

# M10 - 9.1 - Substitution Notes

## Solve by Substitution

①  $y = (x + 1)$

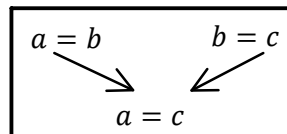
②  $y = (-2x + 4)$

Identify equation # 1

Identify equation # 2

$$\begin{array}{r} y = y \\ x + 1 = -2x + 4 \\ -1 \quad -1 \\ x = -2x + 3 \\ +2x \quad +2x \\ 3x \quad 3 \\ \frac{3x}{3} = \frac{3}{3} \end{array}$$

Make them equal to each other. Do it!



$x = 1$

Solve

①  $y = x + 1$   
 $y = (1) + 1$

Substitute

$y = 2$

Solve

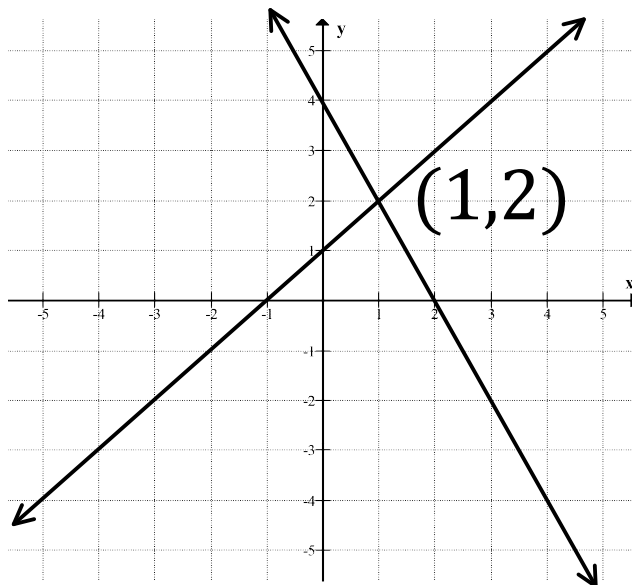
$(1, 2)$

Intersection point

## Solve by Graphing

$y = -2x + 4$

$y = x + 1$



# M10 - 9.2 - Don't/Need to Isolate Substitution Notes

## Substitution - Don't Need to Isolate

(1)  $x = (3 - y)$       (2)  $2y - 2x = 10$

Identify equation # 1  
 Identify equation # 2

Put Brackets around what  $x =$  in eq. #1  
 Put Brackets around  $x$  in eq. #2

(2)  $2y - 2(x) = 10$   
 $2y - 2(3 - y) = 10$   
 $2y - 6 + 2y = 10$   
 $4y - 6 = 10$   
 $\quad +6 \quad +6$   
 $4y = 16$

Substitute  
 Distribute  
 Combine Like Terms  
 Solve

(1)  $x = 3 - y$   
 $x = 3 - (4)$       (2)  $y = 4$

Substitute  
 Solve

(1)  $x = -1$   
 (2)  $(-1, 4)$

Intersection point

If a variable is already isolated go ahead and substitute what that variable equals into the other equation.

## Substitution - Need to Isolate

(1)  $x + y = 11$       (2)  $2x - 2y = 6$

Identify equation # 1  
 Identify equation # 2

Put Brackets around what  $y =$  in eq. #1  
 Put Brackets around  $y$  in eq. #2

(1)  $x + y = 11$   
 $-x \quad -x$   
 $y = (11 - x)$

Isolate

(2)  $2x - 2(y) = 6$   
 $2x - 2(11 - x) = 6$   
 $2x - 22 + 2x = 6$   
 $4x - 22 = 6$   
 $\quad +22 \quad +22$   
 $4x = 28$   
 $\frac{4x}{4} = \frac{28}{4}$

Substitute

(1)  $y = 11 - x$   
 $y = 11 - 7$       (2)  $x = 7$

Solve  
 Substitute  
 Solve

(1)  $y = 4$   
 (2)  $(4, 7)$

Intersection point:

# M10 - 9.3 - Elimination Notes

## Solving a system of equations using elimination

①  $2y = x - 2$

②  $y = x - 3$

Identify equation # 1  
Identify equation # 2

$$\begin{array}{r} 2y = x - 2 \\ -(y = x - 3) \\ \hline y = 0 + 1 \end{array}$$

$-2 - (-3) = 1$

$y = 1$

Subtract equations to eliminate  $x$   
Solve  
Substitute  
Solve  
Intersection point:

Put brackets around what you're subtracting

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

$x = 4$

$(4,1)$

①  $y + x = 6$

②  $y - x = 4$

Identify equation # 1  
Identify equation # 2

$$\begin{array}{r} y + x = 6 \\ +(y - x = 4) \\ \hline 2y + 0x = 10 \end{array}$$

Add equations to eliminate  $x$

You could have subtracted equations to eliminate  $y$

$$\begin{array}{r} 2y = 10 \\ 2y = 10 \\ \hline \frac{2y}{2} = \frac{10}{2} \end{array}$$

$y = 5$

Solve

①  $y + x = 6$   
 $(5) + x = 6$   
 $-5 \quad -5$

Substitute

$x = 1$

Solve

$(1,5)$

Intersection point:

# M10 - 9.4 - Line Up Elimination Notes

## Solving a system of equations using elimination

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

$$\textcircled{2} \quad y + 4x = 0$$

Identify equation # 1

Identify equation # 2

$$\begin{array}{r} y = -6x + 2 \\ +6x + 6x \\ y + 6x = 2 \end{array} \quad \text{Algebra}$$

$y + x = \#$	For
$y + x = \#$	Example

$$\textcircled{1} \quad y + 6x = 2$$

$$\textcircled{2} \quad y + 4x = 0$$

Line up equations

Subtract equations to eliminate y

Solve

Substitute

Solve

Intersection point:

$$\begin{array}{r} (y + 6x = 2) \\ -(y + 4x = 0) \\ \hline 0y + 2x = 2 \end{array}$$

$$2x = 2$$

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

$$\textcircled{x = 1}$$

$$\textcircled{1} \quad \begin{array}{l} y = -6x + 2 \\ y = -6(1) + 2 \end{array}$$

$$\textcircled{y = -4}$$

$$\textcircled{(1, -4)}$$

# M10 - 9.5 - Multiply/Fraction/Decimal Elimination Notes

## Solving a system of equations using elimination

①  $2x - 3y = 2$

②  $x + 2y = 8$

Identify equation # 1

Identify equation # 2

$$\begin{array}{r} 2x - 3y = 2 \\ -(2x + 4y = 16) \\ \hline 0x - 7y = -14 \end{array}$$

$$-\frac{7y}{-7} = -\frac{14}{-7}$$

$y = 2$

②  $2(x + 2y = 8)$   
 $2x + 4y = 16$

Multiply equation #2 by 2

Line up equations

Subtract equations to eliminate x

②  $x + 2y = 8$   
 $x + 2(2) = 8$   
 $x + 4 = 8$

Solve

Substitute

$x = 4$

Solve

$(4, 2)$

Intersection point:

## Solving a system of equations using elimination

①  $3y + x = 4$

②  $0.5y + \frac{x}{3} = 3$   
 $\frac{1}{2}y + \frac{x}{3} = 3$

Identify equation # 1

Identify equation # 2

Get Rid of Decimals

$$\begin{array}{r} 3y + x = 4 \\ -(3y + 2x = 18) \\ \hline -x = -14 \\ x = 14 \end{array}$$

②  $(\frac{y}{2} + \frac{x}{3} = 3) \times 6$   
 $3y + 2x = 18$

Multiply equation #2 by 6 (LCD)

To get rid of denominator

Subtract equations to eliminate x

Solve

②  $3y + 2x = 18$   
 $3y + 2(14) = 18$   
 $3y + 28 = 18$   
 $3y = 18 - 28$   
 $3y = -10$   
 $\frac{3y}{3} = -\frac{10}{3}$

Substitute

$y = -\frac{10}{3}$

Solve

$(14, -\frac{10}{3})$

Intersection point:

# M10 - 9.6 - Let Statement/Value of Notes

A person has 24 quarters and dimes.

let  $q = \# \text{ of quarters}$   
let  $d = \# \text{ of Dimes}$

Let Statements

$$q + d = 24$$

Equation

A person has some Toonies. How much do they have in Toonies?

let  $t = \# \text{ toonies}$

Round the bottom of your t!

$t$	Value \$	Calculation
0	0	$0 \times 2 = 0$
1	2	$1 \times 2 = 2$
2	4	$2 \times 2 = 4$
$t$	$2t$	$t \times 2 = 2t$

# of  $\times$  Value

$$2t$$

## Value of a Toonie $\times$ # Toonies

A person has the \$2.30 in Dimes, How many Dimes do they have?

let  $d = \# \text{ of Dimes}$

$d$	Value \$	Calculation
0	0	$0 \times 0.1 = 0$
1	0.1	$1 \times 0.1 = 0.1$
2	0.2	$2 \times 0.1 = 0.2$
$d$	$0.1d$	$d \times 0.1 = 0.1d$

$$0.1d$$

$$0.1d = 2.30$$

$$\frac{0.1d}{0.1} = \frac{2.30}{0.1}$$

$$d = 23$$

They have 23 Dimes

$$0.1 \times 23 = 2.30$$

Check Answer

An airplane is flying at a height of 400 m and descending at 5 m/s.

let  $h = \text{height (m)}$   
let  $t = \text{time (s)}$

$$h = 400 - 5t$$

Jane's hair is 30 cm long and grows at 2 cm per month.

let  $h = \text{hair length (cm)}$   
let  $t = \text{time (months)}$

$$h = 20 + 2m$$

# M10 - 9.6 - $Ax + By = C$ Coins/Mixture Notes

Jay has 12 Total Coins of Quarters and Dimes worth \$2.40. How many does he have of each?

Let  $d = \# \text{ dimes}$   
Let  $q = \# \text{ quarters}$

$$d + q = 12$$

$$0.1d + 0.25q = 2.40$$

2 equations

$$-q \quad -q$$

$$d = 12 - q$$

Isolate

$$0.1(d) + 0.25q = 2.40$$

Substitute

$$0.1(12 - q) + 0.25q = 2.40$$

Distribute

$$1.2 - 0.1q + 0.25q = 2.40$$

Combine Like Terms

$$1.2 + 0.15q = 2.40$$

Subtract Both Sides

$$-1.2 \quad -1.2$$

$$\frac{0.15q}{0.15} = \frac{1.20}{0.15}$$

Divide Both Sides

$$d = 12 - q$$

$$d = 12 - (8)$$

$$q = 8$$

Solve

Substitute

$$d = 4$$

Solve

$$4 + 8 = 12 \quad \checkmark$$

$$0.1 \times 4 + 0.25 \times 8 = 2.40 \quad \checkmark$$

Check your answer

*Jay has 4 dimes and 8 quarters worth \$2.40.*

Answer the question

As scientist wants to make 50 L of a 40% acid solution. They mixed together a 30% acid solution with the 70% acid solution. How many litres of each solution must the scientist mix?

let  $a = \text{litres of 30\% mix}$   
let  $b = \text{litres of 70\% mix}$

$$\% \times \text{Amount} + \% \times \text{Amount} = \% \times \text{Amount}$$

$$a + b = 50$$

$$b = 50 - a$$

$$0.3a + 0.7b = 0.4(50)$$

$$0.3a + 0.7(50 - b) = 20$$

...

$$b = 12.5$$

...

$$a = 37.5$$

12.5 L of 70% Mix

37.5 L of 30% Mix

# M10 - 9.6 - $y = mx + b$ Cell Phone Word Problems Notes

Create Let Statements, an equation, and solve the equation.

A cell phone company Data Costs \$40 per month plus \$0.1 per Megabyte of Data.

Let  $c = \text{cost}$

$$c = 40 + 0.1d$$

Let  $d = \# \text{ megabytes of data}$

If a person uses 480 megabytes of Data what will month bill cost?

$$d = 480$$

If a person's bill is \$52.60, How many Megabytes did the use?

$$c = 52.60$$

$$c = 40 + 0.1d$$

Formula

$$c = 40 + 0.1d$$

Formula

$$c = 40 + 0.1(480)$$

$$c = 40 + 4.8$$

Substitute

$$52.60 = 40 + 0.1d$$

Substitute

$$\begin{array}{r} -40 \quad -40 \\ 12.60 \quad 0.1d \\ \hline 0.1 = 0.1 \\ 126 = d \end{array}$$

$$c = \$44.80$$

Solve

$$d = 126$$

Solve

480 megabytes of Data will cost \$44.80

\$52.60 will buy 126 megabytes of data

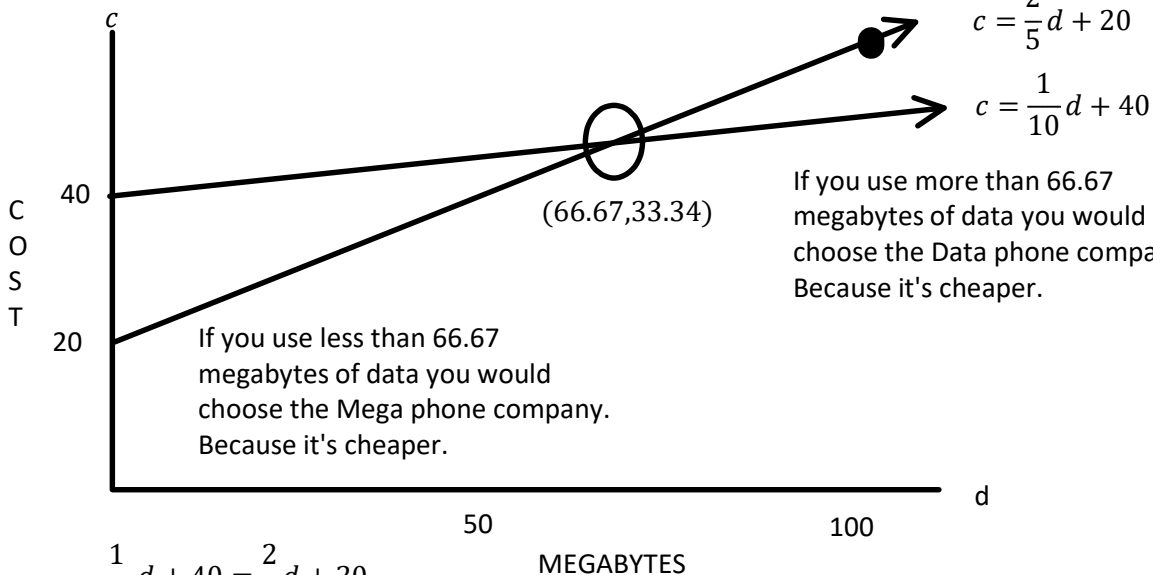
Mega Cell Phone Company charges \$30 per month plus \$0.2 per megabyte of data. Which company would you choose?

Let  $c = \text{cost}$

$$c = 20 + 0.4d$$

Let  $d = \# \text{ megabytes of data}$

$$y = mx + b$$



$$\begin{aligned} \frac{1}{10}d + 40 &= \frac{2}{5}d + 20 \\ \left(\frac{1}{10}d + 40 = \frac{2}{5}d + 20\right) \times 10 & \\ d + 400 &= 4d + 200 \\ \frac{200d}{3} &= \frac{3d}{3} \end{aligned}$$

$$d = 66.67$$

$$c = \frac{1}{5}d + 20$$

$$c = \frac{1}{5}(66.67) + 20$$

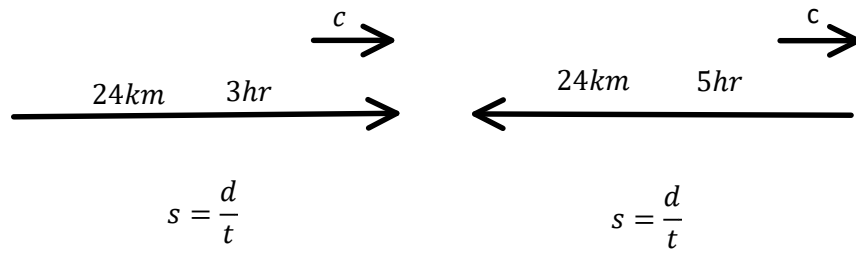
$$c = 33.34$$



# M10 - 9.6 - $s = \frac{d}{t}$ Boat/Wind Word Problems Notes

A boat took 3 hours to travel 24 km with the current. On the return trip, the boat took 5 hours to travel 24 km against the current. Determine the speed of the current.

$x = \text{speed of boat}$   
 $c = \text{speed of current}$



<p style="font-size: 2em; font-weight: bold;">①</p> $x + c = \frac{24}{3}$ $x + c = 8$ $x = 8 - c$	<p style="font-size: 2em; font-weight: bold;">→</p>	<p style="font-size: 2em; font-weight: bold;">②</p> $(x) - c = \frac{24}{5}$ $(8 - c) - c = \frac{24}{5}$ $8 - 2c = 4.8$ $+2c \quad +2c$ $8 = 4.8 + 2c$ $-4.8 \quad -4.8$ $\frac{3.2}{2} = \frac{2c}{2}$		<p style="font-size: 2em; font-weight: bold;">←</p>	<p style="font-size: 2em; font-weight: bold;">③</p>
<p style="font-size: 2em; font-weight: bold;">⑤</p> $x = 8 - c$ $x = 8 - 1.6$ $x = 6.4$		<p style="font-size: 2em; font-weight: bold;">④</p>			

$x = \text{speed of boat} = 6.4 \frac{km}{h}$

$c = \text{speed of current} = 1.6 \frac{km}{h}$