

Math 95–Mixture Problems Day 1–page 1

There are several ways to approach mixture problems. If you read your book, it will use charts to organize your information. I will show you how I dissect the problem and how I think. Observe. Then try the problems on this worksheet, if you need the practice. The problems in your book are the homework so look at your syllabus.

A. Chemistry

- a. How much pure acid is in 60 gallons of 30% acid solution?

Think: 30% of 60 gallons = pure acid
 $.30(60) = \text{pure acid}$

- b. This is the start of a formula: $\%(\text{number of gallons}) = \text{pure acid}$
This can be adapted to fit the problem:

$\%(\text{number of liters}) = \text{pure acid}$
 $\%(\text{number of ounces}) = \text{pure acid}$

- c. How many liters of 50% antifreeze must be mixed with 80 liters of 20% antifreeze to get a mixture that is 40% antifreeze?

I read this in “chunks” of words and write it like this (and then write algebra):

liters of 50% $\Rightarrow .50(x \text{ liters})$
mixed with 80 liters of 20% $\Rightarrow + .20(80 \text{ liters})$
to get a mixture that's 40% $\Rightarrow = .40(\quad)$

Notice on the bottom line on the right side, there is an empty set of parentheses. The other two sets of parentheses will help you create an expression for the bottom set of parentheses. When you have an empty set of parentheses at the bottom, you will always add the top and the middle (think: mix x liters and 80 liters). So the expression for the bottom is $x + 80$.

So you will now have this equation:

$$.50(x) + .20(80) = .40(x + 80) \quad \text{now solve!}$$

$$.50x + 16 = .40x + 32$$

$$.50x + 16 - .40x = .40x + 32 - .40x$$

$$.10x + 16 = 32$$

$$.10x + 16 - 16 = 32 - 16$$

$$.10x = 16$$

$$x = 16 \div .10$$

$$x = 160 \text{ liters of } 50\% \text{ solution}$$

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- d. How many gallons of 16% solution and of 24% solution must be mixed to get 20 gallons of 18% solution?

I read this in “chunks” of words and write it like this (and then write algebra):

$$\begin{array}{ll} \text{gallons of 16\%} & \Rightarrow .16(x \text{ gallons}) \\ \text{and of 24\%} & \Rightarrow + .24(\quad) \\ \text{to get 20 gallons of 18\%} & \Rightarrow = .18(20 \text{ gallons}) \end{array}$$

Notice on the middle line on the right side, there is an empty set of parentheses. The other two sets of parentheses will help you create an expression for the middle set of parentheses. When you have an empty set of parentheses in the middle, you create an expression with subtraction. It will always be the bottom number subtract x . So here it will be $20 - x$.

So you will now have this equation:

$$\begin{aligned} .16x + .24(20 - x) &= .18(20) \\ .16x + 4.8 - .24x &= 3.6 \\ -.08x + 4.8 &= 3.6 \\ -.08x + 4.8 - \mathbf{4.8} &= 3.6 - \mathbf{4.8} \\ -.08x &= -1.2 \\ x &= -1.2 \div -.08 \\ x &= 15 \text{ gallons of 16\% solution} \\ 20 - x &= 20 - 15 = 5 \text{ gallons of 24\% solution} \end{aligned}$$

You just need to practice to conquer these type problems **so try these**.

1. How many liters of a 14% solution must be mixed with 20 liters of a 50% solution to get a 20% solution?
2. How many liters of a 10% solution must be mixed with 40 liters of a 50% solution to get a 20% solution?
3. Find the number of liters of 10% solution and of 20% solution that must be mixed together to obtain 100 liters of 18% solution.
4. Find the number of liters of 70% solution and of 30% solution that must be mixed together to obtain 200 liters of 38% solution.

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Answer Key. On this answer key, I will show the three lines of how I think in pieces. Then I'll show the equation. I'll leave the solving to you, but I will show the answer(s). This should help you know how to think!

1. liters 14% $\Rightarrow .14(x)$
 with 20 liters 50% $\Rightarrow .50(20)$
 to get mixture 20% $\Rightarrow .20(\quad)$
 empty at bottom so add $(x + 20)$
 $0.14(x) + 0.50(20) = 0.20(x + 20)$
 $x = 100$ liters of 14% solution

2. liters 10% $\Rightarrow .10(x)$
 with 40 liters 50% $\Rightarrow .50(40)$
 to get mixture 20% $\Rightarrow .20(\quad)$
 empty at bottom so add $(x + 40)$
 $0.10(x) + 0.50(40) = 0.20(x + 40)$
 $x = 120$ liters of 10% solution

3. liters 10% $\Rightarrow .10(x)$
 and of liters 20% $\Rightarrow .20(\quad)$
 to get 100 liters 18% $\Rightarrow .18(100)$
 empty in middle so subtract $(100 - x)$
 $0.10(x) + 0.20(100 - x) = 0.18(100)$
 $x = 20$ liters of 10% solution
 $100 - x = 80$ liters of 20% solution

4. liters 70% $\Rightarrow .70(x)$
 and of liters 30% $\Rightarrow .30(\quad)$
 to get 200 liters 38% $\Rightarrow .38(200)$
 empty in middle so subtract $(200 - x)$
 $0.70(x) + 0.30(200 - x) = 0.38(200)$
 $x = 40$ liters of 70% solution
 $200 - x = 160$ liters of 30% solution

B. Investment

- a. How much interest is there on \$1200 at 4% for one year?

Think: 4% of \$1200 = interest
 $.04(1200) = \text{interest}$

- b. This is the start of a formula: %(\$ invested) = \$ interest

- c. Renee won a prize for her work. She invested part of the money at 4% and \$3000 more than this at 6%. The annual interest was \$780. How much was invested at each rate?

I read this in “chunks” of words and write it like this (and then write algebra):

invested part at 4% $\Rightarrow .04(x)$

\$3000 more than this at 6% $\Rightarrow + .06(x + 3000)$

recall: more than is add/reverse so \$3000 is to right of + symbol and x in front

Total interest \$780 $\Rightarrow = 780$

Notice you use direct translation on the second line to create the second parentheses. Just read a few words and write the math symbols.

So you will now have this equation:

$.04(x) + .06(x + 3000) = 780$ now solve!

$.04x + .06x + 180 = 780$

$.10x + 180 = 780$

$.10x + 180 - 180 = 780 - 180$

$.10x = 600$

$x = 600 \div .10$

$x = \$6000$ invested at 4%

$x + 3000 = 6000 + 3000 = \9000 invested at 6%

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- d. Adam invested some money at 3% and \$30,000 more than twice as much at 4%. The total interest was \$5600. How much was invested at each rate?

I read this in “chunks” of words and write it like this (and then write algebra):

invested some at 3% \Rightarrow $.03(x)$

\$30,000 more than twice at 4% \Rightarrow $+ .04(2x + 30,000)$

recall: more than is add/reverse so \$30,000 is to right of + symbol and 2x in front

Total interest \$5600 \Rightarrow $= 5600$

Notice you use direct translation on the second line to create the second parentheses. Just read a few words and write the math symbols.

So you will now have this equation:

$$.03(x) + .04(2x + 30,000) = 5600 \quad \text{now solve!}$$

$$.03x + .08x + 1200 = 5600$$

$$.11x + 1200 = 5600$$

$$.11x + 1200 - \mathbf{1200} = 5600 - \mathbf{1200}$$

$$.11x = 4400$$

$$x = 4400 \div \mathbf{.11}$$

$$x = \$40,000 \text{ invested at } 3\%$$

$$2x + 30,000 = 2(40,000) + 30,000 = \$110,000 \text{ invested at } 4\%$$

Now you try these.

- Wayne invested some money at 3% simple interest, and \$250 more than this amount at 6%. He earned \$54 in interest. How much did he invest at each rate.
- Mabel invested some money at 9% simple interest, and \$5000 more than 3 times this amount at 10%. She earned \$2,840 in interest. How much did she invest at each rate?
- Evelyn invested some money at 8% simple interest and \$1000 less than twice this amount at 14%. Her total annual interest was \$580. How much was invested at each rate?

Answer Key.

5. some \$ at 3% $\Rightarrow .03(x)$
\$250 more at 6% $\Rightarrow .06(x + 250)$
total interest \$54 $\Rightarrow 54$
 $0.03(x) + 0.06(x + 250) = 54$
 $x \approx \$433.33$ invested at 3%
 $x + 250 \approx 433.33 + 250 \approx \683.33 invested at 6%
6. some \$ at 9% $\Rightarrow .09(x)$
\$5000 more than 3 times at 10% $\Rightarrow .10(3x + 5000)$
total interest \$2840 $\Rightarrow 2840$
 $0.09(x) + 0.10(3x + 5000) = 2840$
 $x = \$6,000$ invested at 9%
 $3x + 5000 = 3(6000) + 5000 = \$23,000$ invested at 10%
7. some \$ at 8% $\Rightarrow .08(x)$
\$1000 less than twice at 14% $\Rightarrow .14(2x - 1000)$
recall: less than means subtract/reverse so 1000 is to right of - and 2x in front
total interest \$580 $\Rightarrow 580$
 $0.08(x) + 0.14(2x - 1000) = 580$
 $x = \$2,000$ invested at 8%
 $2x - 1000 = 2(2000) - 1000 = \$3,000$ invested at 14%