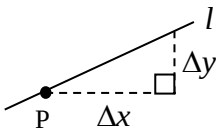
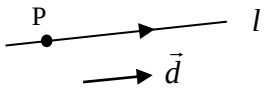
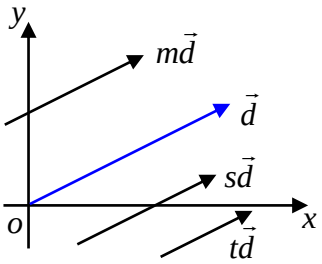
Vector and Parametric Equations of a line in Plane (2D)

How can a line be formed?		
a) 2 points are given	b) 1 point + slope m	c) 1 point + its direction $\vec{d}$
		

Direction vector $\vec{d}$

- It is a non-zero vector issued from the origin.
- It represents the direction of a line.
- A line may have infinite number of direction vectors namely $t\vec{d}, s\vec{d}, m\vec{d}$, etc.
- Direction vectors can be written both ways: $\overrightarrow{AB}$ or $\overrightarrow{BA}$.



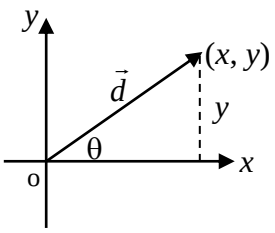
Forming a direction vector

- Any two points can form a direction vector. (See Example 1)
- Direction vector can be reduced to lowest terms. i.e. $\vec{d} = (2,4)$ can be reduced to $(1,2)$.

Slope and Inclination of Line

$\vec{d} = (x, y)$ $\quad m = \frac{y}{x}$ $\quad \tan\theta = m = \frac{y}{x}$

θ is called inclination of line

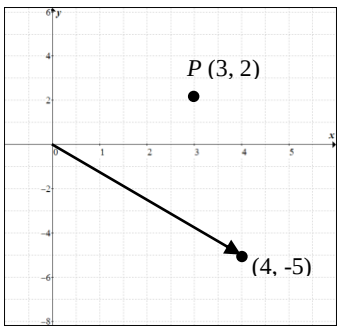


Example 1: Direction Vector

Find the direction vector $\vec{d}$ of the line *AB* where *A* = (4, 5) and *B* = (2, -3).

Example 2: Vector Equation of Line

Develop the vector equation of line with point *P*(3, 2) and direction vector $\vec{d}$ = (4, -5).



To test if a point Q lies on line

1) Substitute the point *Q* into symmetric equation of the line.
2) If L.S.=R.S. $\Rightarrow$ point *Q* lies on the line. If L.S. $\neq$ R.S. $\Rightarrow$ point *Q* dies not lie on the line.

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Example 3: Vector, Parametric and Symmetric Equation of Line

a) Find vector, parametric, and symmetric equations of line passing through the points *A*(3, 4) and *B*(7, -2).
b) Create two more points of the line.
c) Does the point *Q*(2,1) lie on the line?

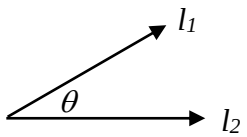
Example 4: Collect information from a line in plane

Identify the point, direction vector, slope and inclination of each line:

a) $(x, y) = (4, -3) + t(-5, 7)$ b) $\begin{aligned} x &= 4 - 2t \\ y &= -6 + t \end{aligned}$ c) $\frac{x+7}{2} = \frac{y-4}{5}$

Properties of Lines in Plane

1) $\ell_1 \parallel \ell_2 \Leftrightarrow \vec{d_1} = \vec{d_2}$
2) $\ell_1 \perp \ell_2 \Leftrightarrow \vec{d_1} \perp \vec{d_2} \Leftrightarrow \vec{d_1} \bullet \vec{d_2} = 0$
3) $\cos\theta = \frac{\vec{d_1} \bullet \vec{d_2}}{\left|\vec{d_1}\right|\left|\vec{d_2}\right|}$ (angle **between *l*₁ & *l*₂)**



Example 5: Determine the Vector equation of line with given information

Find vector equation of l_1 in each case:

a) with point (5, -2) and parallel to l_2: (*x*, *y*) = (3, 1) + *t*(4, 3)

b) with *y* - intercept = 4 and perpendicular to l_2: (*x*, *y*) = (3, -2) + *t*(5, -3).

c) with point (7, 2) and parallel to the *x*-axis.

Homework: P. 434
#1-3,6-7,9,10