Calculations for Pharmacy Technicians: Math and Measurements
Date of Expiration: Nov 30, 2014

By having an understanding of basic math skills, such as decimals, fractions, household and metric measurements, you can succeed at solving many math problems in the pharmacy. But some of your everyday calculations are complex. The most common calculation you'll use in the pharmacy involves ratios and proportions. Being skilled with these types of calculations helps you to determine doses, quantities, and days' supply...and accurately prepare prescriptions.

Ratios

Ratios are similar to fractions in that a ratio is represented as one number divided by another number. This explains the relationship between two quantities. Ratios are written as **a to b** or **a:b**. In the pharmacy, ratios are often used when compounding prescriptions...where you may mix one part of something to two parts of something else. Ratios are also used to express the strength of a medication. For example, an *EpiPen* contains epinephrine solution in a 1 to 1000 or 1:1000 ratio. This means there is one part of epinephrine in every 1000 parts of solution.

> Ratios explain the relationship between two quantities:
>
> **a to b** or **a:b**
>
> *EpiPen* 1:1000 (one part epinephrine in 1000 parts of solution)

Proportions

Proportions are a way to determine how two ratios are equal to each other. In the pharmacy, using ratios and proportions will help you figure out drug doses, number of doses needed per day, number of tablets, and concentrations.

Within the ratios and proportion calculations, you will have **known** and **unknown** terms. It is important to understand how to solve for the unknown term (X). The unknown term is variable from problem to problem. Once the calculations are set up, you will have to use cross-multiplication and division to solve the problem. Keep in mind when performing ratio and proportion calculations, **three of the four terms must be known** and **the units on each side of the equation must be kept in the same order**.

Set up ratio and proportion using the following equation:

$$\frac{a}{b} = \frac{c}{d}$$

Let's say your unknown term is "a." In this case, you'll put an "X" in its spot to indicate it is the unknown term that you are trying to determine.

$$\frac{X}{b} = \frac{c}{d}$$

You will then use cross multiplication and division to solve for X.

$$(X)(d) = (c)(b)$$

$$\frac{X\cancel{(d)}}{\cancel{(d)}} = \frac{(c)(b)}{(d)}$$

$$X = \frac{(c)(b)}{(d)}$$

For example, a 1000 milliliter (mL) stock bottle of a solution contains 30 grams (g) of drug. If a patient takes 3 g of the drug, how many mL will the patient need? Set up the equation using the three known terms, and putting X in for the fourth unknown term. Remember to keep the units on each side of the equal sign the same, so that like terms can be canceled out. Then cross multiply and divide, to find X. In this case, X is 100 mL. The patient will need 100 mL of the solution to get 3 grams of drug.

$$\frac{30\text{ g}}{1000\text{ mL}} = \frac{3\text{ g}}{X\text{ mL}}$$

$$(30\text{ g})(X\text{ mL}) = (3\text{ g})(1000\text{ mL})$$

$$X\text{ mL} = \frac{(3\text{ g})(1000\text{ mL})}{30\text{ g}} = 100\text{ mL}$$

Pharmacy technician Ray is inputting prescription orders today. He's working on a prescription for Mr. Holmes's constipation medication, lactulose. Ray sees lactulose 10 g/15 mL is available in 473 mL bottles. The pharmacist is in "teaching mode" today, and asks Ray to figure out how many grams of active drug are contained in one 473 mL stock bottle of lactulose?

Ray sets up the ratio and proportion calculation, using the three known terms. After cross multiplying and dividing, Ray determines one stock bottle of lactulose contains a total of 315 grams of active drug.

Step 1: Set up proportion calculations with given terms

$$\frac{10\text{ g}}{15\text{ mL}} = \frac{X\text{ g}}{473\text{ mL}}$$

Step 2: Cross multiply the ratios

$$(10\text{ g})(473\text{ mL}) = (X\text{ g})(15\text{ mL})$$

Step 3: Divide both sides by 15 to get X by itself

$$\frac{(10\text{ g})(473\text{ mL})}{15\text{ mL}} = \frac{(X\text{ g})(15\text{ mL})}{15\text{ mL}}$$

$$\frac{(10\text{ g})(473\text{ mL})}{15\text{ mL}} = X\text{ g}$$

Step 4: Solve for X

$$X\text{ g} = \frac{(10\text{ g})(473\text{ mL})}{15\text{ mL}} = 315\text{ g}$$

The pharmacist explains to Ray that this is a good opportunity to remember his conversion factors. If the pharmacist asks Ray to determine how many milligrams (mg) of lactulose are in one stock bottle instead of grams (g), Ray would need to use the 1 gram = 1000 mg conversion (315 g x 1000 mg/1 g = 315,000 mg). To see this and other common conversions between measurement systems, go to our *PL CE Course*, *Calculations for Pharmacy Technicians: Math and Measurements Part I*.

What steps do you take in your pharmacy to be sure you're performing ratio and proportion calculations correctly? Do you use scratch paper or do you just do the calculations in your head? Do you double check your calculations with the pharmacist?

Now it's time to get into the heart of everyday pharmacy calculations. You can now use ratios, proportions, and conversion calculations to determine dosage units and drug dosages. It is imperative to have a good understanding of these calculations to ensure the health and well-being of patients.

Dosage Unit Calculations: Solid Dosage Forms

Ratio and proportion calculations can help determine dosing with solid tablets. In many cases, figuring the amount of tablets needed is straightforward...and you may not even realize that you're using a ratio and proportion to get your answer. For example, a patient takes metoprolol extended-release (*Toprol-XL*, etc) 50 mg once a day. If the prescriber wrote for a 30-day supply, how many tablets would you dispense? Since the patient takes 1 tablet per day, you'd multiply the 1 tablet by 30 days to get 30 tablets.

$$\frac{1\text{ tablet}}{1\text{ day}} = \frac{X\text{ tablets}}{30\text{ days}}$$

(1 tablet)(30 days) = (X tablets)(1 day)

$$X\text{ tablets} = \frac{(1\text{ tablet})(30\text{ days})}{1\text{ day}} = 30\text{ tablets}$$

Occasionally, a prescriber will put the days' supply instead of quantity, or the abbreviation "QS" for quantity sufficient. For example, a patient takes *Keflex* 500 mg twice daily. If the prescriber wrote "QS x 10 days," how many capsules would you give the patient? Since the patient takes 2 capsules per day, you'd multiple the 2 capsules by 10 days to get 20 capsules.

$$\frac{2\text{ capsules}}{1\text{ day}} = \frac{X\text{ capsules}}{10\text{ days}}$$

$$(2 \text{ capsules})(10 \text{ days}) = (X \text{ capsules})(1 \text{ day})$$

$$X \text{ capsules} = \frac{(2 \text{ capsules})(10 \text{ days})}{1 \text{ day}} = 20 \text{ capsules}$$

Ray is now working on Dorothy Rock's metformin prescription. The prescription calls for metformin 1000 mg tablets, to take 1 tablet in the morning (AM) and 1½ tablets in the evening (PM), #75. But Ray realizes there is a problem...metformin 1000 mg tablets are on backorder due to a drug shortage. Ray alerts the pharmacist to the problem. After talking with the prescriber, the pharmacist says it is okay to use the 500 mg tablets in place of the 1000 mg tablets. In this case, how can Ray use metformin 500 mg to fill Mrs. Rock's metformin prescription? Mrs. Rock will receive two 500 mg metformin tablets in the morning and three 500 mg metformin tablets in the evening, for a total of 150 tablets.

Step 1: Set up proportion calculations with given terms (for the AM dose)

$$\frac{500 \text{ mg}}{1 \text{ tablet}} = \frac{1000 \text{ mg}}{X \text{ tablets}}$$

Step 2: Cross multiply the ratios

$$(500 \text{ mg})(X \text{ tablets}) = (1000 \text{ mg})(1 \text{ tablet})$$

Step 3: Divide both sides by 500 to get X by itself

$$\frac{(500 \text{ mg})(X \text{ tablets})}{500 \text{ mg}} = \frac{(1000 \text{ mg})(1 \text{ tablet})}{500 \text{ mg}}$$

$$X \text{ tablets} = \frac{(1000 \text{ mg})(1 \text{ tablet})}{500 \text{ mg}}$$

Step 4: Solve for X

$$X \text{ tablets} = \frac{(1000 \text{ mg})(1 \text{ tablet})}{500 \text{ mg}} = 2 \text{ tablets}$$

Repeat the same steps for the evening (PM) dose.

Step 1: Set up proportion calculations with given terms

$$\frac{500 \text{ mg}}{1 \text{ tablet}} = \frac{1500 \text{ mg}}{X \text{ tablets}}$$

Step 2: Cross multiply the ratios

$$(500 \text{ mg})(X \text{ tablets}) = (1500 \text{ mg})(1 \text{ tablet})$$

Step 3: Divide both sides by 500 to get X by itself

$$\frac{(500 \text{ mg})(X \text{ tablets})}{500 \text{ mg}} = \frac{(1500 \text{ mg})(1 \text{ tablet})}{500 \text{ mg}}$$

$$\text{X tablets} = \frac{(1500\text{ mg})(1\text{ tablet})}{500\text{ mg}}$$

Step 4: Solve for X

$$\text{X tablets} = \frac{(1500\text{ mg})(1\text{ tablet})}{500\text{ mg}} = 3\text{ tablets}$$

Ray puts a note on the prescription bag to make sure Mrs. Rock receives pharmacist counseling on her new dosing. If Mrs. Rock was to take just one 500 mg tablet in the morning and one and one-half 500 mg tablets in the evening, her blood sugar could creep up...leading to her diabetes worsening.

How does your pharmacy handle changes to prescriptions? Do you put a note on the prescription bag? Do you apply auxiliary labels to the prescription container alerting the patient to a change? Does the pharmacist counsel the patient on the change?

Dosage Unit Calculations: Liquid Dosage Forms

The ratio and proportion calculations are often used for determining how much of a liquid medication to use. Some cases will be straightforward, like it is with solid dosage forms. But others will require you to use conversion calculations, such as teaspoons (tsp) to milliliters (mL) or tablespoons (tbsp) to teaspoons (tsp), before setting up your ratios and proportions. This is a big deal since most liquid meds are for children. Using teaspoons instead of milliliters could cause a 5-fold overdose. To prevent these and other medication errors in kids, see our *Technician Training Tutorial*: Dispensing Drugs for Pediatric Patients.

Ray comes across a prescription for Taylor McKee. She recently fell on the playground at school, and was given ibuprofen for pain. The prescription calls for 300 mg of ibuprofen suspension, to take every 6 hours as needed for pain. Ray grabs the ibuprofen suspension from the pharmacy shelf, and notices the product strength is 100 mg/5 mL. How much of the ibuprofen suspension will Taylor take at each dose?

Ray sets up the ratio and proportion calculation. After plugging in the three known terms and solving for the unknown term, X, he determines Taylor will need 15 mL, or 1 tablespoonful, of ibuprofen suspension at each dose. Ray types out the prescription label so it reads: Give 15 mL (1 tablespoonful) by mouth every 6 hours as needed for pain.

Step 1: Set up proportion calculations with given terms

$$\frac{300\text{ mg}}{\text{X mL}} = \frac{100\text{ mg}}{5\text{ mL}}$$

Step 2: Cross multiply the ratios

$$(300\text{ mg})(5\text{ mL}) = (100\text{ mg})(\text{X mL})$$

Step 3: Divide both sides by 100 to get X by itself

$$\frac{(300\ mg)(5\ mL)}{100mg} = \frac{(100\ mg)(X\ mL)}{100mg}$$

$$\frac{(300\ mg)(5\ mL)}{100\ mg} = X\ mL$$

Step 4: Solve for X

$$X\ mL = \frac{(300\ mg)(5\ mL)}{100\ mg} = 15\ mL$$

This is a good time for Ray to ensure that Taylor receives a calibrated dosing device from the pharmacy. Household spoons should not be used to measure out medications. The volumes vary greatly among spoons found in the kitchen drawer...and can lead to serious dosing errors.

What type of calibrated dosing devices does your pharmacy carry? Do all of your pediatric patients get a measuring device with their liquid prescriptions?

Drug Dosages

Many medications that are used in children are dosed based on the patient's weight, since children handle and metabolize drugs differently than adults. Drug doses for pediatric patients are usually determined on a mg/kg basis. Technicians are often asked to get a child's weight so that the pharmacist can double check the dose of a drug. Keep in mind many parents refer to their child's weight in pounds (lb), not kilograms (kg). Make sure to clearly indicate the unit of a patient's weight on the prescription order. An error in calculation because of a misunderstanding about the patient's weight could lead to either underdosing by about half, or overdosing by about double the appropriate dose.

Mr. Burkey brings in a *Biaxin* prescription for his son, Steven. Ray looks over the prescription and notices the prescriber did not include Steven's weight. Ray asks Mr. Burkey for this information, and clearly notes 44 lbs on the prescription. If the prescription is written for *Biaxin* 7.5 mg/kg twice daily for 10 days, how many milligrams (mg) of *Biaxin* will Steven get at each dose?

Ray starts by converting pounds to kilograms. Then he plugs in the three known terms and solves for the unknown term, X. He determines Steven will get 150 mg of *Biaxin* at each dose. The pharmacist double checks Ray's calculation, and determines that Steven will be getting a safe dose.

Step 1: Convert lb to kg

$$1\ kg = 2.2\ lb$$

$$\frac{(44\ lb)(1\ kg)}{2.2\ lb} = 20\ kg$$

Step 2: Set up ratios and proportion calculation

$$\frac{7.5 \text{ mg}}{1 \text{ kg}} = \frac{X \text{ mg}}{20 \text{ kg}}$$

Step 3: Cross multiply the ratios

$$(7.5 \text{ mg})(20 \text{ kg}) = (X \text{ mg})(1 \text{ kg})$$

Step 4: Divide both sides by 1 to get X by itself

$$\frac{(7.5 \text{ mg})(20 \text{ kg})}{1 \text{ kg}} = \frac{(X \text{ mg})(1 \text{ kg})}{1 \text{ kg}}$$

$$\frac{(7.5 \text{ mg})(20 \text{ kg})}{1 \text{ kg}} = X \text{ mg}$$

Step 5: Solve for X

$$X \text{ mg} = \frac{(7.5 \text{ mg})(20 \text{ kg})}{1 \text{ kg}} = 150 \text{ mg}$$

Does your pharmacy require you to get the patient's weight when you receive a prescription for a child? How do you make note of the patient's weight? Do you write the weight in pounds, in kilograms, or both?

Days' Supply Calculations

It is very important to calculate days' supply correctly. Inputting the incorrect days' supply can lead to a patient getting the wrong amount of medication...rejected insurance claims...and insurance audit flags. For meds that come in tablets or capsules, the calculation is relatively simple. You determine days' supply by dividing the quantity on the prescription by the number of units used per day. For example, a prescription is written for *Pradaxa* 150 mg, to take 1 capsule twice daily, #60. The days' supply would be 30 (60 caps ÷ 2 caps/day = 30 days).

Calculating days' supply for fixed quantity medications like inhalers, creams, and insulin can be a little tricky. You'll need to know how much the entire container holds, and use the ratios and proportions calculations to determine days' supply. Keep in mind the units on each side of the equation must match. In many of these calculations you'll need to convert ounces (oz) to milliliters (mL) or teaspoonsful (tsp) to milliliters (mL). For strategies on calculating days' supply for fixed quantity meds and tips for preventing errors, see our *Technician Training Tutorial*: Calculating Days' Supply.

Mr. George Cruz is getting a new prescription for a *ProAir HFA* inhaler. As Ray is inputting Mr. Cruz's prescription, he remembers that he has had trouble in the past with entering the correct days' supply for fixed quantity meds. Ray takes out scratch paper to do the calculation...to ensure he enters the correct days' supply. If Mr. Cruz uses 2 puffs four times daily, what days' supply will Ray enter into the pharmacy computer for one inhaler?

Ray starts by looking at the product labeling to determine how many actuations or puffs are in ONE inhaler. He finds out that one *ProAir HFA* inhaler contains 200 puffs. Ray then determines how many puffs Mr. Cruz uses each DAY, which is 8 actuations (2 puffs x 4/day = 8 puffs/day). After setting up the ratio and proportion calculation and filling in the known terms, Ray determines that one *ProAir HFA* inhaler will last 25 days. He enters 25 days into the days' supply field in the computer and proceeds with filling Mr. Cruz's order.

Step 1: Calculate how many puffs the patient will use each day

2 puffs four times a day = (2 puffs)(4) = 8 puffs per day

Step 2: Set up ratio and proportion calculation

$$\frac{8 \text{ puffs}}{1 \text{ day}} = \frac{200 \text{ puffs}}{X \text{ days}}$$

Step 3: Cross multiply

(8 puffs)(X days) = (200 puffs)(1 day)

Step 4: Divide both sides by 8 to leave X by itself

$$\frac{(8 \text{ puffs})(X \text{ days})}{8 \text{ puffs}} = \frac{(200 \text{ puffs})(1 \text{ day})}{8 \text{ puffs}}$$

$$X \text{ days} = \frac{(200 \text{ puffs})(1 \text{ day})}{8 \text{ puffs}}$$

Step 5: Solve for X

$$X \text{ days} = \frac{(200 \text{ puffs})(1 \text{ day})}{8 \text{ puffs}} = 25 \text{ days}$$

Have you ever put in the wrong days' supply for a fixed quantity medication? How do you handle situations where the wrong days' supply is entered? Does it vary based on the pharmacist working or the insurance company being billed?

The Bottom Line

Avoiding medication errors in the pharmacy is very important to the care of your patients. Many technicians are called upon to perform complex calculations when preparing medications. Technicians should be skilled in the use of ratios and proportions in order to accurately prepare prescriptions. Being able to comfortably calculate appropriate dosing will ensure the health and well-being of patients.

Calculations for Pharmacy Technicians: Math and Measurements

Name: ______________________ **Date:** ______________

Question #1

Which of the following is TRUE about ratios?

☐ a. Ratios are often written as a:b.
☐ b. Ratios are often set up as a decimal.
☐ c. Ratios are represented by one number multiplied by another number.
☐ d. Epinephrine 1:1000 means 1000 parts of epinephrine in 1 part of solution.

Question #2

How many mg of estradiol are delivered each hour by one estradiol 0.075 mg/day patch?

☐ a. 0.003125 mg
☐ b. 3.15 mg
☐ c. 0.00075 mg
☐ d. 7.5 mg

Question #3

Ms. Ashley Dunman brings in a prescription for levothyroxine 175 mcg, to take once daily. She is allergic to red food dye, and wishes to use the 50 mcg tablets instead. How many 50 mcg tablets will be required to make her 175 mcg daily dose?

☐ a. 2.5 tablets
☐ b. 3 tablets
☐ c. 3.5 tablets
☐ d. 4 tablets

Question #4

Mr. Stuart George brings in the following prescription:
BuSpar 5 mg
1 tab q AM, ½ tab at noon, 2 tabs hs x 90 days
QS
How many *BuSpar* tablets are needed to fill Mr. George's prescription?

☐ a. 90 tablets
☐ b. 105 tablets
☐ c. 315 tablets
☐ d. 360 tablets

Question #5

You receive the following prescription:
Bactrim suspension
Sig: 1 tsp QID x 10d
#QS
How many mL should be dispensed for entire prescription?

- ☐ a. 5 mL
- ☐ b. 20 mL
- ☐ c. 40 mL
- ☐ d. 200 mL

Question #6

Mrs. Suzanne Penney is in the hospital for a severe infection. Her doctor sends down the following order:
Cipro 400 mg q 12 h
What volume of drug is needed to prepare one dose of the order using a 100 mL vial containing 500 mg of *Cipro*?

- ☐ a. 125 mL
- ☐ b. 80 mL
- ☐ c. 25 mL
- ☐

Question #7

You receive a prescription for amoxicillin suspension 10 mg/kg q 8h x 7 days. If the patient weighs 39 pounds, how much amoxicillin will the patient receive at each dose?

- ☐ a. 2 mg
- ☐ b. 177 mg
- ☐ c. 390 mg
- ☐ d. 858 mg

Question #8

You have a patient that weighs 15 kg. If the patient is to take *Bactrim* 4 mg/kg twice daily, how much *Bactrim* will the patient receive each day?

- ☐ a. 8 mg
- ☐ b. 54.5 mg
- ☐ c. 120 mg
- ☐

Question #9

You receive a prescription for albuterol syrup 2 mg/5 mL, take 2 teaspoonfuls four times daily, 8 oz. What days' supply should be entered into the pharmacy computer?

- ☐ a. 6 days
- ☐ b. 16 days
- ☐ c. 24 days
- ☐ d. 30 days

Question #10

You receive the following prescription:
Lantus insulin
Sig: 40 units at bedtime
Disp: #1
If one mL of *Lantus* contains 100 units, how many days will one 10 mL vial last?

- ☐ a. 2 days
- ☐ b. 3 days
- ☐ c. 15 days
- ☐ d. 25 days