Linear Equations and Inequalities in One Variable

Exercise: 12.1

i. \[5x - 3 = 3x - 5\]
\[5x = 3x - 5 + 3\]
\[5x = 3x - 2\]
\[5x - 3x = -2\]
\[2x = -2\]
\[x = -1\]

ii. \[3x - 7 = 3(5 - x)\]
\[3x - 7 = 15 - 3x\]
\[3x = 15 + 7 - 3x\]
\[6x = 22\]
\[x = \frac{22}{6}\]

2.

i. \[4(2x + 1) = 3(x - 1) + 7\]
\[8x + 4 = 3x - 3 + 7\]
\[8x = 3x - 3 + 7 - 4\]
\[8x - 3x = -3 + 3 = 0\]
\[5x = 0 \Rightarrow x = 0\]
ii) \[ 3(2p-1) = 5-(3p-2) \]

\[ 6p-3 = 5-3p+2 \]

\[ 6p = 5-3p+2+3 \]

\[ 6p + 3p = 10 \]

\[ 9p = 10 \]

\[ p = \frac{10}{9} = 1 \frac{1}{9} \]

3.

i) \[ 5y - 2[y - 3(y-5)] = 6 \]

\[ 5y - 2y + 6(y-5) = 6 \]

\[ 3y + 6y - 30 = 6 \]

\[ 9y = 6 + 30 = 36 \]

\[ y = \frac{36}{9} = 4 \]

ii) \[ 0.3(6-x) = 0.4(x+8) \]

\[ 1.8 - 0.3x = 0.4x + 3.2 \]

\[ 0.4x = 1.8 - 0.3x - 3.2 \]

\[ 0.4x + 0.3x = -1.4 \]

\[ 0.7x = -1.4 \]

\[ x = \frac{-1.4}{0.7} = -2 \]
i) \( \frac{x-1}{3} = \frac{x+2}{6} + 3 \)

Multiply and divide \( 2 \) on L.H.S.

\[
\frac{2(x-1)}{2 \times 3} = \frac{x+2}{6} + 3
\]

\[
\frac{2x-1}{6} - \frac{x+2}{6} = 3
\]

\[
\frac{2x-1-x-2}{6} = 3
\]

\[
\frac{x-3}{6} = 3
\]

\[
x-3 = 3 \times 6
\]

\[
x-3 = 18
\]

\[
x = 18 + 3
\]

\[
x = 21
\]

ii) \( \frac{x+7}{3} = 1 + \frac{3x-2}{5} \)

\[
\frac{x+7}{3} = \frac{5}{5} + \frac{3x-2}{5}
\]

\[
\frac{x+7}{3} = \frac{5+3x-2}{5}
\]

\[
\frac{x+7}{3} = \frac{3x+3}{5}
\]

Cross Multiplying
\[ 5(x+9) = 3(3x+3) \]
\[ 5x + 35 = 9x + 9 \]
\[ 9x = 5x + 35 - 9 \]
\[ 9x - 5x = 26 \]
\[ 4x = 26 \]
\[ x = \frac{26}{4} = \frac{13}{2} = 6.5 \]

5) \[ \frac{y+1}{3} - \frac{y-1}{2} = \frac{1+2y}{3} \]

Multiplying both sides by 6 i.e L.C.M of 3, 2, 3 we get

\[ 2(y+1) - 3(y-1) = 2(1+2y) \]
\[ 2y + 2 - 3y + 3 = 2 + 4y \]
\[ 5 - y = 4y + 2 \]
\[ 4y + y = 5 - 2 \]
\[ 5y = 3 \]
\[ y = \frac{3}{5} \]

\[ \frac{p}{3} + \frac{p}{4} = 55 - \frac{p+40}{5} \]

\[ \frac{4p + 3p}{12} = \frac{55 \times 5}{5} - \frac{p+40}{5} \]

\[ \frac{7p}{12} = \frac{275 - p - 40}{5} \]
\[
\frac{7p}{12} = \frac{235 - p}{5}
\]

Cross multiplication

\[7p \times 5 = 12(235 - p)\]

\[35p = 12 \times 235 - 12p\]

\[35p + 12p = 12 \times 235\]

\[47p = 12 \times 235\]

\[p = \frac{12 \times 235 - 5}{47}\]

\[p = 60\]

6.

i) \[n - \frac{n-1}{2} = 1 - \frac{n-2}{3}\]

\[\frac{2n - (n-1)}{2} = \frac{3 - (n-2)}{3}\]

\[\frac{2n - n + 1}{2} = \frac{3 - n + 2}{3}\]

\[\frac{n + 1}{2} = \frac{5 - n}{3}\]

Cross multiplication

\[3 \times (n + 1) = 2(5 - n)\]

\[3n + 3 = 10 - 2n\]

\[3n + 2n = 10 - 3\]
5\eta = 7
\eta = \frac{7}{5}

\text{(ii) } \frac{3t-2}{3} + \frac{2t+3}{2} = t + \frac{3}{6}

\frac{3t-2}{3} + \frac{2t+3}{2} = \frac{6t+9}{6}

\text{Multiplying 6 on both sides}

2(3t-2) + 3(2t+3) = 1(6t+3)

6t - 4 + 6t + 9 = 6t + 9

6t + 5 = 7
6t = 7 - 5 = 2
\eta = \frac{2}{6} = \frac{1}{3}

7

\text{(i) } 4(3x+2) - 5(6x-1) = 2(x-8) - 6(3x-4)

12x + 8 - 30x + 5 = 2x - 16 - 18x + 24

13 - 18x = 8 - 40x

40x - 18x + 13 = 8

22x = 8 - 13 = -5

x = \frac{-5}{22}
ii. \[3(5x+3) + 5(2x-11) = 3(8x-5) - 15\]
\[15x + 21 + 10x - 55 = 24x - 15 - 15\]
\[25x - 34 = 24x - 30\]
\[25x - 24x = 34 - 30\]
\[x = 4\]

8.
1) \[\frac{9-2x}{2x+5} = -\frac{3}{11}\]

Cross Multiplying both sides

\[-11(3-2x) = 3(2x+5)\]
\[22x - 33 = 6x + 15\]
\[22x - 6x = 33 + 15\]
\[16x = 48\]
\[x = 3\]

ii) \[\frac{5p+2}{8-2p} = \frac{7}{2}\]

Cross Multiplying on both sides

\[6(5p+2) = 7(8-2p)\]
\[30p + 12 = 56 - 14p\]
\[30p + 14p = 56 - 12\]
\[44p = 44 \Rightarrow p = 1\]
i) \[ \frac{5}{x} = \frac{3}{x-4} \]

Cross multiplying on both sides

\[ 5(x-4) = 3x \]

\[ 7x = 5x - 20 \]

\[ 2x = -20 \]

\[ x = -10 \]

ii) \[ \frac{4}{2x+3} = \frac{5}{x+y} \]

Cross multiplying on both sides

\[ 5(2x+3) = 4(x+y) \]

\[ 10x + 15 = 4x + 16 \]

\[ 10x - 4x = 16 - 15 \]

\[ 6x = 1 \quad \Rightarrow \quad x = \frac{1}{6} \]

10) \[ \frac{2x+5}{2} - \frac{5x}{x-1} = x \]

\[ \frac{(2x+5)(x-1) - (5x)(x)}{2(x-1)} = x \]
\[2x^2 - 2x + 5x - 5 - 10x = 2x(x - 1)\]
\[2x^2 + 3x - 5 - 10x = 2x^2 - 2x\]
\[-7x - 5 = -2x\]
\[-5 = 5x - 2x\]
\[5x = -5\]
\[x = -1\]

ii) \[\frac{1}{5}(\frac{1}{3x} - 5) = \frac{1}{3}(3 - \frac{1}{x})\]
\[\frac{1}{5} \left(1 - \frac{15x}{3x} \right) = \frac{2x - 1}{3x}\]
\[1 - 15x = 5(3x - 1)\]
\[1 - 15x = 15x - 5\]
\[15x + 15x = 7 + 5\]
\[30x = 6\]
\[x = \frac{30}{6} = \frac{1}{5}\]

i) \[\frac{2x - 3}{2x - 1} = \frac{3x - 1}{3x + 1}\]

Subtracting "1" on both sides
\[
\frac{2x - 3}{2x - 1} - 1 = \frac{3x - 1}{3x + 1}
\]

\[
\frac{2x - 3 - 2x + 1}{2x - 1} = \frac{3x - 1 - 3x - 1}{3x + 1}
\]

\[-\frac{2}{2x - 1} = -\frac{2}{3x + 1}
\]

\[3x + 1 = 2x - 1
\]

\[3x - 2x = -1 - 1
\]

\[x = -2
\]

ii) \[
\frac{2y + 3}{3y + 2} = \frac{4y + 5}{6y + 3}
\]

Cross multiplication \[
(2y + 3)(6y + 3) = (3y + 2)(4y + 5)
\]

\[12y^2 + 19y + 18y + 9 = 12y^2 + 19y + 8y + 10
\]

\[22y + 21 = 23y + 10
\]

\[3y - 23y = 10 - 21
\]

\[9y = -11
\]

\[y = -\frac{11}{9}
\]
12. \(x = p + 1\)

\[
\frac{5x - 30}{2} - \frac{3p + 1}{3} = \frac{1}{4}
\]

Multiplying 12 on both sides

\[6(5x - 30) - 4(3p + 1) = 3\]
\[30x - 180 - 12p - 4 = 3\]
\[30x - 180 - 12p - 4 - 3 = 0\]
\[30p + 30 - 180 - 28p - 3 = 0\]

\[2p - 157 = 0\]

\[p = \frac{157}{2}\]

13. \(x + 3\)

\[
\frac{x + 3}{3} - \frac{x - 2}{2} = 1
\]

Multiplying 6 on both sides

\[2(x + 3) - 3(x - 2) = 6\]
\[2x + 6 - 3x + 6 = 6\]

\[x = 6\]

\[\frac{1}{x} + p = 1 \implies p = 1 - \frac{1}{x} = 1 - \frac{1}{6}\]

\[p = \frac{5}{6}\]
EXERCISE: 12.2

1. Let the number be 'x'.

   Three more than twice a number is
   \[ 2x + 3 \]  \[ \textcolor{red}{(1)} \]

   Four less than the number = \[ x - 4 \]  \[ \textcolor{red}{(2)} \]

\[ \textcolor{red}{(1)} = \textcolor{red}{(2)} \]

\[ 2x + 3 = x - 4 \]

\[ 2x - x = -4 - 3 \]

\[ \boxed{x = -7} \]

The number is \(-7\).

2. Let the four consecutive integers are \(x+1, x+3, x+5, x+7\).

Given sum of them = 46

\[ (x+1) + (x+2) + (x+3) + (x+7) = 46 \]

\[ 4x + 10 = 46 \]

\[ 4x = 46 - 10 = 36 \]

\[ \boxed{x = 9} \]

The integers are \(9+1, 9+2, 9+3, 9+4\)

\[ = 10, 11, 12, 13. \]
3. Let the number be "x"

Manjula subtracts $\frac{2}{3}$ from it = $x - \frac{2}{3}$

The above result is multiplied by 6 i.e. $6 \left( x - \frac{2}{3} \right)$

Now it is equal to less than twice the number 'x'

i.e. $6 \left( x - \frac{2}{3} \right) = 2x - 2$

$6x - 4 = 2x - 2$

$6x - 2x = 14 - 2$

$4x = 12$

$x = 3$

4. Let the numbers be $x$, $7x$

15 is added to both numbers, then it becomes $x + 15$, $7x + 15$

Then one new number becomes $\frac{5}{2}$ times the other new number.

$7x + 15 = \frac{5}{2} (x + 15)$

$2(7x + 15) = 5(x + 15)$

$14x + 30 = 5x + 75$

$14x - 5x = 75 - 30$
9\(x = 45\)
\[
\begin{array}{c}
x = 5
\end{array}
\]

Therefore the numbers are 5, 35.

5. Let the three consecutive even integers are \(x, x+2, x+4\).

Given sum = 0.

\[
x + (x+2) + (x+4) = 0
\]
\[
3x + 6 = 0
\]
\[
3x = -6
\]
\[
\begin{array}{c}
x = -2
\end{array}
\]

\[
\therefore \text{the integers are} -2, -2+2, -2+4
\]
\[
= -2, 0, 2
\]

6. Let the two consecutive odd integers are \(x+1, x+3\).

Given two fifth of smaller exceeds two-ninth of greater by 4.

\[
\frac{2}{5}(x+1) + 4 = \frac{2}{9}(x+3)
\]
\[
\frac{2x+2+20}{5} = \frac{2x+6}{9}
\]

Cross Multiplication.
\[(2x + 22) 9 = 5(2x + 6)\]

\[18x + 198 = 10x + 30\]

\[18x - 10x = 30 - 198\]

\[8x = -168\]

\[x = -21\]

The consecutive odd integers are -20, -18

7. Given the denominator of a fraction is 1 more than twice its numerator.

It is written as \[\frac{x}{2x + 1}\]

Given numerator and denominator are both increased by 5

It becomes \[\frac{3}{5}\]

\[\frac{x + 5}{2x + 1 + 5} = \frac{3}{5}\]

\[\frac{x + 5}{2x + 6} = \frac{3}{5}\]

Cross Multiplication

\[5(x + 5) = 3(2x + 6)\]

\[5x + 25 = 6x + 18\]
6x - 5x = 25 - 18

\[ x = 7 \]

Therefore, the original fraction is \( \frac{7}{15} \).

8. Let the two numbers be 2x, 5x.

Given their difference is 15.

i.e. 5x - 2x = 15

\[ 3x = 15 \]

\[ x = \frac{15}{3} = 5 \]

\[ x = 5 \]

Therefore, the two positive numbers are 10, 25.

9. Let the number added to each be 'x'.

On adding 'x' to each of the numbers, it becomes

12 + x, 22 + x, 42 + x, 72 + x

For the numbers to be in proportion:

\[ \frac{12 + x}{22 + x} = \frac{42 + x}{72 + x} \]

Cross Multiplication.
(x+12)(x+32) = (x+22)(x+42)

x^2 + 72x + 12x + 864 = x^2 + 22x + 42x + 924

84x + 864 = 64x + 924

84x - 64x = 924 - 864

20x = 60

x = 3

So the number that must be added is x = 3

10.

Let the unit’s digit be x.

As the difference of both digits is 3, the ten’s digit is x + 3.

The number is 10x(x+3) + x.

On reversing the digits, we have ten’s digit ‘x’ and (x+3) at unit’s place.

The new number = 10x(x+3) + x

By adding both number, we get 143.

10(x+3) + x + 10x + (x+3) = 143

10x + 30 + x + 10x + x + 3 = 143.
\[23x + 33 = 143\]
\[23x = 143 - 33\]
\[23x = 110\]
\[x = 5\]

\[\therefore 10(x + 3) + x = 10(5+3) + 5\]
\[= 80 + 5 = 85\]

\[\therefore \text{The two digit number is 85}\]

12.

Let the Raju's present age be \(x\) years.
Then, Ritu's present age be \(4x\) years.

In four times, Ritu's age will be twice of Raju's age.

i.e. \[4x + 4 = 2(x + 4)\]
\[4x + 4 = 2x + 8\]
\[4x - 2x = 8 - 4\]
\[2x = 4\]
\[x = 2\]

\[\therefore \text{The present ages of Raju, Ritu are 2, 8 years}\]
Let the unit's digit be \(x\).

Then, the ten's digit is \(11-x\).

The two digit number = \(10(11-x) + x\).

When we interchange the digits, the resulting new number is greater than the original number by 63.

\[
10(11-x) + x = 10(11-x) + x + 63.
\]

\[
10x + 11 - x = 110 - 10x + x + 63.
\]

\[
9x + 11 = 173 - 9x
\]

\[
9x + 9x = 173 - 11
\]

\[
18x = 162
\]

\[
x = 9
\]

\[
\therefore 10(11-x) + x = 10(11-9) + 9
\]

\[
= 10(2) + 9 = 20 + 9 = 29
\]

\[
\therefore \text{The two digit number is 29.}
\]

13. Let the son's age be \(x\) years.

Then, the father's age be \(7x\) years.

Two years ago, father was 13 times as old as his son.
\[7x - 2 = 13(x - 2)\]
\[7x - 2 = 13x - 26\]
\[13x - 7x = 26 - 2\]
\[6x = 24\]
\[x = 4\]

Their present age of son, father are 4, 28.

4. Let the ages of Sona and Sonali are 5x, 3x.

Five years hence, the ratio of their ages were 10:7.

\[\frac{5x + 5}{3x + 5} = \frac{10}{7}\]

Cross Multiplication

\[7(5x + 5) = 10(3x + 5)\]
\[35x + 35 = 30x + 50\]
\[35x - 30x = 50 - 35\]
\[5x = 15\]
\[x = 3\]

Therefore, their present ages are 15, 9.
15. An employee works on a contract of 30 days for that he will receive ₹ 200 for each day, and he will be fined ₹ 20 for each day he is absent. Let the number he remain absent be ‘x’ days, then the no of days he worked are ‘30-x’ days.

\[200(30-x) - 20x = 3800\]

\[6000 - 200x - 20x = 3800\]

\[6000 - 220x = 3800\]

\[220x = 6000 - 3800\]

\[220x = 2200\]

\[x = 10\]

The no. of days he remained absent are 10 days.

16. Let the No of ₹ 5 coins be ‘x’.
No of ₹ 2 coins be ‘3x’
No of ₹ 1 coins be 160-4x.

Total ₹ 300 in coins of denomination

\[5x(5) + 2(3x) + 1(160-4x) = 300\]

\[5x + 6x + 160 - 4x = 300\]

\[7x + 160 = 300\]

\[7x = 140\]

\[x = 20\]
$7x = 300 - 160$

$7x = 140$

$x = 20$

Coins of each denomination are

- 25 coins = 20
- 22 coins = 60
- 21 coins = 80

Let the no. of passengers with 25 tickets be 'x''

The no. of passengers with 22 tickets be '40-x''

Total receipts from passengers is 2230

i.e. $5x + 2.5(40 - x) = 230$

$5x + 300 - 7.5x = 230$

$7.5x - 5x = 300 - 230$

$2.5x = 70$

$x = \frac{70}{2.5}$

$x = 28$

Number of passengers with 25 tickets = 28
18. Let the no. of students in the group be \(x\). They paid equally for use of a full boat and pay £10 each, i.e., \(10 \times x = 10x\) \(\text{---(1)}\)

If there were 3 more students in the group, each would have paid £2 less, i.e., \(8 \times (x+3)\) \(\text{---(2)}\)

\(1 = 2\)

\[10x = 8(x+3)\]

\[10x = 8x + 24\]

\[2x = 24\]

\[x = 12\]

\[\text{No. of students in group are 12}\]

19. Let the number of deer in the herd be \(x\). Half of a herd of deer are grazing in field, i.e., \(\frac{1}{2}x\)

Three-fourths of remaining are playing, i.e., \(\frac{3}{4}\left(\frac{1}{2}x\right)\)

\[= \frac{3}{8}x\]

The rest 9 are drinking water.

\[\text{i.e. } x - \left\{\frac{x}{2} + \frac{3x}{8}\right\} = 9\]

\[x - \frac{4x + 3x}{8} = 9\]
\[ \frac{8x - 7x}{8} = 9 \]
\[ \frac{x}{8} = 9 \]
\[ x = 72 \]

Number of deer in the herd are 72

20. Let the no. of flower in the beginning be \( x \)

At 1st temple she offers \( \frac{1}{2} \times x = \frac{x}{2} \)

2nd temple she offers \( \frac{1}{2} \times \frac{x}{2} = \frac{x}{4} \)

3rd temple she offers \( \frac{1}{2} \times \frac{x}{4} = \frac{x}{8} \)

Now she is left with 6 flowers at end

i.e., \[ x - \left( \frac{x}{2} + \frac{x}{4} + \frac{x}{8} \right) = 6 \]

\[ x - \frac{4x + 2x + x}{8} = 6 \]

\[ x = \frac{4x + 2x + x}{8} = 6 \]

\[ \frac{8x - 7x}{8} = 6 \]

\[ \frac{x}{8} = 6 \]

\[ x = 48 \]

\[ x = 48 \]

No of flowers in the beginning are 48.
21. Let the two supplementary angles be $x, 90 - x$

These angles differ by $50^\circ$.

i.e. $90 - x - x = 50$

$90 - 2x = 50$

$2x = 90 - 50$

$2x = 40$

$x = 20^\circ$

:. The two supplementary angles are $20, 70^\circ$.

22. Let the angles of triangles are $5x, 6x, 7x$.

Sum of angles of Triangle = $180^\circ$

i.e. $5x + 6x + 7x = 180^\circ$

$18x = 180$

$x = 10^\circ$

:. The angles of triangle are $50^\circ, 60^\circ, 70^\circ$.

23. Two equal sides of an isosceles triangle are $3x - 1, 2x + 2$

i.e. $3x - 1 = 2x + 2$

$3x - 2x = 2 + 1$

$\therefore x = 3$
The third side is \(2x = 2 \times 3 = 6\) units.

The two sides are \(3x - 1 = 3 \times 3 - 1 = 9 - 1 = 8\) units.
\[2x + 2 = 2 \times 3 + 2 = 6 + 2 = 8\text{ units}\]

\[\text{Perimeter of triangle} = 6 + 8 + 8 = 22\text{ units}\]

24.

Let the perimeter of given triangle be \(x\) cm.

As each side is increased by 4 cm, so the perimeter is increased by \(3 \times 4 = 12\) cm.

According to given information:

\[
\frac{x + 12}{x} = \frac{7}{5}
\]

Cross Multiplication

\[7x = 5(x + 12)\]

\[7x = 5x + 60\]

\[7x - 5x = 60\]

\[2x = 60\]

\[x = 30\]

\[\text{Perimeter of given triangle} = 30 \text{ cm}\]
25. Length of a rectangle is 5 cm less than twice its breadth.

\[ l = 2b - 5 \]

\[ 2b = l + 5 \]  \( \text{(1)} \)

Length is decreased by 2 cm, i.e. \( l - 3 \) cm.

Breadth is increased by 2 cm, i.e. \( b + 2 \) cm.

Resulting perimeter of rectangle is 72 cm.

\[ 2(l-3+b+2) = 72 \]

\[ 2l + 2b - 2 = 72 \]

From eq. (1) we get

\[ 2l + l + 5 + 2 = 72 \]

\[ 3l + 2 = 72 \]

\[ 3l = 72 - 2 \]

\[ 3l = 70 \]

\[ l = 23 \text{ cm} \]

**Length of Rectangle = 23 cm**

From eq. (1)

\[ 2b = l + 5 = 23 + 5 \]

\[ 2b = 28 \Rightarrow b = 14 \text{ cm} \]

**Breadth of Rectangle = 14 cm**

**Area of Rectangle = \( l \times b = 23 \times 14 = 322 \text{ cm}^2 \)**
26. Length of rectangle \( a = 10 \text{ cm} \)
   breadth of rectangle \( b = 8 \text{ cm} \)

Each side of rectangle is increased by \( x \text{ cm} \), its perimeter is doubled.

Perimeter of rectangle \( = 2(10 + 8) = 2 \times 18 = 36 \text{ cm} \)

\[ 2 \left[ (10 + x) + (8 + x) \right] = 2 \times 36 \]
\[ 18 + 2x = 36 \quad \text{--- (1)} \]
\[ 2x = 36 - 18 = 18 \]
\[ x = \frac{18}{2} = 9 \]
\[ x = 9 \text{ cm} \]

Area of new rectangle \( = (10 + 9) \times (8 + 9) \)
\[ = 19 \times 17 = 323 \text{ cm}^2 \]

27. Let the speed of streamer in still water be \( x \text{ km/h} \)

Given the speed of stream = \( 5 \text{ km/h} \)

The speed of streamer downstream = \( (x + 5) \text{ km/h} \)

Speed of streamer upward stream = \( (x - 5) \text{ km/h} \)
Both upstream and downstream takes same time

Time taken by streamers for downstream is \( \frac{90}{x+5} \) hr
Time taken by streamers for upstream is \( \frac{60}{x-5} \) hr

\[ \text{i.e. } \frac{90}{x+5} = \frac{60}{x-5} \]

Cross Multiplication

\[ 3(x-5) = 2(x+5) \]
\[ 3x - 15 = 2x + 10 \]
\[ 3x - 2x = 10 + 15 \]
\[ x = 25 \]

\[ \therefore \text{ Speed of streamer in still water } = 25 \text{ km/h} \]

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Let the speed of streamer in still water be "x"

Given the speed of stream = 1 km/h

Speed of streamer downstream = \( (x + 1) \) km/h
Speed of streamer upstream = \( (x - 1) \) km/h

Distance covered by streamer, downstream = 5 \((x + 1)\) km
Distance covered by streamer, upstream = 6 \((x - 1)\) km
According to given information

\[ 5(x+1) = 6(x-1) \]
\[ 5x + 5 = 6x - 6 \]
\[ 6x - 5x = 5 + 6 \]
\[ x = 11 \]

1. Speed of streamer in still water is 11 km/h.

Distance between two ports = \[ 5(x+1) = 5(11+1) \]
\[ = 60 \text{ km} \]

29. Let the speed of faster car be \( x \) km/h.

Then the speed of other car can be \( (x-8) \) km/h.

Let the faster car starts from place A and the slower car starts from place B.

Let \( p \) and \( q \) be their position after 4 hours.

\[ \begin{align*} &\quad A \rightarrow 4x \text{ km} \rightarrow P \rightarrow 62 \text{ km} \rightarrow Q \rightarrow 4(\text{x-8}) \text{ km} \rightarrow B. \\
\end{align*} \]

\[ AP = 4x \text{ km}, \quad PQ = 62 \text{ km}, \quad P Q = 4(x-8) \text{ km} \]

According to the given p,

\[ AP + PQ + QP = 350 \]
\[ 4x + 62 + 4(x-8) = 350 \]
4x + 62 + 4x - 30 = 350
8x + 30 = 350
8x = 350 - 30 = 320
x = 320/8
x = 40 km/hr

: Speed of faster car is 40 km/hr and the speed of slower car is (40 - 8) i.e. 32 km/hr.
EXERCISE : 12.3

i) \( x > -2 \)
   Solution set = \{-1, 0, 1, 3\}

ii) \( x < -2 \)
    Solution set = \{-3, -5, -3\}

iii) \( x > 2 \)
     Solution set = \{3\}

iv) \(-5 \leq x \leq 5\)
    Solution set = \{-3, -1, 0, 1, 3\}

v) \(-8 < x < 1\)
   Solution set = \{-7, -5, -3, -1, 0\}

vi) \(0 \leq x \leq 4\)
    Solution set = \{0, 1, 3\}

2. It is shown by tick dots on number line.

i) \( x \leq 4, x \in \mathbb{N} \)

\[ \text{Number line: } 0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \]

ii) \( x < 5, x \in \mathbb{W} \)

\[ \text{Number line: } 0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \]
iii) \[ -3 \leq x < 3 \text{, } x \in \mathbb{I} \]

![Number line with -4 to 3 marks]

3. Replacement set = \{ -6, -4, -2, 0, 2, 4, 6 \}

\[ -4 \leq x < 4 \]

![Number line with -4 to 3 marks]

4. i) \{1, 2, 3\}

![Number line with 0 to 5 marks]

ii) \{-1, 0, 1, 2, 5, 8\}

![Number line with -2 to 4 marks]

iii) \{-5, 10\}

![Number line with -5 to 0 marks]

iv) \{5, 6, 7, 8, 9, 10\}

Solution set = \phi
\( \begin{align*}
\text{i)} & \quad 2x - 3 & \geq & \ 2 \\
& \quad 2x & \geq & \ 2 + 3 \\
& \quad 2x & \geq & \ 10 \\
& \quad x & \geq & \ 5 \\
& \quad \text{Solution set} & = & \{6, \ 9, \ 12\} \\
\text{ii)} & \quad 3x + 8 & \leq & \ 2 \\
& \quad 3x & \leq & \ 2 - 8 \\
& \quad 3x & \leq & \ -6 \\
& \quad x & \leq & \ -2 \\
& \quad \text{Solution set} & = & \{-6, \ -3\} \\
\text{iii)} & \quad -3 & \leq & \ 1 - 2x \\
& \quad 3 & \geq & \ 2x - 1 \\
& \quad 2x - 1 & \leq & \ 3 \\
& \quad 2x & \leq & \ 4 \\
& \quad x & \leq & \ 2 \\
& \quad \text{Solution set} & = & \{-6, \ -3, \ 0\}
\end{align*} \)
6. i) \(4x + 1 < 17, \ x \in \mathbb{N}\)

\[4x < 17 - 1\]
\[4x < 16\]
\[x < 4, \ x \in \mathbb{N}\]

As \(x \in \mathbb{N}\), the solution set is \(\{1, 2, 3\}\)

ii) \(4x + 1 \leq 17, \ x \in \mathbb{W}\)

\[4x \leq 17 - 1\]
\[4x \leq 16\]
\[x \leq 4\]

As \(x \in \mathbb{W}\), the solution set is \(\{0, 1, 2, 3, 4\}\)

iii) \(4 > 3x - 11, \ x \in \mathbb{N}\)

\[3x - 11 > 4\]
\[3x > 4 + 11\]
\[3x > 15\]
\[x > 5\]

As \(x \in \mathbb{N}\), the solution set is \(\{6, 7, 8\}\)

iv) \(-17 \leq 9x - 8, \ x \in \mathbb{Z}\)

\[9x - 8 \geq -17\]
\[9x \geq -17 + 8\]
\[9x \geq -9\]
\[x \geq -1\]

As \(x \in \mathbb{Z}\), the solution set is \((-1, 0, 1, 2, 3, \ldots\)\)
7) \[ \frac{2y-1}{5} \leq 2, \; y \in \mathbb{N} \]

\[ 2y-1 \leq 10 \]

\[ 2y \leq 11 \]

\[ y \leq \frac{11}{2} \cdot \]

As \( y \in \mathbb{N} \), the solution set is \( \{1, 2, 3, 4, 5\} \)

ii) \[ \frac{2y+1}{3} + 1 \leq 3, \; y \in \mathbb{N} \]

\[ \frac{2y+1}{3} \leq 2-1 \]

\[ \frac{2y+1}{3} \leq 2 \]

\[ 2y+1 \leq 6 \]

\[ 2y \leq 5 \]

\[ y \leq \frac{5}{2} \]

As \( y \in \mathbb{N} \), the solution set is \( \{0, 1, 2\} \)

iii) \[ \frac{a}{7} p + 5 < 9, \; p \in \mathbb{N} \]

\[ \frac{a}{3} p < 9-5 \]

\[ \frac{2p}{3} < 4 \]
2p < 12
p < 6
At pc W, the solution set is \{0, 1, 2, 3, 4, 5\}

iv. \(-2(p+3) > 5\) \(p \in I\)

Multiplying "-" on both sides

\[2(p+3) < -5\]
\[2p + 6 < -5\]
\[2p < -5 - 6\]
\[2p < -11\]
\[p < -\frac{11}{2}\]

At pc \(I\), the solution set is \{-9, -8, -7, -6\}

8.
i) \(2x - 3 < x + 2\), \(x \in N\)

\[2x < x + 2 + 3\]
\[2x - x < 5\]
\[x < 5\]
At \(x \in N\), the solution set is \{1, 2, 3, 4\}

ii) \(3 - x \leq 5 - 3x\), \(x \in W\)

\[-x + 3x \leq 5\]
\[2x + 3 \leq 5\]
\[2x \leq 5 - 3\]
\[2x \leq 2\]
\[x \leq 1\]

As \(x \in \mathbb{N}\), the solution set is \(\{0, 1\}\)

iv. \(\frac{3}{2} - \frac{x}{2} > -1, \ x \in \mathbb{N}\)

\[\frac{3-x}{2} > -1\]

\[3-x > -2\]

Multiplying with \(\times -1\) on both sides

\[x-3 < 2\]

\[x < 2+3\]

\[x < 5\]

As \(x \in \mathbb{N}\), the solution set is \(\{1, 2, 3, 4\}\)

9. \(\{-3, -2, -1, 0, 1, 2, 3\}\)

\[\frac{3x-1}{2} < 2\]

\[3x-1 < 4\]

\[3x-4 < 4+1\]

\[3x < 5\]
\( x < 5/3 \)

As \( x \) should be in replacement set, the solution set is \( \{ -3, -2, -1, 0, 1 \} \).

\[ \frac{x}{3} + \frac{1}{4} < \frac{x}{6} + \frac{1}{2}, \quad x \in \mathbb{W} \]

\[ \frac{x}{3} - \frac{x}{6} + \frac{1}{4} < \frac{1}{2} \]

\[ \frac{x}{3} - \frac{x}{6} < \frac{1}{2} - \frac{1}{4} \]

\[ \frac{2x - x}{6} < \frac{2 - 1}{4} \]

\[ \frac{x}{6} < \frac{1}{4} \]

\[ x < \frac{6}{4} \]

\[ x < \frac{3}{2} \]

As \( x \in \mathbb{W} \), the solution set is \( \{ 0, 1 \} \).
11 i) \(-y \leq yx < 14, \: x \in \mathbb{N}\)

\[
\begin{align*}
&yx > y : yx < 14 \\
&x > -1 : x < 14/y \\
&x \in \mathbb{N} \\
&x \in \{1, 2, 3\}
\end{align*}
\]

As \(x \in \mathbb{N}\), the solution set is \(\{-1, 0, 1, 2, 3\}\)

\[
\begin{array}{cccccccc}
\cdots & -4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

ii) \(-1 < \frac{x}{2} + 1 \leq 3, \: x \in \mathbb{I}\)

\[
\begin{align*}
\frac{x}{2} + 1 > -1 & : \frac{x}{2} + 1 \leq 3 \\
\frac{x}{2} > -1 - 1 & : \frac{x}{2} \leq 3 - 1 \\
\frac{x}{2} > -2 & : \frac{x}{2} \leq 2 \\
\frac{x}{2} > -4 & : x \leq 4 \\
\end{align*}
\]

i.e. \(-4 < x \leq 4\)

As \(x \in \mathbb{I}\), the solution set is \(\{-3, -2, -1, 0, 1, 2, 3, 4\}\)

\[
\begin{array}{cccccccc}
\cdots & -5 & -4 & -3 & -2 & -1 & 0 & 1 & 2 & 3 & 4 \\
\end{array}
\]