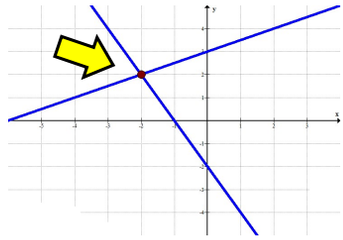
2.3 Solving Systems by Substitution

Recall: Solving a system of equations means...

Finding the point of intersection of the lines.

It is the only point where both lines have the same x-value and y-value.



Drawbacks of solving by graphing...

- not always accurate
- time consuming

What's so great about solving algebraically?

- gives exact values
- less time / less space

Ex. 1 How would you solve

① $x = 5$

② $3x - 4y = 3$

Sub ① into ②

$3(5) - 4y = 3$

$15 - 4y = 3$

$-4y = 3 - 15$

$-4y = -12$

$y = 3$

∴ Intersection at $(5, 3)$

Ex. 2 Rogers charges $35/month plus $10 for every extra Gb. Bell charges $40/month plus $8 for every extra Gb. When are they the same monthly price? Solve without graphing.

Let x be the # of extra Gb (gigabytes)

Rogers $C = 35 + 10x$ ①

Bell $C = 40 + 8x$ ②

Sub ① into ②

$35 + 10x = 40 + 8x$

$10x - 8x = 40 - 35$

$2x = 5$

$x = \frac{5}{2}$

∴ They are the same price @ $\frac{5}{2}$ or 2.5 gb

THE SUBSTITUTION METHOD:

1. **Isolate** a variable in one equation (pick the best one)
2. **Substitute** to create an equation with only one variable.
3. **Solve** the equation.
4. ***Substitute*** the solved variable into the equation from #1 to determine the value of the other variable.
5. **Write** a conclusion.
6. (**Check**) - formal if asked, otherwise complete a mental check.

Ex. 3 Solve using the substitution method.

a) $x + 3y = -4$ ①
$2x - 3y = 1$ ②

From ①
$x + 3y = -4$
$x = -4 - 3y$

Sub ① into ②
$2(-4-3y) - 3y = 1$
$-8 - 6y - 3y = 1$
$-8 - 9y = 1$
$-9y = 9$
$y = -1$

Sub $y = -1$ into ①
$x = -4 - 3(-1)$
$= -4 + 3$
$= -1$

$\therefore (-1, -1)$

b) $5a + 3b = 10$ ①
$2a - b = 4$ ②

From ②
$2a - b = 4$
$2a - 4 = b$
$b = 2a - 4$

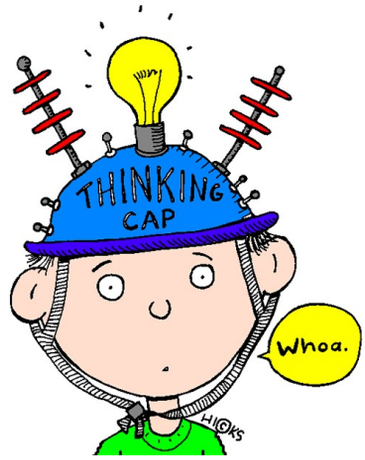
Sub ② into ①
$5a + 3(2a - 4) = 10$
$5a + 6a - 12 = 10$
$11a = 22$
$a = 2$

Sub $a = 2$ into ②
$b = 2(2) - 4$
$b = 0$

$\therefore$ Solution is $a = 2$
$b = 0$

$(a, b) \Rightarrow (2, 0)$

SPECIAL CASES



A. $x + y = 8$ ①

$3x + 3y = -5$ ②

From ①

$x = 8 - y$

Sub into ②

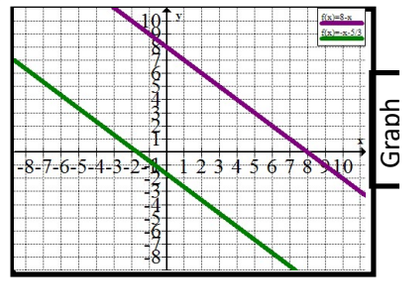
$3(8-y) + 3y = -5$

$24 - 3y + 3y = -5$

$0y = -29$???

∴ NO SOLUTION

(Lines are parallel)



B.

① $p - 2q = -3$

② $4q = 2p + 6$

From ①

$p = -3 + 2q$

Sub into ②

$4q = 2(-3+2q) + 6$

$4q = -6 + 4q + 6$

$0q = 0$???

∴ Infinite Solutions

(same line)

Graph

Working with fractions...
pg. 26 #4a)

$$x + 2y = 3 \quad (1)$$
$$5x + 4y = 8 \quad (2)$$

Challenge!

Answer $\left(\frac{2}{3}, \frac{7}{6}\right)$

Challenge:

The following three lines all intersect at one point. List the steps you would follow to determine the coordinates of the point of intersection and the value of *k*.

$$2x + 3y = 7$$
$$x + 4y = 16$$
$$4x - ky = 9$$

Homework:

Set 1: p.26 #1ab,2d,4bd,5ac,12

Set 2: p.26 #5de,12,17a,19,20b