

# Solution for Solutions

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Conquering The Math of  
Healthcare

1 2  
4 5



# Math and the Current Trend

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- The US was once ranked third in the world in math and science.
- Our current ranking has dropped to 16<sup>th</sup> worldwide.
- This is reflected in the TAKS scores we are seeing in Texas and the number who have to retake the math TAKS test.

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# Math and the Current Trend

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- In comparing notes with other pharmacy tech teachers at the state HOSA conference recently, math or calculations appears to be a major stumbling block for our health science students around the state.

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# Word Problems

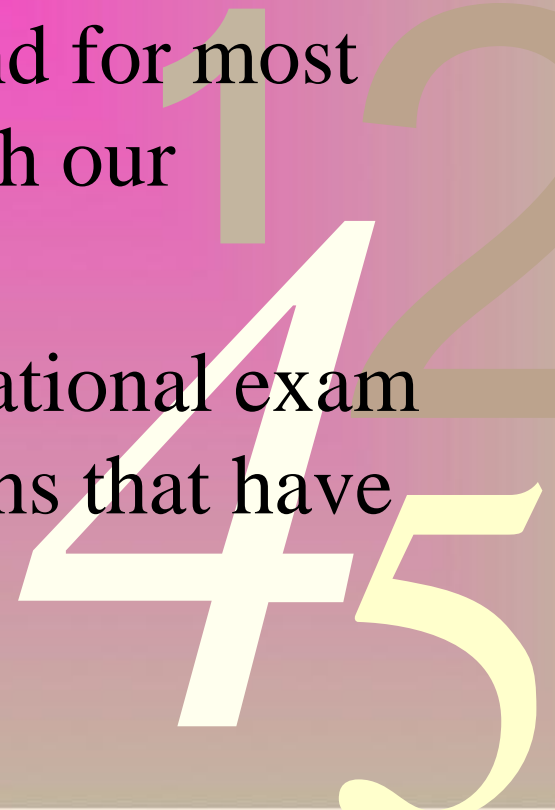
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- From personal experience even some of my best students who received “commended” on their TAKS in their junior year have difficulty with pharmacy math which is considered equal to Algebra 2.
- The problem seems to be in their ability to apply their math concepts to real life situations. In other words—word problems.

# Word Problems

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- Basic knowledge of how to approach solving a math word problem is a tool for a pharmacy technician student and for most healthcare professions for which our students are preparing .
- Many of the problems on the national exam will involve solving for solutions that have to be diluted or compounded.



# Word Problems

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- Solving for solutions is not an unrelated problem for students.
- Most students have done solution compounding when they go to a fast food place and mix a “suicide” drink.
- They are mixing different percentages of two or more drinks.

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# Terms

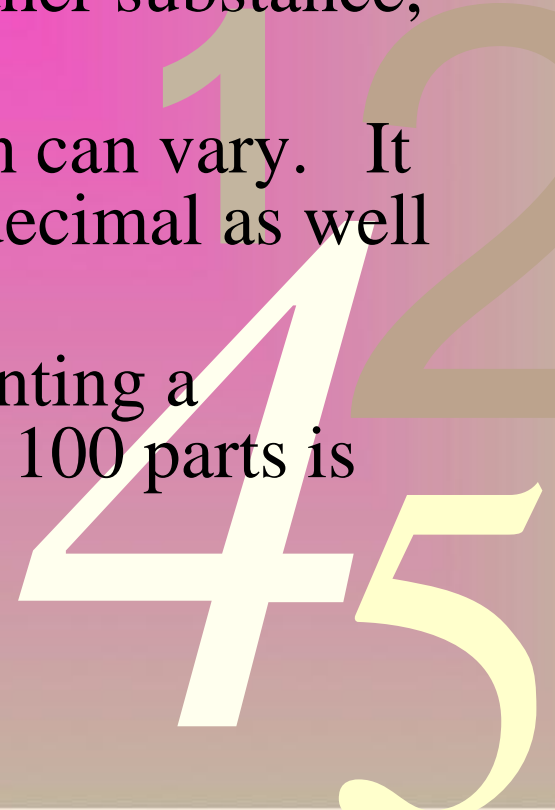
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- **Solute**—A substance dissolved in another substance, usually the component of a solution present in a lesser amount.
- **Solvents/diluents**
  - 1. A substance in which another substance is dissolved, forming a solution.
  - 2. A substance, usually a liquid, capable of dissolving another substance.

# Percentages

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- Percentages represent concentrations.
- Concentrations are the amount of a particular substance in a given amount of another substance, especially a solution or mixture.
- The expression of that concentration can vary. It can be expressed as a fraction or a decimal as well as percentage.
- 1% is also 1:100 or 0.01. If representing a solution, this means that one part of 100 parts is the solute.



# Percentages

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- When doing the math for word problems it is usually easier to work with the decimal expression.
- If no strength is given for the solvent or diluent, it is zero (0%).
- A solute not given is 100%.



# Common Solutions and Set Percentages

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- D5W—5 % dextrose in water.  
(5% Dextrose solution is also considered hypotonic compared with blood, because although it is isotonic while infusing, the dextrose is metabolized and free water is left, which is hypotonic.)

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# Common Solutions and Set Percentages

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- Saline solution—a solution of sodium chloride and distilled water. Normal saline solution (0.9 % NaCl) is considered isotonic with blood.
- Ringer's Lactate—an aqueous solution containing the chlorides of sodium and potassium and calcium that is isotonic to animal tissues; used to correct dehydration

# Three Formulas to Solve for Solutions

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- There are three basic formulas to solve word problems involving solutions:
- Alligation
- Means and Extremes
- Simple
- They are based on the amount of information parts that are given in a problem.



# Alligation

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- **Alligation**—four parts are known, usually three percentages and one volume or weight.
1. To start with using alligation, draw a tic-tac-toe pattern
- And label it as follows—

1 2  
4 5

# Alligation

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- What You
  - Have
- What You  
Want
- What You  
Will Need


1 2  
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# Alligation

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2. On your left hand side fill in on the top square the larger of the two percentage strengths that you have on hand.
  - On the bottom fill in the lesser strength or solvent.
  - In the middle square fill in the needed strength.
  - Cross subtract disregarding normal rules for minus values.
  - Add the two values on the right hand side.

# Alligation

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75%		40
	50%	
10%		25

Total: 65

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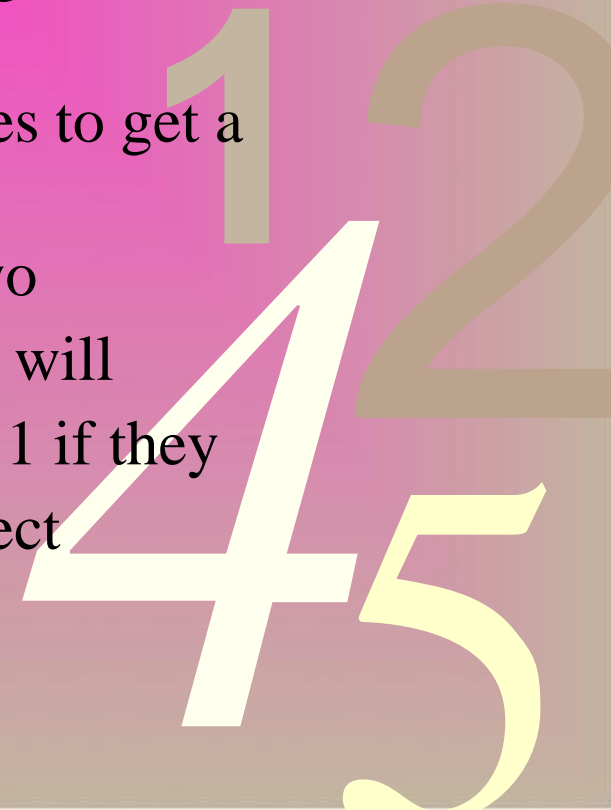


# Alligation

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- 3. As you go to the next step, it is wise to keep the values even on the right hand side with the beginning strength so that the student knows which value belongs to which solution or solute.
- Divide each value by the total of the values to get a decimal numeral.
- 75% solution  $40/65 = 0.62$
- 10% solution  $25/65 = \underline{0.38}$
- 1

These two decimals will add to a 1 if they are correct



# Alligation

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4. You then multiply the volume or weight by the decimals to get a correct amount to mix to produce the needed strength of solution.

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# Means and Extremes

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- **Means and Extremes**—three parts are known
1. The four parts of a means and extremes formula are:
    - Initial strength and Final strength
    - Initial volume and Final volume

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# Means and Extremes

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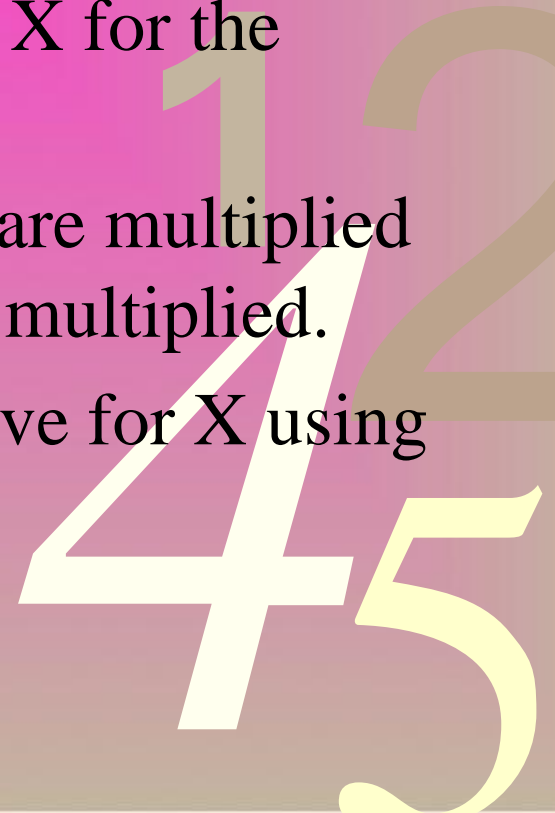
- 2. The formula is set up thus—
- Final strength : Initial strength :: Initial volume : Final volume

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# Means and Extremes

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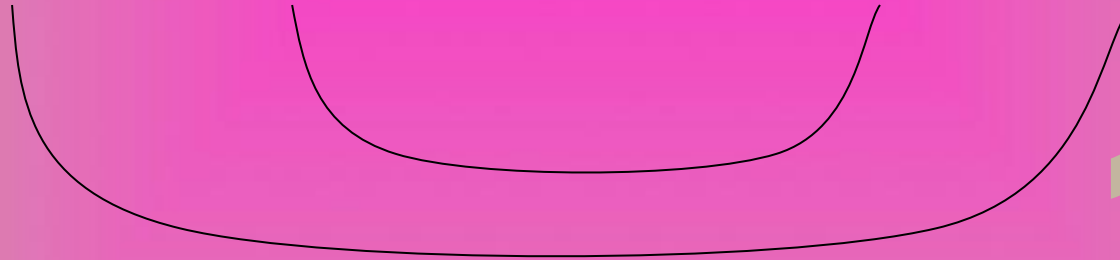
3. After labeling the components given in a word problem, the student needs to fill in the three values that are presented and put an X for the unknown.
  - Then the extremes (outer numbers) are multiplied and the means (inside numbers) are multiplied.
  - This should set the student up to solve for X using proportion.



# Means and Extremes

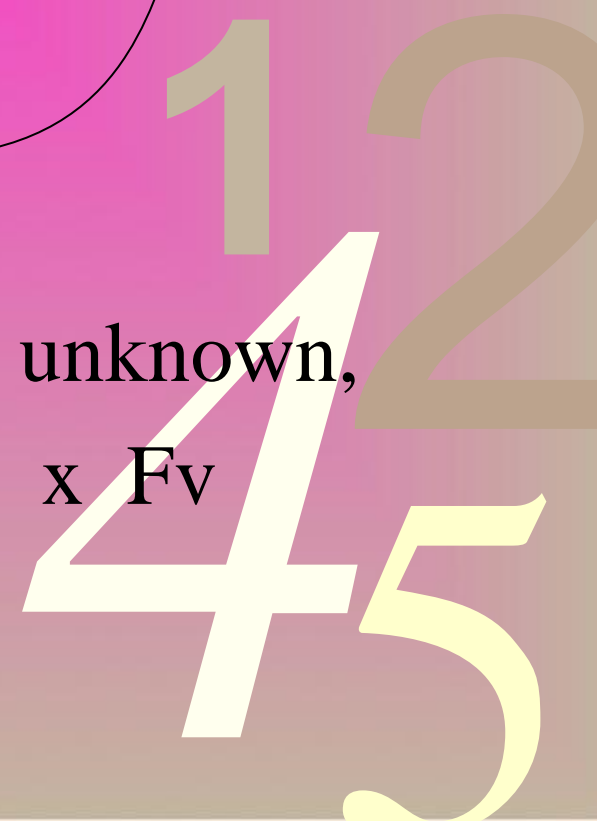
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- Final strength : Initial strength :: Initial volume : Final volume



- Example: If the initial strength is unknown,

- $F_s \times X(\text{unknown}) = I_v \times F_v$



# Simple

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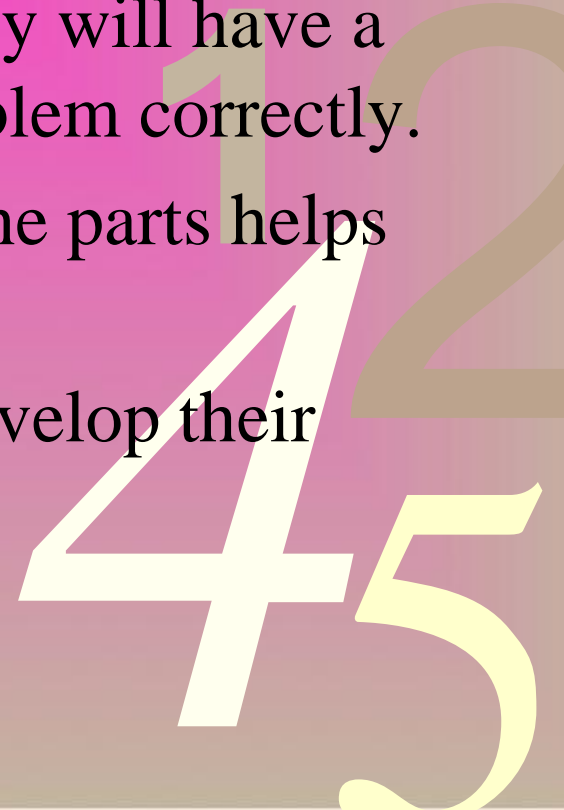
- **Simple**—two parts are known
- When only two parts of the problem are given usually a strength and a volume of a solution and the amount of solute is unknown, the following formula may be used—
- Final strength x Final Volume = Grams or milliliters of solute/solution

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# Word Attack on the Word Problem

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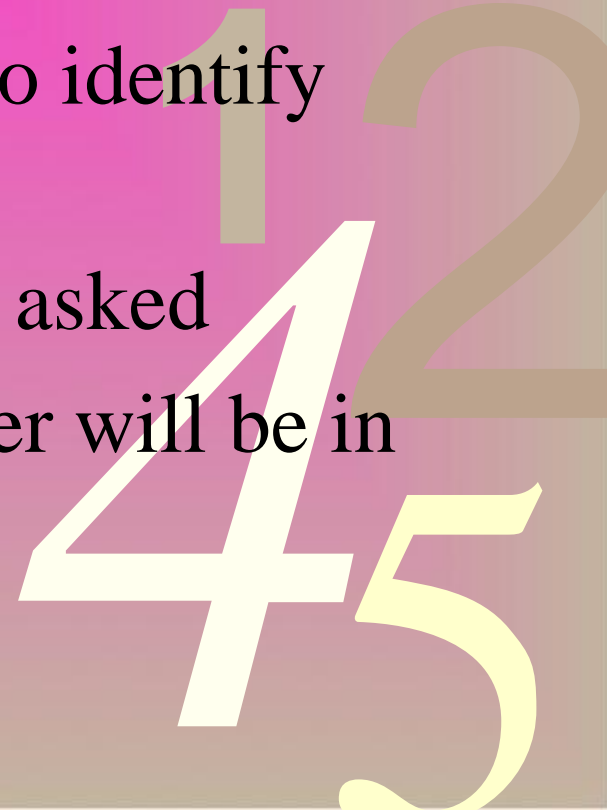
- If a student can eliminate unnecessary information in a word problem and identify the key parts of information given they will have a better chance of solving their problem correctly.
- Using a basic pattern to identify the parts helps simplify the word problem.
- The teacher or the student may develop their own pattern.



# Word Attack on the Word Problem

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- A. Determine the number of parts of information given
- B. Use symbols and objects to identify parts
  1. Underline what is being asked
  2. Circle the unit the answer will be in if known



# Word Attack on the Word Problem

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- For **Alligation**—
  1. Fill in strength for unknown solvent as 0%
  - Fill in strength for unknown solute as 100%.
  2. Identify the largest strength and the smallest strength—A and B
  3. Identify the strength desired C

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# Word Attack on the Word Problem

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- For **Means and Extremes**—
  1. Identify strengths (%) with S
  2. Identify usable volumes with V
  3. Use I for initial
  4. Use F for final
- For **Simple**—use the same identification as above

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# Word Attack on the Word Problem

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C. Determine anything not needed in the problem.

Mark through unneeded information.

D. Determine the formula needed based on number of parts provided

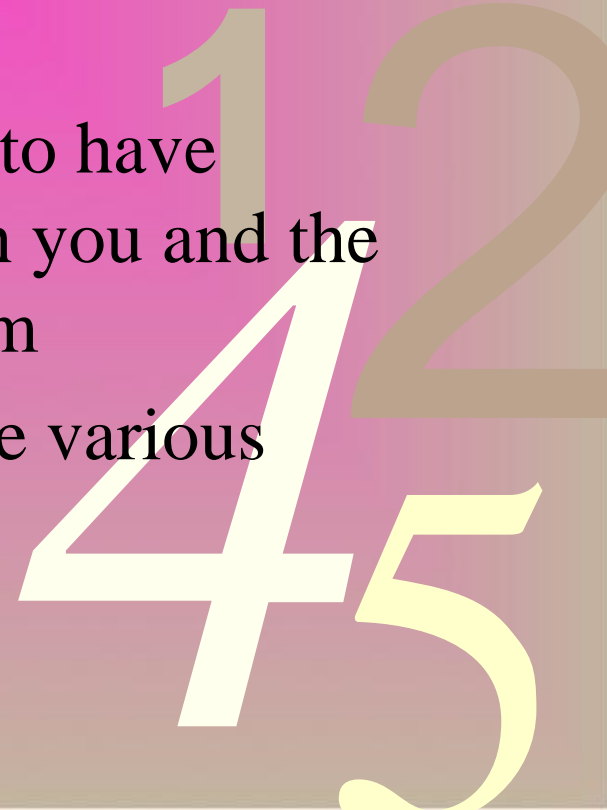
E. Determine the unit that will define the answer

- 1. If it is a solid it will be in a gram weight
- 2. If it is a liquid it will be in a liter measurement

# Word Attack on the Word Problem

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- All that is left then is to practice, practice, **PRATICE!**
- Suggestions—
  1. Use a white board or Promethean to have students practice individually with you and the class doing a sample word problem
  2. Give them work sheets that use the various methods



# Final Word

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- Math concepts need to be visited at every level of the health science sequence.
- **Concepts that need reinforcement** are:
- Simple math: addition, subtraction, etc
- Percentages
- Using decimals—rounding
- Conversions between metric and household measurements
- Household measurements—tsp, tbsp, cups, pints, quarts, gallons

