination is 475.

Quick Tip

When solving problems involving ratios and changes in values, set up equations based on the given conditions and solve them systematically.
