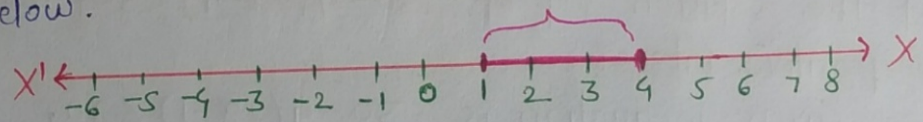
Chapter 4. Linear Inequations

1.) Solve the inequation $(3x-11)<3$, where $x \in \{1,2,3,\dots,10\}$.
Also represent its solution on a number line.

→ Given inequation is $(3x-11)<3$,
where $x \in \{1,2,3,\dots,10\}$

$$(3x-11)<3 \Rightarrow 3x<(3+11)$$
$$3x<14$$
$$\boxed{x<14/3}$$

But $x \in \{1,2,3,\dots,10\}$
Hence, the solution set is $(1,2,3,4)$.
And, we can represent solution set on a number line as given below.



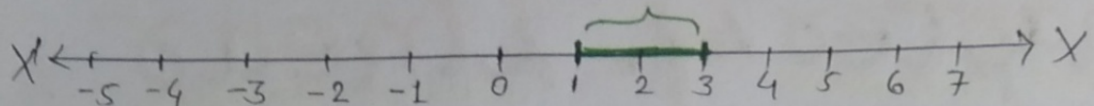
2.) Solve: $2(x-3)<1$, where $x \in \{1,2,3,\dots,10\}$.

→ Given inequation is $2(x-3)<1$,
where $x \in \{1,2,3,\dots,10\}$

$$\Rightarrow 2(x-3)<1 \Rightarrow (2x-6)<1$$
$$2x<(1+6)$$
$$2x<7$$
$$\boxed{x<7/2}$$

But, $x \in \{1,2,3,\dots,10\}$

Hence, the set of solution is $\{1, 2, 3\}$.



3) Solve: $(5-4x) > (2-3x)$, $x \in W$. Also represent its solution on the number line.

→ Given inequation is $(5-4x) > (2-3x)$

where, $x \in W = \{0, 1, 2, \cdots\}$

Then, $(5-4x) > (2-3x) \Rightarrow (5-2) > (4x-3x)$

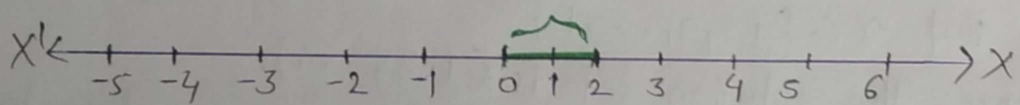
$3 > (x)$

$\therefore \boxed{x < 3}$

But, here $x \in W = \{0, 1, 2, \cdots\}$

Hence, the solution set is $\{0, 1, 2\}$.

We can represent the solution set on number line as below:



4) List the solution set of $30 - 4(2x-1) < 30$, where x is a positive integer.

→ Given inequation is $30 - 4(2x-1) < 30$,

where x is a positive integer.

$\Rightarrow$ $30 - 4(2x-1) < 30$

$(30 - 8x + 4) < 30$

$-8x < (30 - 30 - 4)$

$-8x < -4 \quad \Rightarrow \quad 8x > 4$

$\cancel{x < \frac{-4}{-8}} \qquad x > 4/8$

$\boxed{x > 1/2}$

But, x is a positive integer.

Then, solution set is $\{1, 2, 3, 4, \cdots\}$.

5) Solve: $2(x-2) < (3x-2)$, where $x \in \{-3,-2,-1,0,1,2,3\}$

→ Given equation is $2(x-2) < (3x-2)$,

where $x \in \{-3,-2,-1,0,1,2,3\}$

Then $2(x-2) < (3x-2) \Rightarrow (2x-4) < (3x-2)$

$$(-4+2) < (3x-2x)$$

$$(-2) < x$$

$$\boxed{x > -2}$$

But, here $x \in \{-3,-2,-1,0,1,2,3\}$

Hence, the required solution set is $\{-1,0,1,2,3\}$.

6) If x is a negative integer, find the solution set of $\frac{2}{3}+\frac{1}{3}(x+1) > 0$.

→ Given inequation is $\frac{2}{3}+\frac{1}{3}(x+1) > 0$,

where 'x' is a negative integer.

$$2+(x+1) > 0$$

$$(x+3) > 0$$

$$\boxed{x > -3}$$

But, x is a negative integer here.

Hence, the required solution set is $\{-2,-1\}$.

7) Solve: $x-3(2+x) > 2(3x-1)$, where $x \in \{-3,-2,-1,0,1,2,3\}$

Also represent its solution on the number line.

→ Given inequation is $x-3(2+x) > 2(3x-1)$

where, $x \in \{-3,-2,-1,0,1,2,3\}$

Then, $x-3(2+x) > 2(3x-1)$

$$\Rightarrow x-(6+3x) > (6x-2)$$

$$(x-6-3x) > (6x-2)$$

$$(-2x-6) > (6x-2)$$

$$(-6+2) > (6x+2x)$$

$$-4 > 8x$$

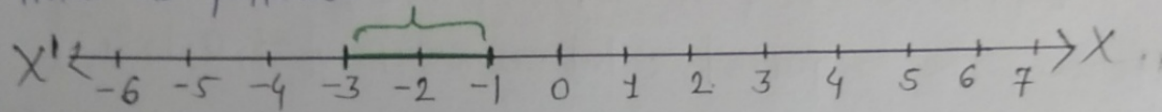
$$\frac{-4}{8} > x$$

$$\boxed{x < \frac{-1}{2}}$$

But, Here, $x \in \{-3, -2, -1, 0, 1, 2\}$

Hence, the required set solution is $\{-3, -2, -1\}$.

We can represent the solution set $\{-3, -2, -1\}$ on number line as follows:



8.) Solve: $(x-3) < (2x-1)$, where $x \in \{1, 2, 3, 4, 5, 6, 7, 9\}$

→ Given that, $(x-3) < (2x-1)$

where $x \in \{1, 2, 3, 4, 5, 6, 7, 9\}$

Then, $(x-3) < (2x-1)$

$\Rightarrow$

$$(x-3) < (2x-1)$$

$$(x-2x) < (-1+3)$$

$$(-x) < 2$$

$$\boxed{x > -2}$$

But, here $x \in \{1, 2, 3, 4, 5, 6, 7, 9\}$

Hence, the required solution set is $\{1, 2, 3, 4, 5, 6, 7, 9\}$

9.) List the solution set of the inequation $(\frac{1}{2} + 8x) > (5x - 3/2)$, where $x \in Z$.

→ Given inequation is $(\frac{1}{2} + 8x) > (5x - 3/2)$

where $x \in Z$

Then, $(\frac{1}{2} + 8x) > (5x - 3/2)$

$$(8x - 5x) > (-3/2 - 1/2)$$

$$(3x) > (-4/2 = -2)$$

$$3x > -2$$

$$\boxed{x > -2/3}$$ But, $x \in Z$

Hence, the required set of solution is $\{0, 1, 2, 3, 4, \cdots\}$

10) List the solution set of $\left(\frac{11-2x}{5}\right) \geq \left(\frac{9-3x}{8}\right) + \left(\frac{3}{4}\right)$, $x \in N$

→ Given that, $\left(\frac{11-2x}{5}\right) \geq \left(\frac{9-3x}{8} + \frac{3}{4}\right)$

$$\left(\frac{11-2x}{5}\right) \geq \left(\frac{9-3x+6}{8}\right)$$

$$8(11-2x) \geq 5(9-3x+6)$$

$$(88-16x) \geq (45-15x+30)$$

$$(15x-16x) \geq (45+30-88)$$

$$(-x) \geq (75-88)$$

$$-x \geq -13 \qquad N = \{1, 2, 3, 4, \cdots\}$$

$$-x \geq -13$$

$$\text{or } \boxed{x \leq 13} \qquad \text{But } x \in N$$

Hence, the required solution set is $\{1, 2, 3, 4, 5, \cdots 13\}$.

11) find the values of x, which satisfy the inequation:
$\left(-2 \leq \frac{1}{2} - \frac{2x}{3} \leq 1\frac{5}{6}\right)$, $x \in N$.
Graph the solution on the number line.

→ Given that, $-2 \leq \frac{1}{2} - \frac{2x}{3} < 1\frac{5}{6}$, $x \in N$

$$\Rightarrow -2 - \frac{1}{2} \leq \frac{1}{2} - \frac{2x}{3} - \frac{1}{2} < \frac{11}{6} - \frac{1}{2}$$

By subtracting $\frac{1}{2}$ on both sides of inequality.

$$\frac{-5}{2} \leq \frac{-2x}{3} \leq \frac{8}{6}$$

$$-15 \leq -4x \leq 8$$

$$\Rightarrow 15 \geq 4x \geq -8$$

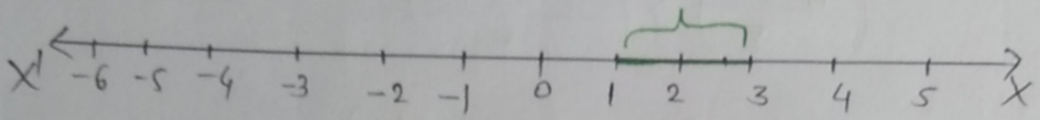
$$\Rightarrow 15/4 \geq x \geq -8/4$$

$$\boxed{\frac{15}{4} \geq x \geq -2}$$

But $x \in N = \{1, 2, 3, 4, 5, \cdots\}$

Hence, the required set of solution is $\{1, 2, 3\}$

We can represent the set of solution $\{1, 2, 3\}$ on number line as below.



12.) If $x \in W$, find the solution set of $\frac{3}{5}x - \frac{(2x-1)}{3} > 1$. Also graph the solution set on the number line, if possible.

$\rightarrow$ Given that, $\frac{3}{15}x - \frac{(2x-1)}{3} > 1$, where $x \in W$

$$\Rightarrow \quad 9x - 5(2x-1) > 15$$

$$9x - 10x + 5 > 15$$

$$-x > 15 - 5$$

$$-x > 10$$

$$\boxed{x < -10} \qquad \text{But } x \in W = \{0, 1, 2, 3, \cdots\}$$

Hence, the required set of solution is empty set (ϕ).
And hence, we cannot represent it on the number line also.

14.) Given that $x \in I$, solve the inequation and graph the solution on the number line:

$$3 \geq \left(\frac{x-4}{2}\right) + \frac{x}{3} \geq 2\ (2004)$$

$\rightarrow$ Given that, $3 \geq \frac{(x-4)}{2} + \frac{x}{3} \geq 2\ (2004)$, $x \in I$

$$\Rightarrow \quad 3 \geq \frac{(3x - 12 + 2x)}{6} \geq 2$$

$$3 \geq (5x-12)/6$$

$\Rightarrow \ 18 \geq (5x-12)$

That means, $(5x-12) \leq 18$

$5x \leq (18+12)$

$5x \leq 30$

$\boxed{x \leq 6}$

But $x \in I$

Hence, required set of solution is $\{\cdots, -1, 0, 1, 2, 3, 4, 5, 6\}$.

15.) Solve: $1 \geq 15-7x > 2x-27$, $x \in N$

$\rightarrow$ Given that, $1 \geq (15-7x) > (2x-27)$ where $x \in N$

$\Rightarrow \ 1 \geq (15-7x)$ and $(15-7x) > (2x-27)$

$7x \geq (15-1)$ and $(-7x-2x) > (-27-15)$

$7x \geq 14$ and $-9x > -42$

$x \geq 2$ and $-x > -42/9$

$\Rightarrow \boxed{2 \leq x}$ and $x < 42/9 = 14/3$

Thus, here $\boxed{2 \leq x < 14/3}$ But $x \in N$

Hence, the required set of solution is $\{2, 3, 4\}$.

16.) If $x \in Z$, Solve: $(2+4x) < (2x-5) \leq 3x$.

Also, represent its solution on the number line.

$\rightarrow$ Given that, $(2+4x) < (2x-5) \leq 3x$, where $x \in Z$

$\Rightarrow (2+4x) < (2x-5)$ and $(2x-5) \leq 3x$

$(4x-2x) < (-5-2)$ and $(2x-3x) \leq 5$

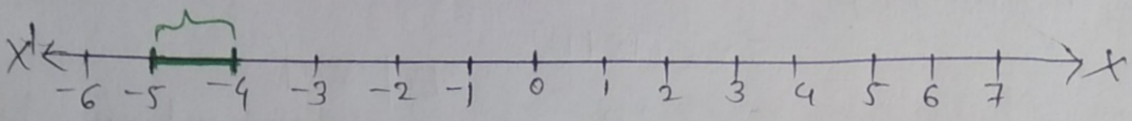
$2x < -7$ and $(-x) \leq 5$

$\boxed{x < -7/2}$ and $\boxed{x \geq -5}$

$\Rightarrow \ -5 \leq x < -7/2$ But $x \in Z$

Hence, the required set of solution is $\{-5, -4\}$.

Thus, we can represent the set of solution $\{-5,-4\}$ on the number line as bellow.

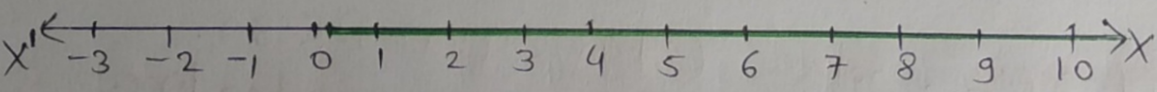


17) Solve: $\frac{(4x-10)}{3} \leq \frac{(5x-7)}{2}$, where $x \in R$ and represent the solution set on the number line.

→ Given that, $\frac{(4x-10)}{3} \leq \frac{(5x-7)}{2}$, where $x \in R$

$$\Rightarrow 2(4x-10) \leq 3(5x-7)$$
$$\Rightarrow (8x-20) \leq (15x-21)$$
$$(8x-15x) \leq (-21+20)$$
$$-7x \leq -1$$
$$-x \leq -1/7$$
$$\boxed{x > 1/7} \quad \text{But } x \in R$$

Thus, the required solution set is $\{x : x \in R, x > 1/7\}$
We can represent the solution set on number line as below.



18) Solve: $\frac{3x}{5} - \frac{(2x-1)}{3} > 1$, $x \in R$ and represent the solution set on number line.

→ Given that, $\frac{3x}{5} - \frac{(2x-1)}{3} > 1$, $x \in R$

$$3(3x) - 5(2x-1) > 15$$
$$9x - 10x + 5 > 15$$
$$-x + 5 > 15$$

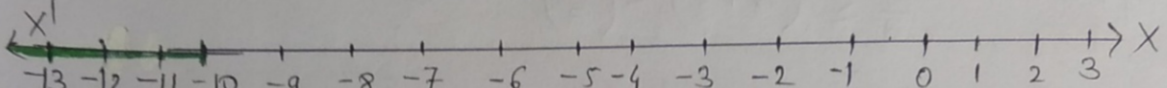
$-x+5>15$

$-x>15-5$

$-x>10$

$\boxed{x<-10}$ But $x \in R$

Hence, the required solution set is $\{x : x \in R, x<-10\}$
We can represent the solution set on number line as below.



19.) Given that $x \in R$, solve the following inequation & graph the solution on the number line: $-1 \leq (3+4x) < 23$.

→ Given that; $-1 \leq (3+4x) < 23$, where $x \in R$

$\Rightarrow (-1-3) \leq 4x < (23-3)$

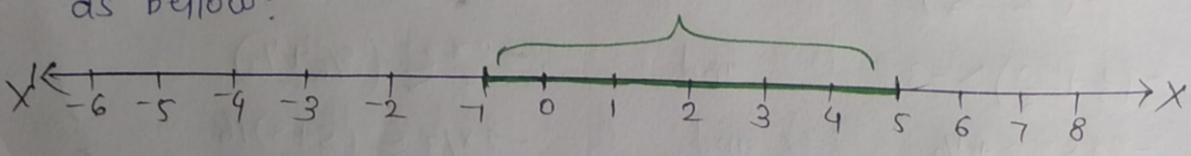
$\Rightarrow -4 \leq 4x < 20$

$-4 \leq 4x$ and $4x < 20$

$-1 \leq x$ and $x < 5$

$\Rightarrow \boxed{-1 \leq x < 5}$ But $x \in R$

Hence, the required set solution is $\{x \in R : -1 \leq x < 5\}$
We can represent the required solution set on number line as bellow:



20.) Solve the following inequation & graph the solution on the number line.

$-2\frac{2}{3} \leq \left(x+\frac{1}{3}\right) < \left(3+\frac{1}{3}\right)$, where $x \in R$

→ Given inequation is $-2\frac{2}{3} \leq \left(x+\frac{1}{3}\right) < \left(3+\frac{1}{3}\right)$, $x \in R$

Throughout equation multiply by 3,

we get $-\frac{8}{3} \leq \left(x+\frac{1}{3}\right) < \left(\frac{10}{3}\right)$ —— ①

① × 3 ⇒ $-8 \leq (3x+1) < 10$

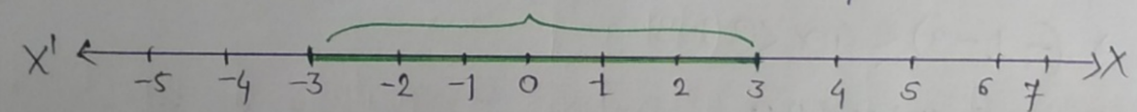
$(-8-1) \leq 3x < (10-1)$

$-9 \leq 3x < 9$

$\boxed{-3 \leq x < 3}$ But $x \in R$

Thus, the solution set found is $\{x : x \in R, -3 \leq x < 3\}$

i.e. $\{-3, -2, -1, 0, 1, 2\}$



21.) Solve the following inequation and represent the solution set on the number line. $-3 < \left(-\frac{1}{2} - \frac{2x}{3}\right) \leq \frac{5}{6}$, $x \in R$

→

i) $-3 < \left(-\frac{1}{2} - \frac{2x}{3}\right) \leq \frac{5}{6}$ is the given inequality, where $x \in R$

$-3 < \left(-\frac{1}{2} - \frac{2x}{3}\right)$ and $\left(-\frac{1}{2} - \frac{2x}{3}\right) \leq \frac{5}{6}$

$-\left(\frac{1}{2} + \frac{2x}{3}\right) > -3$ and $-\frac{2x}{3} \leq (5/6 + 1/2)$

$-\frac{2x}{3} > -3 + 1/2$ and $-2x/3 \leq (5+3)/6$

⇒ $-2x/3 > -5/2$ and $-2x/3 \leq 8/6$

⇒ $2x/3 < 5/2$ and $2/3\,x \geq -8/6$

$x < \left(5/2 \times \frac{3}{2}\right)$ and ⇒ $x \geq \left(-8/6 \times \frac{3}{2}\right)$

$\boxed{x < 15/4}$ and ⇒ $\boxed{x \geq -2}$

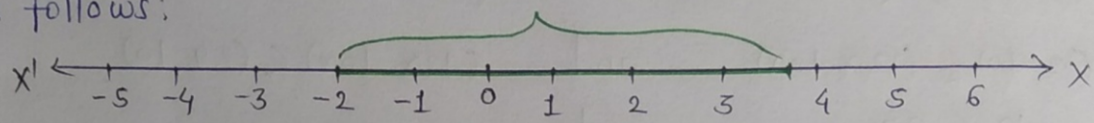
Thus, $x < 15/4$ and $x \geq -2$

$\Rightarrow$ $\boxed{-2 \leq x < 15/4}$ But $x \in R$

Thus, the required solution set is $\{x : x \in R, -2 \leq x < 15/4\}$

i.e. $\{-2, -1, 0, 1, 2, 3\}$

The required solution set can be represented on the number line as follows:



22) Solve the following inequation, write the solution set and represent it on number line $-3(x-7) \geq (15-7x) > \frac{(x+1)}{3}$, $n \in R$

$\rightarrow$ Given inequation is

$$-3(x-7) \geq (15-7x) > \frac{(x+1)}{3}, \text{ where } n \in R$$

$-3(x-7) \geq (15-7x)$ and $(15-7x) > \frac{(x+1)}{3}$

$(-3x+21) \geq (15-7x)$ and $3(15-7x) > (x+1)$

$(-3x+7x) \geq (15-21)$ and $(45-21x) > (x+1)$

$\Rightarrow$ $4x \geq -6$ and $(45-1) > (x+21x)$

$x \geq -6/4$ and $44 > 22x$

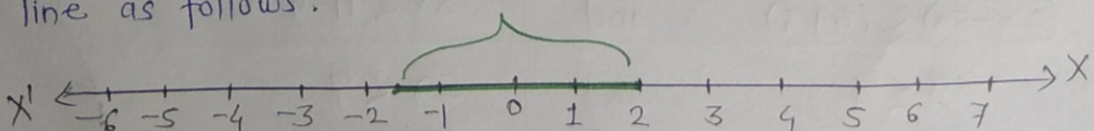
$\Rightarrow$ $x \geq -3/2$ and $\boxed{2 > x}$

$\boxed{-3/2 \leq x}$

Thus, $\boxed{-3/2 \leq x < 2}$ But $x \in R$

Thus, the required solution set is $\{x : x \in R, -3/2 \leq x < 2\}$

The required solution set can be represented on the number line as follows:



23.) Solve the following inequation, write the solution set and represent it on the real number line.

$(-2+10x) \leq (13x+10) < (24+10x)$, $x \in Z$

→ Given inequation is

$$(-2+10x) \leq (13x+10) < (24+10x) \quad , x \in Z$$

$(-2+10x) \leq (13x+10)$ and $(13x+10) < (24+10x)$

$(-2-10) \leq (13x-10x)$ and $(13x-10x) < (24-10)$

$-12 \leq 3x$ and $3x < 14$

$-4 \leq x$ and $x < 14/3$

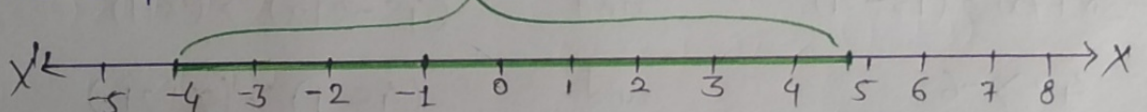
$\boxed{x \geq -4}$ and $\boxed{x < 14/3}$

Thus, $\boxed{-4 \leq x < 14/3}$ But $x \in Z$

Hence, the required solution set is $\{x : -4 \leq x < 14/3 , x \in Z\}$

or $[-4, 14/3)$.

The required solution set can be represented on the number line as follows:



24) Solve the inequation $(2x-5) \leq (5x+4) < 11$, where $x \in I$. Also represent the solution set on the number line.

→ Given inequation is $(2x-5) \leq (5x+4) < 11$, where $x \in I$

$(2x-5) \leq (5x+4)$ and $(5x+4) < 11$

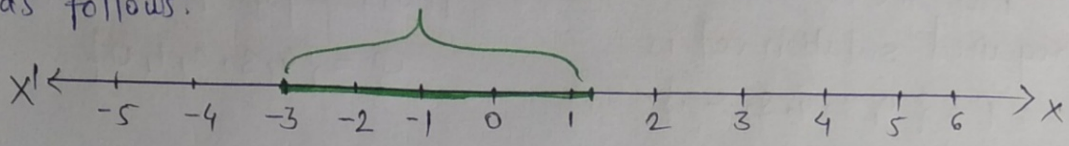
$(2x-5x) \leq (4+5)$ and $5x < 11-4$

$-3x \leq 9$ and $5x < 7$

$-x < 3$ and $\boxed{x < 7/5}$

$\boxed{x > -3}$ Thus, $\boxed{-3 < x < 7/5}$ But $x \in I$

Thus, the required set of solution is $\{x : -3 < x < 7/5,\ x \in I\}$
The required set can be represented on the number line as follows:



25> If $x \in I$, A is the solution set of $2(x-1) < (3x-1)$ and B is the solution set of $(4x-3) \leq (8+x)$, find $A \cap B$.

→ Given inequation is

$2(x-1) < (3x-1)$ and $(4x-3) \leq (8+x)$

$(2x-2) < (3x-1)$ and $(4x-x) \leq (8+3)$

$(2x-3x) < (2-1)$ and $3x \leq 11$

$-x < 1$ and $\boxed{x \leq 11/3}$

$\boxed{x > -1}$

Thus, $\boxed{-1 < x \leq 11/3}$ where $x \in I$

Thus, the required two solution sets are as given below:

$A = \{0, 1, 2, 3, \cdots\}$ and $B = \{3, 2, 1, 0, -1, \cdots\}$

Hence, $\boxed{A \cap B = \{0, 1, 2, 3\}}$

26> If P is the solution set of $(-3x+4) < (2x-3)$, $x \in N$ and Q is the solution set of $(4x-5) < 12$, $x \in W$. find

i) $P \cap Q$ ii) $Q - P$.

→ Given inequations are

$(-3x+4) < (2x-3)$ and $(4x-5) < 12$

$(-3x-2x) < (-3-4)$ and $4x < (12+5)$

$(-5x) < (-7)$ and $4x < 17$

$-5x < -7$ and $\boxed{x < 17/4}$

$-5x < -7$ and $\boxed{x < 17/4}$

$\Rightarrow \boxed{x > 7/5}$

But $x \in N$

Thus, required solution set is

$P = \{2, 3, 4, 5, \dots\}$

But $x \in W$

Thus, required solution set is

$Q = \{4, 3, 2, 1, 0\}$

i) $P \cap Q = \{2, 3, 4\}$

ii) $Q - P = \{1, 0\}$

27) $A = \{x : 11x - 5 > (7x + 3), x \in R\}$ and

$B = \{x : 18x - 9 \geq (15 + 12x), x \in R\}$

Find the range of set $A \cap B$ and represent it on number line.

→ Given set are $A = \{x : (11x - 5) > (7x + 3), x \in R\}$ and

$B = \{x : (18x - 9) \geq (15 + 12x), x \in R\}$

For set A:

$(11x - 5) > (7x + 3)$

$(11x - 7x) > (3 + 5)$

$4x > 8$

$\boxed{x > 2}, x \in R$

For set B:

$(18x - 9) \geq (15 + 12x)$

$(18x - 12x) \geq (15 + 9)$

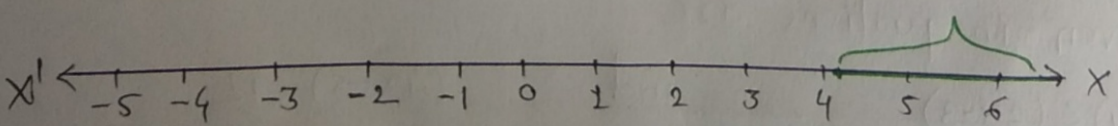
$6x \geq 24$

$\boxed{x \geq 4}, x \in R$

Thus, the required set solution is found to be

$A \cap B = \{x : x \geq 4, x \in R\}$

Hence, Range of $A \cap B = \{x : x \geq 4, x \in R\}$ and it can be represented on graph or number line as follows:



28) Given, $P = \{x : 5 < 2x - 1 \leq 11, x \in R\}$ and
$q = \{x : -1 \leq 3 + 4x < 23, x \in I\}$ where
$R \rightarrow$ Real numbers, $I \rightarrow$ Integers
Represent P & q on number line. Write down the elements of $P \cap q$.

$\rightarrow$ Given that, $P = \{x : 5 < (2x-1) \leq 11, x \in R\}$ and
$q = \{x : -1 \leq (3+4x) < 23, x \in I\}$
$R \rightarrow$ Real numbers and $I \rightarrow$ Integers

$\boxed{\text{for P}}$

$5 < (2x-1) \leq 11$

$\Rightarrow$ $5 < (2x-1)$ and $(2x-1) \leq 11$
$(5+1) < 2x$ and $(2x) \leq (11+1)$
$6 < 2x$ and $2x \leq 12$
$3 < x$ and $x \leq 6$
$\boxed{x > 3}$ and $\boxed{x \leq 6}$

$\Rightarrow$ $x > 3$ or $3 < x$

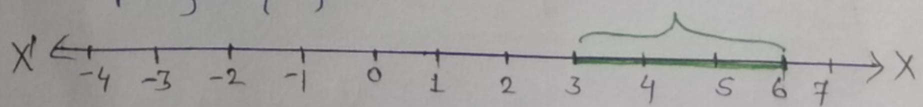
Hence, the required solution set is $3 < x \leq 6 = \{4, 5, 6\}$

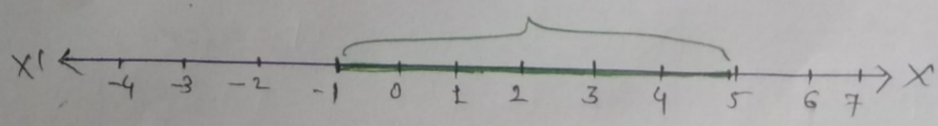
$\boxed{\text{for q}}$ $-1 \leq (3+4x) < 23$

$-1 \leq (3+4x)$ and $(3+4x) < 23$
$\Rightarrow (-1-3) \leq 4x$ and $4x < (23-3)$
$-4 \leq 4x$ and $4x < 20$
$-1 \leq x$ and $\boxed{x < 5}$
$\boxed{x \geq -1}$ $\Rightarrow$ $\boxed{-1 \leq x < 5}$ $x \in I$

The required solution set is found to be $-1 \leq x < 5$
i.e. $\{-1, 0, 1, 2, 3, 4\}$

$P \cap q = \{4\}$





29) If $x \in I$, find the smallest value of x, which satisfies the inequation $(2x + 5/2) > (\frac{5x}{3} + 2)$

→ Given inequality is $(2x + 5/2) > (\frac{5x}{3} + 2)$, $x \in I$

$\Rightarrow (2x - \frac{5x}{3}) > (2 - 5/2)$

$\Rightarrow (x/3) > (-1/2)$

$2x > -3$

$\boxed{x > -3/2}$. But $x \in I$

Hence, the required smallest value of x is $\boxed{x = -1}$

30) Given $(20 - 5x) < 5(x+8)$, find the smallest value of x, when i) $x \in I$
ii) $x \in W$
iii) $x \in N$

→ Given inequality is $(20 - 5x) < 5(x+8)$

$\Rightarrow (20 - 5x) < (5x + 40)$

$\Rightarrow (5x - 5x) < (40 - 20)$

$-10x < 20$

$-x < 2$

$\boxed{x > -2}$

i) When $x \in I$, the smallest value of x is found to be $x = -1$.

ii) When $x \in W$, the smallest value of x is found to be $x = 0$.

iii) When $x \in N$, the smallest value of x is found to be $x = 1$.

32) Solve the given inequation and graph the solution on the number line: $(2y-3) < (y+1) \leq (4y+7)$, $y \in R$

→ Given inequality is $(2y-3) < (y+1) \leq (4y+7)$, $y \in R$

$\Rightarrow$ $(2y-3) < (y+1)$ and $(y+1) \leq (4y+7)$

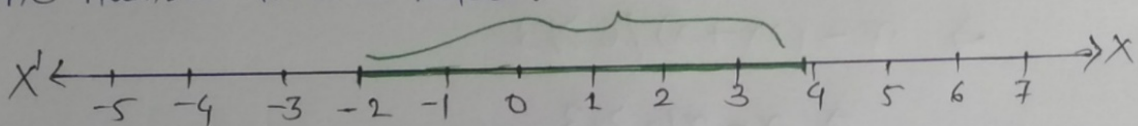
$(2y-y) < (1+3)$ and $1-7 \leq (4y-y)$

$\boxed{y < 4}$ and $-6 \leq 3y$

$\boxed{-2 \leq y}$ i.e. $\boxed{y \geq -2}$

Thus, $\boxed{4 > y \geq -2}$ or $\boxed{-2 \leq y < 4}$

is the required solution set which can be represented on the number line as below:



33) Find the greatest integer which is such that if 7 is added to its double, the resulting number becomes greater than three times the integer.

→ Let us consider the greatest integer be 'x'.

From given condition we can write,

$(2x+7) > 3x$

$\Rightarrow 2x-3x > -7$

$-x > -7$

$\boxed{x < 7}$

Thus, the greatest value of x is found to be $\boxed{x=7}$.

35) One-third of a bamboo pole is buried in mud, one-sixth of it is in water and the part above the water greater than or equal to 3 meters. Find the length of the shortest pole

→ Let us consider the length of shortest pole is 'x'.

Then, from given condition we can write,

Length of pole buried in mud is '$x/3$'.

and length of pole which is in water is '$x/6$'.

According to given conditions,

$$x - (x/3 + x/6) \geq 3$$

$$\Rightarrow x - (2x + x)/6 \geq 3$$

$$\Rightarrow x - x/2 \geq 3$$

$$x/2 \geq 3$$

$$\boxed{x \geq 6}$$

Thus, the shortest length of the pole is found to be 6 meters.