Reminders: 1) A straight line is a set of infinite number of collinear points in plane.
2) In a given plane through ***two points one and only one*** straight ***line*** can be drawn.

Formula: The equation of a straight line in ***slope intercept*** form is:

$$y = ax + b$$

Where, ***a*** is the ***slope*** or slant (director coefficient) of a straight line and, ***b*** is the ***y- intercept***.

- Application:

  Does the equation $2y - 3x = 11$ represent an equation of a straight line? Justify and precise slope and y-intercept if possible

  Soln:

$$2y - 3x = 11$$
$$2y = 3x + 11$$
$$y = \frac{3x}{2} + \frac{11}{2}$$

  Yes, since it it is of the form $y = ax + b$, where $a = \frac{3}{2}$ and $b = \frac{11}{2}$

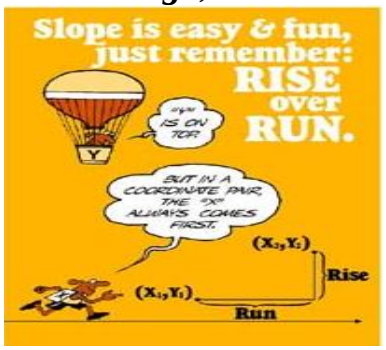
Ex1: Indicate which of the following expressions, represent equation (s) of a straight line in plane, then precise its slope and ordinate of origin?

1. $y - 3x = 7$	2. $y = \frac{2}{x} + 1$	3. $y = 5x^2 - 3$	4. $y = 5x$
5. $y = \frac{2x-5}{3}$	6. $2y = x - 6$	7. $y - 4 = \frac{2x}{3}$	8. $\frac{2y-3}{x+1} = \frac{2y+1}{x-5}$

- ***What is the slope (a)?***

Slope: is the ratio that describes the steepness of a line.

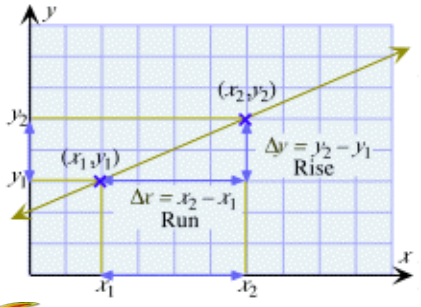
For any straight line in a plane, slope compares the ***vertical change***, called the ***rise***, to the ***horizontal change***, called the ***run***.



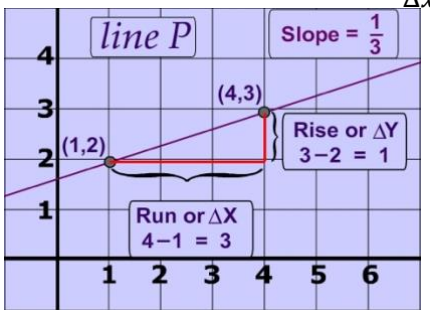
$$a = \frac{rise}{run}$$

How to calculate a slope?

To find the slope compute the *y*-change Δy, and the *x*-change Δx , then form the ratio $\frac{\Delta y}{\Delta x}$



$$a = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$



WATCH OUT! Always use the same order in the numerator and denominator!

Application: Determine the slope of the line passing through points: $A(3,5)$ & $B(-2;1)$

Soln: $a = \frac{y_B - y_A}{x_B - x_A} = \frac{1-5}{-2-3} = \frac{4}{5}$

Ex$_2$: Consider in an orthonormal system of axes $(x'Ox$ & $y'Oy)$, the points

$A(-3,4)$ & $B(2;5)$	$E(-1,4)$ & $F(-5;2)$	$D(2,3)$ & $C(1;3)$	$R(-2,5)$ & $N(-2;1)$
$J(5;-3)$& $L(-1;2)$	$S(0;2)$& $K(-3;0)$	$G(5;-1)$ & $H(1;-1)$	$Q(4;1)$& $P(4;-5)$

1- Determine the ***slope*** of lines passing the through each pair of the above points.

2- What can you say about the coordinates of the points: $\begin{cases} a)\ (D\ \&C)\ and\ \ (G\ \&H)\ ? \\ b)\ (Q\ \&P)\ and\ \ (R\ \&N)? \end{cases}$

3- What are the relative positions of lines: $\begin{cases} (a)\ (DC)\ and\ (GH) \text{ with respect to } x-axis? \\ (b)\ (QP)\ and\ (RN) \text{ with respect to } y-axis? \end{cases}$

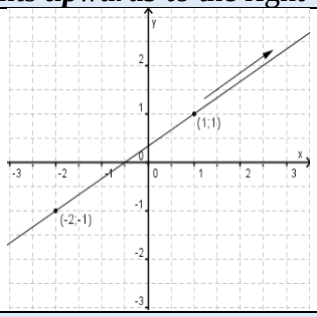
4- What do you conclude?

5- Are either of the lines $(AB)\ or\ (SK)$ parallel to one of the coordinate axes?

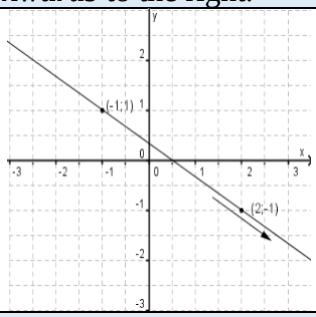
Direction of a straight line: The direction of a straight line depends on its slope

1	If slope is strictly positive $(a > 0)$, then the line slants ***upwards*** to the right	2	If slope is strictly negative $(a < 0)$, then the line slants ***downwards*** to the right.

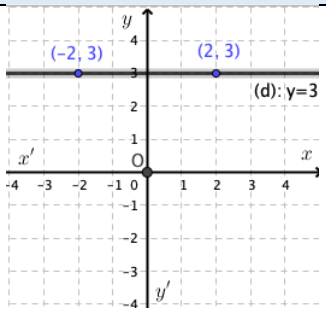
(UP-Slope)

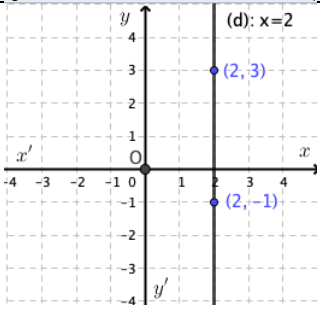


(Down-Slope)



3	If slope is zero $(a = 0)$, then the line is ***parallel*** to *x*-axis and of the form (*y = cst*).	4	If slope does not exist $(a \to \infty)$, then the line is ***parallel*** to *y*-axis and of the form (*x = cst*).



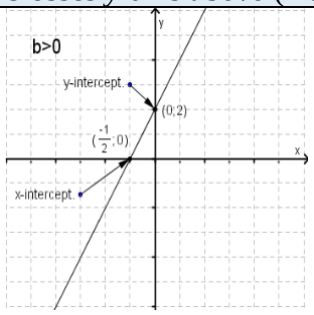


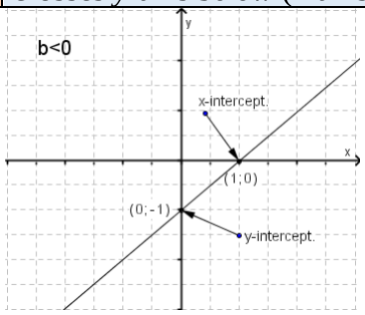
Ex3: Determine the slope of each of the following lines.

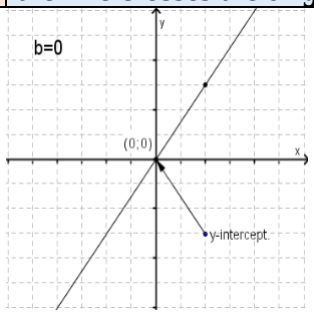
1) $y - 2x = 1$
2) $3y - x = \sqrt{7}x$
3) $2y - 3x = -3$
4) $y - 3x = \sqrt{2}x + 1$
5) $-3x = +1$
6) $y = \sqrt{5} + 1 - 3y$

The y-intercept, b: b, is the value at which the line ***crosses*** the $y-axis$:

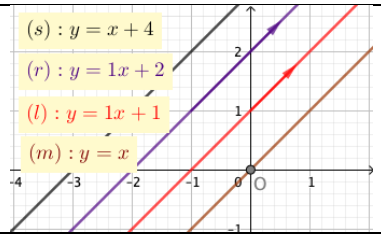
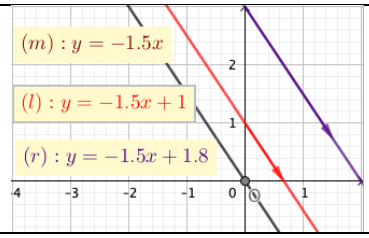
1	If ***b***, is ***positive***, then the line crosses y-axis ***above*** (x-axis).	2	If ***b***, is ***negative***, then line crosses y-axis ***below*** (x-axis).	3	If ***b***, is equal to ***zero***, then the line crosses the ***origin***

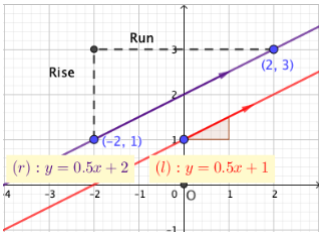
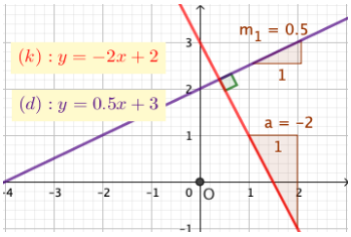






Relative positions of two straight lines in a plane:

Graphical representation		
What is the relative positions of given lines?		
Compare their slopes		
What do you conclude?		

Two lines a plane can be		
	Parallel	Perpendicular
In words	If lines have equal slopes	If the product of their slopes is -1
In symbols	$a_1 = a_2$	$a_1 \times a_2 = -1$
Graphically		

Ex4: Determine the relative positions of the following straight lines:

1) $(d): 2y - 3x = 12$ & $(\Delta): y^2 - 3x + 1 = (y-1)^2$
2) $(l): \left(\sqrt{y-3}\right)^2 = 3x + 1$ & $(m): 3y + x = 6$
3) $(r): y = 2x - 1$ & $(s): y = -2x + 3$

Ex5: Find the values of a & b so that the lines:

1) $(d_1): y = 2ax + 1$ & $(d_2): y - 4ax = 3x - 5$, are parallel.
2) $(l_1): y - bx = 3$ & $(l_2): y = (b-2)x - 1$, are perpendicular.

Ex6: Find numerical values of m, if st. lines of slopes $a_1 = \frac{m-2}{m-3}$ & $a_2 = m + 1$ are perpendicular.