Writing Systems of Equations from Word Problems

EQ: How do I translate a paragraph into a system of equations?

MCC9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Writing Systems of Equations:
Step 1: Define the variables.
Step 2: Write 2 equations from the phrases.
Step 3: Use substitution, elimination, or graphing to solve for variables.
Step 4: Answer question using proper units.
**Slope Intercept Form**
Scenarios that lend themselves to fit the $y = mx + b$ format.

Example: You pay $2 to ride in a taxi and $.20 per mile.

$$y = .20x + 2$$

$x =$ # of miles

$y =$ total cost

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**Total Items Form**
Scenarios that deal with buying two or more types of items.

Example: You are buying cokes and sprites for 10 people.

$$C = \# \text{ of cokes}$$

$$S = \# \text{ of sprites}$$

$$C + S = 10$$
**Total Price Form**
Scenarios that deal with buying two or more types of items and paying a total price.

Example: You are buying hot dogs for $2 each and hamburgers for $3 each. You spend $13 total.

\[
\begin{align*}
d &= \# \text{ of hot dogs} \\
b &= \# \text{ of hamburgers} \\
2d + 3b &= 13
\end{align*}
\]

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Ex. A  The difference of two numbers is 7. The sum of the two numbers is 29. Find the two numbers.

\[
\begin{align*}
x &= \text{1st } \# \\
y &= \text{2nd } \# \\
y - x &= 7 \\
y + x &= 29 \\
2y &= 36 \\
y &= 18
\end{align*}
\]

\[
\begin{align*}
18 + x &= 29 \\
x &= 11
\end{align*}
\]

The 2 numbers are 18 and 11.
Ex. B  You have 25 coins in your pocket, all nickels and dimes. Total, the coins add up to $2.10. How many of each do you have?

\[ n = \# \text{ of nickels} \]
\[ d = \# \text{ of dimes} \]
\[ n + d = 25 \]
\[ .05n + .10d = 2.10 \]

\[ \begin{align*}
\frac{n + d}{-d} &= 25 - d \\
n &= 25 - 17 \\
n &= 8
\end{align*} \]

You have 8 nickels and 17 dimes.

Ex. C  You went to Pizza Hut. The first time, you bought 3 breadsticks and 2 pizzas; it cost you $26. The second time, you bought 1 breadstick and 5 pizzas; it cost you $39. How much does a single breadstick cost? How much does a single pizza cost?

\[ b = \$ \text{ of breadsticks} \]
\[ p = \$ \text{ of pizza} \]

\[ \begin{align*}
3b + 2p &= 26 \\
(1b + 5p = 39) \cdot -3 \\
-3b - 15p &= -117 \\
2b + 2p &= 26 \\
-13p &= -91 \\
-13 \cdot -13 &= p \\
p &= 7
\end{align*} \]

The pizza cost $7 each and the breadsticks cost $4 each.
Ex. D  You are selling tickets for a high school play. Student tickets cost $4 and general admission tickets cost $6. You sell 31 tickets and collect $170. How many of each type did you sell?

\[
\begin{align*}
S &= \# \text{ of Student tickets} \\
G &= \# \text{ of Gen. Ad. tickets} \\
4S + 6G &= 170 \\
S + G &= 31 \\
-6S - G &= -31G \\
S &= 31 - G \\
4(31-G) + 6G &= 170 \\
124 - 4G + 6G &= 170 \\
12G + 2G &= 170 \\
2G &= 46 \\
G &= 23 \\
S &= 31 - 23 \\
S &= 8
\end{align*}
\]

You sold 23 General Admission tickets and 8 student tickets.

Ex. E  Two planes are currently landing at Hartsfield. One plane is descending at 300 feet per minute from 9000 feet. The other is descending at 200 feet per minute from 6000 feet. When will they be at the same height and at what time will that be?

\[
\begin{align*}
h &= \text{height} \\
t &= \text{time} \\
h &= -300t + 9000 \\
h &= -200t + 6000 \\
-300t + 9000 &= -200t + 6000 \\
+300t &= +300t \\
9000 &= 100t + 6000 \\
3000 &= 100t \\
30 &= t
\end{align*}
\]

The planes meet after 30 minutes on the ground.
Ex. F  You are taking a trip cross-country. When you are flying to California, the plane is traveling at 528 mph with a headwind. When you are flying home to Georgia, the plane is traveling at 572 mph with a tailwind. What is the speed of the plane and what is the speed of the wind?

\[ p = \text{speed of plane} \]
\[ w = \text{speed of wind} \]
\[ p - w = 528 \]
\[ p + w = 572 \]

\[ \frac{2p}{2} = \frac{1100}{2} \]
\[ p = 550 \]

\[ 550 + w = 572 \]
\[ w = 22 \]

The plane’s speed is 550 mph and the wind’s speed is 22 mph.