MODULE 3

CONVERSIONS TO THE METRIC SYSTEM

Conversions to the Metric System

OBJECTIVES:

1. Given a measurement expressed in one of the following units: grains, fluid ounces, pints, or pounds, convert that measurement into the specified metric system equivalent.

2. Given a volume expressed in milliliters, express that volume in a specified household measurement (teaspoonful or tablespoonful).

You have already completed the module on the system of measurement most commonly used in medicine: The Metric System. The metric system has been shown to be both useful and accurate in performing various types of dosage calculations. However, as you know, other systems of measurement are sometimesencountered when one works with drugs. In this module, two types of conversions will be discussed: (a) conversion of grains, fluid ounces, pints, and pounds into a specified metric system equivalent, and (b) the use of common household equivalents like the teaspoonful and the tablespoonful.

In order to perform these conversions quickly and accurately, you must memorize the equivalents. To this end, you are provided with the following conversions*:

WEIGHT CONVERSIONS

2.2 pounds = 1 kilogram (kg)
1 grain (gr) = 65 milligrams (mg)

VOLUME CONVERSIONS

1 pint (pt) = 473 milliliters (ml)
1 fluid ounce (fl. oz.) = 30 milliliters (ml)

HOUSEHOLD EQUIVALENTS

1 teaspoonful (tsp) = 5 milliliters
1 tablespoonful (tbsp) = 15 milliliters

**Some of these conversions are approximate.*

Conversions can be made quickly and easily if you follow the steps below:

1. Remember the conversion factor (i.e., 2.2 pounds = 1 kilogram) and write the conversion factor as your IF ratio.

2. Write the unknown factor (i.e., 154 pounds = X kilograms) as your THEN ratio.

3. Write the IF and THEN ratios as a ratio and proportion statement and solve for X as in any ratio and proportion problem.

Let us now apply these steps to the following problem:

PROBLEM: A patient weighs 154 pounds. Express this weight in kilograms.

SOLUTION: (Follow the steps!)

STEP 1: Remember the conversion factor and write the conversion factor as your IF ratio.

$$\text{IF} \quad \frac{2.2 \text{ pounds}}{1 \text{ kilogram}}$$

STEP 2: Write the unknown factor as your THEN ratio:

$$\text{THEN} \quad \frac{154 \text{ pounds}}{X \text{ kilograms}}$$

STEP 3: Write the IF and the THEN ratios as a ratio and proportion statement and solve for X as in any ratio and proportion problem. Therefore,

$$\text{IF } \frac{2.2 \text{ pounds}}{\text{kilogram}} \quad \text{THEN} \quad \frac{154 \text{ pounds}}{X \text{ kilograms}}$$

Cross multiply:

$$(2.2)(X) = (1)\,(154)$$

Solve for X (Divide each side of the equation by 2.2)

$$\frac{2.2X}{2.2} = \frac{154}{2.2}$$

Express the answer as kilograms:

$$X = 70 \text{ kilograms}$$

Therefore, by following the steps presented, we have found that 154 pounds = 70 kilograms.

You, too, can be successful at performing these types of calculations if you follow the steps as shown.

As you saw from the problem, 154 pounds is equivalent to 70 kilograms. In that particular problem, the answer came out to be exactly 70 kilograms. There are some instances in which the answer will not result in an even answer. When you encounter such instances, you are to use the following rounding rules:

ROUNDING RULES

Milligrams: Round to the nearest whole milligram.

Examples: 2.9 milligrams = 3 milligrams

4.3 milligrams = 4 milligrams

286.2 milligrams = 286 milligrams

Kilograms: a. Round to the nearest 1/10 th (0.1) kilogram in patients who weigh less than 10 kilograms.

Examples: 3.94 kilograms = 3.9 kilograms

3.98 kilograms = 4.0 kilograms

6.38 kilograms = 6.4 kilograms

b. Round to the nearest whole kilogram in patients who weigh more than 10 kilograms.

Examples: 29.62 kilograms = 30 kilograms

21.42 kilograms = 21 kilograms

154.33 kilograms = 154 kilograms

Milliliters: Round to the nearest 1/10th (0.1) milliliter.

Examples: 3.94 milliliters = 3.9 milliliters

4.33 milliliters = 4.3 milliliters

1.68 milliliters = 1.7 milliliters

One word of warning: The rounding rules above are presented as general guidelines. That is, you must be cautious when rounding. For example, if you round too early in a problem (i.e., on the first of four sequential steps), you may find that a significant error has resulted. Second, be advised that since some drugs are so potent, rounding the answer (i.e., 0.5 milligram to 1.0 milligram) could adversely impact upon the patient. These points are discussed to neither alarm nor confuse you at this point. Instead, the points are discussed to make you aware that you must approach rounding with caution.

PROBLEM: ½ grain = _____ milligrams.

STEP 1: Remember the conversion factor and write the conversion factor as your IF ratio.

IF $\frac{1 \text{ grain}}{65 \text{ milligrams}}$

STEP 2: Write the unknown factor as your THEN ratio:

THEN $\frac{\frac{1}{2} \text{ grain}}{\text{"X" milligrams}}$

STEP 3: Write the IF and the THEN ratios as a ratio and proportion statement and solve for X as in any ratio and proportion problem.

IF $\frac{1 \text{ grain}}{65 \text{ milligrams}}$ THEN $\frac{\frac{1}{2} \text{ grain}}{X \text{ milligrams}}$

$(1)(X) = (\frac{1}{2})(65)$

$X = 32.5 = 33$ milligrams

PROBLEM: 2 pints = _____ milliliters

STEP 1: Remember the conversion factor and write the conversion factor as your IF ratio.

IF $\frac{1 \text{ pint}}{473 \text{ milliliters}}$

STEP 2: Write the unknown factor as your THEN ratio:

THEN_____

STEP 3: Write the IF and the THEN ratios as a ratio and proportion statement and solve for X as in any ratio and proportion problem.

IF _____THEN _____

ANSWER: THEN 2 pints
"X" milliliters

IF	1 pint	THEN	2 pints
	473 milliliters		X milliliters
	(1) (X)	=	(2) (473)
	X	=	946 milliliters

Thus, 2 pints is equivalent to 946 milliliters.

PROBLEM: 4 fluid ounces =_____milliliters.

STEP 1: Remember the conversion factor and write the conversion factor as your IF ratio.

IF _____

STEP 2: Write the unknown factor as your THEN ratio:

THEN_____

STEP 3: Write the IF and the THEN ratios as a ratio and proportion statement and solve for "X" as in any ratio and proportion problem.

IF _____THEN_____

ANSWER: IF $\frac{\text{1 fluid ounce}}{\text{30 milliliters}}$ THEN $\frac{\text{4 fluid ounces}}{\text{X milliliters}}$

(1) (X) = (4) (30)

X = 120 ml

PROBLEM: 138 pounds = _____kilograms

STEP 1:

STEP 2:

STEP 3:

ANSWER: IF $\frac{2.2 \text{ pounds}}{1 \text{ kilogram}}$ THEN $\frac{138 \text{ pounds}}{X \text{ kilogram}}$

$(2.2)(X) = (1)(138)$

$2.2X = 138$

$\frac{2.2X}{2.2} = \frac{138}{2.2}$

$X = 62.72 = 63$ kilograms

Problem: Most aspirin tablets contain 5 grains of aspirin. How many milligrams of aspirin are contained in one of these aspirin tablets?

STEP 1:

STEP 2:

STEP 3:

ANSWER:

STEP 1: IF $\frac{1 \text{ grain}}{65 \text{ milligrams}}$

STEP 2: THEN $\frac{5 \text{ grains}}{X \text{ milligrams}}$

STEP 3: IF $\frac{1 \text{ grain}}{65 \text{ milligrams}} = \text{THEN} \frac{5 \text{ grains}}{X \text{ milligrams}}$

$(1)(X) = (5)(65)$

$X = 325$ milligrams

PROBLEM: 8 fluid ounces = _____ milliliters

STEP 1:

STEP 2:

STEP 3:

SOLUTION:

STEP 1: IF $\frac{\text{1 fluid ounce}}{\text{30 milliliters}}$

STEP 2: THEN $\frac{\text{8 fluid ounces}}{\text{X milliliters}}$

STEP 3: IF $\frac{\text{1 fluid ounce}}{\text{30 milliliters}} = \text{THEN} \frac{\text{8 fluid ounces}}{\text{X milliliters}}$

$$(1)(X) = (8)(30)$$

$$X = 240 \text{ milliliters}$$

PROBLEM: 1 ½ pints =_____ milliliters

STEP 1:

STEP 2:

STEP 3:

X = _____ milliliters

SOLUTION:

STEP 1: IF $\frac{1 \text{ pint}}{473 \text{ milliliters}}$

STEP 2: THEN $\frac{1\ ½ \text{ pints}}{X \text{ milliliters}}$ (NOTE: 1 ½ may be written as 1.5)

STEP 3: IF $\frac{1 \text{ pint}}{473 \text{ milliliters}} =$ THEN $\frac{1\ ½ \text{ pints}}{X \text{ milliliters}}$

$$(1)(X) = (1.5)(473)$$

$$X = 709.5 \text{ milliliters}$$

PROBLEM: Most "baby" aspirin tablets contain 1 1/4 grains of aspirin. State the number of milligrams of aspirin contained in one of these tablets.

In this problem, the steps will not be listed for you.

SOLUTION: IF $\frac{1 \text{ grain}}{65 \text{ milligrams}} = \frac{1\ 1/4 \text{ grains}}{X \text{ milligrams}}$ THEN

$$(1)(X) = (1.25)(65)$$

$$X = 81.25 = 81.3 = 81 \text{ mg}$$

PROBLEM: A child weighs 17 pounds. Express this child's weight in kilograms.

SOLUTION: IF $\frac{2.2 \text{ pounds}}{1 \text{ kilogram}} = \frac{17 \text{ pounds}}{X \text{ kilograms}}$ THEN

$$(2.2)(X) = (1)(17)$$

$$2.2X = 17$$

$$\frac{2.2X}{2.2} = \frac{17}{2.2}$$

$$X = 7.727 = 7.7 \text{ kilograms}$$

PROBLEM: 6 fluid ounces =_____ milliliters

SOLUTION: IF $\frac{\text{1 fluid ounce}}{\text{30 milliliters}}$ = THEN $\frac{\text{6 fluid ounces}}{\text{X milliliters}}$

(1) (X) = (6) (30)

X = 180 milliliters

CHECKUP QUIZ:

PROBLEM 1. 3/4 grain = _____milligrams.

PROBLEM 2. 36 pounds = _____ kilograms

PROBLEM 3. You think your patient may be morbidly obese. This has many consequences for your anesthetic plan. One definition morbid obesity is a body mass index (BMI) greater than 35. BMI can be calculated as the patients weight in Kilograms (Kg) divided by their (height)2 in meters.

$$BMI = \frac{Wt\ (Kg)}{(Ht)2\ meters}$$

Your patient is 5 foot 4 inches and weighs 250 lbs.

What is your patient's BMI? (1cm = 2.54 inches and 100cm = 1 meter)

ANSWERS:
1. 48.75mg (rounded to 49 mg)
2. 16.36 Kg (rounded to 16Kg)
3. BMI = 43