Things You'll Use Every Day

Anyone going into the practice of pharmacy will recognize that there is a lot of memorization involved. Memorization of basic conversions will be your first step toward mastery of pharmaceutical calculations. By the end of this lesson, you will be ready to move on to problems where you will use these facts to solve problems that arise in daily practice.

Measurement Systems

You may have already encountered the four kinds of measurement systems used in the world of pharmacy: the metric, apothecaries', avoirdupois, and "common" systems.

Metric System

You are probably familiar with metric measurements already. In pharmacy, you will be dealing with metric measurements of length/height, volume, and weight. These measurements will be the meter (m), liter (L), and gram (g), respectively.

It is likely that you know the prefixes that represent multiples or fractions of these measurements. However, in case you are a bit rusty, here are the ones you will likely encounter in clinical practice. Be sure you know all of these.

Abbreviation: Meaning	Example
kilo (k): one thousand	kilogram (kg): drug dosing commonly needs the patient's weight in kg
deci (d): one-tenth	deciliter (dL): some drug concentrations are reported as g/dL
centi (c): one-hundredth	centimeter (cm): patient's height often has to be converted from inches to cm
milli (m): one-thousandth	milliliter (mL): most injectable drug amounts are in mL
micro (mc or μ): one-millionth	microgram (μg or mcg): some drugs have low serum concentrations, e.g., μg/L
nano (n): one-billionth	nanogram (ng): some drugs have very low serum concentrations, e.g., ng/L
pico (p): one-trillionth	picogram (pg): a few drugs have barely detectable concentrations, e.g., pg/L

Apothecaries' System

As you can guess from the name, this system was used by the old time apothecaries—forerunners to today's pharmacists and pharmacy technicians. In this system, one troy pound was made up of 5760 grains. The troy (apothecary) pound was divided into 12 ounces, each of these ounces (symbol: ℥) into eight drams (originally spelled "drachm"; symbol: ʒ), each dram into three scruples, and each scruple into 20 grains.

There was also a fluid measure in this system. Here one gallon was divided into four quarts, each quart into two pints, each pint into 16 fluidounces, each fluidounce into eight fluidrams, and each fluidram into 60 minims. Although this may seem overwhelming, you will nonetheless recognize some of the volume components if you cook.

Here are some relationships involving measures of this system.

Fluid Measures

1 fluidram (fʒ)	=	60 minims		
1 fluidounce (f℥)	=	8 fluidrams	=	480 minims
16 fluidounces	=	1 pint		
32 fluidounces	=	1 quart	=	2 pints
4 quarts	=	1 gallon	=	8 pints

Solid Measures

20 grains (gr)	=	1 scruple (℈)		
60 grains	=	3 scruples	=	1 dram (ʒ)
480 grains	=	8 drams	=	1 ounce (℥)
5760 grains	=	12 ounces	=	1 pound

Avoirdupois System

This system is Roman in origin, has a French name, and was adopted by the English as a standard for weights in commerce. An avoirdupois (pronounced ah-vwor-doo-pwuh') pound is divided into 16 avoirdupois ounces. One avoirdupois ounce is made of 437.5 grains.

You will notice that the number of ounces in a pound is different in this system, compared to the apothecaries' system, as is the number of grains (7000 grains per pound in the avoirdupois system versus 5760 grains per pound in the apothecaries' system). The common measure between the two systems is the grain, such that a grain in the avoirdupois system has the same weight as a grain in the apothecaries' system.

Here's all you really need to remember: **437.5 grains = 1 ounce (oz) and 16 ounces = 1 pound (lb).** Notice how the avoirdupois definition of 16 ounces/pound is used in the American system. This is also the grain definition used in the grain:ounce conversion in pharmacy practice.

Please double check this with your calculator.

Common or Household System

This system combines bits of both the apothecary and avoirdupois systems and also throws in a couple of new measures. This system is used commonly in the United States. Although it is being replaced by the metric system, this change is occurring at a pace so painfully slow that our children's children may still be learning both metric and common systems of measurement, at least when they cook. The basics of this system are outlined in the accompanying list, although it is likely that you know these already.

1 gallon (gal)	=	4 quarts
1 quart (qt)	=	2 pints
1 pint (pt)	=	2 cups
1 cup	=	8 fluidounces
1 fluidounce (oz)	=	2 tablespoonfuls*
1 tablespoonful (T or tbsp)	=	3 teaspoonfuls* (tsp)
1 pound (lb)	=	16 ounces (oz)
1 yard (yd)	=	3 feet
1 foot (ft or ')	=	12 inches (in or ")

**Some people will use the term tablespoonsful or teaspoonsful.*

Converting between Measurement Systems

The most basic calculations you will do in pharmacy will consist of converting between the metric system and the other measurement systems. You will need to memorize these conversions.

Length

Patient heights are often relayed to you in feet and inches, but calculation of body surface area or some nutrition calculations require the measurements to be in centimeters.

1 inch = 2.54 cm

It is unlikely that you will need to convert between centimeters and feet or meters and feet in the practice of pharmacy. If you do, then it is simple to use the relationship between inch and centimeter in a proportional calculation to determine what you want to know.

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A grain weight originated from the weight of a dried grain of wheat (France) or barleycorn (England), pulled from the middle of the ear (that's the wheat or barleycorn ear, not the measurer's...).

The reason that the standard English measurement system has a French name is that at the time of adoption, French was the language spoken by the English court. Avoirdupois has been roughly translated into "heavy goods," "goods of weight," and "to have weight."

Volume

You will frequently work with volumes—of total product, of dose, and as the denominator in a concentration.

Total volumes of liquid drugs prescribed by physicians will be conveyed in ounces (e.g., 8 ounces of a cough syrup) or in milliliters (e.g., 200 mL of an antibiotic suspension). If ordered in ounces, the physician will really mean the apothecaries' fluidounce, but the term "fluidounce" is rarely used anymore—everyone just refers to it as an ounce. The relationships that you will need to memorize are:

1 pint = 473 mL

1 fluidounce = ℥ (symbolically) = 29.6 mL
(Some practitioners round this to 30 mL.)

Volumes you will encounter most frequently in doses are teaspoonfuls, which physicians still represent symbolically as ʒ.

The conversion is:

1 teaspoonful = ʒ (symbolically) = 5 mL

If you are a mathematically nimble person, you may be saying,

"Now just hold on a minute! If there are 8 drams (ʒ) in one fluidounce (℥), then 29.6 mL ÷ 8 should mean that there are 3.7 mL in each fluidram (ʒ)." Although you are absolutely correct here, in real practice it's not interpreted that way. When a physician or pharmacist writes ʒ on a prescription, he or she **always** means "one teaspoonful" and so you **must** interpret it as 5 mL.

One final volume that you should know about is the dropper. The "official" dropper contains 20 drops/mL (of water). You, however, will always need to calibrate the dropper if a need for accuracy exists, since drop size varies with formulation and the "official" dropper may not be available. Fortunately, droppers that accompany commercially available prescription and over-the-counter medications are precalibrated.

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The abbreviation for ounce, oz, is probably derived from the Italian word for ounce, "onza." The abbreviation for pound, lb, is derived from the Latin word "libra," meaning pound or scales.

Weight

The most important weight conversions are those between ounces and grams for solid dosage forms and those between pounds and kilograms for people. Patients will tell you their weight in pounds but dosage recommendations will be based on kilogram weight. The conversions are:

1 kg = 2.2 lb

1 ounce = 28.35 g ≈ 28.4 g

When compounding, do **not** round 28.4 to 30 g. The two numbers vary by more than 5%, which is too inaccurate for compounding. It is best if you memorize the conversion to the nearest tenth of a gram (i.e., 28.4 g), but if you must round to the nearest whole number, please round to 28 g, rather than to 30 g.

Rules for Rounding Weights

When you perform weight calculations, use the following rules:

- For adults and children who weigh more than 25 pounds, round to the nearest whole kilogram, e.g., 70 kg
- For children who weigh between 6 and 25 pounds, round to the nearest tenth of a kilogram, e.g., 6.8 kg
- For premature infants (weight is expressed in grams), round to the nearest whole gram, e.g., a 4-pound preemie would be 1818 g

The use of grains as a measure of weight has almost gone by the wayside in the medical profession (most health-care practitioners think of grains as a way to obtain fiber in the diet, rather than as a unit of weight). You will occasionally encounter grains, however, so you will need to memorize the conversion:

1 grain = 64.8 mg

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In medieval times, the merchants came to the people, rather than the people coming to the merchants. Merchants would thus travel the countryside spending a day or more at each regional fair, returning periodically to port cities or to craftsmen to restock their wares. Some cities were large enough to have "great fairs," which drew merchants and traders from many countries. One such city was Troyes, in the Champagne region of France, home to a great fair in the 700–800s. It is likely that the apothecary "troy" pound came from the name of this city, where a standard weight of coinage for metals, jewels, and medicines was determined that ended up being adopted all over Europe. Troy weight is still used in the jewelry industry. In England, a troy pound of silver became a measure of currency and eventually gave its name to the sterling pound.

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Here are the most important measurements and symbols that you need to know.

Length
1 inch = 2.54 cm

Volume
1 pint = 473 mL = 16 fluidounces
1 fluidounce = 29.6 mL = $\overline{3}$ (symbolically) = approximately 2 tablespoonfuls
1 fluidram = 3 (symbolically) = 5 mL = 1 teaspoonful
1 tablespoonful = 15 mL
2 cups = 1 pint
8 pints = 1 gallon

Weight
1 grain = 64.8 mg
1 kg = 2.2 lb
1 ounce = 28.4 g

Symbol		Meaning
3	=	one teaspoonful or 5 mL or one fluidram
$\overline{3}$	=	one ounce or one fluidounce or two tablespoonfuls or 30 mL
$\overline{a}\,\overline{a}$	=	of each
$\overline{s}\,\overline{s}$	=	one-half
$\overline{c}$	=	with
$\overline{s}$	=	without
Δ	=	change

Note: If you see either the ounce or the teaspoonful symbol followed by lower case roman numerals (e.g., ii, iii, iv), this indicates the number of either teaspoonfuls or ounces desired, e.g., 3ii = 2 teaspoonfuls, $\overline{3}$viii = 8 oz. If the symbol itself is not followed by the lower case roman numerals, you should assume the measure is 1 teaspoonful or ounce.

Now that you have all this under control, let's move on to temperatures and their conversion.

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The metric system was created in France with the groundwork for the system laid, several hundred years ago, by scientists and astronomers. They chose a basic unit of length as being 1/10,000,000 part of the earth's quadrant (the distance from one of the poles to the equator): a meter. There were six other standards chosen as basic units for mass (gram), time (second), amount of a substance (mole), thermodynamic temperature (kelvin), electric current (ampere), and luminous intensity (candela). These were all based on the meter; for example, the basic unit for weight is the gram, which is the weight of one cubic centimeter (cm^3) of water at 4°C, measured at sea level. Other units such as area (m^2), volume (m^3), and temperature degree (°C) were derived from one of the basic units. In 1960, this measurement system was adopted as the official measurement system worldwide, and is called Le Système International d'Unités (International System of Units) and is abbreviated as "SI units."

Thermometry

You need to be able to convert back and forth between the Fahrenheit and centigrade/Celsius temperature scales. These are both used in the clinical setting for reporting patient temperatures. Some institutions/clinics will report Fahrenheit, others Celsius. More commonly, the patient will report a temperature in Fahrenheit but your dosing guide for medications will give guidelines using the Celsius scale; it is imperative that you can move comfortably back and forth between them. You should memorize one of the following methods for converting from Fahrenheit to Celsius and from Celsius to Fahrenheit:

$$°F = \frac{(°C)(9)}{5} + 32 \text{ or } °F = (°C \times 1.8) + 32 \text{ or } (5)(°F) = (9)(°C) + 160$$

$$°C = \left(\frac{°F - 32}{9}\right)(5) \text{ or } °C = (°F - 32) \times 0.556 \text{ or } (9)(°C) = (5)(°F) - 160$$

Temperatures should be rounded to the nearest tenth of a degree (both Fahrenheit and centigrade, e.g., 98.6°F, 37.0°C).

If you were to insert thermometers in several of your major orifices at the same time, you would find (besides feeling like a porcupine victim) that they would not give you the same reading. Rectal temperatures are around 1°F (0.5°C) greater than oral temperatures. Oral temperatures are around 1°F (0.5°C) greater than axillary (armpit) temperatures. Remember:

Rectal

−1°F (0.5°C)

⇓

Oral

−1°F (0.5°C)

⇓

Axillary

If dosing directions for a medication are based on temperature, which site do you use to determine temperature for a patient? Generally, for individuals 5 years and older, you will use an oral temperature, and for children younger than 5 you will use a rectal temperature, in order to determine whether to give a fever-reducing agent. You will always need to adjust an axillary temperature since recommendations for dosing of fever-reducing medications are never based on an axillary temperature. Many clinicians use an ear thermometer to check a patient's temperature. Such thermometers will be set to read the temperature at either an oral or rectal setting.

You should memorize the Fahrenheit–centigrade and centigrade–Fahrenheit conversion equation that you like best, and you should memorize the conversion between oral, rectal, and axillary temperatures.

Setting Up Calculations

Proportional Calculations

Most of the problems you will solve here, and some in the next lesson, are best solved using proportional calculations. Proportional calculations involve using a known ratio to determine the strength or volume of a similar ratio, where one of the values (strength or volume) is unknown. If you cook, you've probably done proportional calculations, unless you cook using only a can-opener and a microwave. Proportional calculations are set up like this:

$$\frac{a}{b} = \frac{\mathbf{x}}{c}$$

where you solve for **x** by multiplying (a)(c) and dividing by (b).

You can use proportional calculations to determine a simple dose of a drug. Let's say you need to know the volume that will give you a dose of 400 mg, and you have a suspension that is 250 mg/5 mL. You would do it like this:

$$\frac{250 \text{ mg}}{5 \text{ mL}} = \frac{400 \text{ mg}}{\mathbf{x} \text{ mL}}$$

Then (400 mg)(5 mL)/(250 mg) = 8 mL.

If this is the way you are used to doing proportional calculations, then realize that although you **can** get the correct answer this way, it is also possible to get the **incorrect** answer. This outcome can happen if you don't write out the units for (a), (b), (c), and (**x**) and an incorrect answer is even more likely to occur if there are other variables such as (d) and (e) involved. Because you are dealing with medications that could harm and, in some cases, even kill patients if the dose is miscalculated, you **must** use a method that will allow you to get the right answer every time. So, let's get some help.

Dimensional Analysis and Why You Need It

If you didn't learn about dimensional analysis in your high school mathematics or physics classes, it will be in your best interest to learn it now. Dimensional analysis is a method of checking an equation or solution to a problem by the way you set up the dimensions (units of measurement). If the two sides of an equation do not have the same dimensions, the equation is wrong. If they do have the same dimensions, then the equation is set up correctly. *(I learned about this in high school, but not by that name. It was called the "make sure all your units cancel out, leaving the ones you want" method. I think. Or maybe Mr. Kays told us the name and I wasn't listening. Always a possibility.)* Let's see how it works.

Use Dimensional Analysis to Get the Right Answer Every Time.

1. **Write out your final units** (the units you would like to arrive at) on the right-hand side of the page **first.** Leave a small space to the left, and then write an = sign.

For example, let's say you want to calculate a dose of amoxicillin, in mL:

$$= \_\_\_\_\_ \text{ mL}$$

2. On the left-hand side of the equation, begin to **line up all of your available data**. Be sure to include a unit for every number. If you're dealing with more than one drug or drug strength, assign a drug name to all necessary units.

To continue with the example, the variables you have are a 36-pound child, a 250-mg/5-ml concentration of amoxicillin suspension, a dosing guideline of 13 mg/kg, and your memorized conversion between pounds and kilograms:

$$36 \text{ lb} \quad \frac{250 \text{ mg}}{5 \text{ mL}} \quad \frac{13 \text{ mg}}{\text{kg}} \quad \frac{1 \text{ kg}}{2.2 \text{ lb}} \quad = \_\_\_\_\_ \text{ mL}$$

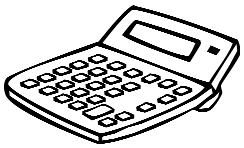
3. Invert dimensions as needed so that the units cancel out. Make sure that all possible units cross out. If you have done it correctly, you will end up with the same units remaining on the left side of the equation as on the right-hand side of the equation. If you have additional units left that have not canceled out, then you have missed an important dimension or included an unnecessary one. Continuing with the example:

$$36 \text{ lb} \times \frac{5 \text{ mL}}{250 \text{ mg}} \times \frac{13 \text{ mg}}{\text{kg}} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \quad = \_\_\_\_\_ \text{ mL}$$

4. Perform the calculations. You should have crossed out all units that appear in both a numerator and a denominator somewhere on the same side of the equation. You are left with mL **as the only unit not crossed out on either side of the equation,** so you know that you have set the equation up correctly.

$$36 \cancel{\text{ lb}} \times \frac{5 \text{ mL}}{250 \cancel{\text{ mg}}} \times \frac{13 \cancel{\text{ mg}}}{\cancel{\text{kg}}} \times \frac{1 \cancel{\text{ kg}}}{2.2 \cancel{\text{ lb}}} \quad = \quad 4.2 \text{ mL}^{*}$$

**Do not round to 4.3 mL. A 5-mL oral syringe, necessary for dosing a medication this way, has measurement lines in 0.2-mL increments, not 0.1-mL increments. In order for someone to measure a dose of amoxicillin accurately, the dose needs to be in a 0.2-mL increment.*



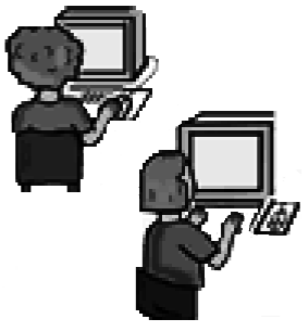
If you use dimensional analysis, you can feel comfortable that your answer is correct, as long as you keyed in the correct numbers on your calculator (make "always double check" a motto you live by). You will see dimensional analysis used in this workbook whenever more than two units of measurement (dimensions) are involved in a calculation, with a few exceptions (e.g., body surface area and creatinine clearance calculations). Dimensional analysis is vitally important if you intend to get the right dose to the patient. "First, do no harm." Dimensional analysis is included because you need to know it.

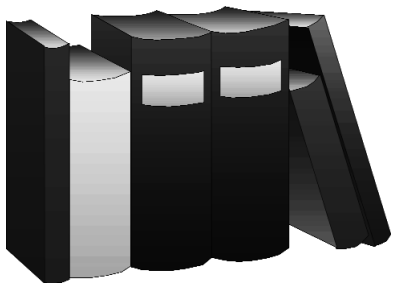
Abbreviations Used on Prescriptions

Why do you need to learn information about abbreviations used on a prescription for a pharmacy calculations class? The main reason is that you need to evaluate every dose for every patient to determine whether or not you think it is the right dose for that patient. The first step in evaluating the dose is to be able to **read** the prescribed dose on the prescription, which will usually be communicated in a series of symbols and abbreviations. You will need to know how to interpret these in order to select the correct medication, as well as to check the dose and to translate the directions into something the patient will understand. To accomplish this, some tedious memorization is involved. The most common abbreviations you will use are summarized here in the order in which you would read them on a prescription.

Drug Names

First, after you have confirmed that you have the correct name and contact/location information for the patient, you will need to determine the drug name. Prescribers may abbreviate the names of some drugs (this doesn't mean that it is the correct thing to do, but you will see it done). The following are abbreviations used in some parts of the country. Your preceptors and calculations instructor will be able to tell you other abbreviations used in your area. It is also important to become familiar with the printed and internet references for drug names.





Prescribers will also use standard chemical abbreviations for electrolytes and other substances, e.g., KCl, NaCl, $MgSO_4$, but you will already know these through your general chemistry courses.

Abbreviation	Meaning
3TC	lamivudine
5-FU	fluorouracil
APAP	acetaminophen
ASA	aspirin
AZT	zidovudine (chemical name: azidothymidine)
CE	conjugated estrogens
d4T	stavudine
D5-1/2NS	5% dextrose and half-normal saline (0.45% sodium chloride) in water (this is a solution for intravenous infusion)
D5W	5% dextrose in water (this is a solution for intravenous infusion)
ddC	zalcitabine
EES	erythromycin ethylsuccinate
EPO	erythropoietin/epoetin
HCTZ	hydrochlorothiazide
INH	isoniazid
LR	lactated Ringer's solution (this is a solution for intravenous infusion)
MOM	milk of magnesia
MPA	medroxyprogesterone acetate
MS	morphine sulfate (Caution! MS is also used as an abbreviation for multiple sclerosis, a disease)
MVI	multivitamin
NS	normal saline (0.9% sodium chloride in water)
NTG	nitroglycerin
PB	phenobarbital
PCN	penicillin
PPD	purified protein derivative (this means a tuberculin skin test)
TMP/SMX	trimethoprim + sulfamethoxazole
TPN	total parenteral nutrition

Strength

After the drug name the prescriber may indicate the strength of the medication to be dispensed. There are only two times when this may not be done. If the drug comes in only one strength, then the prescriber will usually not note the strength. The other time the prescriber may omit the strength is if he or she writes “dose per pharmacy” on the prescription, indicating that the pharmacist may determine the correct product strength and dose for the patient.

At all other times, you should see a prescribed strength on the prescription. If it is missing and there are multiple strengths, you have no choice but to contact the prescriber to determine the strength. Strengths will usually be given as a number with an abbreviation after it. You will need to read the abbreviation correctly.

Abbreviation	Meaning
%	g/100 finished units: commonly, g/100 ml (g/dL) or g/100 g
g	gram
gr	grain (please write out the full word when you use this term—the abbreviation could be confused with a gram abbreviation)
IU	international units
mg	milligram
mEq	milliequivalent
u or U	unit (but please write out the full word when you use this term)

Drug Form

If the drug comes in more than one form, the prescriber will need to identify the desired form.

Abbreviation	Meaning
Cap or caps	capsules
crm	cream
elix	elixir
gtts	drops
MDI	metered dose inhaler
nebs	solution for nebulization
NPO	nothing by mouth; not a drug form but means the patient is not to receive any medications administered by the oral route
PO or po	by mouth, orally, or swallowed
PR	suppository (this is the meaning when written after the drug name)
SL	sublingual form
sol or soln	solution
supp	suppository
susp	suspension
SVN	small volume nebulizer
syr	syrup (Caution! syr is also used as an abbreviation for syringe)
tab or tabs	tablets
ung	ointment

Total Amount of Drug Product

Next, you will need to interpret the total amount of drug product that needs to be dispensed if the prescriber has indicated this on the prescription. Sometimes the prescriber may not indicate the total amount and will instead leave it up to you to determine what that amount should be. More information on how to determine this will be provided later. Most of the time, the total amount will be written as a standard number, with a # sign in front of it, e.g., #30 or #60. This will be easy for you to interpret (i.e., 30 capsules, 60 tablets). A few prescribers still write the quantity in Roman numerals; some of these are in the following table in case you're rusty. The only other symbol that may be unrecognizable to you is the number of ounces prescribed if a prescriber uses the ounce symbol (℥). This symbol is included for the commonly prescribed drug amounts listed.

Abbreviation	Meaning
disp	dispense
mL*	milliliter
qs	Latin for quantum sufficit; add a sufficient quantity to make...
℥ii	2 ounces
℥iii	3 ounces
℥iv	4 ounces
℥vi	6 ounces
℥viii	8 ounces
I or i	1
IV or iv	4
V or v	5
X or x	10
C or c	100

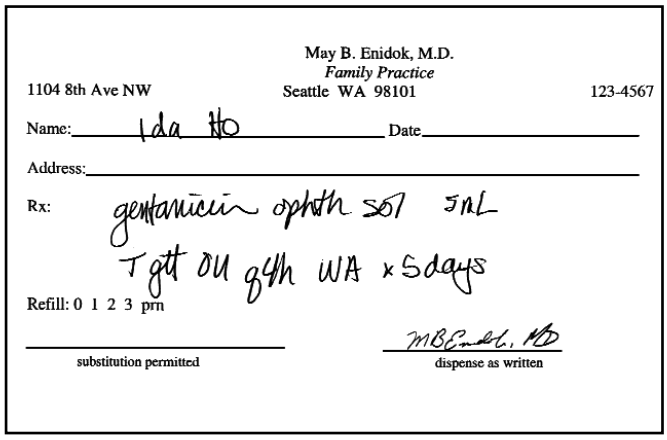
** Please note that while a large L is correct abbreviation for liter, many people use a small l in abbreviations when combined, e.g., ml, µl. Don't let this bother you.*

As a final comment on prescribed amounts, for controlled substances it is optimal for the prescriber to spell out the total number of capsules, tablets, or other total amount to be dispensed, in addition to writing the number, e.g., #20 (twenty). When the number is spelled out like this, it is much harder for people to alter the number of tablets prescribed. This addition really helps to protect you from the heartache of filling a forged/altered prescription (you can pass this suggestion on to prescribers to enable them to better safeguard the number of tablets dispensed to their patients).

Interpreting the Directions

The following abbreviations for the dose, route, frequency, and modifiers that are used for frequency have to do with the directions. Directions are often indicated on the prescription by the abbreviation "sig," a Latin abbreviation for "signa" that basically means "directions."

The directions written on a prescription by a prescriber will contain abbreviations in the dose, the route, the frequency, and the frequency modifiers that the prescriber may specify.


May B. Enidok, M.D.
Family Practice
1104 8th Ave NW Seattle WA 98101 123-4567
Name: Ida Ho Date
Address:
Rx: gentamicin ophth 5% 5mL
1 gtt OU q4h WA x 5 days
Refill: 0 1 2 3 prn
substitution permitted
MB Enidok, MD
dispense as written

Directions: Dose

The prescriber may use the following abbreviations to indicate the amount of drug product that should be used for each dose.

Abbreviation	Meaning
ʒ	teaspoonful or teaspoonfuls
aa or $\overline{a}\,\overline{a}$	of each
cc	milliliter (actually means cubic centimeter, but 1 cc = 1 mL)
gtt	drop (gtt is Latin for guttae, which means drops)
i	1
ii	2
ss or $\overline{s}\,\overline{s}$	one-half
t or tsp	teaspoonful or tablet; this is dangerous because it is confusing, so don't use it
tbsp or T	tablespoonful
TKO or KVO	"to keep open" or "keep vein open"

Directions: Route

This refers to how the drug enters the body. Sometimes route is used to indicate a drug form.

Abbreviation	Meaning
ad	right ear
as	left ear
au	each ear
IM	intramuscularly
IV	intravenously
IVP	intravenous push
IVPB	intravenous piggyback
od	right eye
os	left eye
ou	each eye
po	by mouth or orally
PR	rectally
PV	vaginally
SC or SQ	subcutaneously
SL	sublingually; "under the tongue" is a more patient friendly translation
S/S	swish and spit
top	topically; "on the skin" is a more patient friendly translation if the medication is to be applied there

Directions: Frequency

As you can probably guess, this is how often the patient takes the drug.

Abbreviation	Meaning
alt	alternating
BID	twice a day or twice daily
BIW	twice weekly
CID	5 times a day
HS	bedtime
q	every
q12h	every 12 hours
q24h	every 24 hours or once daily
q4–6h	every 4–6 hours
q4h	every 4 hours
q6h	every 6 hours
q8h	every 8 hours
qAM	every morning or daily in the morning
qd	daily or once daily
qHS	bedtime or daily at bedtime
QID	4 times a day
q5min	every 5 minutes
qOd	every other day
qPM	every evening or daily in the evening
q week	once weekly
TID	three times daily
TIW	three times weekly

Directions: Frequency Modifiers and Miscellaneous Abbreviations

Here are some of the more common ones that you may encounter.

Abbreviation	Meaning
Δ	change
ac	before meals
ASAP	as soon as possible
ATC	around the clock
BS, FBG	blood sugar, fasting blood glucose
c or $\overline{c}$	with
max	maximum
min	minutes or minimum (depends on context)
MR	may repeat
NR	no refills
NTE	not to exceed
OTC	over-the-counter
pc	after meals
prn	as needed, if needed, when needed; use “as needed for” if there's an indication present
s or $\overline{s}$	without; lay individuals use the abbreviation w/o
stat	immediately
ut dict or ud	as directed
WA	while awake
x or X	times
x1	one time
x2	two times
x3	three times or up to three

Composing the Label Instructions

Once you have deciphered the information on the prescription, you will need to translate it into instructions that a patient can understand. Complete prescription sentences generally:

- start with a command (e.g., take, place, insert, unwrap and insert, apply, inhale),
- follow with a command modifier (e.g., by mouth, rectally, sparingly),
- then note the dosage number and form/unit (e.g., 2 tablets, 1 capsule, 1 teaspoonful),
- follow with the dosing frequency (e.g., twice daily, every 4–6 hours),
- and finish with a frequency modifier (e.g., as needed for pain, on an empty stomach, with food, for blood pressure, with a full glass of water, for 10 days).

Written on a prescription	What you would type on a label
Tylenol #3 disp. 30 i po q4-6h prn pain	Tylenol #3 #30 Take 1 tablet by mouth every 4–6 hours as needed for pain.
APAP 5 gr supp #10 i PR prn temp>101	Acetaminophen 325 mg Supp. #10 Unwrap and insert rectally 1 suppository as needed when temperature is higher than 101°F.
Cheracol ℥ iv ℥ ii po q4h prn cough	Cheracol 4 oz. Take 2 teaspoonfuls by mouth every 4 hours as needed for cough.
Gentamicin ophth soln 5 ml i gtt ou q4h WA x 5 days	Gentamicin 0.3% 5 ml Place in each eye one drop every 4 hours while awake for 5 days.
Ampicillin 250 mg #40 i po ac & HS	Ampicillin 250 mg #40 Take 1 capsule by mouth 4 times a day: before meals and at bedtime.

Other Abbreviations You Will See in Practice

Indications

This outlines why the patient is receiving the drug or warns of a reason to alter intake of the drug if an adverse event occurs (e.g., hold pain medication if respiratory rate less than 12). Pharmacists love indications but usually have to guess at them. Only the most common ones are noted here.

Abbreviation	Meaning
BP	blood pressure
CHF	congestive heart failure
COPD	chronic obstructive pulmonary disease; includes emphysema and bronchitis
CP	chest pain
HTN, HBP	hypertension, high blood pressure
HR	heart rate
MI	myocardial infarction: a heart attack
N/V	nausea and/or vomiting
temp	temperature
RR	respiratory rate
SOB	shortness of breath
sz	seizures
UTI	urinary tract infection

Abbreviations of Prescriber

The final thing you should see on a prescription is the signature of the prescriber, followed by his or her degree. Because authority to prescribe varies from state to state, any of the following professionals may be able to write prescriptions in your state.

Abbreviation	Meaning
ARNP	Advanced Registered Nurse Practitioner
CNM	Certified Nurse Midwife
DDS	Doctor of Dental Surgery; a dentist
DPM	Doctor of Podiatric Medicine; a foot physician
DO	Doctor of Osteopathy; an osteopathic physician
DVM	Doctor of Veterinary Medicine
MD	Medical Doctor; a physician
ND	Doctor of Naturopathy; a naturopathic physician
OD	Doctor of Optometry
PA	Physician's Assistant; often called a Medex
PharmD or RPh	Pharmacist with collaborative authority to prescribe

Other Health-Care Professionals

In addition to the prescriber's initials, you will also see other health-care practitioners' qualifications after their notes in the chart. This list outlines degrees of people who are not prescribers, but who still are health-care professionals.

Abbreviation	Meaning
BSN	Bachelor of Science in Nursing
CNA or NAC	Certified Nursing Assistant; also called a nurse's aide
CPT	Certified Pharmacy Technician
DC	Doctor of Chiropractic
HCP	Health-care professional; not a degree but used often
LMT	Licensed Massage Therapist
LPN	Licensed Practical Nurse
MHA	Masters of Health Care Administration
MPH	Masters of Public Health
MSW	Masters of Social Work
MT or MLT	Medical Technologist or Medical Laboratory Technologist
OT	Occupational Therapist
PharmD	Doctor of Pharmacy*
PhD	Doctor of Philosophy
PT	Physical Therapist
RD	Registered Dietition
RN	Registered Nurse
RPh	Registered Pharmacist*
RT or RRT	Respiratory Therapist or Registered Respiratory Therapist

** Pharmacists can sometimes prescribe medications under prescriptive authorities established with a prescriber. These stipulate the conditions under which independent prescribing can occur.*

Some of these people (e.g., RNs, RPhs, RRTs, MSWs) may write an order for a medication but only if told to do so by a physician or other prescriber. In this case, they will sign the prescription using the abbreviations v.o., for voice order, or t.o., for telephone order, to indicate how the order was communicated to them, then sign the prescriber's name and degree, followed by a slash and then their name and degree. For example:

v.o. W. Harrison, MD/T. O'Sullivan, RPh

Laboratory Values

You may need to convert between laboratory value measurement systems; there will be more on this in the next unit. For now, you need to be able to recognize the units before you can begin to convert. A few abbreviations from frequently ordered laboratory tests are also included here.

Abbreviation	Meaning
dL or dl	deciliter (100 mL)
µL or mcL or µl	microliter (1/1000 of a mL)
µg or mcg	microgram (1/1000 of a mg)
ng	nanogram (1/1000 of a µg)
pg	picogram (1/1000 of a ng)
Cr or SCr	serum creatinine; you will use this for calculating kidney function
BUN	blood urea nitrogen; used to calculate if a patient is dehydrated
K	potassium
Na	sodium
Cl	chloride
glu	serum glucose (blood sugar)
Ca	calcium
PO_4	phosphate
alb	albumin; a serum protein
CBC	complete blood count (counts all cells in the blood)
C/S	culture and sensitivities (used to determine type of bacteria)
Hb	hemoglobin; used to calculate a dose of IV iron
Hct	hematocrit; also used to calculate a dose of IV iron

You will learn more laboratory abbreviations during your therapeutics courses.

Now it is time to see how much you have learned. So let's work some problems.

FUN FACTS FUN FACTS FUN FACTS FUN FACTS FUN FACTS FUN

The story about the connection between the scruple as a measure of weight and a scruple as a moral principle that keeps people from doing wrong is an interesting one. It seems that the medieval apothecaries' apprentices were supposed to use weights in order to measure out the correct amount of medication for a prescription. Because the amount in a scruple was so small, however (about 1.3 g, around the weight of a quarter teaspoonful of salt), some of the apprentices would just take a pinch of the ground substance for each scruple and add it to the drug mixture they were concocting, rather than go through the laborious process of using the scruple weight and balance to make sure they had the right amount. If the apothecary (who was both physician and pharmacist in medieval times) didn't see the scruple weight laid out, he would ask the apprentice, "Have you no scruples?" This phrase became first associated with carelessness or an unconcern for accuracy and in time changed to mean a lack of principles or moral integrity; individuals with these attributes came to be described as "unscrupulous."

PRACTICE PRACTICE PRACTICE PRACTICE PRACTICE PRACTICE PRACTICE

1. 1 gr aspirin = _____ mg

If a doctor told you to recommend a product that would give a patient "a grain per day of aspirin," which product would you dispense? _____

(a) *Bayer®* Children's Aspirin, 81-mg chewable tabs

(b) *Halfprin®,* 165-mg enteric-coated tablets

(c) *Ecotrin®* (enteric-coated aspirin), 325 mg

(d) Generic enteric-coated aspirin, 650 mg

2. 1/200 gr nitroglycerin SL = _____ mg

You get a prescription for the above. Which product will you dispense? _____

(a) *Nitrostat®* 0.3 mg (nitroglycerin)

(b) *Nitrostat* 0.4 mg (nitroglycerin)

(c) *Nitrostat* 0.6 mg (nitroglycerin)

(d) *Nitrobid®* 2.5-mg capsules (nitroglycerin)

3. 5 gr ferrous gluconate = _____ mg

A patient tells you her doctor wanted her to take one of these every day.
Which product would you recommend? _____

(a) ferrous sulfate 324-mg tablets

(b) ferrous fumarate 324-mg tablets

(c) ferrous gluconate 240-mg tablets

(d) ferrous gluconate 325-mg tablets

4. A patient has been receiving penicillin 1,000,000 units IV q6h while in hospital. He is now to be sent home. You need to convert him to an oral form of this drug. The bottle of penicillin tells you that 250 mg = 400,000 units.

What dosage regimen will you recommend for this patient? _____

(a) penicillin VK 250 mg po QID

(b) penicillin VK 500 mg po QID

(c) penicillin VK 500 mg po BID

5. Convert the following patient weights to their metric equivalent. (See rules for rounding patient weights).

(a) 120 lb = _____ kg

(b) 150 lb = _____ kg

(c) 183 lb = _____ kg

(d) 330 lb = _____ kg

(e) 93 lb = _____ kg

(f) 25 lb = _____ kg

(g) 7.5 lb = _____ kg

(h) 5 lb, 9 oz = _____ g

(i) 3 lb, 4.5 oz = _____ g

(j) 1 lb, 5.2 oz = _____ g

6. Calculate the metric heights of the following patients:

(a) 5′ 10″ = _____ cm

(b) 4′ 6″ = _____ cm

(c) 5′ 4″ = _____ cm

(d) 6′ 4″ = _____ cm

(e) 36″ = _____ cm

7. Convert the following:

(a) 1 mg/L = _____ µg/mL

(b) 1.6 ng/mL = _____ mg/L

(c) 100 mg/dL = _____ mg/mL

(d) 60 mg/dL = _____ g/L

(e) 2 ng/mL = _____ µg/L

(f) 20 mg/dL = _____ mg/L

(g) 20 pg/mL = _____ ng/L

(h) 50 µg/mL = _____ mg/dL

8. Working with temperatures:

(a) "Normal" oral body temperature is 98.6°F. What is this temperature in °C? _____ °C

(b) You see on a patient's chart that he has an oral temperature of 39.6°C.

What is the Fahrenheit equivalent? _____ °F

(c) Calculate the Fahrenheit equivalent of an oral temperature of 36.2°C. _____ °F

(d) A pediatric patient has a rectal temperature of 102.4°F. Calculate the oral equivalent of this temperature in both °F and °C.

_____ °F _____ °C

(e) A premature infant registers an axillary temperature of 99.6°F. What would this be equivalent to if it were taken rectally?

_____ °F

9. Now some work with symbols:

(a) You have a plastic amber prescription fluid vial that reads ℥iv.

How many ounces is this? _____ oz How many mL? _____ mL

(b) A physician has written ℥ii po TID on a prescription. What would you type on a label?

Take _____ three times a day.

What would be another way of interpreting this sig? Take _____ three times a day.

(c) A prescription lists two inhalers and the directions are ii puffs $\overline{a}\,\overline{a}$ QID.

This prescriber means for the patient to inhale 2 puffs _____ four times a day.

(d) A prescriber has written for HCTZ 25 mg with the following directions: i tab po qd.

You will type on the prescription label: Take _____ tablet by mouth every day.

(e) A prescription reads: i po BID. Take $\overline{c}$ food. You will type:

Take one tablet twice daily _____ food.

10. Consider the following sigs (shorthand directions found on the prescription that the patient brings in from the prescriber) and write out the directions that you would place on the prescription label for the patient:

(a) *Septra*® DS #20: i po BID x 10 days

Your label directions:_____

(b) Kaolin-pectin 8 oz: ℥i-ii po q loose stool

Your label directions:_____

(c) Nitroglycerin 0.4 mg #100: i SL prn CP. MR q5min x 2

Your label directions:_____

_____

(d) *Ventolin*® *Syrup* 4 oz: ℥i po TID prn SOB, wheezing

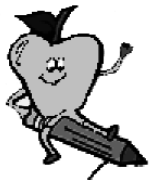
Your label directions:_____

(e) Amoxicillin 125 mg/5 mL 100 mL: 2.5 mL po TID x 10 days

Your label directions:_____

BONUS FUN BONUS FUN BONUS FUN BONUS FUN BONUS FUN BONUS FUN

Test your prowess!



The following prescriptions were written in haste by a prescriber.
Can you tell what they are for?

What prescription directions would you type on the label?

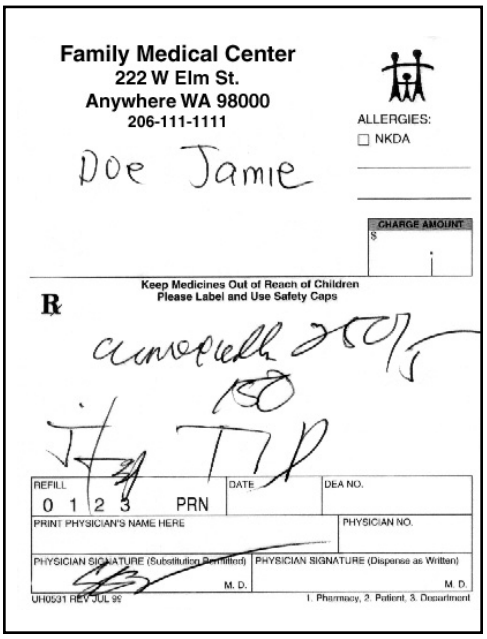
(a) What drug do you think this is?

_____

(b) What directions would you type on the label?

_____

_____



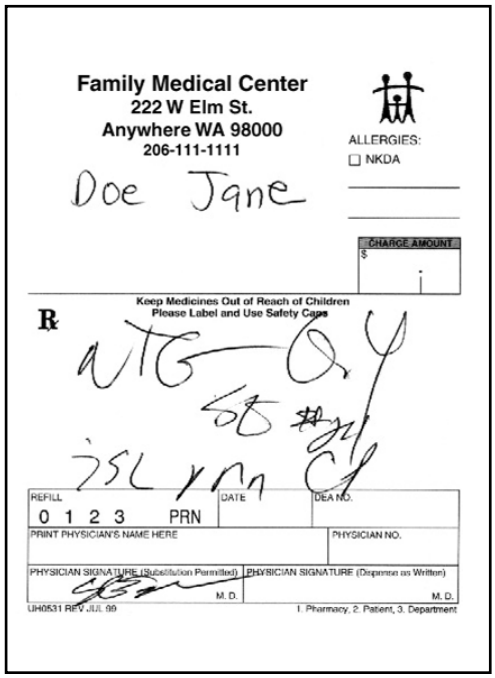
(c) What drug do you think this is?

_____

(d) What directions would you type on the label?

_____

_____



ANSWERSANSWERSANSWERSANSWERSANSWERSANSWERSANSWERS

1. 1 gr aspirin = 65 mg
If a doctor told you to recommend a product that would give a patient "a grain per day of aspirin," which product would you dispense?

(a) ***Bayer Children's Aspirin,* 81-mg chewable tabs** *(Note: No 65-mg dose is available, so you would use the closest dosage form available.)*

2. 1/200 gr nitroglycerin SL = 0.325 mg

Which product would you dispense?

(a) ***Nitrostat* 0.3 mg (nitroglycerin)**

3. 5 gr ferrous gluconate = **325 mg**

(d) ferrous gluconate 325-mg tablets
(Note: The first two choices are the wrong salt and the third is the wrong strength.)

4.
(b) penicillin VK 500 mg po QID *(Note: 500 mg is closest dosage form available.)*

5. Convert the following patient weights to their metric equivalent:

(a) 120 lb = **55 kg**
(b) 150 lb = **68 kg**
(c) 183 lb = **83 kg**
(d) 330 lb = **150 kg**
(e) 93 lb = **42 kg**
(f) 25 lb = **11.4 kg**
(g) 7.5 lb = **3.4 kg**
(h) 5 lb, 9 oz = **2528 g**
(i) 3 lb, 4.5 oz = **1491 g**
(j) 1 lb, 5.2 oz = **602 g** *(Note: You may actually see a preemie this size, almost small enough to fit in the palm of your hand. We live in amazing times.)*

6. Calculate the metric heights of the following patients:

(a) 5′ 10″ = **178 cm**
(b) 4′ 6″ = **137 cm**
(c) 5′ 4″ = **163 cm**
(d) 6′ 4″ = **193 cm**
(e) 36″ = **91 cm**

7. Convert the following:

(a) 1 mg/L = **1 µg/mL**
(b) 1.6 ng/mL = **0.0016 mg/L**
(c) 100 mg/dL = **1 mg/mL**
(d) 60 mg/dL = **0.6 g/L**
(e) 2 ng/mL = **2.0 µg/L**
(f) 20 mg/dL = **200 mg/L**
(g) 20 pg/mL = **20 ng/L**
(h) 50 µg/mL = **5 mg/dL**

8. Working with temperatures:

(a) "Normal" oral body temperature is 98.6°F. What is this temperature in °C? **37.0°C**
(b) You see on a patient's chart that he has an oral temperature of 39.6°C. What is the Fahrenheit equivalent? **103.3°F**
(c) Calculate the Fahrenheit equivalent of an oral temperature of 36.2°C. **97.2°F**
(d) A pediatric patient has a rectal temperature of 102.4°F. Calculate the oral equivalent of this temperature in both °F and °C. **A thermometer placed in the mouth at the same time would register an oral temp of 101.4 °F or 38.6 °C.**
(e) A premature infant registers an axillary temperature of 99.6°F. What would this be equivalent to if it were taken rectally? **101.6°F**

9. Now some work with symbols:

(a) You have a plastic amber prescription fluid vial that reads ℥iv. How many ounces is this? **4 oz** How many mL? **118.4 mL or 120 mL, either is OK.**
(b) A physician has written ʒii po TID on a prescription. What would you type on a label? Take **2 teaspoonfuls by mouth** three times a day. What would be another way of interpreting this sig? Take **10 mL by mouth** three times daily.
(c) A prescription lists two inhalers and the directions are ii puffs $\overline{a}\,\overline{a}$ QID. This prescriber means for the patient to inhale 2 puffs **of each inhaler** four times a day.
(d) A prescriber has written for HCTZ 25 mg with the following directions: i tab po qd. You will type on the prescription label: Take **one-half** tablet by mouth every day.
(e) A prescription reads: i po BID. Take $\overline{c}$food. You will type: Take one tablet twice daily **with** food.

10. Consider the following sigs (shorthand directions found on the prescription that the patient brings in from the prescriber) and write out the directions you would place on the prescription label for the patient:

(a) *Septra* DS #20: i po BID x 10 days; your label directions:
Take 1 tablet twice daily for 10 days.

(b) Kaolin-pectin 8 oz: ℥i-ii po q loose stool; your label directions:
Take 2-4 tablespoonfuls after each loose stool.

(c) Nitroglycerin 0.4 mg #100: i SL prn CP. MR q5min x 2; your label directions:
Dissolve under the tongue one tablet as needed for chest pain. May repeat every 5 minutes if pain persists, to a maximum of 2 additional doses.

(d) *Ventolin Syrup* 4 oz: ℥i po TID prn SOB, wheezing; your label directions:
Take 1 teaspoonful up to 3 times a day as needed for shortness of breath or wheezing.

(e) Amoxicillin 125 mg/5 mL 100 mL: 2.5 mL po TID x 10 days; your label directions:
Take 1/2 teaspoonful (2.5 mL) 3 times a day for 10 days.

BONUS FUN ANSWERS BONUS FUN ANSWERS BONUS FUN ANSWERS

Test your prowess!

Bonus Fun Answers:

(a) Amoxicillin 250-mg/5-mL susp, 150-mL

(b) Take one teaspoonful three times a day for 10 days. *(I added the "for 10 days" information on the end of this because the intention of the prescriber is that the patient take the drug for a full 10 days.)*

(c) Nitroglycerin 0.4 mg SL tabs, #24 *(This product is available in a bottle of 24 tablets which is what you will dispense.)*

(d) Dissolve under the tongue one tablet as needed for chest pain.