Important Conversion Factors Name _____

Length Conversion Factors
1 foot = 12 inches
1 yard = 3 feet
1 mile = 5280 feet

1 meter = 1000 millimeters
1 meter = 100 centimeters
1 kilometer = 1000 meters

1 inch = 2.54 centimeters
1 meter = 3.28 feet
1 mile = 1.61 kilometers

Time Conversion Factors
1 minute = 60 seconds
1 hour = 60 minutes
1 day = 24 hours
1 week = 7 days
1 year = 365.25 days
1 century = 100 years

NOTE: "months" are not a standard unit, because not all months have the same number of days!

Mass Conversion Factors
1 kilogram = 1000 grams
1 gram = 1000 milligrams
1 slug = 14.6 kilograms
1 metric ton (also called tonne) = 1000 kilograms

NOTE: "pounds" are *not* a unit of mass, but a unit of force!!! The unit English system unit for mass is *slugs*.

Force Conversion Factors
1 pound = 4.45 Newtons
1 Newton = 100,000 dynes
1 ton = 2000 pounds

Reasons to Learn Conversion Factors

Even though most everyone says that basic conversions are intuitive, it is still very important to learn the *conversion factor method*! Three reasons why:

- The conversion factor method can be easily applied to more and more complex conversion problems.
- The conversion factor method helps you invent your own formulas to solve new problems. This is especially helpful in chemistry.
- The conversion factor method teaches you to treat units like any other number, and prepares you for learning dimensional analysis.

This is an example of how to apply the conversion factor method to two simple questions.

Example Question 1:
"How many feet are there is 36 inches?"
The correct answer, drawn out precisely:

$$36 \text{ inches} = \frac{36 \text{ } \cancel{\text{inches}}}{1}\left(\frac{1 \text{ foot}}{12 \text{ } \cancel{\text{inches}}}\right) = \frac{36 \text{ feet}}{12} = 3 \text{ feet}$$

Step 1: Put your number over 1:

$$36 \text{ inches} = \frac{36 \text{ inches}}{1}$$

Step 2: Multiply by a *conversion factor* that will allow you to cancel out the unit you don't want and give you the unit you do want.

$$\frac{36 \text{ inches}}{1}\left(\frac{1 \text{ foot}}{12 \text{ inches}}\right)$$

Step 3: Cancel out the units that are in both the numerator and denominator, and ignore all 1s.

$$\frac{36 \text{ } \cancel{\text{inches}}}{1}\left(\frac{1 \text{ foot}}{12 \text{ } \cancel{\text{inches}}}\right) = \frac{36 \text{ feet}}{12}$$

Step 4: Now, just divide or multiply and get your answer!

$$\frac{36 \text{ feet}}{12} = 3 \text{ feet}$$

Example Question 2:
"How many inches are in 7 feet?"
The correct answer, drawn out precisely:

$$7 \text{ feet} = \frac{7 \text{ ~~feet~~}}{1}\left(\frac{12 \text{ inches}}{1 \text{ ~~foot~~}}\right) = \frac{7 \cdot 12 \text{ inches}}{1} = 84 \text{ inches}$$

Step 1: Put your number over 1

$$7 \text{ feet} = \frac{7 \text{ feet}}{1}$$

Step 2: Multiply by the right *conversion factor*.

$$7 \text{ feet} = \frac{7 \text{ feet}}{1}\left(\frac{12 \text{ inches}}{1 \text{ foot}}\right)$$

Step 3: Cancel out units and ignore 1s.

$$\frac{7 \text{ ~~feet~~}}{1}\left(\frac{12 \text{ inches}}{1 \text{ ~~foot~~}}\right) = \frac{7 \cdot 12 \text{ inches}}{1}$$

Step 4: Divide or multiply to get the answer:

$$\frac{7 \cdot 12 \text{ inches}}{1} = 84 \text{ inches}$$

In the problems below, use the conversion factor method to solve each problem in a single step.

1. Convert 48 inches to feet

Yes, I know that you know the answer is 4. Nevertheless, please write out the problem correctly with conversion factors, as illustrated above. Learning to use conversion factors is the first step of understanding dimensional analysis, a very crucial piece of physics. And it's good to start on a problem you know the answer to.

2. Convert 5 feet to inches.

3. Convert 29 feet to meters.

One-Step Conversion Problems Name _____

4. Convert 6 meters to feet.

Remember, on each problem you must write out the answer with the conversion factor method to receive full credit!
For full credit, you must:
- write each value including the unit
- represent conversion factors as fractions
- cross out canceled units

5. Convert 785 hours to days.

6. Convert 294 hours to days.

7. Convert 13 days to hours.

8. Convert 24 kilograms to slugs.

9. Convert 146 slugs to kilograms.

10. Convert 21,419 feet to miles.

Answers:

1.

$$48 \text{ inches} = \frac{48 \text{ } \cancel{\text{inches}}}{1}\left(\frac{1 \text{ foot}}{12 \text{ } \cancel{\text{inches}}}\right) = \frac{48 \text{ feet}}{12} = 4 \text{ feet}$$

2.

$$5 \text{ feet} = \frac{5 \text{ } \cancel{\text{feet}}}{1}\left(\frac{12 \text{ inches}}{1 \text{ } \cancel{\text{foot}}}\right) = \frac{5 \cdot 12 \text{ inches}}{1} = 60 \text{ inches}$$

3.

$$29 \text{ feet} = \frac{29 \text{ } \cancel{\text{feet}}}{1}\left(\frac{1 \text{ meter}}{3.28 \text{ } \cancel{\text{feet}}}\right) = \frac{29 \text{ meters}}{3.28} = 8.84 \text{ meters}$$

4.

$$6 \text{ meters} = \frac{6 \text{ } \cancel{\text{meters}}}{1}\left(\frac{3.28 \text{ feet}}{1 \text{ } \cancel{\text{meter}}}\right) = \frac{6 \cdot 3.28 \text{ feet}}{1} = 19.7 \text{ feet}$$

5.

$$785 \text{ hours} = \frac{785 \text{ } \cancel{\text{hours}}}{1}\left(\frac{1 \text{ day}}{24 \text{ } \cancel{\text{hours}}}\right) = \frac{785 \text{ days}}{24} = 32.7 \text{ days}$$

6.

$$294 \text{ hours} = \frac{294 \text{ } \cancel{\text{hours}}}{1}\left(\frac{1 \text{ day}}{24 \text{ } \cancel{\text{hours}}}\right) = \frac{294 \text{ days}}{24} = 12.3^{**} \text{ days}$$

** Note that I rounded this answer to 3 significant figures, which is why it is 12.3 and not 12.25.

7.

$$13 \text{ days} = \frac{13 \text{ } \cancel{\text{days}}}{1}\left(\frac{24 \text{ hours}}{1 \text{ } \cancel{\text{day}}}\right) = \frac{13 \cdot 24 \text{ hours}}{1} = 312 \text{ hours}$$

8.

$$24 \text{ kilograms} = \frac{24 \text{ } \cancel{\text{kilograms}}}{1}\left(\frac{1 \text{ slug}}{14.6 \text{ } \cancel{\text{kilograms}}}\right) = \frac{24 \text{ slugs}}{14.6} = 1.64 \text{ slugs}$$

9.

$$146 \text{ slugs} = \frac{146 \text{ } \cancel{\text{slugs}}}{1}\left(\frac{14.6 \text{ kilograms}}{1 \text{ } \cancel{\text{slug}}}\right) = \frac{146 \cdot 14.6 \text{ kilograms}}{1} = 2130^{**} \text{ kilograms}$$

** Again, rounded from 2131.6 to 3 significant figures. See the worksheets on significant figures for the rules of how that work.

10.

$$21419 \text{ feet} = \frac{21419 \text{ feet}}{1}\left(\frac{1 \text{ mile}}{5280 \text{ feet}}\right) = \frac{21419 \text{ feet}}{5280 \text{ miles}} = 4.06 \text{ miles}$$