Algebra 1   Unit 1: Algebraic Expressions & Equations   Notes

Dimensional Analysis

Metric Conversions

The Metric System of Measurement is based on multiples of 10. The three base units are meters, liters, and grams. The 6 prefixes are kilo (1000), hector (100), deka (10), base unit (1), deci (.1), centi (.01), and milli (.001). A helpful way to remember the order of the prefixes is **King Henry Died Unusually Drinking Chocolate Milk**.

Metric Conversion

King	**H**enry	**D**ied	**U**nusually	**D**rinking	**C**hocolate	**M**ilk
Kilo	Hecto	Deca	* Unit *	Deci	Centi	Milli
10 x 10 x 10 x LARGER than a unit	10 x 10 x LARGER than a unit	10 x LARGER than a unit	**Meter** (length) **Liter** (liquid volume) **Gram** (mass/weight)	10 x SMALLER than a unit	10 x 10 x SMALLER than a unit	10 x 10 x 10 x SMALLER than a unit
1 kilo = 1,000 units	1 hecto = 100 units	1 deca = 10 units	**1 unit**	10 deci = 1 unit	100 centi = 1 unit	1,000 milli = 1 unit
km = kilometer kL = kiloliter kg = kilogram	hm = hectometer hL = hectoliter hg = hectogram	dam = decameter daL = decaliter dag = decagram	m = meter L = liter g = gram	dm = decimeter dL = deciliter dg = decigram	cm = centimeter cL = centiliter cg = centigram	mm = millimeter mL = milliliter mg = milligram
Example: 5 kilo	50 hecto	500 deca	5,000 units	50,000 deci	500,000 centi	5,000,000 milli

◄ DIVIDE numbers by 10 if you are getting bigger (same as moving decimal point one space to the left)

MULTIPLY numbers by 10 if you are getting smaller (same as moving decimal point one space to the right) ►

Examples: Convert from one prefix to another

A. 2500 dL = __0.25__ kL

B. 38.2 dkg = _38290020_ cg   38 30000

C. 5 dm = __.5__ m

K H D ✗ d c m

Examples: Compare measurements using <, >, or =.
(Hint: They have to be written in the same units of measure before you can compare.)

A. 502 mm __=__ .502 m   .502 m $=$ .502 m

B. 90.801 cg _____ 5 hg   9.0801 hg $\geq$ 5 hg

C. 160 dL _____ 1.6 L   16.0 L $\geq$ 1.6 L

K H D ✗ d c m

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Customary Units of Conversion

There are many different units of measure specific to the U.S. Customary System that you will need to remember. The list below summarizes some of the most important.

Measurement	Time	Capacity	Weight
1 foot = _12_ inches	1 minute = _60_ seconds	1 cup = _8_ fl. oz	1 ton = _2000_ lbs
1 yard = _3_ feet	1 day = _24_ hours	1 pint = _2_ cups	1 lb = _16_ oz
1 mile = _5280_ feet	1 year = _52_ weeks	1 quart = _2_ pints	
1 mile = _1760_ yards	1 hour = _60_ minutes	1 gal = _4_ quarts	
	1 week = _7_ days		

year = 365 days

In order to convert between units, you must use a conversion factor. A **conversion factor** is a fraction in which the numerator and denominator represent the same quantity, but in different units of measure.

Examples: 3 feet = 1 yard: $\dfrac{3\,feet}{1\,yard}$ OR $\dfrac{1\,yard}{3\,feet}$ | 100 centimeters = 1 meter: $\dfrac{100\,cm}{1m}$ OR $\dfrac{1m}{100\,cm}$

Multiplying a quantity by a unit conversion factor changes only its units, not its value. It is the same thing as multiplying by 1.

$$\frac{100\,cm}{1m} = \frac{100\,cm}{100\,cm} = 1$$

The process of choosing an appropriate conversion factor is called **dimensional analysis.**

Understanding Dimensional Analysis

When setting up your conversion factors, don't worry about the actual numbers until the very end. The key to set up your conversion factors so that they cancel out the units you don't want until you end up with the units that you do want.

1. Convert from inches to miles

Possible Conversion Factors: $\dfrac{yards}{miles}$ **or** $\dfrac{miles}{yard}$ $\dfrac{Inches}{feet}$ **or** $\dfrac{feet}{inches}$ $\dfrac{yard}{feet}$ **or** $\dfrac{feet}{yards}$

$$\frac{inches}{1} \cdot \frac{1\,ft}{12\,inches} \cdot \frac{1\,mile}{5280\,ft} = miles$$

$$\frac{1}{63360}\ miles$$

$$7.36\,s = \underline{\quad} min$$

$$\frac{7.36\,sec}{1} \cdot \frac{1\,min}{60\,sec} = 0.1226\,min$$

2. Convert from gallons to cups

Possible Conversion Factors: $\dfrac{cups}{pints}$ **or** $\dfrac{pints}{cups}$ $\dfrac{quarts}{pints}$ **or** $\dfrac{pints}{quarts}$ $\dfrac{gallons}{quarts}$ **or** $\dfrac{quarts}{gallons}$

$$\frac{gal}{1} \cdot \frac{4\,qts}{1\,gal} \cdot \frac{2\,pts}{1\,qt} \cdot \frac{2\,cups}{1\,pt}$$

$$1\,gal = 16\,cups$$

$$1 = \frac{gal}{gal}$$

$$1 = \frac{4}{4}$$

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Practicing Dimensional Analysis

Scenario: How many feet are in 72 inches?

Step 1: Write the given quantity with its unit of measure.	
Step 2: Set up a conversion factor. (Choose the conversion factor that cancels the units you have and replaced them with the units you want. $\dfrac{\text{what you want}}{\text{what you have}}$	
Step 3. Divide the units (only the desired unit should be left).	
Step 4: Solve the problem using multiplication and/or division.	

in → ft

$$72 \, in \cdot \frac{1 \, ft}{12 \, in} = 6ft$$

$$72 \, in \cdot \frac{1 \, ft}{12 \, in} = \frac{72 \, ft}{12} = 6ft$$

Scenario: How many cups are in 140 pints?

Possible Conversion Factors:

pt → cups

$$140 \, pt \cdot \frac{2 \, cup}{1 \, pt} = 280 \text{ cups}$$

$$\frac{140 \, pt \cdot 2 \, cups}{1 \cdot 1 \cdot pt} = \frac{140 \cdot 2 \cdot cups}{1} = 280 \, cups$$

Scenario: How many feet are in 4.5 miles?

Possible Conversion Factors:

mi → ft

$$\frac{4.5 \, miles}{1} \cdot \frac{5280 \, ft}{1 \, mile} = 23760 \, ft$$

Scenario: Convert 408 hours to days.

Possible Conversion Factors:

hrs → days

$$\frac{408 \, hrs}{1} \cdot \frac{1 \, day}{24 \, hrs} = 17 \, days$$