

**4P0X1 READINESS SKILLS
VERIFICATION LESSON PLAN
CALCULATIONS**



4P0X1 RVSP LESSON PLAN
PHARMACEUTICAL CALCULATIONS

INTRODUCTION:

OVERVIEW:

3a. Given medication dosing and compounding scenarios solve pharmaceutical calculations accurately. STS: 10.1, 10.2, 10.3

- 1) Ratio and proportion calculations
- 2) Calculation of doses
- 3) Reduce and enlarge formulas
- 4) Calculating the amount of medication in a dose
- 5) Percentage preparations
- 6) Concentration and dilution of stock solutions and triturations
- 7) Alligation alternate
- 8) Alligation medial
- 9) IV administration rate calculation

TRANSITION:

3a. Given medication dosing and compounding scenarios solve pharmaceutical calculations accurately.

1) Ratio and proportion – nearly 80 percent of the problems you will encounter in pharmacy can be solved using this method.

a) A ratio is the numerical comparison of two similar quantities

b) A proportion is a statement of the equality of two ratios

c) Solving problems using ratio and proportion

i) Step 1: Read the question. Ask yourself the question and write it down.

Example: Convert 4 fl oz to ml (How many mls in 4 fl oz?)

ii) Step 2: Draw an ratio and proportion (R & P) grid. Insert the question of the problem across the top of the grid.

X mls	4 fl oz

iii) Step 3: Choose a conversion equivalent that has the same or similar denominations as the problem

Example: In this case, use 1 fl oz – 29.57 mls

iv) Step 4: Write the conversion across the bottom of the R & P grid.

NOTE: Be sure that you place likes over likes (mls over mls, oz over oz, etc.)

X mls	4 fl oz
29.57 ml	1 fl oz

v) Step 5: Cross multiply

X mls	4 fl oz
29.57 ml	1 fl oz

vi) Step 6: Write down the products as an equation

$$4 \cdot 29.57 = 1 \cdot X$$

$$118.28 = 1 X$$

vii) Step 7: Divide both sides of the equation by the number multiplied by X

$$\frac{118.28}{1} = \frac{1X}{1}$$

viii) You answer is: $118.28 = X$

Be sure and label as the unit of the original unknown: $118.28 \text{ mls} = X$

d) Alternate Ratio/Proportion Method

Example: A prescriber orders 20 mg of a drug for a patient. The drug is available in a 10 ml vial which contains 50 mg of the drug. How many ml are needed to supply the dose of 20 gm?

i) Three things are known from the example problem's statement.

(1) 10 ml vial is available

(2) 50 mg of the drug is in the 10 ml vial

(3) 20 mg is the prescribed dose

ii) State the drug on hand as a ratio

$$\frac{10 \text{ ml}}{50 \text{ mg}} \text{ reduced to its lowest terms} = \frac{1 \text{ ml}}{5 \text{ mg}}$$

iii) State the required dosage as a ratio

$$\frac{1 \text{ ml}}{5 \text{ mg}} = \frac{X \text{ ml}}{20 \text{ mg}}$$

iv) Note in the proportion that the units are labeled and like units are located in the same position in each fraction or ratio (1 ml is opposite X ml and 5 mg is opposite 20 mg. It is important to label the parts of the proportion correctly. The answer label is always the label with the "X".

Three conditions must be met when using this method of ratio and proportion calculation

(1) The numerators must have the same units

(2) The denominators must have the same units

(3) Three of the four parts must be know (also true for the first method discussed)

v) To solve, simply find the cross product and solve for the unknown (X)

$$\frac{1 \text{ ml}}{5 \text{ mg}} = \frac{X \text{ ml}}{20 \text{ mg}}$$

$$5 \cdot X = 1 \cdot 20$$

$$5X = 20$$

$$X = 4 \text{ ml (20 divided by 5)}$$

Therefore, 4 ml of the solution contains 20 mg of the drug.

vi) This method is set up the way we think logically: if this is so, then that will follow. Many problems can be analyzed with the “if-then” approach.

In the last example we could say IF we have 10 ml containing 50 mg of drug, THEN X ml of solution will contain 20 mg of drug.

$$\begin{array}{ccc} \text{IF} & & \text{THEN} \\ \frac{10 \text{ ml}}{50 \text{ mg}} \text{ or } \frac{1 \text{ ml}}{5 \text{ mg}} & = & \frac{x \text{ ml}}{20 \text{ mg}} \end{array}$$

vii) Remember that the first ratio of a proportion is always formed from the quantity and strength of the drug on hand.

2) Calculations of doses

- a) Dose – a dose is the amount of preparation a patient takes at one time.
- b) Solving problems pertaining to calculation of doses

What is the size of each dose if a patient is given 300 ml and instructed to take the medication once daily for 20 days?

i) Step 1: Use this standard formula

$$\begin{array}{ccc} \frac{\text{Total Preparation}}{\text{Number of doses}} & \left| \right. & \text{Size of each dose} \\ \uparrow & & \leftarrow \text{Divide line} \\ \text{Multiply line} & & \end{array}$$

- ii) Step 2: Place the X or unknown in the formula first. Then place the information given in the appropriate places.

$$\frac{300 \text{ ml}}{20 \text{ doses}} \quad | \quad X$$

- iii) Step 3: Make sure that the total preparation and size of each dose is in the same metric units. If they are not, convert as needed. Units must be metric.

$$\frac{300 \text{ ml}}{\text{doses}} \quad | \quad X \qquad 300 \div 20 = X$$

- iv) Step 4: Write the equation as the formula shows it to be written. Always place X by itself

- v) Step 5: Divide to arrive at the answer. Remember to label.

$$X = 15 \text{ ml}$$

3) Reduce and enlarge formulas

- a) The ratio and proportion method can be used to reduce and enlarge formulas, however, the factor method requires less calculations
- b) Factor method

Example: Reduce this formula to make 120 ml.

Peppermint Oil	2 ml
Talc	15 gm
Purified Water (QSAD)	1000 ml

- i) Step 1: How much will the original (old) formula make? 1000 ml
- ii) Step 2: How much of the original formula do you wish to make (new)? 120 ml
- iii) Step 3: Place these values over each other as illustrated

$$\frac{120 \text{ ml (new amount)}}{1000 \text{ ml (old amount)}}$$

iv) Step 4: Solve for your FACTOR.

Formula for factoring

$$\frac{\text{NEW}}{\text{OLD}}$$

v) Step 5: Divide the Old into the NEW. $120 \div 1000$

Your FACTOR is: 0.12

vi) Step 6: Once this factor is found, find the amount of active ingredient to be used in the new formula by multiplying each ingredient by this FACTOR.

$$\begin{aligned} \text{Peppermint Oil: } & 2 \text{ ml} \cdot 0.12 \text{ (factor)} = 0.24 \\ \text{Talc: } & 15 \text{ gm} \cdot 0.12 \text{ (factor)} = 1.80 \text{ gm} \end{aligned}$$

vii) Step 7. Your new formula is:

Peppermint Oil	0.24 ml
Talc	1.8 gm
Purified Water (QSAD)	120 ml

viii) To enlarge formulas, use exactly the same procedure. Remember to place the New over the Old to find your factor and multiply this number by your active ingredient.

In reducing formulas the value of your factor will be less than one. In enlarging formulas, the value of your factor will be greater than one.

c) Proportionate parts method

Example: Prepare 130 gm of this ointment

Starch	5 parts
Zinc Oxide	10 parts
Hydrophilic Ointment Base	50 parts

i) Step 1: Add up all the parts to find the total parts in the formula

$$5 + 10 + 50 = 65 \text{ parts}$$

- ii) Step 2: What is the total number of grams you wish to make? 130 gms
- iii) Step 3: Since 130 gms represents the total weight and 65 parts represents the total parts, 130 gms equals 65 parts.

To find the weight of one part, divide the number of parts into the total weight.

$$130 \text{ gms} \div 65 \text{ parts} = 2 \text{ gms} \quad \text{Each part will weigh 2 gms.}$$

- iv) Step 4: Multiply the weight of one part times the number of parts required for each ingredient.

Starch	5	· 2	=	10 gms
Zinc Oxide	10	· 2	=	20 gms
Hydrophilic Ointment	50	· 2	=	100 gms

- v) Your new formula:

Starch	10 gms	
Zinc Oxide	20 gms	
Hydrophilic Ointment	100 gms	
Total Weight	130 gms	

4) Calculating the amount of medication in a dose

- a) Example: How many mg of Codeine Phosphate will each 5 ml dose contain?

Codeine Phosphate	240 mg
Elixir of Terpin Hydrate (QSAS)	120 ml

- i) Step 1: How much active ingredient is in the “old” formula? 240 mg How many ml will the “old” formula make? 120 ml Write these values side by side.

$$240 \text{ mg} \quad 120 \text{ ml}$$

- ii) Step 2: How much active ingredient will each dose contain? _____ This is the unknown so use “X” and place it over the 240 mg. How many ml will be in each dose (new)? 5 ml Write this value over 120 ml.

A.I.	T
X mg	5 ml
240 mg	120 ml

iii) Solve this problem using the ratio and proportion method.

$$\begin{array}{l} \text{Cross multiply:} \\ \text{Divide both sides of the equation by 120.} \end{array} \qquad \begin{array}{l} 120x = 1200 \\ x = 10 \end{array}$$

b) When calculating for one active ingredient, it is not necessary to use the factor method. The factor method is a short cut when finding several active ingredients.

5) Percentage preparations

a) There are three types of percentage preparations:

Weight in Volume (W/V) is defined as the number of grams of solute in 100 ml of solution

Volume in Volume (V/V) is defined as the number of ml of solute in each 100 ml solution

Weight in Weight (W/W) is defined as the number of grams of solute in 100 gms of a solid preparation

b) The general formulas used in calculating percentage preparations are:

$$\text{Active Ingredient (AI)} = \text{Total Amount} \cdot \text{Percent (\%)}$$

$$\text{Percent (\%)} = \frac{\text{Active Ingredient (AI)}}{\text{Total Amount}}$$

$$\text{Total Amount} = \frac{\text{Active Ingredient (AI)}}{\text{Percent (\%)}}$$

c) In working these problems, the percent is converted to a decimal before solving. The general rule for changing a percent to a decimal is to divide by 100. The general rule for changing a decimal to a percentage is to multiply by 100. Watch your decimal placement!

d) Instead of learning the three general formulas listed, you can use the following method

$$\begin{array}{c} \text{AI} \\ \hline \text{Total} \quad | \quad \% \\ \downarrow \\ \text{Multiply} \end{array} \quad \begin{array}{l} \leftarrow \text{Divide} \\ = \text{convert to a decimal before solving} \end{array}$$

NOTE: Change your percentage (%) to a decimal before solving the problem

- e) Calculating the amount of active ingredient in a percentage preparation when given the percentage strength and the total amount.

Example: How many grams of Sodium Chloride will be required to prepare 100 ml of a 15% (W/V) solution?

- i) Step 1: Assign values to the appropriate terms

- | | |
|--|-------------------|
| (1) What are you looking for? | Active Ingredient |
| Therefore, the Active Ingredient becomes | X grams |
| (2) What is your total amount? | 100 milliliters |
| (3) What is your percentage? | 15% |
| Change the percentage to a decimal by dividing it by 100 | 0.15 |

- ii) Step 2: Write the problem, placing values in the proper placement

$$\frac{\text{AI} = X}{\text{Total} = 100 \text{ ml} \quad | \quad \% = 0.15}$$

$$X = 100 \times 0.15$$

- iii) Step 3: Solve by the process indicated: $X = 15$

- (1) Since you have assigned the value of X as grams, your answer is: 15 grams

- iv) Notice in your problem after 15% you see the symbol (WV). Remember the definitions. If the volume is given to you as milliliters, your weight will be in grams. In solving these problems, make sure you are working in the proper system – Metric, Apothecary, or Avoirdupois. This will depend on what is given to you and what you are to solve.

- f) Calculating the percentage strength of a preparation (V/V) when given the total amount and amount of active ingredient

Example: What is the percentage strength of 240 ml (V/V) of a solution containing 12ml of Orange Oil?

i) Step 1: Assign values to the appropriate terms

- | | |
|---|---------------------|
| (1) What is your total amount? | 240 ml |
| (2) What is your active ingredient? | 12 ml of Orange Oil |
| (3) What are you looking for? | Percentage strength |
| Therefore, let X represent the percentage strength. | X % |

ii) Step 2: Write the problem, placing values in the proper placement

$$\frac{\text{AI} = 12 \text{ ml}}{\text{Total} = 240 \text{ ml} \quad | \quad \% = X}$$

$$X = 250 \div 12$$

iii) Step 3: Solve by the process indicated: $X = 0.05$

iv) Step 4: $X = 0.05$, is this your final answer? NO, it is a decimal answer.

v) Step 5: Change a decimal to a percentage (%), multiply by 100. Therefore, your answer is: 5%

g) Always make sure you know what you are looking for. As in this case you were looking for percentage (%). Therefore, an additional step is indicated, changing your decimal to a percent.

h) Calculating the total amount of a preparation when given the percentage strength and the amount of active ingredient

Example: How many grams of a 15% (W/W) Sulfur Ointment can be made from 30 grams of Sulfur Powder?

i) Step 1: Assign values to the appropriate terms

- | | |
|---|--|
| (1) What are you looking for?
therefore, the total amount
becomes: | Total Amount

X grams |
| (2) What is your active ingredient? | 30 grams |
| What is your percentage?
Change the percentage to a
decimal by dividing by 100. | <u>15%</u>

0.15 (decimal form of 15%) |

ii) Step 2: Write the problem, placing values in the proper placement

$$\begin{array}{r|l} \text{AI} = 30 \text{ gms} & \\ \hline \text{Total} = X & \% = 15\% \\ & = 0.15 \end{array}$$

$$X = 30 \div 0.15$$

iii) Step 3: Solve by the process indicated: $X = 200$

iv) Step 4: Since you have assigned the value of X as Grams, your answer is: 200 grams

- i) Notice in your problem after 15% you see the symbol (W/W). This means that there are solids involved in this problem. If one is given to you as grams, then the other will be in grams. Make sure that you stay in the proper system when solving and convert to any other system after solving for the unknown if necessary.

6) Concentration and dilution of stock solutions and triturations

- Stock solutions are solutions of known concentration that are frequently prepared by the pharmacy for convenience in dispensing.
- Stock triturations are dilutions of potent substances prepared by mixing finely powdered medicaments with finely powdered Lactose in a definite proportion by weight.
- General Formula

$$\text{Amt}_1 \cdot \%_1 = \text{Amt}_2 \cdot \%_2$$

Example: If 500 ml of a 10% solution was diluted to make a 2% solution, how many mls will the new solution measure?

i) Step 1: What information is given concerning the first solution?

500 ml of 10%

ii) Step 2: What information is given concerning the second solution? (use “X” for the unknown)

X ml of 2%

iii) Step 3: Write the complete formula:

$$\text{Amt}_1 \cdot \%_1 = \text{Amt}_2 \cdot \%_2$$

iv) Step 4: Assign values to the appropriate terms:

$$\begin{aligned}\text{Amt}_1 &= 500 \text{ ml} \\ \%_1 &= 0.10 \text{ (as a decimal)} \\ \text{Amt}_2 &= \text{“X” ml} \\ \%_2 &= 0.02 \text{ (as a decimal)}\end{aligned}$$

v) Step 5: Rewrite the formula substituting the assigned values for the terms

$$500 \text{ ml} \cdot 0.10 = \text{X ml} \cdot 0.02$$

vi) Step 6: Solve by the process indicated:

$$50.00 = 0.02x$$

vii) Step 7: Divide both sides of the equation by 0.02

$$2500 = X$$

viii) Step 8: Since X is mls, your answer is: 2500 ml

d) Calculating the amount of diluent

Example: How much water should be added to 1 liter of a 70% solution to make a 35% solution?

i) Step 1: Write the complete formula: $\text{Amt}_1 \cdot \%_1 = \text{Amt}_2 \cdot \%_2$

ii) Step 2: Assign values to the appropriate terms:

$$\begin{aligned}\text{Amt}_1 &= 1000 \text{ ml (1 liter)} \\ \%_1 &= 0.70 \text{ (as a decimal)} \\ \text{Amt}_2 &= \text{“X” ml}\end{aligned}$$

$$\%_2 = 0.35 \text{ (as a decimal)}$$

iii) Step 3: Rewrite the formula substituting the assigned values for the terms

$$1000 \text{ ml} \cdot 0.70 = X \text{ ml} \cdot 0.35$$

iv) Step 4: Solve by the process indicated:

$$700.00 = 0.35x$$

v) Step 5: Divide both sides of the equation by 0.35

$$2000 = X$$

vi) Step 6: Since X is mls, your answer is: 2000 ml

vii) Step 7: Subtract the amount of the first solution from the amount of the new solution to find how much water was added.

$$2000 \text{ ml} - 1000 \text{ ml} = 1000 \text{ ml}$$

viii) Step 8: The difference between the volume of the first solution and that of the second solution is the amount of water to be added.

1000 ml of water added

7) Alligation Alternate

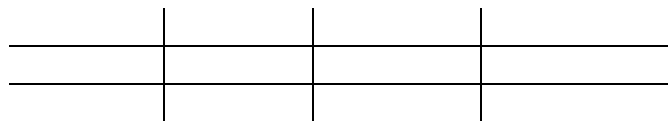
a) The method of calculating the number of parts of two or more components of a given strength when they are to be mixed to prepare a mixture of desired strength.

Example: To make 1000 ml of a 40% solution using a 10% solution and a 50% solution, how many milliliters of each is required?

i) Step 1: What is the percentage strength of the solution you are going to make and its amount? 40% 1000 ml This is called the WANTED %.

ii) Step 2: What are the strengths of the solutions you are going use? 50% and 10% These are called the HAVES %'s.

iii) Step 3: Draw the following configuration to set up your problem. It is similar to the game of Tic-Tac-Toe.



- iv) Step 4: Label each section of the Tic-Tac-Toe configuration as follows: Have, Want, Parts, Amounts. Then place the “WANTED” in the proper location. It always goes in the center box.

HAVE	WANT	PARTS	AMOUNTS
	40		1000 ml

- v) Step 5: Place the largest percentage of the HAVES in the upper LEFT corner; and the lower percentage in the lower LEFT corner.

HAVE	WANT	PARTS	AMOUNTS
50			
	40		1000 ml
10			

- vi) Step 6: The difference between 50 and 40 is 10. Place this number in the bottom section of the PARTS. The difference between the 40 and 10 is 30. Place this number in the top section of the PARTS.

HAVE	WANT	PARTS	AMOUNTS
50		30	
	40		1000 ml
10		10	

Note: Since the question asks for the number of milliliters of the 50% and 10%, you must use the parts section of this Tic-Tac-Toe structure. However, in solving any ratio proportion problem, you must have three knows and solve for the fourth. Therefore:

- vii) Step 7: In this case we must find the total parts the solution will contain. To do this, all that you do is add the parts you already have and place the sum into the center square.

$$30 + 10 = 40$$

HAVE	WANT	PARTS	AMOUNTS
50		30	
	40	40	1000 ml
10		10	

- viii) Step 8: Reduce the parts section if possible. In this case it can be reduced by 10.

HAVE	WANT	PARTS	AMOUNTS
50		3	
	40	4	1000 ml
10		1	

- ix) Step 9: Since 4 parts equal 1000 ml (the total), how many ml will each part contain? This can be calculated by setting up a ratio and proportion since you have three sections to the problem.

HAVE	WANT	PARTS	AMOUNTS
50		3	X ml
	40	4	1000 ml
0		1	X ml

$$\frac{3 \text{ parts}}{4 \text{ parts}} = \frac{X \text{ ml}}{1000 \text{ ml}}$$

- x) Step 10: Solve by the process indicated

$$4X = 3000$$

$$X = 750$$

- xi) Step 11: Since X equals the number of ml of the 50% solution, your answer is:

750 ml of 50% solution

- xii) Step 12: Solve for the 10% solution the same way

$$\frac{4 \text{ parts}}{1 \text{ part}} = \frac{1000 \text{ ml}}{x \text{ ml}}$$

$$4X = 1000$$

$$X = 250$$

- xiii) Step 13: Since X equals the number of ml of the 10% solution, your answer is:

250 ml of 10% solution

8) Alligation Medial

Example: If you mixed the following solutions together, what would the percentage strength of the total be?

100 ml of a 50% (W/V)
 200 ml of a 10% (W/V)
 50 ml of water 0% (Water is always considered 0%)

a) Step 1: List all the amounts and their percentages (converted to a decimal)

100 ml 0.50
 200 ml 0.10
 50 ml 0.00

b) Step 2: Multiply each of the volumes times its respective percentage strength and place the answer to the right on the same line.

100 ml x 0.50 = 50.00
 200 ml x 0.10 = 20.00
 50 ml x 0.00 = 00.00

c) Step 3: Add the first column and write the total under it, then add the third column and write its total under it.

100 ml x 0.50 = 50.00
 200 ml x 0.10 = 20.00
50 ml x 0.00 = 00.00
 350 ml 70.00 gm

d) Step 4: The 350 ml is the total volume of the mixture and the 70 grams will be the total amount of Active Ingredient in that total.

e) Step 5: Remember the formula we covered in percentage preparations section? If you had the total amount and amount of Active Ingredient (AI) you could find the percentage strength.

$$\frac{\text{AI}}{\text{Total}} = \frac{\%}{100} \quad \leftarrow \text{Divide}$$

↑
Multiply

f) Step 6: Assign the values to the appropriate terms.

$$\frac{\text{AI} = 70 \text{ gm}}{\text{Total} = 350 \text{ ml}} = \frac{\% = X}{100}$$

$X = \underline{70 \text{ gm}}$

350 gms (ml to gm)

g) Step 7: Solve for the process indicated.

$$X = 0.2$$

h) Step 8: The answer of 0.2 is a decimal and you are asked for a percentage. To change a decimal to a percent multiply by 100. Therefore, your answer is:

$$100 \times 0.2 = 20 \quad X = 20\%$$

9) IV administration rate calculation

a) Drops per minute calculation: Prescribers often order IV solutions to run for a stated number of hours. You may have to calculate the number of drops per minute to comply with this order.

Example: The prescriber orders 3000 ml of dextrose 5% in water (D5W) IV over a 24-hour period. If the IV administration set is calibrated to deliver 15 drops per ml, how many drops must be administered to the patient per minute?

i) Step 1: Determine the number of ml the patient will receive per hour.

$$\frac{3000 \text{ ml}}{24 \text{ hr}} = \frac{X \text{ ml}}{1 \text{ hr}} = 24x = 3000$$

$$X = 125 \text{ ml/hr or } 125 \text{ ml}/60 \text{ minutes}$$

ii) Step 2: Determine the number of ml the patient will receive per minute

$$\frac{125 \text{ ml}}{60 \text{ min}} = \frac{X \text{ ml}}{1 \text{ ml}} = 60X = 125$$

$$X = 2 \text{ ml/min}$$

iii) Step 3: Determine the number of drops per minute that will equal the number of ml calculated in step 2. The drop rate specified for the IV administration set being used must be considered in this step. The drop rate is expressed as a ratio of drops per ml (gtt/ml).

$$\frac{15 \text{ gtt}}{1 \text{ ml}} = \frac{X \text{ gtt}}{2 \text{ ml (amount needed/min)}} = 1X = 30$$

$$X = 30 \text{ gtt/min}$$

- b) IV administration rate time: To calculate the time required to administer an IV solution when you already know the volume and flow rate, follow these steps.

Example: Use information in previous example, 9a

- i) Step 1: Calculate the number of ml/min being infused.

$$\text{Drop rate of IV administration set} = \frac{15 \text{ gtt}}{1 \text{ ml}} = \frac{45 \text{ gtt}}{X \text{ ml}} = 15X = 45$$

$$X = 3 \text{ ml/min}$$

- ii) Step 2: Calculate the number of ml/hr

$$3 \text{ ml/min} \times 60 \text{ min/hr} = 180 \text{ ml/hr}$$

- iii) Step 3: Calculate the number of hours needed to administer the total volume of solution.

If 180 ml are delivered each hour, how many hours are required to administer 1500 ml?

$$\frac{180 \text{ ml}}{1 \text{ hr}} = \frac{1500 \text{ ml}}{\text{hr}} = 180X = 1500$$

$$X = 8.3 \text{ hours or } 8 \text{ hours } 20 \text{ minutes}$$

- c) IV fluid volume control

- i) There may be times when a patient is restricted to a certain amount of fluid during a stated time. There can be many reasons for this, one of which is diminished kidney functioning. The prescriber's order may read something like this

Restrict patient IV fluid intake to 1500 ml/24 hours

- ii) To determine the maximum hourly IV administration flow rate to achieve 1500 ml in 24 hours, you simply divide 1500 ml by 24 hours. Your maximum IV administration flow rate is 62.5 ml/hr.

- d) Drug amount calculations: to determine how much drug a patient is receiving per day, follow these calculations.

Example: If an order is written to administer 1.5 gm of aminophylline in 1000 ml D5W/0.45% NaCl to run at 50 ml/hr, how much aminophylline is the patient receiving per day?

i) Step 1: Determine the total volume the patient is receiving per day

$$\frac{50 \text{ ml}}{\text{hr}} \times \frac{24 \text{ hrs}}{\text{day}} = \frac{1200 \text{ ml}}{\text{day}}$$

ii) Step 2: Determine the amount of medication contained in the result of step 1

$$\frac{150 \text{ mg (1.5g) of aminophylline}}{1000 \text{ ml of D5W/0.45\% NaCl}} = \frac{X}{1200 \text{ ml}}$$

$$1000X - 1500 \times 1200 = 1000X = 1,800,000$$

$$X = 1800 \text{ mg}$$

This patient will receive 1800 mg (1.8gm) of aminophylline in a 24 hour period.

Example: Using the same IV aminophylline order, calculate how much aminophylline 25mg/ml injection should be added to the 1000 ml IV bag of D5W/0.45% NaCl to achieve the 1500 mg aminophylline dose.

$$\frac{25 \text{ mg}}{1 \text{ ml}} = \frac{1500 \text{ mg}}{X}$$

$$25X = 1500 \text{ mg}$$

$$25X = 60 \text{ ml}$$

You would add 60 ml of aminophylline (25mg/ml) injection to the 1000 ml of D5W/0.45% NaCl

Example: Let's say the patient is a child, weighing 40 kg, and the dosage of aminophylline is 1mg/kg/hr. At what rate should the previously discussed aminophylline IV (1500 mg in 1000 ml) be administered? To calculate this you follow these steps.

iii) Step 1: Determine the hourly dosage of medication for the child

$$\frac{1 \text{ mg}}{\text{kg/hr}} = \frac{X}{40 \text{ kg}} = X (40 \times 1)$$

$$X = 40 \text{ mg/hr}$$

iv) Step 2: Determine the amount of IV solution containing the answer to step 1

$$\frac{1500 \text{ mg aminophylline}}{1000 \text{ ml of D5W/0.45\% NaCl}} = \frac{40 \text{ mg}}{X}$$

$$1500X = 40 \times 1000 = 1500x = 40,000$$

$$X = 27 \text{ ml}$$

The patient's aminophylline IV solution should be administered at a rate of 27 ml/hr to provide the dosage of 40 mg/kg/hr.

TRANSITION:

SUMMARY:

3a. Given medication dosing and compounding scenarios solve pharmaceutical calculations accurately.

- 1) Ratio and proportion calculations
- 2) Calculation of doses
- 3) Reduce and enlarge formulas
- 4) Calculating the amount of medication in a dose
- 5) Percentage preparations
- 6) Concentration and dilution of stock solutions and triturations
- 7) Alligation alternate
- 8) Alligation medial
- 9) IV administration rate calculation

CONCLUSION:

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APPENDIX: Conversion Chart

Roman Numerals

<i>Roman Numeral</i>		<i>Value</i>
I or i	=	1
V or v	=	5
X or x	=	10
L or l	=	50
C or c	=	100
D or d	=	500
M or m	=	1,000

Rule 1

When numerals are repeated, you add to get the value. However, *only* I, X, C, and M may be repeated, but just to a maximum of three times.

$$\text{III} = 1 + 1 + 1 = 3$$
$$\text{XX} = 10 + 10 = 20$$

Rule 2

Add numerals when the numeral written to the right of the number is a *smaller* numeral.

$$\text{XII} = 10 + 1 + 1 = 12$$
$$\text{LXVI} = 50 + 10 + 5 + 1 = 66$$

Rule 3

Subtract the value of a numeral when the numeral is written to the left of a numeral that has a larger value. Only I, X, and C may be written to the left of the next two numerals of higher value. For example, only I can be written to the left of V and X – not L, C, D, or M; only X can be written to the left of L and C, not D or M; and C is only written to the left of D or M.

$$\text{IV} = 5 - 1 = 4$$
$$\text{XL} = 50 - 10 = 40$$

Rule 4

A bar written over a numeral means that the numeral is multiplied by 1,000.

$$\overline{\text{C}} = 1000 \text{ times } 1,000 = 100,000$$

Apothecary System

One of the oldest systems of weights and measures is the Apothecary system and although antiquated and no longer official, it is still used in medicine.

Weights

Grains (gr.)	=	0.0648 gram (gm)
Ounces (oz)	=	1 pound (lb)

Liquid

1 fluid drams	=	15 milliliter (ml)
1 fluid ounces	=	30 ml
16 fluid oz	=	1 pint (pt)
4 quarts (qt)	=	1 gallon (Cong. gal)

Aviordupois System

This system is the official system of commerce. You will come in contact with these measurements in ordering drugs through your supply lines.

437.6 grains (gr)	=	1 ounce (oz)
16 oz	=	1 pound (lb)
7000 grs	=	1 lb

Conversions Equivalents of Weights and Measures

0.648 gm	=	1 gr
64.8 gm	=	1 gr
1 gm	=	15.432 gr
31.1 gm	=	1 oz (Apoth)
28.35 gm	=	1 oz (Av)
454 gm	=	1 lb (Av)
1 kg	=	2.2 lb (Av)
29.57 ml	=	1 fl oz (Apoth)
473 ml	=	1 pt

Common Equivalent

These equivalents are only used in directions to patients to ease dose measurement. Never use these equivalents when compounding sterile and non-sterile preparations.

1 teaspoonful (tsp)	=	1 fl dram	=	5 ml
1 tablespoonful (tbsp)	=	½ fl oz	=	15 ml
1 cc	=	1 ml		

Metric System

The metric system uses standard measures (meter, gram, and liter) and prefixes to describe multiples or fractions of a measure. There are two types of prefixes used to describe multiples or fractions of the standard measures for weight and volume.

Latin prefixes – denotes fractions

micro	1/1000,000	=	0.000001
milli	1/1,000	=	0.001
centi	1/100	=	0.01
deci	1/10	=	0.1

Greek prefixes – denotes multiples

Deca	10
Hecto	100
Kilo	1,00