Linear Equations and Problem Solving
Worksheet #3

Name Key

Date _____ Pd ____

Answer each question in complete sentences and show all work to justify your answer.

1. A pool membership costs $300 a year. If it costs $7 to go each day, how many days would you have to go to the pool to justify a membership?

$300 cost of membership
$7 cost per day w/o membership
V = # of visits until costs are equal

Total cost w/membership = Total cost w/o membership

$$\left(\begin{matrix}\text{cost of}\\ \text{membership}\end{matrix}\right) = \left(\begin{matrix}\text{cost per}\\ \text{day}\end{matrix}\right)\left(\begin{matrix}\text{\# of}\\ \text{visits}\end{matrix}\right)$$

$$\frac{300}{7} = \frac{7V}{7}$$

$$V \approx 42.9$$

It would take 43 days to justify buying the membership.

2. It costs $1 to use the Hanby Bridge. The state of Delaware has decided to offer a monthly pass that will cost $15 and will reduce the toll to $.55 for pass holders. How many times per month must you use the bridge to justify the pass? Should people buy the pass?

$1 - toll without pass
$15 - cost of the monthly pass
$.55 - toll with the pass
t = # of tolls paid in a month

Total cost w/pass = Total cost w/o pass

$$\left(\begin{matrix}\text{cost}\\ \text{of}\\ \text{pass}\end{matrix}\right) + \left(\begin{matrix}\text{reduced}\\ \text{toll}\end{matrix}\right)\left(\begin{matrix}\text{\# of}\\ \text{tolls}\end{matrix}\right) = \left(\text{toll}\right)\left(\begin{matrix}\text{\# of}\\ \text{tolls}\end{matrix}\right)$$

$$15 + .55t = 1t$$

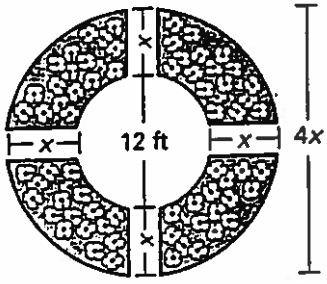
$$-.55t \quad -.55t$$

$$\frac{15}{.45} = \frac{.45t}{.45}$$

$$33\tfrac{1}{3} = t$$

If you will use the Bridge 34 or more times per month, you should buy the pass.

3. A flower garden has the shape pictured below. The diameter of the inner circle is 12 feet. What are the lengths of the walkways?



x = length of walkway (ft)

12 ft - diameter of inner circle

$4x$ = total diameter of the garden

(Total diameter) = (length of walkway) + (diameter of inner circle) + (length of walkway)

$4x = x + 12 + x$

$4x = 2x + 12$

$+(-2x) \quad +(-2x)$

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

$x = 6$ ft

The length of each walkway is 6 feet.

4. Two cars travel the same distance. The first car travels at a rate of 40 miles per hour and reaches its destination in t hours. The second car travels at a rate of 55 miles per hour and reaches its destination 3 hours earlier than the first car. How long does it take for the first car to reach its destination? How long does it take for the second car to reach its destination?

40 mi/hr - Rate of 1st car

55 mi/hr - Rate of 2nd car

t = time of 1st car

$t-3$ = time of 2nd car

Distance of Car 1 = Distance of Car 2

(rate of 1st)(time of 1st) = (rate of 2nd)(time of 2nd)

$40t = 55(t-3)$

$40t = 55t + (-165)$

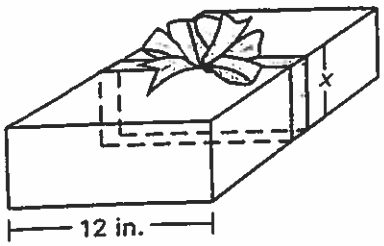
$+(-55t) \quad +(-55t)$

$\frac{-15t}{-15} = \frac{-165}{-15}$

$t = 11$ hr

The 1st car took 11 hours and the 2nd car took 8 hours.

5. It takes 65 inches of ribbon to make a bow and wrap the ribbon around a box. The bow takes 30 inches of ribbon. The width of the box is 12 inches. What is the height of the box?



65 in - Total length of the ribbon

30 in - Length needed for the bow

12 in - width of the box

x = height of the box (in)

$$\begin{pmatrix}\text{Total length}\\ \text{of ribbon}\end{pmatrix} = \begin{pmatrix}\text{Length for}\\ \text{bow}\end{pmatrix} + 2\begin{pmatrix}\text{width of}\\ \text{box}\end{pmatrix} + 2\begin{pmatrix}\text{height of}\\ \text{box}\end{pmatrix}$$

$$65 = 30 + 2(12) + 2x$$

$$65 = 30 + 24 + 2x$$

$$65 = 2x + 54$$

$$+(-54) \qquad +(-54)$$

$$\frac{11}{2} = \frac{2x}{2}$$

$$x = 5\tfrac{1}{2} \text{ in}$$

The height of the box is $5\frac{1}{2}$ in.

6. At West High School, 362 students take Spanish. This number has been increasing at a rate of 20 per year. The number of students taking French is 259 and has been decreasing at a rate of about 3 per year. At these rates, when will there be two times as many students taking Spanish as taking French?

362 - Starting # of students in Spanish

20 - Increase per year for Spanish

259 - Starting # of students in French

3 - Decrease per year for French

y = # of years until there are twice as many in Spanish

$$\begin{pmatrix}\#\text{ of students}\\ \text{in Spanish}\end{pmatrix} = 2\begin{pmatrix}\#\text{ of students}\\ \text{in French}\end{pmatrix}$$

$$\begin{pmatrix}\text{Starting}\\ \#\text{ in}\\ \text{Spanish}\end{pmatrix} + \begin{pmatrix}\text{Inc.}\\ \text{per}\\ \text{year}\end{pmatrix}\begin{pmatrix}\#\text{ of}\\ \text{years}\end{pmatrix} = 2\left[\begin{pmatrix}\text{Starting}\\ \#\text{ in}\\ \text{French}\end{pmatrix} + \begin{pmatrix}\text{Dec.}\\ \text{per}\\ \text{year}\end{pmatrix}\begin{pmatrix}\#\text{ of}\\ \text{years}\end{pmatrix}\right]$$

$$362 + 20y = 2[259 + (-3y)]$$

$$362 + 20y = 518 + (-6y)$$

$$+(-362) \quad +6y \quad +(-362) \quad +6y$$

$$\frac{26y}{26} = \frac{156}{26}$$

$$y = 6$$

It will take 6 years for the number of students taking Spanish to be twice as many as those taking French.

7. You and your friend are each driving 379 miles from Los Angeles to San Francisco. Your friend leaves first, driving 52 miles per hour. She is 32 miles from Los Angeles when you leave, driving 60 miles per hour. How far does each of you drive before you are side by side?

379_{mi} - Distance from LA to SF

52 mi/hr - Rate of friend

32 mi - Head start of friend

60 mi/hr - Your Rate

d = Distance traveled before you catch your friend

t = time it takes you to catch up

Friend's Distance = Your Distance

$$\left(\begin{matrix}\text{Head}\\\text{Start}\end{matrix}\right)+\left(\begin{matrix}\text{Friend's}\\\text{Rate}\end{matrix}\right)\left(\begin{matrix}\text{time}\\\text{to}\\\text{catch-up}\end{matrix}\right)=\left(\begin{matrix}\text{your}\\\text{Rate}\end{matrix}\right)\left(\begin{matrix}\text{time}\\\text{to}\\\text{catch up}\end{matrix}\right)$$

$$32 + 52t = 60t$$

$$+(-52t) \qquad +(-52t)$$

$$\frac{32}{8} = \frac{8t}{8}$$

$$t = 4\ hr$$

$$\left(\begin{matrix}\text{Your}\\\text{Distance}\end{matrix}\right)=\left(\text{Rate}\right)\left(\text{Time}\right)$$

$$d = 60(4)$$

$$d = 240\ mi$$

You will have to drive 240 miles to catch up to your friend.

8. At Barton High School, 45 students are taking Japanese. This number has been increasing at a rate of 3 students per year. The number of students taking German is 108 and has been decreasing at a rate of 4 students per year. At these rates, when will the number of students taking Japanese equal the number taking German?

45 - starting # of students in Japanese

3 - Increase per year for Japanese

108 - Starting # of students in German

4 - Decrease per year for German

y = # of years until the # of students are the same

$$\left(\begin{matrix}\#\text{ of students}\\\text{taking Japanese}\end{matrix}\right)=\left(\begin{matrix}\#\text{ of students}\\\text{taking German}\end{matrix}\right)$$

$$\left(\begin{matrix}\text{Starting}\\\#\text{ in}\\\text{Japanese}\end{matrix}\right)+\left(\begin{matrix}\text{Inc}\\\text{per}\\\text{year}\end{matrix}\right)\left(\begin{matrix}\#\\\text{of}\\\text{years}\end{matrix}\right)=\left(\begin{matrix}\text{Starting}\\\#\text{ in}\\\text{German}\end{matrix}\right)+\left(\begin{matrix}\text{Dec}\\\text{Per}\\\text{year}\end{matrix}\right)\left(\begin{matrix}\#\\\text{of}\\\text{years}\end{matrix}\right)$$

$$45 + 3y = 108 + (-4y)$$

$$+(-45) \quad +4y \qquad +(-45) \quad +4y$$

$$\frac{7y}{7} = \frac{63}{7}$$

$$y = 9\ yr$$

It will take 7 years for the number of students in Japanese and German to be the same.