Review Note: Linear Relations and Linear Systems | MFM2P

Recall: The equation of a line in slope-intercept form is given by: $y = mx + b$

Example: For each line, state the slope and the y-intercept and then graph the lines at the right.

a) $y = \frac{3}{4}x + 2$

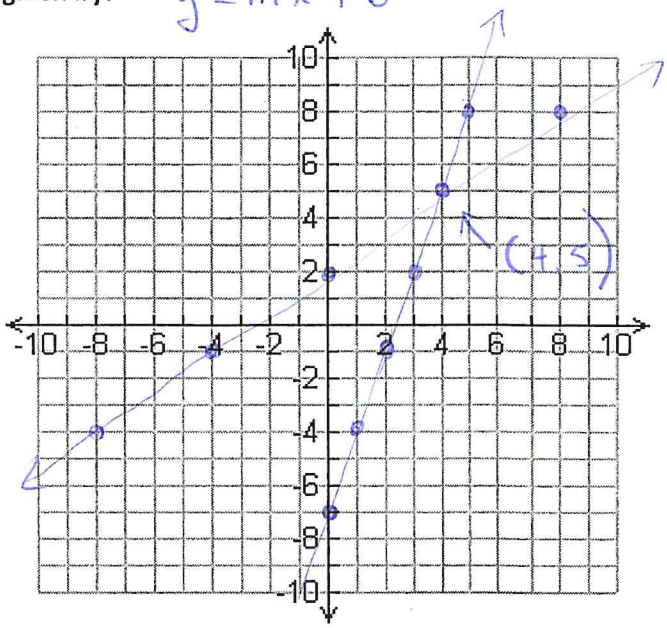
Slope = $3/4$

y-intercept = 2

b) $y = 3x - 7$

Slope = $3/1$

y-intercept = -7



The pair of lines above form a **linear system.** What is the solution or point of intersection of this linear system?

$(4, 5)$

Not every linear system could be solved by graphing. Sometimes our lines wouldn't fit on conventional graphs, and sometimes the lines themselves would be challenging to graph. We needed algebraic methods of solving linear systems.

Method 1: Graphing (we did that above)

Method 2: Using algebra (must have each line in $y = mx + b$ form). Let's solve the linear system above.

Steps	
1) Set the equations equal to each other 2) Solve the equation for "x" 3) Plug your "x" value into one of the original equations to find "y" 4) State the point of intersection	$4\left(\frac{3}{4}x + 2 = 3x - 7\right)$ $3x + 8 = 12x - 28$ $-12x \quad -12x$ $-9x + 8 = -28$ $-8 \quad -8$ $-9x = -36$ $-9 \quad -9$ $\boxed{x = 4}$ Sub in b) $y = 3(4) - 7$ $\boxed{y = 5}$

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Method 3: Elimination

Not all lines were in the form y = mx + b. In these cases we needed another method. There were different levels of difficulty with these elimination problems, sometimes we needed to multiply one or both of the equations to match up variables.

Examples: Solve the following linear systems using elimination.

a) Linear System:

$4x - 3y = 13$ ①
$2x + 3y = 11$ ②

Add the equations (opposites) or Subtract the equations (same sign)?

Do the Addition/Subtraction:

$\frac{6x}{6} = \frac{24}{6}$

$x = 4$

Sub into equation ① or ②

$2(4) + 3y = 11$
$8 + 3y = 11$
$-8 \quad -8$
$\frac{3y}{3} = \frac{3}{3}$
$y = 1$

Solution: (4 , 1)

b) Linear System:

$3x + y = 4$ ①
$5x - 3y = 2$ ②

Match "x's" | Match "y's"

Multiply... ① by 3

New Linear System:
$9x + 3y = 12$
$5x - 3y = 2$

Do the Addition/Subtraction:

$\frac{14x}{14} = \frac{14}{14}$

$x = 1$

Sub into equation ① or ②

$3(1) + y = 4$
$3 + y = 4$
$y = 1$

Solution: (1 , 1)

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c) Linear System:

$5x + 2y = 9$ ①
$2x + 9y = 20$ ②

Match "x's" | Match "y's"

Multiply...
① by 2
② by 5

New Linear System:

$10x + 4y = 18$
$10x + 45y = 100$

Do the Addition/Subtraction:

$\frac{-41y}{-41} = \frac{-82}{-41}$

$y = 2$

Sub into equation ① or ②

$5x + 2(2) = 9$

$5x + 4 = 9$
$-4 \quad -4$

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

$x = 1$

Solution: (1 , 2)

You try this one:

Linear System:

$4x - 3y = 14$ ①
$2x + 9y = 28$ ②

Match "x's" | Match "y's"

Multiply...
② by 2

New Linear System:

$4x - 3y = 14$
$4x + 18y = 56$

Do the Addition/Subtraction:

$\frac{-21y}{-21} = \frac{-42}{-21}$

$y = 2$

Sub into equation ① or ②

$2x + 9(2) = 28$

$2x + 18 = 28$
$-18 \quad -18$

$\frac{2x}{2} = \frac{10}{2}$

$x = 5$

Solution: (5 , 2)