

Linear Inequalities - GCSE Maths

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1. Introduction

- Inequalities are **similar to equations**. Equations do have specific values that satisfies the equation on the hand Inequalities have **feasible region**(set of the values satisfying the inequality) .
- Example of Inequality -

$$x + 9y < 19$$

Expression 1 Expression 2

(lesser than)
Inequality symbol

- Using Inequalities, we can solve **real-life problems** where the maximum or minimum quantity of something is calculated under **multiple constraints**.

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- They are basically used to represent those problems which are **restricted by some constraint or conditions**. That is why they are used in various fields like Business, Engineering and Economics etc.

Inequality is an expression in which variables and constants are present and one expression is lesser than the other.

Inequality Symbols -	
$<$: lesser than	
$>$: greater than	
$\leq$: lesser than or equal to	
$\geq$: greater than or equal to	

- The Solution to these Inequalities exist in form of intervals (set of integers that lies between two numbers) -

Example: $(-12, 1]$ The number is greater than -12 and lesser than 1



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2. Linear Inequalities

- The Inequalities in which the maximum power raised to a variable is one.

- Example:

$$2x + 9 < 15$$

- Steps to Solve Linear Inequality:

$$2x + 9 < 15$$

Step#1: Find value of the variable using addition, Subtraction, Multiplication or division on both sides of inequality so that the variable will get isolated.

$$2x + 9 - 9 < 15 - 9$$

$$2x < 6$$

$$\frac{2x}{2} < \frac{6}{2}$$

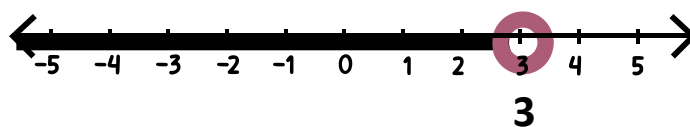
$$x < 3$$

Means that, $x < 3$

(Whenever we change sign on both the sides the symbol is reversed from greater than to lesser than and vice versa)

Step#2: Express the solution in form of interval or using number line.

$$x = (-\infty, 3)$$



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3. Examples of Solving Linear Inequalities

Example : Solve the following linear inequalities -

$$(1) 3y - 8 > 18, \quad (2) 5 + 6y < 17$$

Solution:

(1) $3y - 8 > 10$

Step #1: $3y - 8 > 10$

Adding 8 on both sides, $3y - 8 + 8 > 10 + 8$

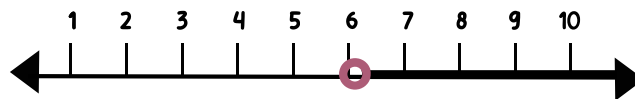
$$3y > 18$$

Dividing both sides by 3, $\frac{3y}{3} > \frac{18}{3}$

$$y > 6$$

Step#2: Representing the solution in form of interval -

$$y = (6, \infty)$$



(2) $5 + 6y < 17$

Step #1: $5 + 6y < 17$

Subtracting 5 on both sides,

$$5 + 6y - 5 < 17 - 5$$

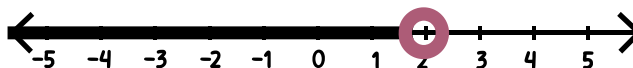
$$6y < 12$$

Dividing both sides by 6, $\frac{6y}{6} < \frac{12}{6}$

$$y < 2$$

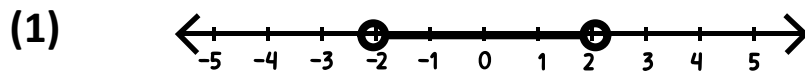
Step#2: Representing the solution in form of interval -

$$y = (-\infty, 2)$$

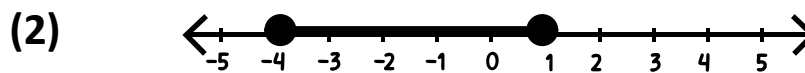


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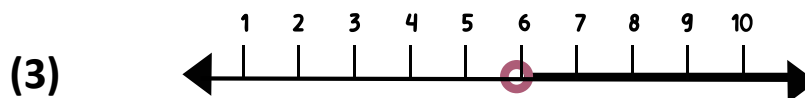
Example: Write the Inequalities that these number lines represents:



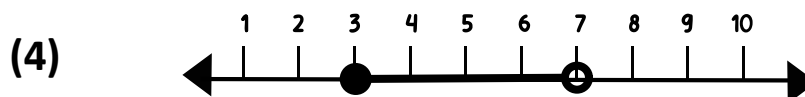
Answer : $(-2, 2)$, Inequality = $-2 < x < 2$



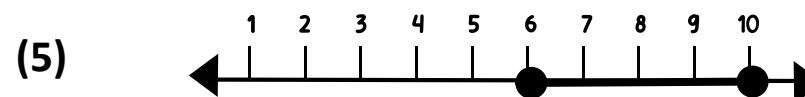
Answer : $[-4, 1]$, Inequality = $-4 \leq x \leq 1$



Answer : $(6, \infty)$, Inequality = $x > 6$



Answer : $[3, 7)$, $3 \leq x < 7$



Answer : $[6, 10]$, $6 \leq x \leq 10$

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Example: Solve the Inequality and represent the answer in interval form as well as on the number line -

$$-5x + 125 > 100$$

Solution:

Step#1: Subtract 125 on both the sides -

$$-5x + 125 - 125 > 100 - 125$$

$$-5x > -25$$

Divide by -5 on both the sides-

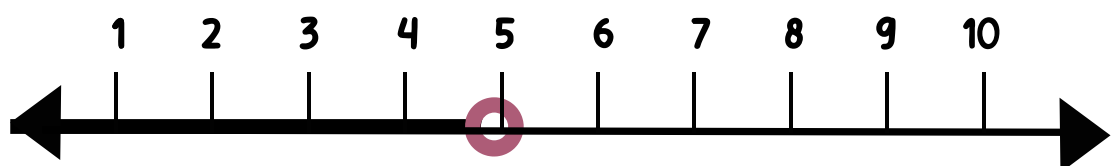
$$\frac{-5x}{-5} > \frac{-25}{-5}$$

$$x < 5$$

(The symbols were changed that is why Inequality symbol is reversed from ' $>$ ' to ' $<$ ')
Interval : $(-\infty, 5)$

Interval : $(-\infty, 5)$

Number Line :



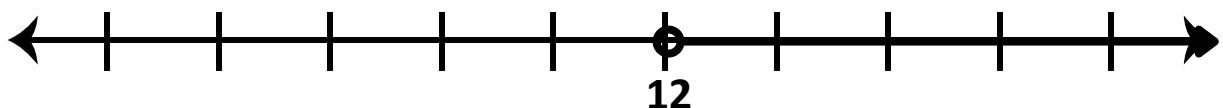
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Example: Draw the number lines to show these Inequalities -

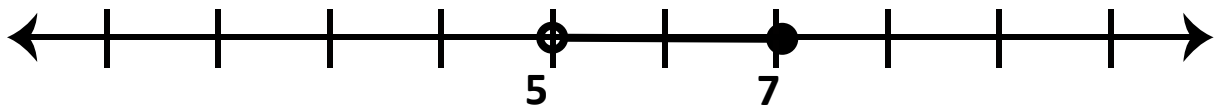
- (1) $x > 12$ (2) $5 < x \leq 7$ (3) $3 < x < 5$
(4) $10 \leq x \leq 13$ (5) $15 \leq x$

Answer:

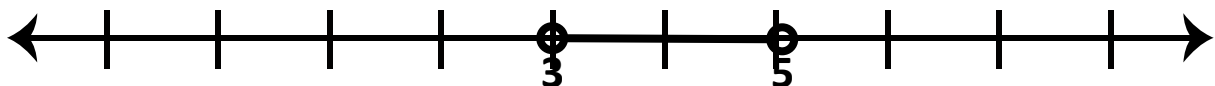
(1) $x > 12$



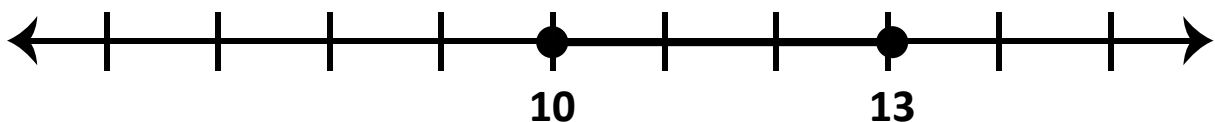
(2) $5 < x \leq 7$



(3) $3 < x < 5$



(4) $10 \leq x \leq 13$



(5) $15 \leq x$

