Southwest Wisconsin Technical College

Dimensional Analysis in Nursing

Module 1.8

DRUG CALCULATIONS – LIQUID MEDICINES

Noteworthy

- With liquid medications, you will want to know the **concentration** (stated on the drug label).
- A concentration of 100 mg/5 mL tells us that there are 100 mg of drug in 5 mL of solution. As an *equivalency*: 100 mg = 5 mL.

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Pete Esser
Knox Learning Center Mathematics Instructor
Contact: pesser@swtc.edu

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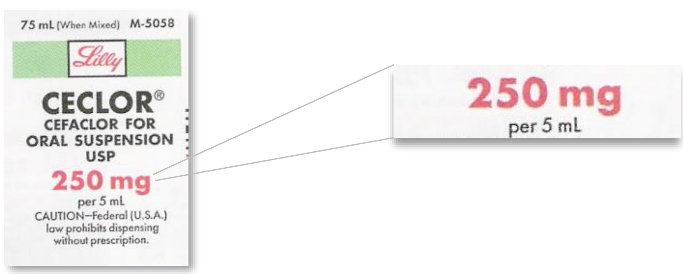
DRUG CALCULATIONS – LIQUID MEDICINES

Introduction
Now that you have had some practice performing drug calculations involving tablets and capsules, let's work with some liquid medicines.

As before, *you will start with doctor's orders*. The orders are usually expressed as a **mass** (milligrams, grams, etc.) but the drug itself is in liquid form. So as a nurse, you will need to know the **volume** to give the patient (milliliters, fluid ounces, teaspoons, tablespoons, etc.).

Concentration
Liquid drugs are described by their *concentration*. Concentration communicates the quantity of drug present in a specific volume of solution.

You can find the concentration of a drug on the product label:



The concentration for Ceclor is 250 mg per 5 mL.

This means there are 250 mg of Ceclor in 5 mL of solution (liquid).

Other examples…

Concentration	What it means:	Equivalency*
5 mg/2 mL	5 mg of medicine in 2 mL of solution (liquid)	5 mg = 2 mL
10 mg/mL	10 mg of medicine in 1 mL of solution	10 mg = 1 mL
25,000 units/5 mL	25,000 units of medicine in 5 mL	25,000 units = 5 mL

* True only for the particular drug you are working with at the moment.

Using Concentration
The concentration of a drug is used for converting from mass to volume.

When you see a concentration such as 250 mg/5 mL regard it as an equivalency; **250 mg = 5 mL**.
Use it like any other equivalency when using dimensional analysis to solve a problem.

Example 1.8.1
Prescription: Dilantin 50 mg per dose
Inventory: Dilantin 125 mg/mL
Quantity to give patient: __________ per dose

***What is the goal in this problem*?**
There are no specific directions about the units of measure required for the answer.

To answer this, start here; the drug available in inventory must be a *liquid* because it is identified by its **concentration** of 125 mg/mL.

Since the drug concentration volume is ***mL*** (**milliliters**) that will be our goal.

Step 1 – Write doctor's orders in fractional form with a denominator of 1.

Continue Step 1 by writing a multiply symbol (×) and another fraction bar with the *same units of measure* in the denominator.

Doctor's Orders

$$\frac{50\text{ mg}}{1} \times \frac{\quad}{\text{mg}}$$

Writing **mg** in the denominator guarantees that **mg** will get cancelled-out.

Goal: mL

Step 2 – Since the concentration of the medicine has the same units of mass as doctor's orders, we can use that to convert from *mg* to *mL*. Think of "125 mg/mL" as **125 mg** = **1 mL**. Having pre-written *mg* in Step 1 helps locate the information correctly.

$$\frac{50\text{ }\cancel{\text{mg}}}{1} \times \frac{1\text{ mL}}{125\text{ }\cancel{\text{mg}}}$$

Showing cancellation is good form. Make this a habit!

Goal: mL

Step 3 – We can compute the answer since *mL* is the only unit of measure remaining and it matches our goal. Solve by multiplying the numerators together, then multiplying the denominators. Finish by dividing numerator by denominator.

$$\frac{50\text{ }\cancel{\text{mg}}}{1} \times \frac{1\text{ mL}}{125\text{ }\cancel{\text{mg}}} = \frac{50\text{ mL}}{125} = \mathbf{0.4\text{ mL}}$$

Answer!

Example 1.8.2

Prescription: Neurontin 300 mg PO BID
Inventory: Neurontin 250 mg/5 mL
Quantity to give patient: __________ per dose

NOTE: In the prescription, the abbreviation **PO** means "*by mouth*" or "*orally*". **BID** means "twice a day".

The **goal** is *milliliters* (mL) since that is the unit of measure for volume used in the concentration of Neurontin; 250 mg/5 mL.

Step 1 – Write doctor's orders in fractional form with a denominator of 1.

Continue Step 1 by writing a multiply symbol (×) and another fraction bar with the *same units of measure* in the denominator.

Doctor's Orders

$$\frac{300\ \text{mg}}{1} \times \frac{\qquad}{\text{mg}}$$

Writing **mg** in the denominator guarantees that **mg** will get cancelled-out.

Goal: mL

Step 2 – Since the concentration of the medicine has the same units of mass as doctor's orders, we can use that to convert from *mg* to *mL*. Think of "250 mg/5 mL" as **250 mg** = **5 mL**.

$$\frac{300\ \cancel{\text{mg}}}{1} \times \frac{5\ \text{mL}}{250\ \cancel{\text{mg}}}$$

Goal: mL

Step 3 – We can compute the answer since *mL* is the only unit of measure remaining and it matches our goal. Solve by multiplying the numerators together, then multiplying the denominators. Finish by dividing numerator by denominator.

$$\frac{300\ \cancel{\text{mg}}}{1} \times \frac{5\ \text{mL}}{250\ \cancel{\text{mg}}} = \frac{1500\ \text{mL}}{250} = \mathbf{6\ mL}$$

Example 1.8.3

Prescription: Tetracycline Syrup 375 mg
Inventory: Tetracycline Syrup 125 mg/teaspoon
Quantity to give patient: __________ per dose

Note the volume unit of measure used in communicating the concentration of the Tetracycline Syrup is *teaspoon*. That indicates our **goal** should be *teaspoon(s)*.

Step 1 – Write doctor's orders in fractional form with a denominator of 1.

Continue Step 1 by writing a multiply symbol (×) and another fraction bar with the *same units of measure* in the denominator.

Doctor's Orders

$$\frac{375\text{ mg}}{1} \times \frac{\quad}{\text{mg}}$$

Writing **mg** in the denominator guarantees that **mg** will get cancelled-out.

Goal: teaspoons

Step 2 – The concentration of the medicine has the same units of mass as doctor's orders, so we can convert from *mg* to *teaspoons* right away.
Think of "125 mg/teaspoon" as **125 mg** = **1 teaspoon**.

$$\frac{375\ \cancel{\text{mg}}}{1} \times \frac{1\text{ teaspoon}}{125\ \cancel{\text{mg}}}$$

Goal: teaspoons

Step 3 – We can compute the answer since *teaspoons* is the only unit of measure remaining and it matches our goal. Solve by multiplying the numerators together, then multiplying the denominators. Finish by dividing numerator by denominator.

$$\frac{375\ \cancel{\text{mg}}}{1} \times \frac{1\text{ teaspoon}}{125\ \cancel{\text{mg}}} = \frac{375\text{ teaspoon}}{125} = \mathbf{3\ teaspoons}$$

Example 1.8.4

Prescription: Gentamicin 75 mg IM*

Inventory: Gentamicin 40 mg/mL

To prepare for the injection, you will need to draw-up ______ mL (nearest tenth) in the syringe.

***IM** refers to *intramuscular injection*.

The **goal** is *mL (milliliters)* since the drug concentration volume is milliliters.

Step 1 – Write doctor's orders in fractional form with a denominator of 1.

Continue Step 1 by writing a multiply symbol (×) and another fraction bar with the *same units of measure* in the denominator.

Doctor's Orders

$$\frac{75\text{ mg}}{1}\times\frac{\qquad}{\text{mg}}$$

Writing **mg** in the denominator guarantees that **mg** will get cancelled-out.

Goal: mL

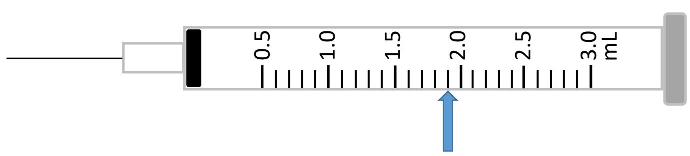
Step 2 – Since the concentration of the medicine has the same units of mass as doctor's orders, we can use that to convert from *mg* to *mL*. Think of "40 mg/mL" as **40 mg** = **1 mL**.

$$\frac{75\ \cancel{\text{mg}}}{1}\times\frac{1\text{ mL}}{40\ \cancel{\text{mg}}}$$

Goal: mL

Step 3 – We can compute the answer since *mL* is the only unit of measure remaining and it matches our goal. Solve by multiplying the numerators together, then multiplying the denominators. Finish by dividing numerator by denominator.

$$\frac{75\ \cancel{\text{mg}}}{1}\times\frac{1\text{ mL}}{40\ \cancel{\text{mg}}}=\frac{75\text{ mL}}{40}=1.875\text{ mL}=\mathbf{1.9\ mL\ (rounded\ to\ nearest\ tenth)}$$



This arrow shows the location of **1.9 mL** on the syringe.

Practice Problems

Directions – For each problem, use dimensional analysis to determine the quantity of medicine required for the patient. Write your goal in the provided box. Your answers should include the appropriate units of measure.

1.) Prescription: Diphenhydramine 50 mg PO BID
Inventory: Diphenhydramine 12.5 mg/5 mL
Quantity to give patient: ___________ per dose

Goal: _______

2.) Prescription: Penicillin 1,500,000 units
Inventory: Penicillin suspension 500,000 units/5 mL
Quantity to give patient: ___________ per dose

Goal: _______

3.) Prescription: Indomethacin 75 mg PO QID
Inventory: Indomethacin 25 mg/mL
Quantity to give patient: ___________ per dose

Goal: _______

4.) Prescription: Methotrexate 15 mg once per week
Inventory: Methotrexate 2.5 mg/mL
Quantity to give patient: ___________ per dose

Goal: _______

5.) Prescription: Morphine 10 mg PO QID
Inventory: Morphine 40 mg/2 mL
Quantity to give patient: ___________ per dose

Goal: _______

6.) Prescription: Potassium Chloride 40 mEq
Inventory: Potassium Chloride 20 mEq/10 mL
Quantity to give patient: ___________ per dose

Goal: _______

7.) Prescription: Magnesium Hydroxide Oral Liquid 800 mg QID
Inventory: Magnesium Hydroxide Oral Liquid 400 mg/teaspoon
Quantity to give patient: ___________ per dose

Goal: ______

8.) Prescription: Clindamycin 600 mg IM twice a day.
Inventory: Clindamycin 150 mg/mL
To prepare for the injection, you will need to draw-up ________ mL (nearest tenth) in the syringe.

Goal: ______

Solutions to Practice Problems

1.) Prescription: Diphenhydramine 50 mg PO BID
Inventory: Diphenhydramine 12.5 mg/5 mL
Quantity to give patient: ___________ per dose

Goal: mL

$$\frac{50\ \cancel{mg}}{1} \times \frac{5\ mL}{12.5\ \cancel{mg}} = \frac{250\ mL}{12.5} = \mathbf{20\ mL}$$

2.) Prescription: Penicillin 1,500,000 units
Inventory: Penicillin suspension 500,000 units/5 mL
Quantity to give patient: ___________ per dose

$$\frac{1{,}500{,}000\ \cancel{units}}{1} \times \frac{5\ mL}{500{,}000\ \cancel{units}} = \frac{7{,}500{,}000\ mL}{500{,}000} = \mathbf{15\ mL}$$

Goal: mL

3.) Prescription: Indomethacin 75 mg PO QID
Inventory: Indomethacin 25 mg/mL
Quantity to give patient: ___________ per dose

$$\frac{75\ \cancel{mg}}{1} \times \frac{1\ mL}{25\ \cancel{mg}} = \frac{75\ mL}{25} = \mathbf{3\ mL}$$

Goal: mL

4.) Prescription: Methotrexate 15 mg once per week
Inventory: Methotrexate 2.5 mg/mL
Quantity to give patient: __________ per dose

$$\frac{15\ \cancel{mg}}{1} \times \frac{1\ \text{mL}}{2.5\ \cancel{mg}} = \frac{15\ \text{mL}}{2.5} = \mathbf{6\ mL}$$

Goal: mL

5.) Prescription: Morphine 10 mg PO QID
Inventory: Morphine 40 mg/2 mL
Quantity to give patient: __________ per dose

$$\frac{10\ \cancel{mg}}{1} \times \frac{2\ \text{mL}}{40\ \cancel{mg}} = \frac{20\ \text{mL}}{40} = \mathbf{0.5\ mL}$$

Goal: mL

6.) Prescription: Potassium Chloride 40 mEq
Inventory: Potassium Chloride 20 mEq/10 mL
Quantity to give patient: __________ per dose

$$\frac{40\ \cancel{mEq}}{1} \times \frac{10\ \text{mL}}{20\ \cancel{mEq}} = \frac{400\ \text{mL}}{20} = \mathbf{20\ mL}$$

Goal: mL

7.) Prescription: Magnesium Hydroxide Oral Liquid 800 mg QID
Inventory: Magnesium Hydroxide Oral Liquid 400 mg/teaspoon
Quantity to give patient: __________ per dose

$$\frac{800\ \cancel{mg}}{1} \times \frac{1\ \text{teaspoon}}{400\ \cancel{mg}} = \frac{800\ \text{teaspoons}}{400} = \mathbf{2\ teaspoons}$$

Goal: teaspoons

8.) Prescription: Clindamycin 600 mg IM twice a day.
Inventory: Clindamycin 150 mg/mL
To prepare for the injection, you will need to draw-up ________ mL (nearest tenth) in the syringe.

$$\frac{600\ \cancel{\text{mg}}}{1} \times \frac{1\ \text{mL}}{150\ \cancel{\text{mg}}} = \frac{600\ \text{mL}}{150} = \mathbf{4\ mL\ must\ be\ drawn-up\ in\ the\ syringe}.$$

Goal: mL