

6.4 Applications of Linear Systems - Mixture Problems - (D2)

SWBAT translate a mixture word problem into a system of linear equations and solve.

Solving a Mixture Problem

Step 1: READ the problem

Step 2: Underline or highlight the QUESTION

Step 3: Define one variable based on the PERCENTAGE of which is being asked

Step 4: SET UP A TABLE like the one to the right

Step 5: Solve for X!

| | Percent | Amt | |
|-----------|---------|-----|--|
| Mixture A | | | |
| Mixture B | | | |
| Total | | | |

1. A dairy owner produces low-fat milk containing 1% fat and whole milk containing 3.5% fat. How many gallons of each type should be combined to make 100 gal of milk that is 2% fat?

Set Up:

Let X = AMT OF 1% FAT MILK

$$.01x + .035(100 - x) = .02(100)$$

$$.01x + 3.5 - .035x = 2$$

$$-.025x + 3.5 - 3.5 = 2 - 3.5$$

$$-.025x = -1.5$$

$$x = \frac{-1.5}{-.025} = 60$$

Table:

MULTIPLY

| | Percent | Amt | |
|-----------|---------|---------|---------------|
| Mixture A | .01 | X | .01X |
| Mixture B | .035 | 100 - X | .035(100 - X) |
| Total | .02 | 100 | .02(100) |

60 is amt of 1%
100 - 60 = 40 gal is amt of 3.5%

2. One antifreeze solution is 20% alcohol. Another antifreeze solution is 12% alcohol. How many liters of each solution should be combined to make 15 L of antifreeze solution that is 18% alcohol?

Set Up:

Let X = AMT OF ANTIFREEZE AT 20%

$$.20x + .12(15 - x) = .18(15)$$

$$.20x + 1.8 - .12x = 2.7$$

$$.08x = .9$$

$$x = \frac{.9}{.08} = 11.25$$

11.25 L of antifreeze of 20%

15 - 11.25 = 3.75 L of 12%

Table:

| | Percent | Amt | |
|-----------|---------|--------|-------------|
| Mixture A | .20 | X | .20X |
| Mixture B | .12 | 15 - X | .12(15 - X) |
| Total | .18 | 15 | .18(15) |

3. John is making punch. How many cups of 50% juice should he add to a drink that contains 10% juice if he wants to make 15 cups of punch containing 20% juice? (How many cups of each drink)

Set Up:

Let X = AMT OF 50% JUICE

$$.5x + .10(15 - x) = .20(15)$$

$$.5x + 1.5 - .10x = 3$$

$$.4x + 1.5 - 1.5 = 3 - 1.5$$

$$.4x = 1.5$$

$$x = \frac{1.5}{.4} = 3.75$$

3.75 cups of 50% Juice
15 - 3.75 = 11.25 of 10% Juice

Table:

| | Percent | Amt | |
|-----------|---------|--------|-------------|
| Mixture A | .50 | x | .50x |
| Mixture B | .10 | 15 - x | .10(15 - x) |
| Total | .20 | 15 | .20(15) |

4. You combine a 10% saltwater mixture with a 40% saltwater mixture to create 6 gallons of a 30% saltwater solution. How many gallons of each mixture did you use?

Set Up:

Let X = AMT OF 10% saltwater

$$.10x + .40(6 - x) = .30(6)$$

$$.10x + 2.4 - .40x = 1.8$$

$$-.30x + 2.4 - 2.4 = 1.8 - 2.4$$

$$-.30x = -.6$$

$$x = \frac{-.6}{-.3} = 2$$

2 gallons of 10% saltwater
4 gallons of 40% saltwater

Table:

| | Percent | Amt | |
|-----------|---------|-----------|------------|
| Mixture A | .10 | X (2) | .10x |
| Mixture B | .40 | 6 - X (4) | .40(6 - x) |
| Total | .30 | 6 | .30(6) |

5. Margaret is making fruit punch. She has juice drink that contains 25% orange juice. How much pure orange juice will she need to combine with the drink to make 17 quarts of a drink that is 60% orange juice?

Set Up:

Let $X =$ amt of 25% oj.

$$\begin{aligned} .25x + 17 - 1x &= .6(17) \\ -.75x + 17 - 17 &= 10.2 - 17 \\ -.75x &= -6.8 \\ \frac{-.75x}{-.75} &= \frac{-6.8}{-.75} = 9.1 = x \end{aligned}$$

Table:

| | Percent | Amt | |
|-----------|---------|------------|---------|
| Mixture A | .25 | X 9.1 | .25x |
| Mixture B | 1 | 17 - X 7.9 | 17 - x |
| Total | .60 | 17 | .60(17) |

9.1 l of 25% oj
7.9 l of 100% oj

6. How much of a 90% solution of acid should be added to a 60% acid solution to create a 5-liter solution that contains 70% acid?

Set Up:

Let $X =$ amt of 90%

$$\begin{aligned} .9x + .6(5 - x) &= .7(5) \\ .9x + 3 - .6x &= 3.5 \\ .3x + 3 - 3 &= 3.5 - 3 \\ .3x &= .5 \\ \frac{.3x}{.3} &= \frac{.5}{.3} \quad x = 1.7 \end{aligned}$$

Table:

| | Percent | Amt | |
|-----------|---------|-----------|-----------|
| Mixture A | .90 | X 1.7 | .90x |
| Mixture B | .60 | 5 - X 3.3 | .6(5 - x) |
| Total | .70 | 5 | .7(5) |

1.7 l of solution 90%
3.3 l of 60% solution

7. You split \$1500 between two savings accounts. Account A pays annual 5% interest and Account B pays 4% annual interest. After one year, you have earned a total of \$69.50 in interest. How much money did you invest in each account?

Set Up:

Let $X =$ amount of 5%

$$\begin{aligned} .05x + .04(1500 - x) &= 69.50 \\ .05x + 60 - .04x &= 69.50 \\ -.01x &= 9.50 \\ \frac{-.01x}{-.01} &= \frac{9.50}{-.01} = 950 = x \end{aligned}$$

Table:

| | Percent | Amt | |
|-----------|---------|----------|---------------|
| Mixture A | .05 | X | .05x |
| Mixture B | .04 | 1500 - X | .04(1500 - x) |
| Total | | 1500 | 69.50 |

\$950 at 5%
550 at 4%

8. A metal worker has a metal alloy that is 20% copper and another alloy that is 60% copper. How many kilograms of each alloy should the metalworker combine to create 80 kg of a 52% copper alloy?

Set Up:

Let $X =$ amt of 20%

$$\begin{aligned} .20x + .6(80 - x) &= .52(80) \\ .20x + 48 - .6x &= 41.60 \\ -.4x + 48 - 48 &= 41.60 - 48 \\ -.4x &= -6.4 \\ \frac{-.4x}{-.4} &= \frac{-6.4}{-.4} = 16 \end{aligned}$$

Table:

| | Percent | Amt | |
|-----------|---------|-----------|------------|
| Mixture A | .20 | X 16 | .20x |
| Mixture B | .60 | 80 - X 64 | .6(80 - x) |
| Total | .52 | 80 | .52(80) |

16 Kg of 20% copper
64 Kg of 60% copper

9. A scientist has a container of 2% acid solution and a container of 5% acid solution. How many fluid ounces of each concentration should be combined to make 25 fl oz. of 3.2% acid solution?

Set UP

Let $x =$ amount of 2% solution

$$\begin{aligned} .02x + .05(25 - x) &= .032(25) \\ .02x + 1.25 - .05x &= .8 \\ -.03x + 1.25 - 1.25 &= .8 - 1.25 \\ -.03x &= -.45 \\ \frac{-.03x}{-.03} &= \frac{-.45}{-.03} = 15 = x \end{aligned}$$

Table

| | Percent | Amt | |
|-----------|---------|--------|-------------|
| Mixture A | .02 | X 15 | .02x |
| Mixture B | .05 | 25 - X | .05(25 - x) |
| Total | .032 | 25 | .032(25) |

15 oz of 2% solution
10 oz of 5% solution

10. A dealer wishes to obtain 50 pounds of mixed cookies to sell for \$1.00 per pound. If he mixes cookies worth \$1.20 per pound with cookies worth \$.70 per pound, find the number of pounds of each kind of cookie he should use.

Set UP

Let X = amount of \$1.20/lb

$$1.2x + .7(50-x) = 50$$

$$1.2x + 35 - .7x = 50$$

$$.5x + 35 - 35 = 50 - 35$$

$$\frac{.5x}{.5} = \frac{15}{.5} = 30$$

30 lbs of \$1.20/lb
20 lbs of \$.70/lb

Table

| | Percent | Amt | |
|-----------|---------|---------|----------|
| Mixture A | 1.2 | X 30 | 1.2x |
| Mixture B | .7 | 50-X 20 | .7(50-x) |
| Total | 1.0 | 50 | 50 |

11. A farmer has some cream which is 24% butterfat and some cream which is 18% butterfat. How many quarts of each must be used to produce 90 quarts of cream which is 22% butterfat?

Set UP

Let X = amount of 24% butterfat

$$.24x + .18(90-x) = .22(90)$$

$$.24x + 16.2 - .18x = 19.8$$

$$.06x + 16.2 - 16.2 = 19.8 - 16.2$$

$$\frac{.06x}{.06} = \frac{3.6}{.06} = 60$$

60 qts of 24% butterfat
30 qts of 18% butterfat

Table

| | Percent | Amt | |
|-----------|---------|---------|-----------|
| Mixture A | .24 | X 60 | .24x |
| Mixture B | .18 | 90-X 30 | .18(90-x) |
| Total | .22 | 90 | .22(90) |

12. How much pure acid must be added to 15 ounces of an acid solution which is 40% acid in order to produce a solution which is 50% acid?

Set UP

Let X = amt of pure acid

$$x + .4(15) = .5(15+x)$$

$$x + 6 = 7.5 + .5x$$

$$-.5x$$

$$.5x + 6 - 6 = 7.5 - 6$$

$$\frac{.5x}{.5} = \frac{1.5}{.5} = 3$$

∴ 3 oz. of pure acid

Table

| | Percent | Amt | |
|-----------|---------|---------|----------|
| Mixture A | 1.0 | x 3 | x |
| Mixture B | .40 | 15 | .40(15) |
| Total | .50 | 15+x 18 | .5(15+x) |

13. For her advisee party, Mary went to Kandy-Korner and purchased 2 pounds of a mixture of hard candy. The butter scotch drops were \$2.50 per pound and the strawberry stars were \$3.75 per pound. How many pounds of each candy did Mary have if the entire mixture cost \$5.50?

Set UP

Let X = amt of \$2.5

$$2.5x + 3.75(2-x) = 5.5(2)$$

$$2.5x + 7.5 - 3.75x = 11$$

$$-1.25x + 7.5 = 11$$

$$-1.25x - 7.5 = 11 - 7.5$$

$$-1.25x = 3.5$$

$$\frac{-1.25x}{-1.25} = \frac{3.5}{-1.25} = -2.8$$

1.6 lb of \$2.50
.4 lb of \$3.75

Table

| | Percent | Amt | |
|-----------|---------|--------|-----------|
| Mixture A | 2.5 | X 1.6 | 2.5x |
| Mixture B | 3.75 | 2-X .4 | 3.75(2-x) |
| Total | 5.50/2 | 2 | 5.5(2) |

14. How much of a 10% saline solution should be mixed with a 20% saline solution to obtain 100ml of a 12% saline solution?

Set UP

Let X = amount of 10%

$$.10x + .2(100-x) = .12(100)$$

$$.10x + 20 - .2x = 12$$

$$-.1x + 20 - 20 = 12 - 20$$

$$\frac{-.1x}{-.1} = \frac{-8}{-.1} = 80$$

Table

| | Percent | Amt | |
|-----------|---------|----------|-----------|
| Mixture A | .10 | X 80 | .10x |
| Mixture B | .20 | 100-X 20 | .2(100-x) |
| Total | .12 | 100 | .12(100) |

80 ml of 10% solution
20 ml of 20% solution