

Choosing the Right Method for Word Problems

5.5 Using linear systems in word problems.

There are generally 4 types of system word problems you will see.

- Type 1) A quantity and A cost/Rate.
- Type 2) Number problems. (NOT TESTED)
- Type 3) Two Equations in Slope-Intercepts form (ish).
- **Type 4) A quantity and a quantity to find a rate or a Rate and a rate to find a quantity. This is the type on your LPA.**

Type 1) Quantity and rate.

- This is the most typical of the 4. Here are the steps to do this problem.
- Identify x and y (x =, y =)
- Write your first equation (usually $x + y = \underline{\quad}$). This is the Quantity equation.
- Write your second equation (usually $\underline{\quad}x + \underline{\quad}y = \underline{\quad}$) This is the rate or money equation.
- Solve the system of equations (usually using elimination method) (sub is ok).
- Put back into context

Type 1: Together

- **Cuisine** Your family goes to a restaurant for dinner. There are 7 people in your family. Some order the chicken dinner for \$13 and some order the steak dinner for \$17. If the total bill was \$107, how many people ordered each dinner?

$x = \text{ordered chicken}$ Q: $(x + y = 7) \xrightarrow{(-13)}$ $-13x - 13y = -91$
 $y = \text{ordered steak}$ R: $13x + 17y = 107 \rightarrow 13x + 17y = 107$

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

3 ordered chicken &
4 ordered steak.

$$\begin{array}{r} 4y = 16 \\ \frac{4y}{4} = \frac{16}{4} \\ \hline y = 4 \end{array}$$

On Your Own: Granola problem

- **Health Food:** A health food store mixes granola and raisins to make 20 pounds of raisin granola. Granola costs them \$4 per pound and raisins cost them \$5 per pound. How many pounds of each should they include if they want the mixture to cost them a total of \$85? Write an algebraic model for the problem.

$$\begin{array}{l}
 x = \text{Granola per lb} \\
 y = \text{Raisins per lb}
 \end{array}
 \quad
 \begin{array}{l}
 Q: (x + y = 20) \xrightarrow{(-4)} -4x - 4y = -80 \\
 R: 4x + 5y = 85 \rightarrow \underline{4x + 5y = 85}
 \end{array}$$

$$\begin{array}{r}
 x + y = 20 \\
 -4x - 4y = -80 \\
 \hline
 3y = 120 \\
 y = 40
 \end{array}$$

$$\begin{array}{r}
 x + y = 20 \\
 -5 \quad -5 \\
 \hline
 x = 15
 \end{array}$$

15 lbs of Granola &
5 lbs of Raisins.

$$y = 5$$

Another example OYO.

- 1. Alysia's jean outlet store sold 44 pairs of Jeans for a total of \$2050. Hollister Brand sold for \$50 per pair and JNCO Brand sold for \$45 per pair. How many of each brand were sold?

$$\begin{array}{l}
 x = \text{Hollister brand} \\
 y = \text{JNCO brand}
 \end{array}
 \quad
 \begin{array}{l}
 (x + y = 44) \xrightarrow{(-50)} -50x - 50y = -2200 \\
 50x + 45y = 2050 \rightarrow \underline{50x + 45y = 2050}
 \end{array}$$

$$\begin{array}{r}
 x + y = 44 \\
 -50x - 50y = -2200 \\
 \hline
 -49y = -1756 \\
 y = 35.83
 \end{array}$$

$$\begin{array}{r}
 x + y = 44 \\
 -30 \quad -30 \\
 \hline
 x = 14
 \end{array}$$

14 Hollister &
30 JNCO Sold.

$$y = 30$$

Type 2) The number problem

- This problem deals with numbers. The first equation tends to be simple, but the second one is more confusing. Here is what to do!
- Identify x and y (They will both be numbers, e.g. first #, second number).
- Write out the first sentence, which is generally addition or subtraction (difference and sum).
- Write out the relation sentence (can be confusing. Remember product = multiply, "is" means equals. Quotient = division, difference = subtraction, sum = add. 3 less than a number is, $x - 3$).
- Solve using either method, substitution or elimination.
- Don't really need to put back into context.
- WE ARE SKIPPING THIS!!!

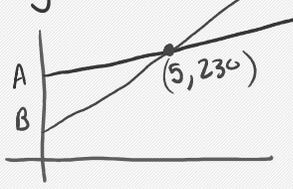
Type 3) Two slope intercept (ish) problems (break even problems)

- These are written like two slope intercepts problems, except they are usually an initial value plus or minus a rate.
- Here is what to do.
- 1) identify x & y (The last sentence is a good helper again).
- 2) Find the 2 similar sentences that discuss initial amounts (or fixed amount) and a rate (per).
- 3) Create the equations and solve using substitution (set them equal to each other).
- 4) be sure to put back into context.

Type 3) problem

- **Electricians Use the following information.**
- The yellow pages identify two different local electrical businesses. Business A charges \$50 for a service call, plus an additional \$36 per hour for labor. Business B charges \$35 for a service call, plus an additional \$39 per hour for labor.
- Let x represent the number of hours of labor and let y represent the total charge. Write a system of equations you could solve to find the length of a service call for which both businesses charge the same amount. Solve the system.

A: $y = 50 + 36x$
 B: $y = 35 + 39x$



$$\begin{array}{r} 50 + 36x = 35 + 39x \\ -36x \quad -36x \\ \hline 50 = 35 + 3x \\ -35 \quad -35 \\ \hline 15 = 3x \\ \frac{15}{3} = \frac{3x}{3} \\ 5 = x \end{array}$$

$$\begin{array}{l} y = 50 + 36(5) \\ y = 50 + 180 \\ y = 230 \end{array}$$

@ 5 hours, the total charge \$230 are equal.

Type 3) Example

$c = \# \text{ of churros}$
 $y = \text{Total charge/cost}$

- Matthew is going to Disneyland and he loves his churros. He went to disneylandchurrodeals.com and found two deals. Deal 1 says he gets into the park for \$98 and churros are \$3 each. Deal 2 says he gets into the park for \$108 and churros are 2 dollars each. At what point/how many churros would the two deals be equal to each other? Matthew will eat at least 15 churros. Which deal would work best for him?

Deal 1: $y = 98 + 3c$
 Deal 2: $y = 108 + 2c$

$$\begin{array}{r} 98 + 3c = 108 + 2c \\ -2c \quad -2c \\ \hline 98 + c = 108 \\ -98 \quad -98 \\ \hline c = 10 \end{array}$$

$y = 108 + 2(10)$
 $y = 128$

@ 10 churros the deals are \$128.



Type 4) You try this on your own.

- A travel agency offers two Boston outings. Plan A includes hotel accommodations for three nights and two pairs of baseball tickets worth \$340. Plan B includes hotel accommodations for five nights and four pairs of baseball tickets worth \$580. Write a system of equations you could solve to find the cost of one night's hotel accommodation and one pair of baseball tickets.

x : \$/Hotel per night A: $3x + 2y = 340$ (2) $\rightarrow -6x - 4y = -680$
 y : \$/pair of Baseball tickets B: $5x + 4y = 580$ $\rightarrow 5x + 4y = 580$

$$\begin{array}{r} 3(100) + 2y = 340 \\ 300 + 2y = 340 \\ \underline{-300} \quad \underline{-300} \\ 2y = 40 \\ \frac{2y}{2} = \frac{40}{2} \end{array}$$

$y = 20$

$$\begin{array}{r} -6x - 4y = -680 \\ \underline{5x + 4y = 580} \\ -x = -100 \\ \frac{-x}{-1} = \frac{-100}{-1} \\ x = 100 \end{array}$$

\$100 per night & \$20 per pair of Tickets

Type 4) Double rate. Large Numbers

- An owner of two stores buys five large delivery vans and five small delivery vans. One store receives three of the large delivery vans and two of the small delivery vans for a total cost of \$80,000. The other store receives the rest of the vans for a total cost of \$60,000. What is the cost of each type of van?

x : large van $3x + 2y = 80,000$ (2) $\rightarrow -6x - 4y = -160,000$
 y : small van $2x + 3y = 60,000$ (3) $\rightarrow 6x + 9y = 180,000$

$$\begin{array}{r} 2x + 3(4000) = 60000 \\ 2x + 12,000 = 60,000 \\ \underline{-12,000} \quad \underline{-12,000} \\ 2x = 48,000 \\ \frac{2x}{2} = \frac{48,000}{2} \\ x = 24,000 \end{array}$$

$$\begin{array}{r} -6x - 4y = -160,000 \\ \underline{6x + 9y = 180,000} \\ 5y = 20,000 \\ \frac{5y}{5} = \frac{20,000}{5} \\ y = 4,000 \end{array}$$

large van costs \$24,000
small van costs \$4,000

Which problem type? Try it on your own.

- **Highway Project** use the following information.
- There's a total of 16 workers employed on a highway project. Some are contracted at \$150 per day and some are not contracted at \$100 per day. The daily total payroll is \$2100.
- Write a system of equations to find the number of workers employed at each wage. How many are contracted and how many are not contracted.

$$\begin{aligned}x + y &= 16 \\150x + 100y &= 2100\end{aligned}$$

Which type is it? Break even.

- Brenda wants to start her own company making original bumper stickers. It will cost \$30 to design each sticker plus another \$3.00 per sticker to make. Brenda plans to sell them for \$6.00 per bumper sticker. How many stickers will you need to sell so that you spend the same money as you make?

$$\begin{array}{l} \text{Cost: } T = 30 + 3b \\ \text{Rev: } T = 6b \end{array}$$

$$\begin{array}{r} 6b = 30 + 3b \\ -3b \quad -3b \\ \hline 3b = 30 \\ \frac{3}{3} \quad \frac{3}{3} \\ \hline b = 10 \end{array}$$

$$T = \$60$$

$$\begin{array}{l} \text{Cost: } T = 30 + 3(1000) \\ T = 3030 \end{array}$$

$$\begin{array}{l} \text{Rev: } T = 6(1000) \\ T = 6000 \end{array}$$

$$6000 - 3030 = \$2970$$