19. a) ① $\frac{1}{2}x + \frac{2}{3}y = 1$ $\times 6$ ② $\frac{1}{4}x - \frac{1}{3}y = \frac{5}{2}$

$3x + 4y = 6$ $-4y$

$\frac{3x}{3} = \frac{6}{3} - \frac{4y}{3}$

$x = \boxed{2 - \frac{4}{3}y}$

$\frac{1}{4}\left(2 - \frac{4}{3}y\right) - \frac{1}{3}y = \frac{5}{2}$

$\frac{2}{4}^{\times 12} - \frac{4}{12}^{\times 12}y - \frac{1}{3}^{\times 12}y = \frac{5}{2}^{\times 12}$

$6 - 4y - 4y = 30$ -6

$\frac{-8y}{-8} = \frac{24}{-8}$

$\boxed{y = -3}$

sub back here

$x = 2 - \frac{4}{3}(-3)$

$x = 2 + \frac{12}{3}$

$x = 2 + 4$

$\boxed{x = 6}$

Substitution: good when a coefficient is ONE

ex ① $2x + y = -13$

② $3x - 2y = -1$

① $y = -2x - 13$

sub ① into ②: $3x - 2(-2x - 13) = -1$

$3x + 4x + 26 = -1$ -26

$\frac{7x}{7} = \frac{-27}{7}$

$\boxed{x = -\frac{27}{7}}$

Sub back into ① or ② and get y

7.5 Solving Systems by Elimination

* Important: This method is most useful when the coefficient of one of the variables in both equations is the same.

ex. Solve the following system algebraically:

$$\begin{cases} 4x - 2y = 10 & ① \\ 5x + 2y = 26 & ② \end{cases} \quad +$$

$$\frac{9x}{9} + \cancel{0y} = \frac{36}{9} \Rightarrow \boxed{x=4}$$

② $5(4) + 2y = 26 \quad -20$

$$\frac{2y}{2} = \frac{6}{2}$$

$$\boxed{y=3}$$

Step 1: * make sure the similar variables are alligned
* add or subtract the equ^{ns} to eliminate one variable

Step 2: sub x back into either ① or ② and solve for y

* Note: If none of the coefficients are the same, this method still works but we need to multiply one, or both, equations by a value that will allow this method to work. If we graph

3x + y = -6 and 6x + 2y = -12 we notice they are the same.

$\times 2$

ex. Solve the following system algebraically:

$$\begin{cases} 4x - 2y = 2 & ① \\ 3x + y = -6 & + ② \times 2 \end{cases}$$

$$4x - 2y = 2$$
$$+ \quad 6x + 2y = -12$$
$$\frac{10x}{10} = \frac{-10}{10} \Rightarrow \boxed{x=-1}$$

sub x=-1 back into ②

$$3(-1) + y = -6 \quad +3$$
$$-3 + y = -6$$
$$\boxed{y=-3}$$

Step 1: choose a variable to eliminate then multiply one or both equ^{ns} so that the coefficients of that variable are the same.

Step 2: add or subtract as necessary

Step 3: Sub variable back into ① or ②

ex. Solve the following system algebraically:

$$\begin{cases} \frac{3}{2}x - \frac{1}{2}y = 4 & ① \times 2 \\ \frac{1}{2}x + \frac{1}{4}y = \frac{5}{2} & ② \times 4 \end{cases}$$

① $3x - y = 8$

$+$ ② $2x + y = 10$

$\frac{5x}{5} = \frac{18}{5} \Rightarrow \boxed{x = \frac{18}{5}}$

Sub $x = \frac{18}{5}$ into ①

$3\left(\frac{18}{5}\right) - y = 8$

$\frac{54}{5} - y = 8 \times 5$

$\frac{54}{5} - y = \frac{40}{5}$ $\quad -\frac{54}{5}$

$+y = +\frac{14}{5}$

$\boxed{y = \frac{14}{5}}$

Step 1: remove all fractions first → then decide which variable to eliminate

Step 2: solve

Step 3: Sub back into ① or ②

ex. Solve the following system algebraically:

$$\begin{cases} 3x - 4y = 7 & ① \times 5 \\ 5x - 6y = 8 & ② \times 3 \end{cases}$$

$15x - 20y = 35$

$\ominus\ 15x - 18y = 24$

$0\ \frac{-2y}{-2} = \frac{11}{-2} \Rightarrow \boxed{y = -\frac{11}{2}}$

sub back into ① or ② and get x

Step 1:

Step 2:

Step 3:

ex. Lilly sold 5 bouquets of tulips and 2 bouquets of roses for \$80. Kate sold 1 bouquet of tulips and 4 bouquets of roses for \$70. Write a system of equations that models this situation and solve it using elimination.

let x = cost of tulips y = cost of roses

Lilly: $5x + 2y = 80$ ①

Kate: $x + 4y = 70$ ②

$2 \times ① - ②$ or $① - 5 \times ②$

$10x + 4y = 160$

$\ominus\ x + 4y = 70$

$\frac{9x}{9} = \frac{90}{9}$

$\boxed{x = 10}$

sub into ① or ② get y

① $5x + 2y = 80$

$\ominus\ 5x + 20y = 350$

$\frac{-18y}{-18} = \frac{-270}{-18}$

$\boxed{y = 15}$

or x

Homefun: Pg. 437 # (3, 4, 6)ac, 8, 10, 12ac, 14, 16, 22

Test wednesday