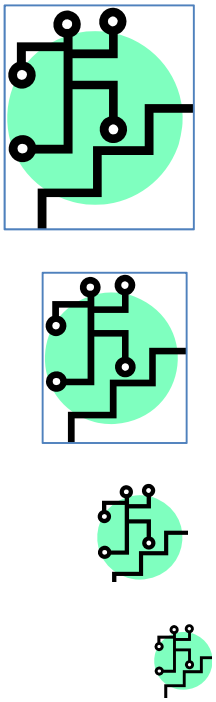
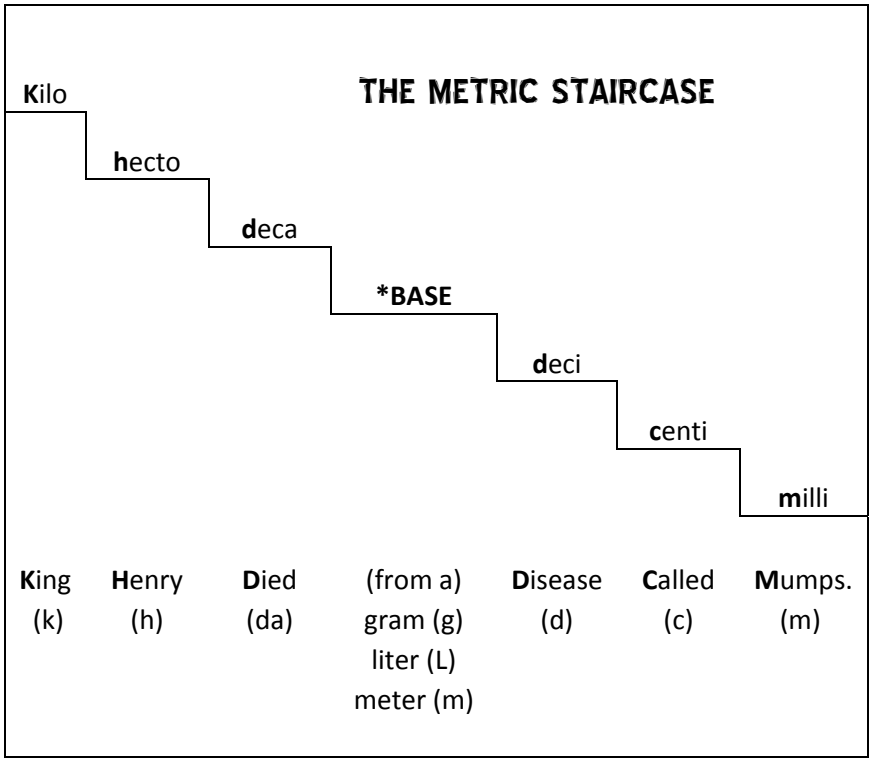
# MOST COMMON METRIC UNITS USED IN THE MEDICAL FIELD

| | | | | | |
|---|---|---|---|---|---|
| Micro (**mc**) | microgram | $10^{-6}$ | One millionth | 0.000001 | $\frac{1}{1{,}000{,}000}$ of the base unit |
| Milli (**m**) | milligram<br>milliliter*<br>millimeter | $10^{-3}$ | One thousandth | 0.001 | $\frac{1}{1{,}000}$ of the base unit |
| Centi (**c**) | centimeter | $10^{-2}$ | One hundredth | 0.01 | $\frac{1}{100}$ of the base unit |
| Deci (**d**) | deciliter | $10^{-1}$ | One tenth | 0.1 | $\frac{1}{10}$ of the base unit |
| **BASE** | gram (g)<br>liter (L)<br>meter (m) | $10^{0}$ | One | 1 | 1 times the base unit |
| Kilo (**k**) | kilogram | $10^{3}$ | Thousand | 1,000 | 1,000 times the base unit |

*1cc = 1 mL






To convert from one unit of measurement to the other, move the decimal to the right or left and add the appropriate zeros.

Example: 1 dg = ? kg

To go from deci to kilo you move the decimal 4 places to the left


Therefore, 1 dg = 0.0001 kg

**Example:** 10 hL = ? mL

To go from hecto to milli you move the decimal 5 places to the right

1 0 0 0 0 0 0 .

Therefore, 10 hL = 1,000,000 mL

☺ Try: Convert each of the following:

1. 2,000 mg = _____ g
2. 16 hL = _____ dL
3. 198 kg = _____ g
4. 56 dam = _____ cm
5. 5 L = _____ mL
6. 104 km = _____ mm
7. 2500 cL = _____ hL
8. 75 cg = _____ kg

Compare each measurement with <, >, or =.

9. 63 cm ☐ 6 m
10. 1,500 mL ☐ 1.5 L
11. 5 g ☐ 508 mg
12. 536 cm ☐ 53.6 dm

## THE APOTHECARY SYSTEM OF WEIGHTS AND MEASUREMENTS

| Unit | Weight | Metric Weight | Household System |
|---|---|---|---|
| grain (gr)* | | 60 mg | 1 drop (gtt) |
| 15 grain | | 1 g or 1,000 mg | |
| dram (ʒ) | 60 grains | 4g | 1 teaspoon (t) = 5 cc = 60 gtt |
| 4 drams | | | 1 tablespoon (T) = 3 t |
| ounce (℥) | 8 drams | 30 g | 2 tablespoons |
| | 12 ounces | 360 g | |
| 2.2 pounds | | 1 kg | |

*Use this unit if working with ≤ 1 grain

## RATIOS AND PROPORTIONS

A ratio is a comparison of two numbers. The first number represents the quantity chosen and the second number represents the total quantity. A ratio can be expressed in the forms:

| | | |
|---|---|---|
| numerator to denominator | numerator : denominator | $\frac{numerator}{denominator}$ |

Notice that the last expression is a fraction!

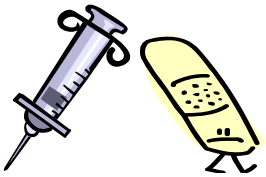
**Example:** There are 149 nurses, 69 doctors, and 230 patients in a hospital. Find the ratios:

| | | | |
|---|---|---|---|
| Nurses to doctors: | 149 to 69 | 149 : 69 | $\frac{149}{69}$ |
| Doctors to patients: | 69 to 230 | 69 : 230 | $\frac{69}{230}$ |
| which reduces to: | 3 to 10 | 3 : 10 | $\frac{3}{10}$ |
| Patients to nurses: | 230 to 149 | 230 : 149 | $\frac{230}{149}$ |
| Patients to doctors and nurses: | 230 to 218 | 230 : 218 | $\frac{230}{218}$ |
| which reduces to: | 115 to 109 | 115 : 109 | $\frac{115}{109}$ |

Notice that the first number corresponds to the first word. On the first example, the ratio was nurses to doctors. If the question had been doctors to nurses, the numbers would have been reversed, giving the ratios:

Doctors to nurses: 69 to 149 69 : 149 $\frac{69}{149}$

On the last example, since it is asking patients to doctors AND nurses, you must add the number of doctors to the number of nurses to get the denominator.



☺ Try: Find the ratios given the information (do not forget to reduce, if possible):
39 syringes, 93 band aids, 26 aspirin, and 71 cotton swabs

13. Syringes to cotton swabs: _____ _____ _____

14. Band Aids to syringes: _____ _____ _____

15. Syringes to aspirin and band aids: _____ _____ _____

16. Cotton Swabs to all the items: _____ _____ _____

17. Band aid and syringes to cotton swabs and aspirin: _____ _____ _____

## EQUIVALENTS USING RATIOS AND PROPORTIONS

When you are working with one unit of measurement and you want to find its equivalent to another unit of measurement, you can set up proportions. A proportion is just two ratios that are equal to each other. Be sure that the same units of measurement are in the numerator and the same units of measurement are in the denominator.

## Example: 45 gr = ? mg

Determine if you can set up a ratio using gr and mg. According to the apothecary system, 15 gr = 1,000 mg.

Set up your ratios: $\frac{45gr}{?} = \frac{15gr}{1000mg}$ (Notice the numerators have grain as the units!)

Solving for proportions: use cross multiplication $\frac{45gr}{?} \quad \frac{15gr}{1000mg}$

| | |
|---|---|
| (45 gr)(1000 mg) = (15 gr)(?) | |
| (45)(1000 mg) = (15)(?) | Divide by gr on both sides (they cancel out) |
| (45000 mg) = 15? | Multiply |
| 3000 mg = ? | Divide both sides by 15 |

## Example: $\frac{1}{200}$ gr = ? mg

Determine if you can set up a ratio using gr and mg. According to the apothecary system, 1 gr = 60 mg.

Set up your ratios and cross multiply: $\frac{\frac{1gr}{200}}{?} = \frac{1gr}{60mg}$

Notice that the numerator on the first ratio is $\frac{1}{200}$ grain and the denominator is ?.

| | |
|---|---|
| ($\frac{1}{200}$ gr)(60mg) = (1 gr)(?) | |
| ($\frac{1}{200}$)(60mg) = (1)(?) | Divide by gr on both sides |
| $\frac{60}{200}$ mg = ? | Multiply |
| .3 mg = ? | Divide 200 by 60 |

☺ Try: Find each equivalent: (Round to the nearest hundredth, if needed.)

18. 5 drops = _____ mg
19. 6 ounces = _____ T
20. 16 grams = _____ ounces
21. $\frac{3}{4}$ grain = _____ mg
22. 2 drams = _____ t
23. 46 lbs = _____ kg
24. 45 drams = _____ T
25. $\frac{15}{16}$ kg = _____ lbs

Sometimes you may not know a conversion, so you may have to set up more than one set of ratios.

**Example:** How many seconds are in a day? You want your answer in seconds per day so you have to work from the seconds units to the day units. We know there are 60 seconds/minute, 60 minutes/hour, and 24 hours/day. (We are using the "/" symbol to indicate "per".) Writing these as ratios, we have:

$$\frac{60sec}{1min} \qquad \frac{60min}{1hr} \qquad \frac{24hr}{1day}$$

Because you want seconds/day, the seconds will be in the numerator and you will end with day in the denominator. You will notice that the minute units and hour units will cancel out.

$$\frac{60sec}{1min} \leftarrow \rightarrow \frac{60min}{1hr} \leftarrow \rightarrow \frac{24hr}{1day}$$

Multiplying the ratios, you will get:

$$\frac{60sec}{1\cancel{min}} \times \frac{60\cancel{min}}{1\cancel{hr}} \times \frac{24\cancel{hr}}{1day} = 86{,}400 \text{ sec/day}$$

☺ Try:

26. How many ounces are in a gallon of milk? _____


Helpful hints:
- 1 cup = 8 ounces
- 4 quarts = 1 gallon
- 1 pint = 16 ounces
- 1 quart = 2 pints

## SOLVING DRUG CALCULATIONS USING THE FORMULA METHOD

To determine the amount of medication to be administered to a patient, you must use the formula method.

$$\frac{Desired\ Dose}{Available\ Dose} \times \text{(conversion ratio(s))} \times \frac{Quantity\ Available}{1} = \text{Volume to Administer}$$

NOTE: The conversion ratio(s) are not always needed.

**Example:** Order: 140 mg

Supply: 100 mg/mL (100 mg "per" 1 mL)

$$\frac{140\ mg}{100\ mg} \times \frac{1\ mL}{1} = 1.4 \text{ mL}$$

No conversation ratios were necessary since both the order and supply were in the same units (mg).

**Example:** Order: 0.75 g

Available: 250 mg/mL

$$\frac{.75\ g}{250\ mg} \text{ X } \frac{1000\ mg}{1\ g} \text{ X } \frac{1\ mL}{1} = 3 \text{ mL}$$

This required a conversion ratio since the order was given in grams and the available unit was in milligrams. You could eliminate this step by using the "Metric Staircase" and converting .75 g to 750 mg by moving the decimal 3 places to the right. Then the formula would look like:

$$\frac{750\ mg}{250\ mg} \text{ X } \frac{1\ mL}{1} = 3 \text{ mL}$$

**Example:** Order: 10 mg

Available: 5 mg/5mL

$$\frac{10\ mg}{5\ mg} \text{ X } \frac{5\ mL}{1} = 10 \text{ ml}$$

☺ Try: Determine the amount of each medication to be administered. (Keep in fraction form, if needed.)

27. Order: 500 mg
    Available: 250 mg/5 mL _____ mL

28. Order: 0.35 g
    Available: 125 mg/5 mL _____ mL

29. Order: 0.25 g
    Available: 0.75 g/1.5 cc _____ cc

30. Order: .375 g
    Available: 500 mg/cc _____ cc

31. Order: $\frac{1}{300}$ grains
    Available: $\frac{1}{150}$ grains/tablet _____ tablet(s)

32. Order: $\frac{1}{75}$ grains
    Available: $\frac{1}{300}$ grains/ 15 drops
    How many drams? _____ drams

33. Order: 500 mg
    Available: 1 g/1 t _____ t

34. Order: 17 mg
Available: 102 mg/2 T
How many teaspoons? _____ t

35. Order: 1000 mg
Available: 0.25 g/2 t
How many tablespoons? _____ T

36. Order: 0.5 g
Available: 250 mg/5 cc
How many teaspoons? _____ t

37. Order: 3 mg
Available: $\frac{1}{5}$ grain/T
How many drams? _____ drams

**Example:** Sometimes dosages are determined by the body weight of the patient. To convert from pounds to kilograms, you need to divide by 2.2, then multiply by the dosage:

{ Body Weight (lb) } ÷ { 2.2 } = Body Weight (kg)

Body Weight (kg) X ordered dosage = Dosage to give

*When given the kg, multiply by 2.2.

A person's weight is 154 lb. The ordered dosage is 5 mg/kg of body weight.

$\frac{154\ lb}{2.2\ kg}$ X 5 mg = 350 mg (It's a ratio!)

☺ Try: Determine the body weight and the dose for each person: (Round to the nearest tenth, if needed.)

38. Susan: 121 lb = _____ kg
Dosage ordered: 3.5 mg/kg of body weight = _____

39. Frank: 180.4 lb = _____ kg
Dosage ordered: 2.2 mg/kg of body weight = _____

40. Sam: 65 kg = _____ lb
Dosage ordered: 0.5 mg/kg of body weight = _____

# ANSWERS TO METRIC AND RATIOS/PROPORTIONS WORKSHEETS

1. 2 g
2. 16,000 dL
3. 198,000 g
4. 56,000 cm
5. 5,000 mL
6. 104,000,000 mm
7. .25 hL
8. .00075 kg
9. <
10. =
11. >
12. =
13. 39 to 71, 39:71, $\frac{39}{71}$
14. 93 to 39, 93:39, $\frac{93}{39}$

    reduced: 31 to 13, 31:13, $\frac{31}{13}$
15. 39 to 119, 39:119, $\frac{39}{119}$
16. 71 to 229, 71:229, $\frac{71}{229}$
17. 132 to 97, 132:97, $\frac{132}{97}$
18. 300 mg
19. 12 T
20. .53 oz
21. 45 mg
22. 1.5t or 2 t
23. 20.91 kg
24. 11.25 T
25. 2.06 lb
26. 128 oz
27. 10 mL
28. 14 mL
29. $\frac{1}{2}$ cc
30. $\frac{3}{4}$ cc
31. $\frac{1}{2}$ tablet(s)
32. 1 dram
33. $\frac{1}{2}$ t
34. 1 t
35. $2\frac{2}{3}$ T
36. 2 t
37. 1 dram
38. 55 kg, 192.5 (dose)
39. 82 kg, 180.4 (dose)
40. 143 lb, 32.5 (dose)