MH-BOARD-CLASS-10-MATHEMATICS-ALGEBRA-71-N-913-2023 Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**80	**Total questions :**96

General Instructions

Important instructions:

1. Each activity has to be answered in complete sentence/s. One word answers will **not** be given complete credit. Just the correct activity number written in case of options will **not** be given credit.
2. Web diagrams, flow charts, tables etc. are to be presented exactly as they are with answers.
3. In point 2 above, just words without the presentation of the activity format/design, will **not** be given credit.
4. Use of colour pencils/pens etc. is **not** allowed. (Only blue/black pens are allowed.)
5. Multiple answers to the same activity will be treated as wrong and will **not** be given any credit.
6. Maintain the sequence of the Sections/ Question Nos./ Activities throughout the activity sheet.

1.i. To draw the graph of $4x + 5y = 19$, find y when $x = 1$:

(A) 4

(B) 3

(C) 2

(D) -3

Correct Answer: (A) 4

Solution:

Step 1: Substitute $x = 1$ into the equation.

The given equation is $4x + 5y = 19$.

Substituting $x = 1$, we get:

$$4(1) + 5y = 19$$

Step 2: Simplify the equation.

$$4 + 5y = 19$$

Step 3: Solve for y.

Subtract 4 from both sides:

$$5y = 19 - 4$$

$$5y = 15$$

Divide both sides by 5:

$$y = 3$$

Step 4: Conclusion.

Hence, when $x = 1$, the value of y is 3.

Final Answer:

$$\boxed{y = 3}$$

Quick Tip

To find the value of one variable in a linear equation, substitute the given value of the other variable and solve step by step.

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ii. Out of the following equations, which one is not a quadratic equation?

(A) $x^2 + 4x = 11 + x^2$

(B) $x^2 = 4x$

(C) $5x^2 = 90$

(D) $2x - x^2 = x^2 + 5$

Correct Answer: (A) $x^2 + 4x = 11 + x^2$

Solution:

Step 1: Recall the definition of a quadratic equation.

A quadratic equation is an equation of the form $ax^2 + bx + c = 0$, where $a \neq 0$.

Step 2: Simplify each option.

(A) $x^2 + 4x = 11 + x^2$

Subtract x^2 from both sides:

$$4x = 11$$

This is a linear equation, not quadratic.

(B) $x^2 = 4x$

Rearranging, $x^2 - 4x = 0$. This is quadratic ($a = 1, b = -4, c = 0$).

(C) $5x^2 = 90$

Rearranging, $5x^2 - 90 = 0$. This is quadratic ($a = 5, b = 0, c = -90$).

(D) $2x - x^2 = x^2 + 5$

Rearranging, $-2x^2 + 2x - 5 = 0$. This is quadratic ($a = -2, b = 2, c = -5$).

Step 3: Conclusion.

Only option (A) results in a linear equation. Therefore, it is not a quadratic equation.

Final Answer:

$$\boxed{(A)\, x^2 + 4x = 11 + x^2}$$

Quick Tip

To check whether an equation is quadratic, rearrange it in standard form $ax^2+bx+c = 0$. If the x^2 term cancels out, the equation is not quadratic.

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iii. For the given A.P. $a = 3.5,\ d = 0$**, find** $t_n = ?$

(A) 0

(B) 3.5

(C) 103.5

(D) 104.5

Correct Answer: (B) 3.5

Solution:

Step 1: Recall the formula for the nth term of an A.P.

For an arithmetic progression, the nth term is given by:

$$t_n = a + (n-1)d$$

Step 2: Substitute the given values.

Given that $a = 3.5$ and $d = 0$, we have:

$$t_n = 3.5 + (n-1)(0)$$

Step 3: Simplify the expression.

$$t_n = 3.5 + 0 = 3.5$$

Step 4: Conclusion.

Therefore, for any value of n, the nth term of the given A.P. is constant, $t_n = 3.5$.

Final Answer:

$$\boxed{t_n = 3.5}$$

Quick Tip

If the common difference $d = 0$, all terms in an arithmetic progression are equal to the first term a.

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iv. If $n(A) = 2$, $P(A) = \frac{1}{5}$, then find $n(S) =?$

(A) 10
(B) $\frac{5}{2}$
(C) $\frac{2}{5}$
(D) $\frac{1}{3}$

Correct Answer: (A) 10

Solution:

Step 1: Recall the formula for probability.

The probability of an event A is given by:

$$P(A) = \frac{n(A)}{n(S)}$$

where $n(A)$ is the number of favorable outcomes and $n(S)$ is the total number of outcomes in the sample space.

Step 2: Substitute the given values.

We are given $n(A) = 2$ and $P(A) = \frac{1}{5}$.

$$\frac{1}{5} = \frac{2}{n(S)}$$

Step 3: Solve for $n(S)$.

Multiply both sides by $n(S)$:

$$n(S) \times \frac{1}{5} = 2$$

$$n(S) = 2 \times 5 = 10$$

Step 4: Conclusion.

Therefore, the total number of outcomes in the sample space is $n(S) = 10$.

Final Answer:

$$\boxed{n(S) = 10}$$

Quick Tip

Always use $P(A) = \frac{n(A)}{n(S)}$ for basic probability problems — rearrange it as $n(S) = \frac{n(A)}{P(A)}$ when total outcomes are required.

B.i. Find the value of the following determinant:

$$\begin{vmatrix} 4 & 3 \\ 2 & 7 \end{vmatrix}$$

Correct Answer: 22

Solution:

Step 1: Recall the formula for a 2×2 determinant.

For a determinant of order 2,

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

Step 2: Substitute the given values.

Here, $a = 4$, $b = 3$, $c = 2$, and $d = 7$.

$$\begin{vmatrix} 4 & 3 \\ 2 & 7 \end{vmatrix} = (4)(7) - (3)(2)$$

Step 3: Simplify.

$$= 28 - 6 = 22$$

Step 4: Conclusion.

Hence, the value of the given determinant is 22.

Final Answer:

$$\boxed{22}$$

Quick Tip

For a 2×2 determinant, simply multiply the diagonal elements and subtract the product of the off-diagonal elements: $ad - bc$.

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ii. Find the common difference of the following A.P.:

$$2,\ 4,\ 6,\ 8, \ldots$$

Correct Answer: 2

Solution:

Step 1: Recall the formula for the common difference.

In an arithmetic progression (A.P.), the common difference is given by:

$$d = a_2 - a_1$$

Step 2: Substitute the values.

The first term $a_1 = 2$ and the second term $a_2 = 4$.

$$d = 4 - 2 = 2$$

Step 3: Conclusion.

Hence, the common difference of the given A.P. is 2.

Final Answer:

$$\boxed{d = 2}$$

Quick Tip

In an A.P., subtract any term from its succeeding term to find the common difference.

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iii. On a certain article, if the rate of CGST is 9%, then what is the rate of SGST?

Correct Answer: 9%

Solution:

Step 1: Understand the concept.

Under the Goods and Services Tax (GST) system, the total GST is divided equally between the Central Government (CGST) and the State Government (SGST). Thus,

$$\text{Rate of CGST} = \text{Rate of SGST}$$

Step 2: Apply the given information.

It is given that CGST = 9%. Hence, SGST = 9%.

Step 3: Conclusion.

The rate of SGST is 9%.

Final Answer:

$$\boxed{\text{Rate of SGST} = 9\%}$$

Quick Tip

Under GST, the tax is divided equally into CGST and SGST for intrastate transactions.

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iv. If one coin is tossed, write the sample space 'S'.

Correct Answer: $S = \{H, T\}$

Solution:

Step 1: Recall the definition of sample space.

The sample space is the set of all possible outcomes of an experiment.

Step 2: Apply it to coin tossing.

When one coin is tossed, there are two possible outcomes: - Head (H) - Tail (T)

Step 3: Represent the sample space.

$$S = \{H, T\}$$

Step 4: Conclusion.

Thus, the sample space for tossing one coin consists of two outcomes — Head and Tail.

Final Answer:

$$\boxed{S = \{H, T\}}$$

Quick Tip

For a single coin toss, always remember the sample space contains exactly two outcomes: Head and Tail.

2.A. i.Complete the following activity and find the value of x:

$$5x + 3y = 9 \quad \text{...(I)}$$
$$2x - 3y = 12 \quad \text{...(II)}$$

Correct Answer: $x = 3$

Solution:

Step 1: Write down the two equations.

$$\text{(I) } 5x + 3y = 9$$
$$\text{(II) } 2x - 3y = 12$$

Step 2: Add equations (I) and (II).

$$(5x + 3y) + (2x - 3y) = 9 + 12$$

Step 3: Simplify.

$$7x = 21$$

Step 4: Solve for x.

$$x = \frac{21}{7} = 3$$

Step 5: Conclusion.

Hence, the value of x is 3.

Final Answer:

$$\boxed{x = 3}$$

Quick Tip

When two linear equations have opposite coefficients for one variable, adding or subtracting them eliminates that variable — making it easier to solve for the other one.

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ii. Complete the following activity to determine the nature of the roots of the quadratic equation $x^2 + 2x - 9 = 0$:

Correct Answer: The roots are real and unequal.

Solution:

Step 1: Compare the given equation with the standard quadratic form.

Given equation:

$$x^2 + 2x - 9 = 0$$

Standard form:

$$ax^2 + bx + c = 0$$

By comparison, we get:

$$a = 1, \quad b = 2, \quad c = -9$$

Step 2: Recall the discriminant formula.

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

Step 3: Substitute the values.

$$\Delta = (2)^2 - 4(1)(-9)$$

Step 4: Simplify.

$$\Delta = 4 + 36 = 40$$

Step 5: Interpret the discriminant.

Since $\Delta = 40 > 0$, the discriminant is positive.

Step 6: Conclusion.

If $b^2 - 4ac > 0$, then the roots of the quadratic equation are **real and unequal**.

Final Answer:

$$\boxed{\text{The roots of the equation are real and unequal.}}$$

Quick Tip

Use the discriminant $\Delta = b^2 - 4ac$ to determine the nature of roots:

- $\Delta > 0$: Real and unequal roots
- $\Delta = 0$: Real and equal roots
- $\Delta < 0$: Imaginary roots

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iii. Complete the following table using the given information:

Sr. No.	**FV ()**	**Share is at**	**MV ()**
1	100	Par	$\boxed{100}$
2	$\boxed{75}$	Premium 500	575
3	10	$\boxed{\text{Discount 5}}$	5
4	200	Discount 50	$\boxed{150}$

Correct Answers:

(1) MV = 100

(2) FV = 75

(3) Share is at Discount 5

(4) MV = 150

Solution:

Step 1: Recall the relationship between FV, MV, and type of share.

- If a share is at **par**, then $\text{MV} = \text{FV}$.

- If a share is at a **premium**, then $\text{MV} = \text{FV} + \text{premium}$.

- If a share is at a **discount**, then $\text{MV} = \text{FV} - \text{discount}$.

Step 2: Apply the given information.

$$\begin{aligned}
\text{(1) Par value:} \quad & \text{MV} = \text{FV} = 100 \\
\text{(2) Premium 500, MV = 575:} \quad & \text{FV} = 575 - 500 = 75 \\
\text{(3) FV = 10, MV = 5:} \quad & \text{Discount} = 10 - 5 = 5 \\
\text{(4) FV = 200, Discount 50:} \quad & \text{MV} = 200 - 50 = 150
\end{aligned}$$

Step 3: Conclusion.

After substitution, the completed table is:

Sr. No.	FV ()	Share is at	MV ()
1	100	Par	100
2	75	Premium 500	575
3	10	Discount 5	5
4	200	Discount 50	150

Final Answers:

$$\boxed{\text{(1) 100,} \quad \text{(2) 75,} \quad \text{(3) Discount 5,} \quad \text{(4) 150}}$$

Quick Tip

Remember: - Share at Par $\rightarrow$ MV = FV - Share at Premium $\rightarrow$ MV = FV + Premium - Share at Discount $\rightarrow$ MV = FV - Discount

B.i. Solve the following simultaneous equations:

$$x + y = 4 \quad \text{and} \quad 2x - y = 2$$

Correct Answer: $x = 2,\ y = 2$

Solution:

Step 1: Write the given equations.

$$\text{(I) } x + y = 4$$

$$\text{(II) } 2x - y = 2$$

Step 2: Add equations (I) and (II) to eliminate y.

$$(x + y) + (2x - y) = 4 + 2$$

$$3x = 6$$

Step 3: Solve for x.

$$x = \frac{6}{3} = 2$$

Step 4: Substitute $x = 2$ in equation (I).

$$2 + y = 4 \implies y = 2$$

Step 5: Conclusion.

Hence, the solution of the given simultaneous equations is $x = 2,\ y = 2$.

Final Answer:

$$\boxed{x = 2,\ y = 2}$$

Quick Tip

To solve simultaneous equations, use elimination or substitution. Adding or subtracting equations helps eliminate one variable easily.

ii. Write the following equation in the form $ax^2 + bx + c = 0$, then write the values of a, b, c:

$$2y = 10 - y^2$$

Correct Answer: $a = 1,\ b = 2,\ c = -10$

Solution:

Step 1: Write the given equation.

$$2y = 10 - y^2$$

Step 2: Bring all terms to one side.

$$y^2 + 2y - 10 = 0$$

Step 3: Compare with the standard quadratic form.

The standard quadratic equation is

$$ax^2 + bx + c = 0$$

By comparison, we get

$$a = 1, \quad b = 2, \quad c = -10$$

Step 4: Conclusion.

Hence, the equation in standard form is $y^2 + 2y - 10 = 0$ with

$$a = 1,\ b = 2,\ c = -10$$

Final Answer:

$$\boxed{a = 1,\ b = 2,\ c = -10}$$

Quick Tip

To convert any equation into standard quadratic form, move all terms to one side and simplify so that one side equals zero.

iii. Write an A.P. whose first term is $a = 10$ and common difference $d = 5$.

Correct Answer: $10, 15, 20, 25, 30, \ldots$

Solution:

Step 1: Recall the general form of an arithmetic progression (A.P.).

An A.P. is given by:

$$a, \; a+d, \; a+2d, \; a+3d, \; \ldots$$

Step 2: Substitute the given values.

Given $a = 10$ and $d = 5$, we get:

$$10, \; 10+5, \; 10+2(5), \; 10+3(5), \; \ldots$$

Step 3: Simplify the terms.

$$10, \; 15, \; 20, \; 25, \; 30, \ldots$$

Step 4: Conclusion.

Thus, the required arithmetic progression is:

$$10, \; 15, \; 20, \; 25, \; 30, \ldots$$

Final Answer:

$$\boxed{10, \; 15, \; 20, \; 25, \; 30, \ldots}$$

Quick Tip

To form an A.P., keep adding the common difference d successively to the first term a.

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iv. A courier service agent charged 590 to courier a parcel from Nashik to Nagpur. In the tax invoice, the taxable value is 500 on which CGST = 45 and SGST = 45. Find the rate of GST charged for this service.

Correct Answer: Rate of GST $= 18\%$

Solution:

Step 1: Write the given information.

Taxable value $= 500$

CGST $= 45$

SGST $= 45$

Step 2: Find total GST amount.

$$\text{Total GST} = \text{CGST} + \text{SGST} = 45 + 45 = 90$$

Step 3: Calculate the GST rate.

$$\text{Rate of GST} = \frac{\text{Total GST}}{\text{Taxable Value}} \times 100$$

$$\text{Rate of GST} = \frac{90}{500} \times 100 = 18\%$$

Step 4: Verify.

Total amount = Taxable value + GST = 500 + 90 = 590, which matches the question.

Step 5: Conclusion.

Therefore, the rate of GST charged for this service is 18%.

Final Answer:

$$\boxed{\text{Rate of GST = 18\%}}$$

Quick Tip

For GST-related problems:

$$\text{Rate of GST} = \frac{\text{CGST + SGST}}{\text{Taxable Value}} \times 100$$

Both CGST and SGST are always equal.

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v. Observe the following table and find the Mean:

Assumed Mean (A) $= 300$

Class Interval	Class Mark (x_i)	Frequency (f_i)	$f_i d_i$
$200 - 240$	220	5	-400
$240 - 280$	260	10	-400
$280 - 320$	300	15	0
$320 - 360$	340	12	480
$360 - 400$	380	8	640
Total		$\Sigma f_i = 50$	$\Sigma f_i d_i = 320$

Correct Answer: Mean $= 306.4$

Solution:

Step 1: Recall the formula for Mean (Assumed Mean method).

$$\bar{X} = A + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

Step 2: Substitute the given values.

$$A = 300, \quad \Sigma f_i d_i = 320, \quad \Sigma f_i = 50$$

Step 3: Substitute in the formula.

$$\bar{X} = 300 + \frac{320}{50}$$

Step 4: Simplify.

$$\bar{X} = 300 + 6.4 = 306.4$$

Step 5: Conclusion.

Therefore, the mean of the given data is 306.4.

Final Answer:

$$\boxed{\bar{X} = 306.4}$$

Quick Tip

When using the Assumed Mean Method, choose a class mark near the center of the data as the assumed mean to simplify calculations.

$$\bar{X} = A + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

3.A.i. Form a 'Road Safety Committee' of two, from 2 boys (B_1, B_2) and 2 girls (G_1, G_2). Complete the activity to write the sample space:

Correct Answer:

$$S = \{(B_1B_2), (B_1G_1), (B_1G_2), (B_2G_1), (B_2G_2), (G_1G_2)\}$$

Solution:

Step 1: Identify the given members.

There are 2 boys — B_1, B_2 and 2 girls — G_1, G_2. We need to form all possible committees of 2 members each.

Step 2: Committees of 2 boys.

$$\text{Committee of 2 boys} = \{B_1B_2\}$$

Step 3: Committees of 2 girls.

$$\text{Committee of 2 girls} = \{G_1G_2\}$$

Step 4: Committees of one boy and one girl.

$$\text{Committee of one boy and one girl} = \{B_1G_1, B_1G_2, B_2G_1, B_2G_2\}$$

Step 5: Write the sample space.

Combining all possible committees:

$$S = \{(B_1B_2), (B_1G_1), (B_1G_2), (B_2G_1), (B_2G_2), (G_1G_2)\}$$

Step 6: Conclusion.

Thus, the sample space contains 6 possible committees that can be formed from 2 boys and 2 girls.

Final Answer:

$$\boxed{S = \{(B_1B_2), (B_1G_1), (B_1G_2), (B_2G_1), (B_2G_2), (G_1G_2)\}}$$

Quick Tip

When forming combinations, list all possible pairs without repetition. For 2 members from 4 people, the number of pairs = ${}^4C_2 = 6$.

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ii. Fill in the boxes with the help of given information:

Tax invoice of services provided (Sample)

Food Junction, Khed-Shivapur, Pune

Invoice Date: 25 Feb., 2020

SAC	Food Items	Qty	Rate ()	Taxable Amount ()	CGST	SGST	Amoun
9963	Coffee	1	20	20.00	$2.5\% = 0.50$	$2.5\% = 0.50$	21.00
9963	Masala Tea	1	10	10.00	$2.5\% = 0.25$	$2.5\% = 0.25$	10.50
9963	Masala Dosa	2	60	120.00	$2.5\% = 3.00$	$2.5\% = 3.00$	126.0
Total				150.00			
Grand Total							**157.5**

Correct Answers:

$$\text{Taxable amount (Dosa)} = 120, \quad \text{SGST (Coffee)} = 0.50, \quad \text{SGST (Tea)} = 0.25$$

$$\text{Grand Total} = 157.50$$

Solution:

Step 1: Compute taxable amounts.

$$\text{Coffee: } 1 \times 20 = 20$$

$$\text{Masala Tea: } 1 \times 10 = 10$$

$$\text{Masala Dosa: } 2 \times 60 = 120$$

$$\text{Total Taxable Value} = 20 + 10 + 120 = 150$$

Step 2: Calculate CGST and SGST at 2.5% each.

$$\text{Coffee: } 2.5\% \text{ of } 20 = 0.50$$

$$\text{Masala Tea: } 2.5\% \text{ of } 10 = 0.25$$

$$\text{Masala Dosa: } 2.5\% \text{ of } 120 = 3.00$$

Step 3: Find the total GST and total bill.

$$\text{Total GST} = (0.50 + 0.25 + 3.00) + (0.50 + 0.25 + 3.00) = 7.50$$

$$\text{Grand Total} = \text{Taxable Value} + \text{Total GST} = 150 + 7.50 = 157.50$$

Step 4: Conclusion.

The invoice shows CGST = 3.75 and SGST = 3.75, hence total GST = 7.50, and total bill = 157.50.

Final Answer:

$$\boxed{\text{Grand Total = 157.50}}$$

Quick Tip

In GST invoices, total GST = CGST + SGST. Each of these is usually half of the total GST rate (e.g., 5% = 2.5% CGST + 2.5% SGST).

B.i. Solve the following simultaneous equations using Cramer's Rule:

$$4m + 6n = 54 \quad \text{and} \quad 3m + 2n = 28$$

Correct Answer: $m = 6,\ n = 5$

Solution:

Step 1: Write the given equations in standard form.

$$4m + 6n = 54 \quad \text{...(i)}$$

$$3m + 2n = 28 \quad \text{...(ii)}$$

Step 2: Write the determinant of coefficients (Δ).

$$\Delta = \begin{vmatrix} 4 & 6 \\ 3 & 2 \end{vmatrix} = (4)(2) - (6)(3) = 8 - 18 = -10$$

Step 3: Find determinant Δ_m (replace first column by constants).

$$\Delta_m = \begin{vmatrix} 54 & 6 \\ 28 & 2 \end{vmatrix} = (54)(2) - (6)(28) = 108 - 168 = -60$$

Step 4: Find determinant Δ_n (replace second column by constants).

$$\Delta_n = \begin{vmatrix} 4 & 54 \\ 3 & 28 \end{vmatrix} = (4)(28) - (54)(3) = 112 - 162 = -50$$

Step 5: Apply Cramer's rule.

$$m = \frac{\Delta_m}{\Delta} = \frac{-60}{-10} = 6$$

$$n = \frac{\Delta_n}{\Delta} = \frac{-50}{-10} = 5$$

Step 6: Conclusion.

Hence, the solution of the given simultaneous equations is $m = 6,\ n = 5$.

Final Answer:

$$\boxed{m = 6,\ n = 5}$$

Quick Tip

Cramer's Rule is a direct method for solving two linear equations using determinants:

$$x = \frac{\Delta_x}{\Delta}, \quad y = \frac{\Delta_y}{\Delta}$$

Always compute $\Delta \neq 0$ before applying the rule.

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ii. Solve the following quadratic equation by formula method:

$$x^2 + 10x + 2 = 0$$

Correct Answer:

$$x = -5 + \sqrt{23} \quad \text{and} \quad x = -5 - \sqrt{23}$$

Solution:

Step 1: Identify the coefficients.

The given equation is $x^2 + 10x + 2 = 0$. Comparing with $ax^2 + bx + c = 0$, we get:

$$a = 1, \quad b = 10, \quad c = 2$$

Step 2: Recall the quadratic formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Step 3: Substitute the values.

$$x = \frac{-10 \pm \sqrt{(10)^2 - 4(1)(2)}}{2(1)}$$

$$x = \frac{-10 \pm \sqrt{100 - 8}}{2}$$

$$x = \frac{-10 \pm \sqrt{92}}{2}$$

Step 4: Simplify.

$$x = \frac{-10 \pm 2\sqrt{23}}{2} = -5 \pm \sqrt{23}$$

Step 5: Conclusion.

Hence, the roots of the quadratic equation are $x = -5 + \sqrt{23}$ and $x = -5 - \sqrt{23}$.

Final Answer:

$$\boxed{x = -5 + \sqrt{23} \quad \text{and} \quad x = -5 - \sqrt{23}}$$

Quick Tip

Use the formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ to solve any quadratic equation. The term $b^2 - 4ac$ (discriminant) helps determine the nature of the roots.

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iii. A two-digit number is formed with digits 2, 3, 5, 7, 9 without repetition. Find the probability of the following events:

Event A: The number formed is an odd number.

Event B: The number formed is a multiple of 5.

Correct Answers:

Event A: $\frac{3}{5}$

Event B: $\frac{1}{5}$

Solution:

Step 1: Total possible two-digit numbers.

We have 5 digits: 2, 3, 5, 7, 9. To form a two-digit number without repetition:

$$\text{Total numbers} = 5 \times 4 = 20$$

Step 2: Event A — The number is odd.

For a number to be odd, the unit place must be an odd digit. Odd digits available = 3, 5, 7, 9 (4 choices). For each, tens place can be any of the remaining 4 digits.

$$\text{Total odd numbers} = 4 \times 4 = 16$$

$$P(A) = \frac{16}{20} = \frac{4}{5}$$

$$\boxed{P(A) = \frac{4}{5}}$$

Step 3: Event B — The number is a multiple of 5.

For a number to be a multiple of 5, the unit digit must be 5. Thus, unit place = 5 (1 choice). Tens place can be filled by any of the remaining 4 digits.

$$\text{Total numbers divisible by 5} = 4$$

$$P(B) = \frac{4}{20} = \frac{1}{5}$$

$$\boxed{P(B) = \frac{1}{5}}$$

Step 4: Conclusion.

$$P(A) = \frac{4}{5}, \quad P(B) = \frac{1}{5}$$

Quick Tip

When finding probabilities from digit-based combinations, always count possible outcomes based on digit placement (tens and units separately).

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iv. The frequency distribution table shows the number of mango trees in a grove and their yield of mangoes. Find the median of the data:

No. of Mangoes	No. of Trees (f)
$50 - 100$	33
$100 - 150$	30
$150 - 200$	90
$200 - 250$	80
$250 - 300$	17

Correct Answer: Median $= 183.33$

Solution:

Step 1: Find the cumulative frequency (c.f.).

Class Interval	Frequency (f)	Cumulative Frequency (c.f.)
$50 - 100$	33	33
$100 - 150$	30	63
$150 - 200$	90	153
$200 - 250$	80	233
$250 - 300$	17	250

Step 2: Find total frequency.

$$N = 250$$

Step 3: Find median class.

$$\frac{N}{2} = \frac{250}{2} = 125$$

The c.f. just greater than 125 is 153. Hence, the median class is $150 - 200$.

Step 4: Apply the median formula.

$$\text{Median} = L + \left(\frac{\frac{N}{2} - c.f.}{f}\right) \times h$$

Where, $L = 150$, $N = 250$, $c.f. = 63$, $f = 90$, $h = 50$

$$\text{Median} = 150 + \left(\frac{125 - 63}{90}\right) \times 50$$

$$\text{Median} = 150 + \left(\frac{62}{90} \times 50\right)$$

$$\text{Median} = 150 + 34.44 = 184.44$$

Step 5: Conclusion.

The median number of mangoes produced per tree is approximately 184.4.

Final Answer:

$$\boxed{\text{Median = 184.4}}$$

Quick Tip

To find the median of grouped data, locate the median class where cumulative frequency $N/2$, then apply

$$\text{Median} = L + \frac{(N/2 - c.f.)}{f} \times h$$

4.i. If the first term of an A.P. is p, second term is q, and last term is r, then show that the sum of all terms is

$$S = (q + r - 2p) \times \frac{(p + r)}{2(q - p)}$$

Correct Answer:

$$S = (q + r - 2p) \times \frac{(p + r)}{2(q - p)}$$

Solution:

Step 1: Recall the general form of an A.P.

Let the first term be $a = p$, the common difference be d, and the last term be r. Thus,

$$\text{Second term} = a + d = q$$

$$\Rightarrow d = q - p$$

Step 2: Use the nth term formula.

The nth term of an A.P. is given by

$$t_n = a + (n - 1)d$$

Since the last term $r = a + (n - 1)d$,

$$r = p + (n - 1)(q - p)$$

$$\Rightarrow n - 1 = \frac{r - p}{q - p}$$

$$\Rightarrow n = \frac{r - p}{q - p} + 1 = \frac{r - p + q - p}{q - p} = \frac{q + r - 2p}{q - p}$$

Step 3: Recall the sum of n terms of an A.P.

$$S_n = \frac{n}{2}(a + l)$$

where $a = p$ and $l = r$.

Step 4: Substitute the values.

$$S = \frac{1}{2} \times \frac{(q + r - 2p)}{(q - p)} \times (p + r)$$

Step 5: Simplify.

$$S = (q + r - 2p) \times \frac{(p + r)}{2(q - p)}$$

Step 6: Conclusion.

Hence proved that

$$\boxed{S = (q + r - 2p) \times \frac{(p + r)}{2(q - p)}}$$

Quick Tip

For problems involving sums of an A.P., always express the number of terms (n) using the first, second, and last terms. Then apply $S_n = \frac{n}{2}(a + l)$.

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ii. Show the following data by a frequency polygon:

Electricity Bill ()	Families (f)
$200 - 400$	240
$400 - 600$	300
$600 - 800$	450
$800 - 1000$	350
$1000 - 1200$	160

Correct Answer: The frequency polygon is drawn by plotting the mid-points of each class interval against the corresponding frequencies and joining them by straight lines.

Solution:

Step 1: Find the class mid-points.

$$\text{Mid-point (x)} = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class Interval	Mid-point (x)	Frequency (f)
$200 - 400$	300	240
$400 - 600$	500	300
$600 - 800$	700	450
$800 - 1000$	900	350
$1000 - 1200$	1100	160

Step 2: Plot the points.

On a graph paper: - Take class mid-points (x) on the X-axis. - Take frequencies (f) on the Y-axis. - Plot the points:

$$(300, 240), (500, 300), (700, 450), (900, 350), (1100, 160)$$

Step 3: Join these points by straight lines.

To complete the polygon, join the first point to the previous mid-point (100, 0) and the last point to the next mid-point (1300, 0).

Step 4: Conclusion.

The resulting closed figure represents the **Frequency Polygon** for the given data.

Final Answer:

$$\boxed{\text{Frequency Polygon drawn with mid-points } (300, 500, 700, 900, 1100)}$$

Quick Tip

A frequency polygon can be obtained by joining the mid-points of histogram rectangles, or directly by plotting class mid-points versus frequencies.

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iii. The sum of the squares of five consecutive natural numbers is 1455. Find the numbers.

Correct Answer: $15, 16, 17, 18, 19$

Solution:

Step 1: Assume the numbers.

Let the five consecutive natural numbers be:

$$x - 2,\ x - 1,\ x,\ x + 1,\ x + 2$$

Step 2: Write their squares and take the sum.

$$(x - 2)^2 + (x - 1)^2 + x^2 + (x + 1)^2 + (x + 2)^2 = 1455$$

Step 3: Expand and simplify.

$$(x^2 - 4x + 4) + (x^2 - 2x + 1) + x^2 + (x^2 + 2x + 1) + (x^2 + 4x + 4) = 1455$$

$$5x^2 + (-4x - 2x + 2x + 4x) + (4 + 1 + 1 + 4) = 1455$$

$$5x^2 + 0x + 10 = 1455$$

Step 4: Solve for x.

$$5x^2 = 1455 - 10 = 1445$$

$$x^2 = 289$$

$$x = 17$$

Step 5: Write the five consecutive numbers.

$$x - 2 = 15,\ x - 1 = 16,\ x = 17,\ x + 1 = 18,\ x + 2 = 19$$

Step 6: Conclusion.

Hence, the required five consecutive natural numbers are $15, 16, 17, 18, 19$.

Final Answer:

$$\boxed{15, 16, 17, 18, 19}$$

Quick Tip

When dealing with consecutive numbers, always take the middle term as x to simplify square or cube-based equations.

5.i. Draw the graph of the equation $x + 2y = 4$. Find the area of the triangle formed by the line intersecting the X-axis and Y-axis.

Correct Answer: Area of the triangle $= 4$ square units.

Solution:

Step 1: Find the intercepts.

Given equation:

$$x + 2y = 4$$

To find the X-intercept, put $y = 0$:

$$x = 4$$

Hence, the X-intercept is $(4, 0)$.

To find the Y-intercept, put $x = 0$:

$$2y = 4 \implies y = 2$$

Hence, the Y-intercept is $(0, 2)$.

Step 2: Plot the graph.

Plot the points $(4, 0)$ and $(0, 2)$ on a graph paper and draw a straight line joining them. This line intersects the X-axis at $(4, 0)$ and the Y-axis at $(0, 2)$.

Step 3: Find the area of the triangle.

The line forms a right-angled triangle with the coordinate axes. Base = 4 units, Height = 2 units.

$$\text{Area} = \frac{1}{2} \times \text{Base} \times \text{Height}$$

$$\text{Area} = \frac{1}{2} \times 4 \times 2 = 4 \text{ sq. units.}$$

Step 4: Conclusion.

Hence, the area of the triangle formed by the line and the coordinate axes is 4 square units.

Final Answer:

$$\boxed{\text{Area = 4 square units}}$$

Quick Tip

For a line $ax + by = c$, the intercepts are $x = \frac{c}{a}$ and $y = \frac{c}{b}$. The area of the triangle formed by the line with the coordinate axes is given by

$$\text{Area} = \frac{1}{2} \times x\text{-intercept} \times y\text{-intercept}.$$

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ii. A survey was conducted for 180 people in a city. 70 ate Pizza, 60 ate Burgers, and 50 ate Chips. Draw a pie diagram for the given information.

Correct Answer: Pizza = $140°$, Burgers = $120°$, Chips = $100°$

Solution:

Step 1: Total number of people.

Total $= 180$

Step 2: Formula for central angle.

$$\text{Central Angle} = \frac{\text{Value of the item}}{\text{Total Value}} \times 360$$

Step 3: Find angles for each food item.

$$\text{For Pizza: } \frac{70}{180} \times 360 = 140°$$
$$\text{For Burgers: } \frac{60}{180} \times 360 = 120°$$
$$\text{For Chips: } \frac{50}{180} \times 360 = 100°$$

Step 4: Verify.

$$140° + 120° + 100° = 360°$$

Hence, the division is correct.

Step 5: Draw the pie chart.

Draw a circle and divide it into three sectors with the calculated central angles: - $140°$ for Pizza - $120°$ for Burgers - $100°$ for Chips

Step 6: Conclusion.

The pie chart represents the distribution of food preferences among 180 people.

Final Answer:

$$\boxed{\text{Pizza} = 140° \text{ , Burgers} = 120° \text{ , Chips} = 100°}$$

Quick Tip

To draw a pie chart, always use the formula

$$\text{Angle} = \frac{\text{Part Value}}{\text{Total Value}} \times 360$$

and ensure that the sum of all angles equals $360°$.
