Only to be used for arranged hours, will count as two activities

Math 31 **Activity # 13**

"Solving Mixture Problems"

Your Name: ___________________

Solving Word Problems: The Cohort Strategy!

Step 1) Read the problem at least once carefully. Look for key words and phrases. Determine the known and unknown quantities. Let x or another variable to represent one of the unknown quantities in the problem.

Step 2) If necessary, using the same variable from Step 1, write an expression using the to represent any other unknown quantities.

Step 3) Write a summary of the problem as an English statement. Then write an equation based on your summary.

Step 4) Solve the equation.

Step 5) Check the solution. Ask yourself "Is my answer reasonable?"

Step 6) Write a sentence to state what was asked for in the problem, and be sure to include units as part of the solution. (inches, square feet, gallons, ounces, etc., for example).

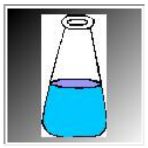
Only to be used for arranged hours, will count as two activities

Task 1) Percent Mixture Problems

Example 1:

How many gallons of a 15% sugar solution must be mixed with 5 gallons of a 40% sugar solution to make a 30% sugar solution?

Begin by creating a drawing of the situation and filling in the known information, as shown below.

Amount of Solution		+	____ gallons	=	
		+		=	
Concentration (Percents)	___		____		____
Amount of Ingredient in Mixture		+		=	

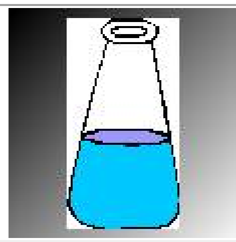
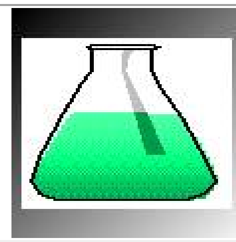
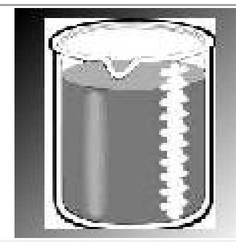
Now we must decide how to represent the unknown quantities. Since the question is asking us to find the number of gallons of 15% solution we will use to obtain the required result, it will be useful to have our variable represent the amount of 15% sugar solution we are using. Therefore:

Step 1) Let x = # of gallons of 15% sugar solution

Step 2) $x+5$ = # of gallons in the mixture

We place this variable and the variable expression in the appropriate place in our drawing and then perform all the mathematical operations which are applicable. See the drawing below for these results.

Only to be used for arranged hours, will count as two activities

Amount of Solution		+		=	
		+		=	
Concentration (Percents)	15%		40%		30%
Amount of Sugar in Mixture	15% times x gallons	+	40% times 5 gallons	=	30% times $(x+5)$ gallon

Step 3) Write an algebraic equation to be solved.

$$15\% \cdot x + 40\% \cdot 5 = 30\% \cdot (x+5)$$
$$0.15 \cdot x + 0.40 \cdot 5 = 0.30 \cdot (x+5)$$

Step 4) Solve the equation.

$$\begin{aligned}
0.15 \cdot x + 0.40 \cdot 5 &= 0.30 \cdot (x+5) \\
15x + 40 \cdot 5 &= 30 \cdot (x+5) \\
15x + 200 &= 30x + 150 \\
200 &= 15x + 150 \\
50 &= 15x \\
\frac{50}{15} &= x \\
\frac{10}{3} &= x
\end{aligned}$$

Step 5) Check:

Only to be used for arranged hours, will count as two activities

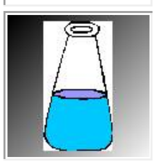
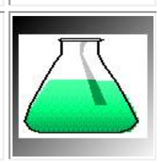
$$15\%\left(\frac{10}{3}\right)+40\%(5)=30\%\left(\frac{10}{3}+5\right)$$
$$0.15\left(\frac{10}{3}\right)+0.40(5)=0.30\left(\frac{10}{3}+5\right)$$
$$15\left(\frac{10}{3}\right)+40(5)=30\left(\frac{10}{3}+5\right)$$
$$50+200=100+150$$
$$250=250$$

Step 6) So, we will need to add $\frac{10}{3}$ or $3\frac{1}{3}$ gallons of 15% sugar solution to 5 gallons of 40% sugar solution to produce a 30% sugar solution.

Exercise 1:

How many ounces of 50% alcohol solution must be mixed with 80 ounces of a 20% alcohol solution to make a 40% alcohol solution?

Begin by creating a drawing of the situation and filling in the known information, in the appropriate place in the drawing below.

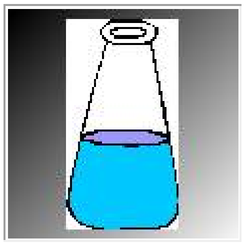
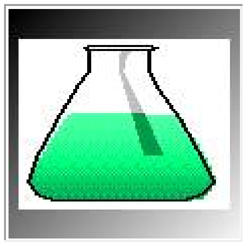
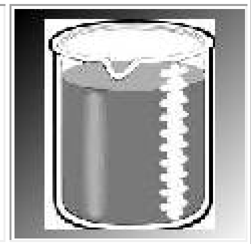
Amount of Solution		+		=	
		+		=	
Concentration (Percents)					
Amount of Ingredient in Mixture		+		=	

Step 1) Let ______ = # of ounces of 50% alcohol solution. Then

Step 2) _________= ___________________________________

Now place this variable and the variable expression in the appropriate place in the drawing below.

Only to be used for arranged hours, will count as two activities

Amount of Solution		+		=	
		+		=	
Concentration (Percents)					
Amount of Alcohol in Mixture		+		=	

Step 3) The resulting equation is:_________________________________

Step 4) Solve:

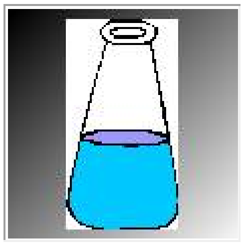
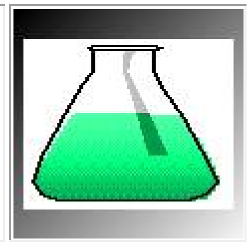
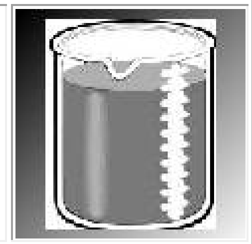
Step 5) Check:

Step 6)

Example 2:

A chemist needs to mix an 18% acid solution with a 45% acid solution to obtain 12 liters of a 36% solution. How many liters of each of the acid solutions must be used?

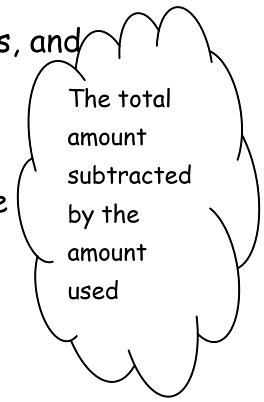
Only to be used for arranged hours, will count as two activities

Amount of Solution	?	+	?	=	12
		+		=	
Concentration (Percents)	18%		45%		36%
Amount of Ingredient in Mixture		+		=	

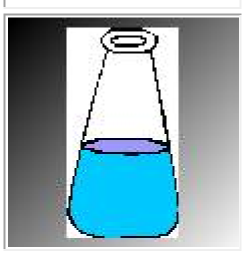
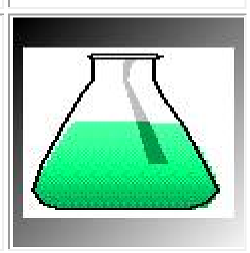
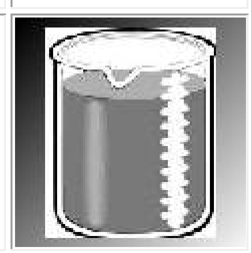
Step 1) Let x = # of liters of 18% acid solution to be used in the mixture.

Step 2) Since the total # of liters to be obtain in the mixture is 12 liters, and we have already used up x liters, so

$12-x$ = # of liters of the 45% acid solution to be used in the mixture.



Now place this variable and variable expression in the appropriate place in the drawing below.

Amount of Solution	x	+	$12-x$	=	12
		+		=	
Concentration (Percents)	18%		45%		36%
Amount of Acid in Mixture	$18\%x$	+	$45\%(12-x)$	=	

Only to be used for arranged hours, will count as two activities

Step 3) The resulting equation would be:

$$18\%x + 45\%(12 - x) = 36\%(12)$$

$$0.18x + 0.45(12 - x) = 0.36(12)$$

$$18x + 45(12 - x) = 36(12)$$

$$18x + 540 - 45x = 432$$

Step 4)

$$-27x + 540 = 432$$

$$-27x = -108$$

$$x = 4$$

4 liters of 18% solution

From step 2 $(12 - x)$ is the # of liters of the 45% solution so $12 - 4 = 8$

Step 5) Check:

$$18\% \cdot 4 + 45\% \cdot (12 - 4) = 36\% \cdot 12$$

$$0.18 \cdot 4 + 0.45 \cdot (12 - 4) = 0.36 \cdot 12$$

$$18 \cdot 4 + 45 \cdot (12 - 4) = 36 \cdot 12$$

$$72 + 45 \cdot (8) = 432$$

$$72 + 360 = 432$$

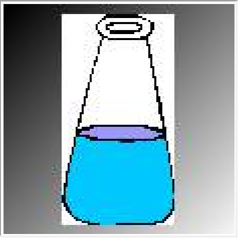
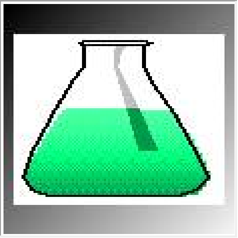
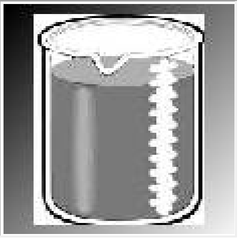
$$432 = 432$$

Step 6) The chemist needs 4 liters of 18% acid solution and 8 liters of 45% acid solution.

Exercise 2: Find the number of liters of an 18% alcohol solution that must be added to a 10% alcohol solution to get 20 liters of a 15% alcohol solution.

Step 1) Let $x =$ ______________________ . Then

Step 2) ___________=___________________________________

Amount of Solution		+		=	
		+		=	
Concentration (Percents)					
Amount of Alcohol in Mixture		+		=	

Only to be used for arranged hours, will count as two activities

Step 3) Equation: ______________________________

Step 4) Solve:

Step 5) Check:

Step 6)

Task 2) Value Mixture Problems

Other types of mixture problems are called value-mixture problems such as mixing 2 ingredients that have different unit cost into one single blend, mixing of items with different monetary values such as coins, stamps, tickets, etc.

a) Mixing two ingredients into a single blend.

unit cost of ingredient (price) $\times$ amount of ingredient $=$ value of ingredient

b) Mixing coins that have different monetary values.

value of one coin $\times$ number of coin $=$ total value

c) Mixing stamps that have different monetary values.

value of one stamp $\times$ number of stamps $=$ total value

Example 3: How many pounds of chamomile tea that cost $9 per pound must be mixed with 8 pounds of orange tea that cost $6 per pound to make a mixture that costs $7.80?

Only to be used for arranged hours, will count as two activities

Begin by creating a drawing of the situation and filling in the known information, as shown below.

Amount of Ingredient	?	+	8 lbs	=	
		+		=	
Unit cost (price)	\$9		\$6		\$7.80
Value of the ingredient		+		=	

Step 1) Let p = # of pounds of chamomile tea that cost \$9/lb.

Step 2) P + 8 = # of pounds of tea in the mixture.

$$\text{unit cost of ingredient (price)} \times \text{amount of ingredient} = \text{value of ingredient}$$

Amount of Ingredient	P	+	8 lbs	=	P+8
		+		=	
Unit cost (price)	\$9		\$6		\$7.80
Value of the ingredient	9p	+	6(8)	=	7.80(p+8)

Step 3) Equation: $9p + 6(8) = 7.80(p+8)$

Step 4)

$$\begin{aligned} 9p + 6(8) &= 7.80(p+8) \\ 9p + 48 &= 7.8p + 62.4 \\ 90p + 480 &= 78p + 624 \\ 12p + 480 &= 624 \\ 12p &= 144 \\ p &= 12 \end{aligned}$$

Step 5)

$$\begin{aligned} 9(12) + 6(8) &= 7.80(12+8) \\ 108 + 48 &= 7.8(20) \\ 156 &= 156 \end{aligned}$$

Only to be used for arranged hours, will count as two activities

Step 6) 12 pounds of chamomile tea that cost \$9/lb is needed.

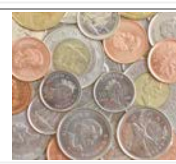
Example 4: A piggy bank  has a mixture of coins in dimes and quarters. There are 3 more quarters than dimes with a total value of \$4.95 or 495 cents. How many quarters and dimes are there in the piggy bank?

Begin by creating a drawing of the situation and filling in the known information, as shown below.

Number of coins	?	+	?	=	
		+		=	
Value per coin	10		25		
Total Value		+		=	495

Step 1) Let d = # dimes.

Step 2) d+7 = # of quarters (since there are 7 more quarters than dimes)

Number of coins	d	+	d+3	=	d+(d+3)
		+		=	
Value per coin	10		25		
Total Value	10d	+	25(d+3)	=	495

Step 3) $10d + 25(d+3) = 495$

$$10d + 25(d+3) = 495$$
$$10d + 25d + 75 = 495$$

Step 4)
$$35d + 75 = 495$$
$$35d = 420$$
$$d = 12$$

Step 5) check:

Only to be used for arranged hours, will count as two activities

Step 6)

Only to be used for arranged hours, will count as two activities

Mixed Practice:

1) A postal clerk has some 18¢ stamps and some 25¢ stamps. Altogether, he has 20 stamps with a total value of $4.23. How many of each type of each type does he have?

Step 1) Let ________=_____________________________Then

Step 2) ___________=_____________________________

Number of Stamps		+		=	
		+		=	
Value per stamp					
Total Value		+		=	

Step 3) Equation: ___________________________

Step 4) Solve

Step 5) Check

Step 6)

Only to be used for arranged hours, will count as two activities

2) A coin purse contains 24 coins in nickels and quarters. The coins have a total value of $4.40. Find the number of nickels and the number of quarters in the bank.

3) How many kilograms of hard candy that cost $7.50 per kg must be mixed with 24 kg of jelly beans that cost $3.25 per kg to make a mixture that costs $4.50 per kg?

4) Beatrice wants 100 ml liters of 5% salt solution but she only has a 2% salt solution and 7% salt solution. She will need to mix a quantity of a 2% salt solution with a 7% salt solution. How many ml of each of the two solutions will she have to use?

5) A chemist needs 5 liters of a 50% salt solution. All she has available is a 20% salt solution and a 70% salt solution. How many liters of each of the two solutions should she mix to obtain her desired solution?