Math 107

Units lesson #1: The problem Solving Power of Units

Consider the following problem:

You have graduated from college and have started working for a large company here in Spokane. You have done well and are offered a possible promotion! However, this promotion will require you to move to Helsinki Finland. You think it is a wise career move and would like to take the promotion. However, you would like to compare the cost of living in Helsinki with the cost of living in Spokane. This will help you negotiate with your supervisor your total salary package.

You decide to start with a mathematical analysis of your costs in Spokane and compare them with what you might expect in Helsinki. You decide to first focus only on your travel costs from work to home and vice versa. With your job in Spokane you currently drive to work and home every work day. Your home and work are located in such a way that taking public transportation in Spokane is not practical. You would like to know what your transportation costs would be in Helsinki and how these would compare with your current costs in Spokane.

In your groups discuss the following:

1) What information would you need to solve this problem?
2) If you had the information you needed, how would you proceed mathematically to solve this problem?

To solve this problem you might have realized that you need to deal with units

Definition: The units of a quantity describe what is being measured or counted

For example you might have discovered that you need to know how far it is from work to home in Spokane – say it is ten miles. Miles is the unit in this quantity.

You also might have noticed that you need to know what mileage your car gets – say it is 29 miles per gallon. Word per here means divide and sometimes this type of unit is known as a **rate**

You might also have noticed that you need is the cost of gasoline in Finland – which might be say 1.66 Euro per liter or the cost of gasoline in Spokane which might be say $3.79 per gallon

Because in the United States does not use metric measurements and uses a different currency than Europe. We may need to use **conversion factors** which relate two common units of measure. For example we might need.

1 euro = 1.3146 US dollars or

1 liter = 1.05669 quarts

The process of converting from one unit to another is called unit (or dimensional) analysis

Example: How many feet are in 168 inches?

Example: If the "exchange rate" for Euros to dollars is 1 euro = 1.3146 US dollars. How much is 1.66 Euro?

Example: Mr. Wildman would like to carpet a room in his basement that measures 25 feet by 12 feet. Carpet is sold in square yards. How many square yards of carpet would he need?

Example: In order to install a HVAC system, installers need to know the amount of air in room. If this classroom measures 30 feet by 25 feet by 12 feet. How much air is in the room in cubic yards?

Reading Units:

Operation	Key Word	Example
Division	Per	Miles per gallon
Raising to 2^{nd} power	Square	Square feet
Raising to 3^{rd} power	Cube or cubic	Cubic yards
Multiplication	Hyphen	Kilowatt-hours

Units are often used in problem solving situations: You might use this guideline when working with units

Step 1: Identify the units involved in the problem. Use the units to help you decide how to approach the problem and what units to expect in the answer

Step 2: Perform any operations on both numbers and their associated units. Remember

- You cannot add or subtract numbers with different units, but you can combine different units through multiplication, division or raising to powers
- It is easier to keep track of units if you replace division with multiplication by the reciprocal

Step 3: When calculations are complete make sure the answer has units you expected

Example: The distance from Mr. Wildman's house to SFCC is exactly 6.3 miles (one way). He would like to know if it is cost effective for him to replace driving to work with riding the bus. He works everyday from Monday – Friday. His car gets 24 miles per gallon for city driving. Assume the cost of gas is approximately $2.25 per gallon. The cost of STA bus pass for an adult for 31 days is $45.

Example: Solve the Finland-Spokane problem given above – use the following assumptions

Your car gets 24 miles per gallon.

The price of gas in Spokane is $3.80 per gallon. The cost in Helsinki is 1.66 Euro per liter

1 liter = 1.05669 quarts

4 quarts = 1 gallon

1 euro = 1.3146 US dollars

Distance from home to work in Spokane is 10 miles- in Helsinki, it is 6 kilometers

The cost per year for a season transit pass in Helsinki is $33.60 Euro per month