I. Solve for x in the following expressions:

1) $x + 2 = 8$ x = _____6_____

2) $3x - 12 = x$ x = _____6_____

3) $\frac{1}{2}x^2 + 14 = 16$ x = _____2_____

4) $(2x^2 + 4)/16 = 6$ x = _____6.78_____

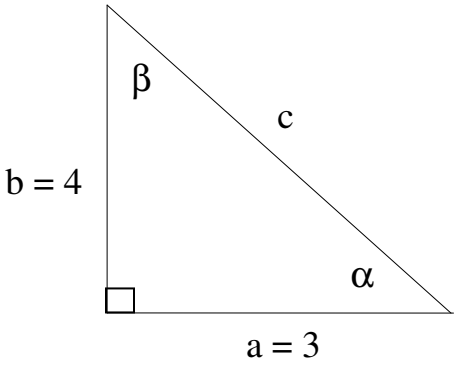
5) $2x^2 + 3x = 4$ x = _-2.35 or 0.85__

6) $5x^2 + 3y = 10$ {where y = 2 } x = __ +/- 0.89_____

7) A right triangle with its two shortest sides of length a = 3 and b = 4 is shown below. Note: α and β are inner angles.

a) What is the length of the longest side, c?

c = _____5_____



b) sin α = _____0.8_____

c) cos β = _____0.8_____

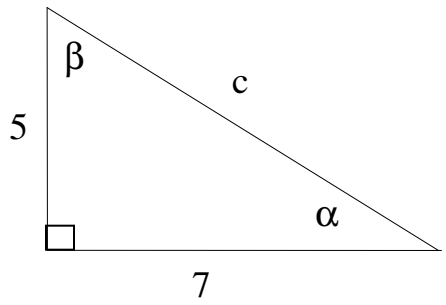
d) What are the values of α and β?

α = _____53.1°_____ and β = _____36.9°_____

8) Consider the triangle shown to the right.

a) If the two shortest sides of the right triangle above are a = 5 and b = 7, what is the angle, α?

{solve using 2 different component methods}



Method 1:

α = _$tan^{-1}(5/7) = 35.5^o$_

Method 2:

α = _$sin^{-1}(5/8.6) = 35.5^o$_

b) What are the new values for c and β?

c = __8.6_____

β = __54.5^o____

In physics, converting units from one unit system to another (especially within the Metric system) can appear daunting at first glance. However, with a little guidance, and a lot of practice, you can develop the necessary skill set to master this process.

To begin, here is a simple mnemonic to guide you through the unit conversion process:

1. **Eliminate**
2. **Replace**
3. **Relate**

All unit conversions, regardless of how complex they appear, involve these 3 simple steps. In the following sections, you will be stepped through the unit conversion process using these 3 words as a guide.

Example: How many can 25.2 miles/hour be expressed in m/s? i.e. $25.2\,\frac{\text{miles}}{\text{hour}} \rightarrow ??\,\frac{\text{m}}{\text{s}}$

Note: *It is important to recognize that* $25.2\,\frac{\text{miles}}{\text{hour}} = \frac{25.2\,\text{miles}}{1\,\text{hour}}$

Let's breakdown the unit conversion process into 2 individual processes, miles to meters and hours to seconds:

1. **Eliminate** – the unit(s) you begin with must be eliminated in a mathematically consistent manner.

If a unit to be eliminated is a numerator unit, it must be divided out:

$$\left(\frac{25.2\,\text{miles}}{1\,\text{hour}}\right)\left(\frac{??}{??\,\text{miles}}\right) = ??\,\frac{\text{m}}{\text{s}}$$

If a unit to be eliminated is a denominator unit, it must be multiplied out:

$$\left(\frac{25.2\,\text{miles}}{1\,\text{hour}}\right)\left(\frac{??\,\text{hour}}{??}\right) = ??\,\frac{\text{m}}{\text{s}}$$

2. **Replace** – the desired unit(s) you end up with must replace the original unit in a mathematically consistent manner.

If a unit to replace is a numerator unit, it must be multiplied in:

$$\left(\frac{25.2\,\text{miles}}{1\,\text{hour}}\right)\left(\frac{??\,\text{m}}{??\,\text{miles}}\right) = ??\,\frac{\text{m}}{\text{s}}$$

If a unit to be eliminated is a denominator unit, it must be divided in:

$$\left(\frac{25.2\,\text{miles}}{1\,\text{hour}}\right)\left(\frac{??\,\text{hour}}{??\,\text{s}}\right) = ??\,\frac{\text{m}}{\text{s}}$$

3. **Relate –** the units must be related to each other in some mathematical expression.

Identify the relationship between the starting and final units:

1 mile = 1609 m

1 hour = 3600 s

To take the guess work out of where the values should go, match the value with its corresponding unit:

For the distance conversion:

$$\left(\frac{25.2\,\text{miles}}{1\,\text{hour}}\right)\left(\frac{1609\,\text{m}}{1\,\text{mile}}\right) = ??\,\frac{\text{m}}{\text{s}}$$

For the time conversion:

$$\left(\frac{25.2\,\text{miles}}{1\,\text{hour}}\right)\left(\frac{1\,\text{hour}}{3600\,\text{s}}\right) = ??\,\frac{\text{m}}{\text{s}}$$

Putting both conversions together:

$$\left(\frac{25.2\,\text{miles}}{1\,\text{hour}}\right)\left(\frac{1609\,\text{m}}{1\,\text{mile}}\right)\left(\frac{1\,\text{hour}}{3600\,\text{s}}\right) = ??\,\frac{\text{m}}{\text{s}}$$

Extending the Process: When the explicit relationship between the units is not known, it is often necessary to link them to a common unit (in the "Relate" phase).

For example, when converting from mg to kg it is difficult to find a direct expression that relates these units. However, these units can both be related to grams (g) (by replacing the prefix with its corresponding power of 10).

1 mg = 10^{-3} g

1 kg = 10^{3} g

Therefore we can no relate mg to kg. To do so, divide the top expression by the bottom expression:

$$\frac{1\,\text{mg}}{1\,\text{kg}} = \frac{10^{-3}\,\text{g}}{10^{3}\,\text{g}} = 10^{-6}$$

or

$$1\text{ mg} = 10^{-6}\text{ kg}$$

Note: *the smaller unit (mg) has a larger value and the larger unit (kg) has a smaller value.*

Let's try one: How is 12.5 mg expressed in kg (i.e. 12.5 mg = ___ kg)?

1. Eliminate: *{assign mg units to the denominator of the conversion factor}*

$$\left(\frac{12.5\,\text{mg}}{1}\right)\left(\frac{??}{??\,\text{mg}}\right) = \_\_\_\_\_\ \text{kg}$$

2. Replace: *{assign kg units to the numerator of the conversion factor}*

$$\left(\frac{12.5\,\text{mg}}{1}\right)\left(\frac{??\,\text{kg}}{??\,\text{mg}}\right) = \_\_\_\_\_\ \text{kg}$$

3. Relate: *{assign the corresponding value to its unit, using 1 mg = 10^{-6} kg}*

$$\left(\frac{12.5\,\text{mg}}{1}\right)\left(\frac{10^{-6}\,\text{kg}}{1\,\text{mg}}\right) = \frac{12.5x10^{-6}kg}{1} = 1.25x10^{-5}\ \text{kg}$$

Now, it's your turn: 0.25 nm = ___ cm?

1. Eliminate: $\left(\frac{0.25\,\text{nm}}{1}\right)\left(\frac{??}{\quad}\right) = ??\,\text{cm}$ *{fill-in the blank with correct unit}*

2. Replace: $\left(\frac{0.25\,\text{nm}}{1}\right)\left(\frac{\quad}{\quad}\right) = ??\,\text{cm}$ *{fill-in both blanks with correct units}*

3. Relate:

a) Write-out the relation between nm & m:

b) Write-out the relation between cm & m:

c) Divide expression (a) by expression (b):

d) Solve this expression for the original unit in (a), in this case 1 nm = _____ cm:

e) Now put all of the pieces together {fill-in the blanks with correct values and units then do the math }:

$$\left(\frac{0.25\,\text{nm}}{1}\right)\left(\frac{\quad}{\quad}\right) = \_\_\_\_\_ = \_\_\_\_\_$$