break-even (linear system)
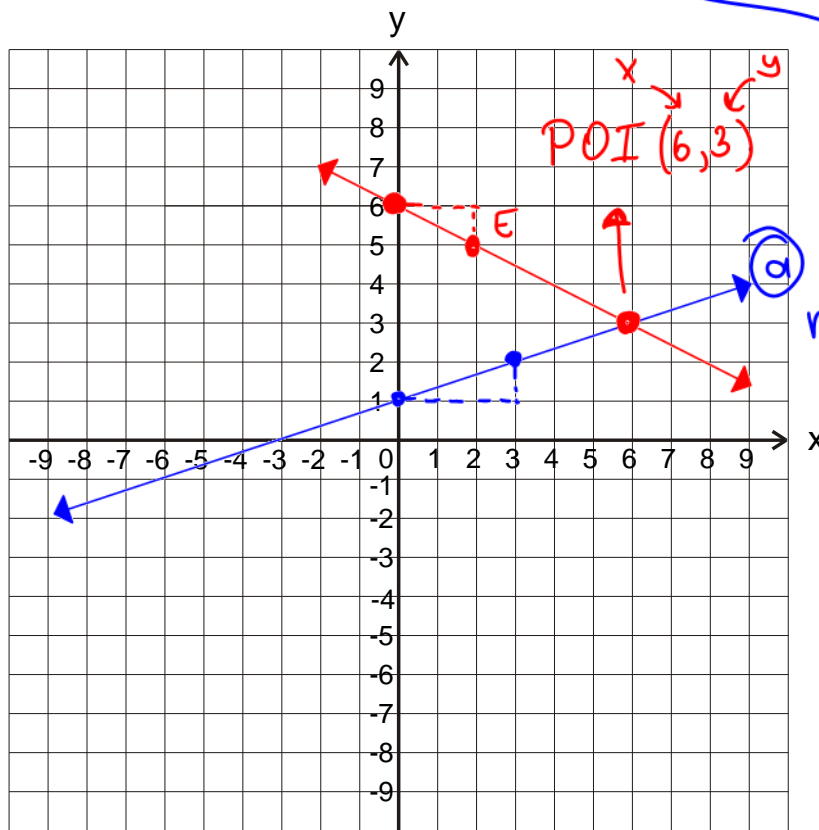
Point of Intersection (POI)

A group of lines studied together is called a **System** of **equations**.

To solve a **system**, we find the **point** of **intersection**.

Plot the two lines on the grid below and solve the system. Label the point of intersection.

(a) (b)
$$y = \frac{1}{3}x + 1 \quad and \quad y = -\frac{1}{2}x + 6$$

$y = \frac{1}{3}x + 1$

$m = \frac{rise}{run} = \frac{1}{3}$

$\boxed{b = 1} \rightarrow y\text{-int}$

POI (6,3)

$y = -\frac{1}{2}x + 6$

$m = \frac{rise}{run} = \frac{-1}{2}$

y-int $b = 6$

POI (6,3)

if $x = 6$
then $y = 3$

Verify your solution using LS=RS.

$y = y$

$\frac{1}{3}x + 1$	$-\frac{1}{2}x + 6$
$\frac{1}{3}(6) + 1$	$-\frac{1}{2}(6) + 6$
$= 2 + 1$	$= -3 + 6$
$= 3$	$= 3$

$LS = RS$

∴ POI is (6,3)

Finding POI Algebraically

→ at POI both equations have the same "x" & "y" values

$y_1 = \frac{1}{3}x + 1$

$y_2 = \frac{-1}{2}x + 6$

Step 1

$y_1 = y_2$

$\frac{1}{3}x + 1 \,^{+\frac{1}{2}x} = \frac{-1}{2}x + 6$

Collect variables on one side, numbers on the other side.

$\frac{1}{3}x + \frac{1}{2}x + 1^{-1} = 6^{-1}$

$\frac{2 \cdot x}{2 \cdot 3} + \frac{3 \cdot x}{3 \cdot 2} = 5$

$\frac{2x}{6} + \frac{3x}{6} = 5$

$\frac{2x + 3x}{6} = 5$

$\frac{5x}{6} \times \frac{5}{1}$ cross multip.

$\frac{5x}{5} = \frac{30}{5}$

$\boxed{x = 6}$

Step 2

sub "6" for "x" in any equation. ①

$y = \frac{1}{3}x + 1$

$= \frac{1}{3}(6) + 1$

$= \frac{6}{3} + 1$

$= 2 + 1$

$\boxed{y = 3}$ ∴ POI is

$(6, 3)$