

Solving Equations: 1.1, 1.2 Today. GOAL:

Linear:  $5x + 1 = 17$

$$\underline{-1 \quad -1}$$

$$5x = \frac{16}{5}$$

$$x = \frac{16}{5}$$

Solve for x / Isolate x

Now check:

$$5\left(\frac{16}{5}\right) + 1 = 16 + 1 = 17.$$

LINEAR TYPE:

$$\frac{3}{3x} + \frac{2}{3x} = 4$$

CROSS  
MULTIPLY

$$\frac{3}{3x} + \frac{2}{3x} = \frac{5}{3x} = \frac{4}{1}$$

gives

$$\begin{array}{r} 3x \cdot 4 = 5 \cdot 1 \\ \hline 12x = 5 \end{array}$$

$$x = 5/12$$

check:

$$\frac{1}{(5/12)} + \frac{2}{3(5/12)} = \frac{15}{12}$$

$$\frac{3}{1} \cdot \frac{12}{5} + \frac{2}{1} \cdot \frac{12}{15} = \frac{36}{15} + \frac{24}{15} = \frac{60}{15} = 4$$

Next, we use linear equations to model real-world questions.

Ex

One number is 3 times another number. The sum of the numbers is 54. What are the two numbers?

$$n = 3x$$

$$n + x = 54$$

↑

$$3x + x = 54$$

$$4x = 54$$

$$x = 13.5$$

$$\Rightarrow n = 3(13.5) = 40.5$$

$$40.5 + 13.5 = \boxed{54}$$

Practice:

(1) Solve & Check

$$\begin{array}{r} 5x + 7 = 3 \\ -7 \quad -7 \\ \hline 5x = -4 \\ x = -4/5 \end{array}$$

check:  $5(-4/5) + 7$   
 $= -4 + 7 = 3 \checkmark$

(2)  $\frac{6 \cdot 4}{6 \cdot x} + \frac{5}{6x} = 7$

$$6x \cdot 7 = 29$$

$$x = \frac{29}{42}$$

$$\frac{24}{6x} + \frac{5}{6x} = \frac{29}{6x} = 7 \Rightarrow$$

(3)

n is 2 more than 5 times m. The sum of the two numbers is 62. Find n and m.

$$n = 2 + 5m, \quad n + m = 62$$

$$(2 + 5m) + m = 62$$

$$2 + 6m = 62$$

$$6m = 60$$

$$m = 10$$

$$n = 52. \quad \checkmark$$

# MORE MODELING-

MQT  $\xrightarrow{45 \text{ m/h}}$  AL.

Drive  $\rightarrow 45 \text{ m/h}$ , spend 20 hours in AL. Then drive home @  $40 \text{ m/h}$ . Total trip time is 50 hours.

What is the distance from MQT to our destination?

We'll use  $D = R \cdot T \Rightarrow D/R = T$

Also use: Total Time = Driving Time + Stationary Time.

$$50 = 30 + 20$$

$\downarrow$                        $\downarrow$                        $\downarrow$   
 50                      30                      20  
                                  {we found this}

DRIVING TIME = (MQT  $\rightarrow$  AL TIME) + (Return Time)

$$30 = \frac{40}{40} \frac{D}{45} + \frac{45}{45} \frac{D}{40}$$

solve this for D.

time it took to get to AL.

$$30 = \frac{40D + 45D}{(40)(45)} = \frac{85D}{(40)(45)}$$

$$\frac{(30)(40)(45)}{85} = D = 638$$

Rectangular Garden Fence:

I've got 160 feet of fence. Make a garden, using all the fencing so that



pretty rectangle has "golden ratio sides"

$$\frac{l}{w} = \frac{5}{3}$$

(postcards)

$$\frac{5x}{3x} = \frac{5}{3}$$

$$2(3x) + 2(5x) = 160$$

(Perimeter)

$$6x + 10x = 16x = 160$$

$$x = 10$$

$$\Rightarrow \begin{array}{l} \text{length} = 50 \\ \text{width} = 30 \end{array}$$

Find the width of the rectangle if.



Area is 100 square feet.

||  
l, w  
||

$$(1.8w)w = 100$$

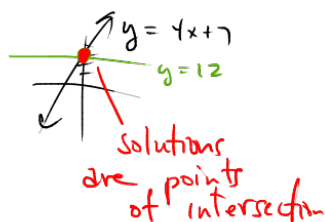
$$\leftarrow \frac{1.8w^2}{1.8} = \frac{100}{1.8}$$

$$\sqrt{w^2 = \frac{100}{1.8}} = \sqrt{55.5}$$

$$w = \sqrt{55.5} = \pm 7.5$$

7.5

Linear Equation:



Goal: Isolate  $x$ . (Solve for  $x$ )

$$4x + 7 = 12$$

$$\begin{array}{r} -7 \quad -7 \\ \hline 4x = 5 \end{array}$$

$$x = 5/4$$

Now check:

$$4\left(\frac{5}{4}\right) + 7$$

$$\underline{\quad} \quad \quad 5 + 7 = 12 \quad \checkmark$$

Ex. Solve the equation

$$4x - 12 = 7x + 5$$

$$\begin{array}{r} -4x \quad -4x \\ \hline -12 = 3x + 5 \\ \quad -5 \quad -5 \\ \hline -17 = 3x \end{array}$$

$$-17 = 3x$$

$$\boxed{-\frac{17}{3} = x}$$

check:

$$4\left(-\frac{17}{3}\right) - 12 \stackrel{?}{=} 7\left(-\frac{17}{3}\right) + 5$$

$$-\frac{68}{3} - 12\frac{2}{3} = -\frac{119}{3} + 5\frac{1}{3}$$

$$-\frac{68}{3} - \frac{36}{3} = -\frac{119}{3} + \frac{15}{3}$$

$$-\frac{104}{3} = -\frac{104}{3}$$

Ex  $\frac{3}{3} \cdot \frac{1}{x} + \frac{2}{3x} = 4$

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

$$\frac{5}{3x} = \frac{4}{1}$$

cross mult.  $\Rightarrow 5 \cdot 1 = 3x \cdot 4$

$$5 = 12x$$

$$\boxed{\frac{5}{12} = x}$$

check:

$$\frac{1}{\left(\frac{5}{12}\right)} + \frac{2}{3\left(\frac{5}{12}\right)} = 4$$

$$\frac{12}{5} + \frac{2}{1} \cdot \frac{12}{15} = 4$$

$$\frac{3}{3} \frac{12}{5} + \frac{24}{15} = \frac{36 + 24}{15} = \frac{60}{15} = 4 \quad \checkmark$$

word problem:

one number is 4 times another. Their sum is 86. What are the numbers?

$$n = 4 \cdot x$$

substitute

$$n + x = 86$$

$$\downarrow$$

$$4x + x = 86$$

$$5x = 86$$

$$x = 17 \frac{1}{5}$$

=>

$$n = 4x = 4 \left( \frac{86}{5} \right)$$

$$= \frac{344}{5}$$

$$\frac{344}{5} + \frac{86}{5} \stackrel{?}{=} 86$$

$$\frac{430}{5} = \textcircled{86}$$

Ex: One number is 2 more than 5 times another. Their sum is 100. What are the numbers?

$$n = 2 + 5m$$

Since  $m = \frac{98}{6}$

$$n = 2 + 5 \left( \frac{98}{6} \right)$$

$$= 2 + \frac{490}{6}$$

$$= \frac{12}{6} + \frac{490}{6} = \frac{502}{6}$$

$$n + m = 100$$

↑  
replace this with  $2 + 5m$

$$(2 + 5m) + m = 100$$

$$2 + 6m = 100$$

$$6m = 98$$

$$m = \frac{98}{6}$$

And:  $\frac{502}{6} + \frac{98}{6} = \frac{600}{6} = \textcircled{100}$  😊

Ex: Suppose your 3 grades on your exams were: 82, 91, 73. What do you need to make on your 4th exam to earn an exam average of 80?

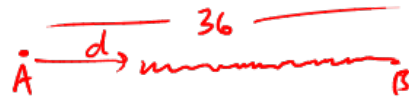
$$\frac{82 + 91 + 73 + x}{4} = 80$$

$$246 + x = 4 \cdot 80 = 320$$

$$x = 320 - 246 = 74$$



$$d = r \cdot t$$



cyclist A: travels a distance  $d$   
at a speed  $r$ .

$$d = 2r$$

the time it takes this  
cyclist to meet the other

is  $2 = \frac{d}{r}$  (b/c  $d = rt$   
 $\frac{1}{1} t = 2$ ).

cyclist B: travels a distance  $36 - d$

$$\textcircled{*} 36 = d + (36 - d)$$

$$2 = \frac{36 - d}{2r}$$

cross  
mult

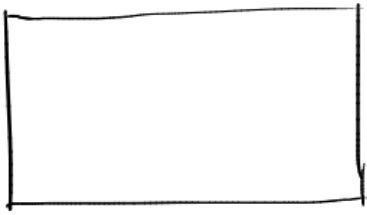
$$\left\{ 2 = \frac{36 - 2r}{2r} \right.$$

$$2 \cdot 2r = 36 - 2r$$

$$4r = 36 - 2r$$

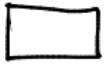
$$6r = 36 \Rightarrow r = 6$$

Faster Speed  $2r = 12$



want: Ratio  $\boxed{\frac{l}{w} = 1.6}$   $l = 1.6w$

have: 200 feet of fencing

use all the fencing  
to make a 

whose ratio  $\frac{l}{w}$  is 1.6.

start:

let  $w$  = width,  $l$  = length

If we use all fencing then

$$200 = 2w + 2l = 2w + \overbrace{2(1.6w)}^{3.2w} = 5.2w$$

↑  
1.6w

$$\boxed{l = 1.6(38.4) = 61.4}$$

$$\boxed{38.4 = \frac{200}{5.2} = w}$$