

Linear InequalitiesEx-5.1

(Que1) Solve  $24x < 100$ , when

i)  $x$  is a natural number  
 Ans-i)  $24x < 100$

$$\frac{24x}{24} < \frac{100}{24} \quad \left\{ \text{Both side divided by 24} \right\}$$

$$x < 4.\overline{1}$$

ii)  $x$  is a natural number  
 Ans-i)  $\{1, 2, 3, 4\}$

iii)  $x$  is an integer  
 Ans-ii)  $\{-\infty, \dots, -3, -2, -1, 0, 1, 2, 3\}$

(Que2) Solve  $-12x > 30$ , when

$$-12x > 30$$

$$-\cancel{12}x < \cancel{1}x 30 \quad \left\{ \text{Both side multiply by } -1 \right\}$$

$$12x < -30$$

$$\frac{12x}{12} < \frac{-30}{12} \quad \left\{ \text{Both side divide by 12} \right\}$$

$$x < -2.5$$

i)  $x$  is a natural number  
 Ans-i) No solution

i)  $x$  is an integer  
(Ans-ii)  $\{-\infty, \dots, -4, -3\}$

(Que3) Solve  $5x - 3 < 7$ , when

$$\begin{aligned} 5x - 3 &< 7 \\ 5x - 3 + 3 &< 7 + 3 \quad \{ \text{Adding } 3 \text{ on both side} \} \\ 5x &< 10 \\ \frac{5x}{5} &< \frac{10}{5} \quad \{ \text{Both side divided by 5} \} \\ x &< 2 \end{aligned}$$

i)  $x$  is an integer  
(Ans-i)  $\{-\infty, \dots, 0, 1\}$

ii)  $x$  is a real number  
(Ans-ii)  $(-\infty, 2)$

(Que4) Solve  $3x + 8 > 2$ , when

$$\begin{aligned} 3x + 8 &> 2 \\ 3x + 8 - 8 &> 2 - 8 \quad \{ \text{both side substrated by 8} \} \\ 3x &> -6 \\ \frac{3x}{3} &> \frac{-6}{3} \quad \{ \text{both side divided by 3} \} \\ x &> -2 \end{aligned}$$

i)  $x$  is an integer  
(Ans-i)  $\{-\infty, \dots, -1, 0, 1, \dots, \infty\}$

ii)  $x$  is a real number  
(Ans-ii)  $(-2, \infty)$

Solve the inequalities in Exercises 5 to 16 for real  $x$ .

(Que 5)  $4x + 3 < 5x + 7$

(Ans-5)  $4x + 3 < 5x + 7$

$$4x + 3 - 4x < 5x + 7 - 4x \quad \{ \text{Both side subtracted by } 4x \}$$

$$3 < x + 7$$

$$3 - 7 < x + 7 - 7 \quad \{ \text{Both side subtracted by } -7 \}$$

$$-4 < x$$

$$(-4, \infty) \text{ Ans}$$

(Que 6)  $3x - 7 > 5x - 1$

(Ans-6)  $3x - 7 > 5x - 1$

$$3x - 7 - 3x > 5x - 1 - 3x \quad \{ \text{Both side added by } -3x \}$$

$$-7 > 2x - 1$$

$$-7 + 1 > 2x - 1 + 1 \quad \{ \text{Adding both side } +1 \}$$

$$-6 > 2x$$

$$\frac{-6}{2} > \frac{2x}{2} \quad \{ \text{Both side divided by } 2 \}$$

$$-3 > x$$

$$(-\infty, -3) \text{ Ans}$$

(Que 7)  $3(x - 1) \leq 2(x - 3)$

(Ans-7)  $3x - 3 \leq 2x - 6$

$$3x - 3 - 2x \leq 2x - 6 - 2x \quad \{ \text{Both side subtracted by } 2x \}$$

$$x - 3 \leq -6$$

$$x - 3 + 3 \leq -6 + 3 \quad \{ \text{Adding both side } +3 \}$$

$$x \leq -3$$

$$(-\infty, -3] \text{ Ans}$$

$$(Ques 8) \quad 3(2-x) \geq 2(1-x)$$

$$(Ans-8) \quad 6-3x \geq 2-2x$$

$$6-3x+3x \geq 2-2x+3x \quad \{ \text{Adding both side } 3x \}$$

$$6 \geq 2+x$$

$$6-2 \geq 2+x-2 \quad \{ \text{Adding both side } -2 \}$$

$$4 \geq x$$

$$(-\infty, 4] \quad \underline{\text{Ans}}$$

$$(Ques 9) \quad x + \frac{x}{2} + \frac{x}{3} < 11$$

$$(Ans-9) \quad \frac{x}{1} + \frac{x}{2} + \frac{x}{3} < 11$$

$$\frac{6x+3x+2x}{6} < 11$$

$$\frac{11x}{6} < 11$$

$$\frac{11x \times 6}{6} < 11 \times 6 \quad \{ \text{Both side multiply by } 6 \}$$

$$11x < 66$$

$$\frac{11x}{11} < \frac{66}{11} \quad \{ \text{Both side divided by } 11 \}$$

$$x < 6$$

$$(-\infty, 6) \quad \underline{\text{Ans}}$$

$$(Ques 10) \frac{x}{3} > \frac{x}{2} + 1$$

$$(Ans-10) \frac{x}{3} - \frac{x}{3} > \frac{x}{2} - \frac{x}{3} + 1 \quad \{ \text{Both side subtracted by } \frac{x}{3} \}$$

$$0 > \frac{3x - 2x}{6} + 1$$

$$-1 > \frac{x}{6} + 1 - 1 \quad \{ \text{Both side subtracted by } 1 \}$$

~~$$-1 \times 6 > \frac{x \times 6}{6} \quad \{ \text{Both side multiply by 6} \}$$~~

$$-6 > x$$

$$(-\infty, -6) \text{ Ans}$$

$$(Ques 11) \frac{3(x-2)}{5} \leq \frac{5(2-x)}{3}$$

~~$$\frac{3x-6}{5} \leq \frac{10-5x}{3}$$~~

~~$$\frac{3x-6}{5} - \frac{10-5x}{3} \leq \frac{10-5x}{3} - \frac{10-5x}{3} \quad \{ \frac{10-5x}{3} \text{ subtracted on both side} \}$$~~

$$\frac{3(3x-6) - 5(10-5x)}{15} \leq 0$$

$$\frac{9x-18-50+25x}{15} \leq 0$$

$$\frac{34x-68}{15} \leq 0$$

~~$$\frac{34x-68}{15} \times 15 \leq 0 \times 15 \quad \{ 15 \text{ multiply on both sides} \}$$~~

~~$$34x-68 \leq 0$$~~

$$34x-68+68 \leq 0+68 \quad \{ \text{Add 68 on both sides} \}$$

$$\frac{34x}{34} \leq \frac{68}{34}$$

$\{ 34 \text{ divided on both sides} \}$

$$x \leq 2$$

$(-\infty, 2]$  Ans

(Que 12)  $\frac{1}{2} \left( \frac{3x}{5} + 4 \right) \geq \frac{1}{3} (x - 6)$

(Ans 12)  $\frac{3x}{10} + 2 \geq \frac{x}{3} - 2$

$$\frac{3x}{10} + 2 + 2 \geq \frac{x}{3} - 2 + 2 \quad \{ \text{Adding 2 on both sides} \}$$

$$\frac{3x}{10} + 4 \geq \frac{x}{3}$$

$$\frac{3x}{10} + 4 - \frac{3x}{10} \geq \frac{x}{3} - \frac{3x}{10} \quad \{ \text{Subtracting both side } \frac{3x}{10} \}$$

$$4 \geq \frac{10x - 9x}{30}$$

$$4 \geq \frac{x}{30}$$

$$4 \times 30 \geq \frac{x}{30} \times 30 \quad \{ \text{Multiplying both sides by 30} \}$$

$$120 \geq x$$

$(-\infty, 120]$  Ans

$$(Ques 13) \quad 2(2x+3) - 10 < 6(x-2)$$

$$(Ans-13) \quad 4x + 6 - 10 < 6x - 12$$

$$4x - 4 < 6x - 12$$

$$4x - 4 - 4x < 6x - 12 - 4x \quad \{ \text{Subtracting both side by } 4x \}$$

$$-4 < 2x - 12$$

$$12 - 4 < 2x - 12 + 12 \quad \{ \text{Adding 12 on both sides} \}$$

$$8 < 2x$$

$$\frac{8}{2} < \frac{2x}{2} \quad \{ \text{dividing both side by 2} \}$$

$$4 < x$$

$$(4, \infty) \quad \text{Ans}$$

$$(Ques 14) \quad 37 - (3x+5) \geq 9x - 8(x-3)$$

$$(Ans-14) \quad 37 - 3x - 5 \geq 9x - 8x + 24$$

$$32 - 3x \geq x + 24$$

$$32 - 3x - 24 \geq x + 24 - 24 \quad \{ \text{Subtracting both side by 24} \}$$

$$8 - 3x \geq x$$

$$8 - 3x + 3x \geq x + 3x \quad \{ \text{Adding both side } 3x \}$$

$$8 \geq 4x$$

$$\frac{8}{4} \geq \frac{4x}{4} \quad \{ \text{dividing both side by 4} \}$$

$$2 \geq x$$

$$(-\infty, 2] \quad \text{Ans}$$

(Que 15)  $\frac{x}{4} < \frac{5x-2}{3} - \frac{7x-3}{5}$

Ans  $\frac{x}{4} < \frac{5(5x-2) - 3(7x-3)}{15}$

$\frac{x}{4} < \frac{25x-10 - 21x+9}{15}$

$\frac{x}{4} < \frac{4x-1}{15}$

$\frac{x}{4} - \frac{x}{4} < \frac{4x-1}{15} - \frac{x}{4}$  } Subtracting both side by  $\frac{x}{4}$

$0 < \frac{16x-4 - 15x}{60}$

$0 < \frac{x-4}{60}$

$60 \times 0 < \frac{x-4}{60} \times 60$  } multiplying 60 on both side

$0 < x-4$

$4+0 < x-4+4$

$4 < x$

{4,  $\infty$ } Ans

$$(Ques 16) \frac{(2x-1)}{3} \geq \frac{(3x-2)}{4} - \frac{(2-x)}{5}$$

$$\text{Ans - 16) } \frac{(2x-1)}{3} \geq \frac{5(3x-2)-4(2-x)}{20}$$

$$\frac{(2x-1)}{3} \geq \frac{15x-10-8+4x}{20}$$

$$\frac{(2x-1)}{3} \geq \frac{19x-18}{20}$$

$$\frac{(2x-1)}{3} - \frac{(2x-1)}{3} \geq \frac{19x-18}{20} - \frac{2x-1}{3} \quad \left\{ \text{Subtracting } \frac{2x-1}{3} \text{ on both sides} \right.$$

$$0 \geq \frac{3(19x-18) - 20(2x-1)}{60}$$

$$0 \geq \frac{57x-54 - 40x+20}{60}$$

$$0 \geq \frac{17x-34}{60}$$

$$0 \times 60 \geq \cancel{\frac{17x-34}{60}} \times 60 \quad \left\{ \text{multiply 60 on both sides} \right\}$$

$$0 \geq 17x-34$$

$$0+34 \geq 17x-34+34 \quad \left\{ \text{Adding 34 on both sides} \right\}$$

$$34 \geq 17x$$

$$\frac{34}{17} \geq \frac{17x}{17} \quad \left\{ \text{Dividing 17 on both sides} \right\}$$

$$2 \geq x$$

$$(-\infty, 2] \quad \underline{\text{Ans}}$$

Solve the inequalities in Exercises 17 to 20 and show the graph of the solution in each case on number line

$$(Ques 17) \quad 3x - 2 < 2x + 1$$

$$(Ans-17) \quad 3x - 2 < 2x + 1$$

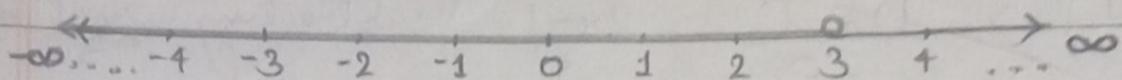
$$3x - 2 - 2x < 2x + 1 - 2x \quad \{ \text{Subtracting } 2x \text{ on both sides} \}$$

$$x - 2 < 1$$

$$x - 2 + 2 < 1 + 2 \quad \{ \text{Adding } 2 \text{ on both sides} \}$$

$$x < 3$$

$$(-\infty, 3)$$



$$(Ques 18) \quad 5x - 3 \geq 3x - 5$$

$$(Ans-18) \quad 5x - 3 \geq 3x - 5$$

$$5x - 3 - 3x \geq 3x - 5 - 3x \quad \{ \text{Subtracting } 3x \text{ on both sides} \}$$

$$2x - 3 \geq -5$$

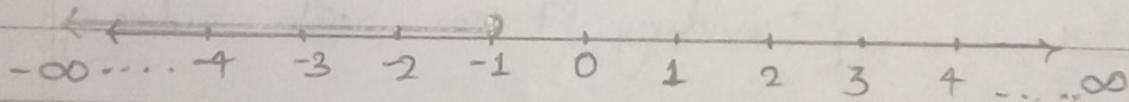
$$2x - 3 + 3 \geq -5 + 3 \quad \{ \text{Adding } 3 \text{ on both sides} \}$$

$$2x \geq -2$$

$$\frac{2x}{2} \geq \frac{-2}{2} \quad \{ \text{Dividing } 2 \text{ on both sides} \}$$

$$x \geq -1$$

$$[-1, \infty)$$



$$(Ques 19) \quad 3(1-x) < 2(x+4)$$

$$(Ans-19) \quad 3 - 3x < 2x + 8$$

$$3 - 3x + 3x < 2x + 8 + 3x \quad \{ \text{Adding } 3x \text{ on both sides} \}$$

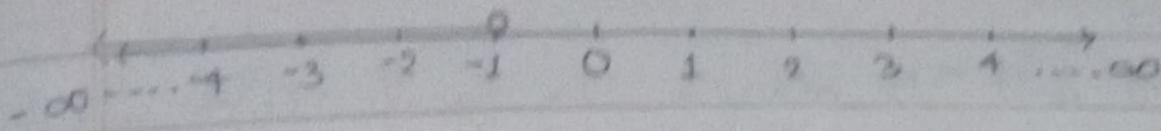
$$3 < 5x + 8$$

$$3 - 8 < 5x + 8 - 8 \quad \{ \text{Subtracting } 8 \text{ on both sides} \}$$

$$-5 < 5x$$

$$\frac{-5}{5} < \frac{5x}{5} \quad \{ \text{Dividing } 5 \text{ on both sides} \}$$

$$-1 < x \Rightarrow (-1, \infty)$$



$$(Q_{1120}) \frac{x}{2} \geq \frac{(5x-2)}{3} - \frac{(7x-3)}{5}$$

$$\frac{x}{2} \geq \frac{5(5x-2) - 3(7x-3)}{15}$$

~~$$\frac{x}{2} \geq \frac{25x-10 - 21x+9}{15}$$~~

$$\frac{x}{2} \geq \frac{4x-1}{15}$$

~~$$\frac{x}{2} - \frac{x}{2} \geq \frac{4x-1}{15} - \frac{x}{2}$$~~

{ Subtracting  $\frac{x}{2}$  on both sides }

~~$$0 \geq \frac{2(4x-1) - 15x}{30}$$~~

~~$$0 \geq \frac{8x-2-15x}{30}$$~~

~~$$0 \geq \frac{-7x-2}{30}$$~~

~~$$30 \times 0 \geq \frac{-7x-2}{30} \times 30$$~~

{ multiplying 30 on both sides }

~~$$0 \geq -7x-2$$~~

~~$$7x+0 \geq -7x-2+7x$$~~

{ Adding  $7x$  on both sides }

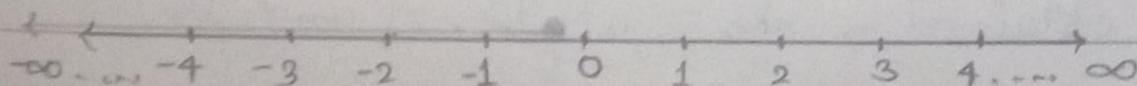
~~$$7x \geq -2$$~~

~~$$\frac{7x}{7} \geq \frac{-2}{7}$$~~

{ dividing 7 on both sides }

$$x \geq -\frac{2}{7}$$

$$\left[ -\frac{2}{7}, \infty \right)$$



(Que 21) Ravi obtained 70 and 75 marks in first two unit test. Find the minimum marks he should get in the third test to have an average of at least 60 marks.

(Ans-21) Given:

Ravi obtained = 70 and 75 marks

Solution:

$$\text{average mark} = \frac{70+75+x}{3}$$

$$\text{average mark} \geq 60$$

$$\frac{70+75+x}{3} \geq 60$$

$$\frac{145+x}{3} \times 3 \geq 60 \times 3 \quad \{ \text{Multiplying 3 on both sides} \}$$

$$145+x \geq 180$$

$$145+x - 145 \geq 180 - 145 \quad \{ \text{Subtracting 145 on both sides} \}$$

$$x \geq 35$$

Therefore, He should get <sup>atleast</sup> 35 marks in his 3<sup>rd</sup> test.

(Que 22) To receive Grade 'A' in a course, one must obtain an average of 90 marks or more in five examinations (each of 100 marks). If Sunita's marks in first four examinations are 87, 92, 94 and 95, find minimum marks that Sunita must obtain in fifth examination to get grade 'A' in the course.

(Ans-22) Given:

Sunita obtained marks = 87, 92, 94 and 95

unit test  
bird

Solution :

$$\text{average mark} = \frac{87+92+94+95+x}{5}$$

$$\text{average mark} \geq 90$$

$$\frac{87+92+94+95+x}{5} \geq 90$$

$$\cancel{368 + x \times 5} \geq 90 \times 5 \quad \{ \text{multiplying 5 on both sides} \}$$

$$368 + x \geq 450$$

$$368 + x - 368 \geq 450 - 368 \quad \{ \text{subtracting 368 on both sides} \}$$

$$x \geq 82$$

Therefore, She should get atleast 82 marks.

(Que 23) Find all pairs of consecutive odd positive integers both of which are smaller than 10 such that their sum is more than 11.

(Ans-23) Given:

Let the odd number =  $x$

$$x < 10$$

$$x + (x+2) > 11$$

Solution:

$$x + x + 2 > 11$$

$$2x + 2 > 11$$

$$\cancel{2x + 2} \geq 11 - 2 \quad \{ \text{subtract 2 on both sides} \}$$

$$2x > 9$$

$$\frac{2x}{2} > \frac{9}{2} \quad \{ \text{divide 2 on both sides} \}$$

$$x > 4.5 \rightarrow \textcircled{1}$$

$$4.5 < x < 10 \quad \{ \text{From eq. 1 and given} \}$$

Therefore,  $x = 5, 7, 9$

Pair of consecutive odd positive integer =

$$(x, x+2)$$

$$\Rightarrow (5, 7) \text{ and } (7, 9) \text{ Ans}$$

(Que 24) Find all pairs of consecutive even positive integers, both of which are larger than 5 such that their sum is less than 23.

(Ans-24) Given:

Let pair of consecutive even positive integer =  $(n, n+2)$

$$n > 5$$

$$n + (n+2) < 23$$

Solution:

$$n + n + 2 < 23$$

$$2n + 2 < 23$$

$$2n + 2 - 2 < 23 - 2$$

$$2n < 21$$

$$\frac{2n}{2} < \frac{21}{2}$$

{ Subtracting 2 on both sides }

{ dividing 2 on both sides }

$$n < 10.5 \rightarrow \textcircled{i}$$

From eq i and given, we get

$$5 < n < 10.5$$

Therefore,

$$n = 6, 8, 10$$

Pair of consecutive even positive integer =

$$(n, n+2)$$

$$\Rightarrow (6, 8), \cancel{(8, 10)} \cancel{(10, 12)} \text{ Ans}$$

Ques 25) The longest side of a triangle is 3 times the shortest side and the third side is 2 cm shorter than the longest side. If the perimeter of the triangle is at least 61 cm, find the minimum length of the shortest side.

(Ans-25) Given:

$$\text{longest side} = 3 \times \text{shortest side}$$

$$\text{longest side} = \text{third side} + 2 \text{ cm}$$

$$\text{perimeter} \geq 61 \text{ cm}$$

Solution:

Let  $x$  be the shortest side.

$$\text{Hence, } 3x = \text{largest side}$$

$$\text{and } \text{third side} = 3x - 2$$

$$\text{perimeter} \geq 61$$

$$x + 3x - 2 + 3x \geq 61$$

$$2 + 7x \geq 61 + 2 \quad \{ \text{Adding 2 on both sides}\}$$

$$7x \geq 63$$

$$\frac{7x}{7} \geq \frac{63}{7} \quad \{ \text{dividing 7 on both sides}\}$$

$$x \geq 9$$

Therefore, the minimum length of the shortest side is 9 cm.

Ques 26) A man wants to cut three lengths from a single board from a single piece of board of length 91 cm.

The second length is to be 3 cm longer than the shortest and the third length is to be twice as long as the shortest. What are the possible lengths of the shortest

board if the third piece is to be at least 5cm longer than the second?

(Ans-26) Given:

$$\text{Second length} = \text{shortest} + 3$$

$$\text{Third length} = 2 \times \text{shortest side}$$

$$\text{Third length} \geq \text{second length} + 5$$

Solution:

$$\text{Let the shortest side} = x$$

$$\text{Third length} \geq \text{second length} + 5 \quad (\text{given})$$

$$2x \geq (x+3) + 5$$

$$2x \geq x+8$$

$$2x - x \geq x+8 - x \quad \{ \text{Subtracting } x \text{ on both sides}\}$$

$$x \geq 8$$

$$x + (x+3) + 2x \leq 91$$

$$4x + 3 \leq 91$$

$$4x + 3 - 3 \leq 91 - 3 \quad \{ \text{Subtracting } 3 \text{ on both sides}\}$$

$$4x \leq 88$$

$$\frac{4x}{4} \leq \frac{88}{4} \quad \{ \text{dividing by } 4 \text{ on both sides}\}$$

$$x \leq 22$$

Greater than or equal to 8cm but less than or equal to 22 cm.

*Friday  
13/8/24*

1<sup>st</sup> term course completed