Calculating Drug Dosages

Calculating Doses from Prepared-Strength Liquids, Tablets, and Capsules

Calculating With Proportions

Steps:
1. Convert to a consistent unit of measure.
2. Set up a proportion:

\[
\frac{\text{Original dose}}{\text{Per amount}} = \frac{\text{Desired dose}}{\text{Per amount}}
\]

3. Cross-multiply and solve for the unknown \(x\).

Example 1: Tablets

How many tablets are needed to deliver 500 mg of Tylenol?

Original dose = 250 mg
Per amount = 1 tablet

Desired dose = 500 mg
Per amount = unknown \((x)\)

1. Set up a proportion:

\[
\frac{250 \text{ mg}}{1 \text{ tab}} = \frac{500 \text{ mg}}{x \text{ tab}}
\]

2. Cross-multiply and solve for the unknown \(x\):

\[
250x = 500
\]

\[
x = \frac{500}{250} = 2
\]

Answer: 2 tablets are needed to deliver 500 mg of Tylenol

Example 2: Solutions

How many milliliters of elixir are needed to deliver 15 mg of Phenobarbital?

Original dose = 120 mg
Per amount = 30 ml
Desired dose = 15 mg  
Per amount = x ml

1. Set up a proportion:

\[
\frac{120 \text{ mg}}{30 \text{ ml}} = \frac{15 \text{ mg}}{x \text{ ml}}
\]

2. Cross-multiply and solve for the unknown (x):

\[120x = 450\]

\[x = \frac{450}{120} = 3.75 \text{ ml}\]

Answer: 3.75 ml are needed to deliver 15 mg of the elixir

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I. **Drug Amounts in Units**

Some drugs are manufactured in units (U) rather than in grams or milligrams.  
Note: A unit does not have a standard metric equivalent. The metric equivalent (milligrams, etc.) varies for each drug. Examples are penicillin, insulin and heparin. Solving dose problems for these drugs is exactly the same as for other dosage units except that unit (U) is substituted for milligrams (mg).

Example 3: Units

How many milliliters are needed to deliver 500 U of heparin?

Original dose = 120 mg  
Per amount = 30 ml  
Desired dose = 15 mg  
Per amount = x ml

1. Set up a proportion:

\[
\frac{1000 \text{ U}}{1 \text{ ml}} = \frac{500 \text{ U}}{x \text{ ml}}
\]

2. Cross-multiply and solve for the unknown (x):

\[1000x = 500\]

\[x = \frac{500}{1000} = 0.5 \text{ ml}\]
Answer: 0.5 ml are needed to deliver 500 units of heparin

II. Calculations With a Dosage Schedule

There are times when the dose of a drug must be obtained from a schedule, which may be based on the size of the person. The dose may be presented in mg/kg of body weight. This means that the dose must first be calculated after the body weight is obtained, and then the amount of the drug preparation needed can be calculated.

Steps:
1. Calculate the dose needed
2. Convert to a consistent unit of measure
3. Set up a proportion

\[
\frac{\text{Original dose}}{\text{Per amount}} = \frac{\text{Desired dose}}{\text{Per amount}}
\]

4. Cross-multiply and solve for the unknown (x)

Example 4: Dosage Schedule

Using a dosage schedule of 0.1 mg/kg for albuterol syrup, and a prepared-strength mixture of 2mg / 5 ml, how much of the syrup is needed for a 30 kg child?

1. Calculate the dose needed:
   \[
   \text{Dose} = 0.1 \text{ mg/kg} \times 20 \text{ kg} = 3.0 \text{ mg}
   \]

2. Set up a proportion:

\[
\frac{2.0 \text{ mg}}{5 \text{ ml}} = \frac{3.0 \text{ mg}}{x \text{ ml}}
\]

3. Set up a proportion, cross-multiply and solve for the unknown (x):

\[
\frac{2.0 \text{ mg}}{5 \text{ ml}} = \frac{3.0 \text{ mg}}{x \text{ ml}}
\]
\[2x = 15\]
\[x = 7.5\]

Answer: 7.5 ml are needed to deliver 3.0 mg of albuterol syrup to this child

III. Calculating Doses From Percentage-Strength Solutions

a. Terms:
   i. Solute – the active ingredient (solid or liquid)
   ii. Solvent – the liquid that dissolves the solute (sterile H2O, NS)
   iii. Solution – a solute which is dissolved in a solvent
   iv. Strength – the percentage of solute to total solvent and solute
   v. Percentage – parts of the active ingredient (solute) in a preparations contained in 100 parts of the total preparation (solute and solvent)

b. Types of Percentage Preparations:
   i. Weight to Weight: Percent in weight (W/W) expresses the number of grams of a drug or active ingredient in 100 ml of a mixture:
      1. W/W: Grams per 100 g of mixture
   ii. Weight to Volume (most common): Percent may be expressed for the number of grams of a drug or active ingredient in 100 ml of a mixture:
      1. W/V: Grams per 100 ml of mixture
   iii. Volume to Volume: Percent expresses the number of milliliters of drug or active ingredient in 100 ml of a mixture:
      1. V/V: Milliliters per 100 ml of a mixture

c. Calculating with Percent-Strength Solutions

Steps:
1. Convert the percent solution to metric units (mg/1ml)

   Useful Trick: Percent Solutions can be quickly converted to milligrams per 1 milliliter by moving the decimal one place to the right:

   Example: 2% solution, move the decimal one place to the right, 2.0 mg/1 ml = 20 mg/1 ml

2. Set up a proportion and substitute knowns

   \[
   \frac{\text{Original dose}}{\text{Per amount}} = \frac{\text{Desired dose}}{\text{Per amount}}
   \]
3. Cross-multiply and solve for the unknown (x)
4. Express answer in the units requested

Example 5: Percent-Strength Solution

How many milligrams of active ingredient are in 3 ml of a 0.083% of albuterol (unit dose)?

1. Convert to metric units (mg/1 ml):
   \[
   \frac{0.083\%}{100 \text{ ml}} = \frac{0.083 \text{ g}}{100 \text{ ml}} = \frac{83 \text{ mg}}{100 \text{ ml}} = \frac{0.83 \text{ mg}}{1 \text{ ml}}
   \]
2. Set up a proportion:
   \[
   \frac{0.83 \text{ mg}}{1 \text{ ml}} = \frac{x}{3 \text{ ml}}
   \]
3. Cross-multiply and solve for the unknown (x):
   \[
   x = 0.83 \times 3
   \]
   \[
   x = 2.49 \text{ mg}
   \]
   Answer: There are 2.5 mg of active ingredient in a unit dose of albuterol.

d. Solutions By Ratio
   i. Frequently when diluting a medication for use in an aerosol treatment, a solute to solvent ratio is given (1:200, 1:1000)

Example 5: Solutions by Ratio

How many milligrams of active ingredient are in 2 ml of a 1:200 solution of isoproterenol?

1. Convert to metric units (mg/1 ml):
   a. Convert to % solution
      i. \(1:200 = \frac{1}{200} = 0.005 \times 100 = 0.5\%\)
   b. Then, convert to metric units (mg/1 ml)
      i. \(0.5\% = \frac{0.5 \text{ g}}{100 \text{ ml}} = \frac{500 \text{ mg}}{100 \text{ ml}} = \frac{5 \text{ mg}}{1 \text{ ml}}\)
2. Alternate method to convert to metric units (mg/1 ml)
   a. \(1:200 = \frac{1 \text{ g}}{200 \text{ ml}} = \frac{1000 \text{ mg}}{200 \text{ ml}} = \frac{10 \text{ mg}}{2 \text{ ml}} = \frac{5 \text{ mg}}{1 \text{ ml}}\)
3. Set up a proportion:
\[
\frac{5 \text{ mg}}{1 \text{ ml}} = \frac{x}{2 \text{ ml}}
\]

4. Cross-multiply and solve for the unknown (x):

\[x = 5 \times 2\]

\[x = 10 \text{ mg}\]

Answer: There are 10 mg of active ingredient in a 1:200 solution of isoproterenol.

IV. Solving Dilutions With a Dilute Solute

a. When the active ingredient, or solute is already diluted and less than pure, the following equation is used:

\[C_1 \times V_1 = C_2 \times V_2\]

Solving for \(V_2\):

\[V_2 = \frac{C_1 \times V_1}{C_2}\]

Where:

- \(C_1\) = desired concentration (in decimals)
- \(V_1\) = desired total volume (mL)
- \(C_2\) = concentration of solution on hand
- \(V_2\) = volume of solution needed for dilution

Steps:
1. Substitute known variables:
   a. Concentration of the solution as a decimal
      i. 20% solution = \(\frac{20}{100} = 0.20\)
   b. Volume (ml)
2. Solve for the unknown variable (\(V_2\))
3. Determine the amount of diluent (normal saline, sterile \(H_2O\)) needed
   a. Total solution amount – \(V_2\)

Example: Dilutions with a Dilute Solute

How much 20% Mucomyst is needed to prepare 5 ml of a 10% Mucomyst?
1. Substitute the known variables:

\[ C_1 = 0.10 \]
\[ V_1 = 5 \text{ ml} \]
\[ C_2 = 0.20 \]
\[ V_2 = \text{unknown} \]

2. Solve for the unknown variable \( V_2 \):

\[ V_2 = \frac{0.10 \times 5}{0.20} = \frac{0.5}{0.2} = 2.5 \text{ ml} \]

3. Determine the amount of diluent needed:

Total solution amount – \( V_2 \) = amount of diluent needed

\[ 5 \text{ ml} – 2.5 \text{ ml} = 2.5 \text{ ml diluent} \]

Answer: 2.5 ml of 20% Mucomyst and 2.5 ml normal saline are mixed to prepare 5 ml of a 10% solution of Mucomyst

***Note: Students are not responsible for calculating intravenous infusion rates.***