Simple Building Blocks -- Complex Structures

Requirements

No required CBL or other equipment. There are, however, two optional CBL exercises.

The art of mathematical modeling relies on the ability to put simple ideas together in complicated ways. This module looks at the simple building blocks we use -- numbers, addition, subtraction, multiplication, division, and functions -- and, if you are teaching calculus, differentiation and integration.

Because we are using numbers, operations, and functions to talk about real things, units are very important. Your computer algebra system (most likely the TI-92 but possibly Mathematica, Maple, or MathCad) can be used to keep track of units and one of the purposes of this module is to develop the ability and the habit of using units with your computer algebra system.

It is often very useful to look at the units involved for every quantity in a formula. Not only is this a good way of checking to see if the formula makes sense, but it is a good way of understanding exactly what the formula says. The process of analyzing the units involved in a formula is called **dimensional analysis**.

Be sure to send email to your instructor following the usual format.

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Questions

This module, like most modules, has many questions and short exercises scattered throughout the module. It is important to do all the exercises and to answer all the questions. **Whenever it is appropriate use your computer algebra system, most likely the TI-92.**

1. Set up your computer algebra system to work with the following units -- fluid ounces, cups, pints, quarts, and gallons. Use fluid ounces as your basic unit of measure.

   a. Express 2 gallons, 1 quart, one pint and three ounces as ounces.

   b. Express 120 gallons per hour as ounces per second.

2. Give three examples of things that can be modeled by **addition**. Explain clearly what the numbers involved represent and indicate the kinds of units used. Explain any conditions that must be met for addition to be appropriate. At least one of your examples should involve numbers representing different things that are measured using the same units.

3. Give three examples of things that can be modeled by **subtraction**. Explain clearly what the numbers involved represent and indicate the kinds of units used. Explain any conditions that must be met for subtraction to be appropriate. At least one of your examples should involve numbers representing different things that are measured using the same units.

4. Give three examples of things that can be modeled by **multiplication**. Explain clearly what the numbers involved represent and indicate the kinds of units used. Explain any conditions that must be met for multiplication to be appropriate.

5. Give three examples of things that can be modeled by **division**. Explain clearly what the numbers involved represent and indicate the kinds of units used. Explain any conditions that must be met for division to be appropriate.

6. Can the relationship between the length of the sides of an equilateral triangle and its area be expressed using one or more functions? If so, find the function(s). Explain the units in which each of the quantities involved is measured.

7. Can the relationship between the length of the hypotenuse of a right triangle and its area be expressed using one or more functions? If so, find the function(s). Explain the units in which each of the quantities involved is measured.

8. If you are familiar with the TI-CBL, then record the temperature at a particular spot in your classroom during the class period using a TI-CBL. If you are not yet familar with the TI-CBL then just draw a rough graph indicating how the temperature in your classroom might vary over the course of a class period. Can this relationship be expressed using one or more functions? Note these function(s) probably cannot be expressed using simple algebraic formulas. Explain the units in which each of the quantities involved is measured.

9. If you are familar with the TI-CBL, then record the light intensity at a particular spot in your school playground during one day using a TI-CBL. If you are not yet familar with the TI-CBL then just draw a rough graph indicating how the light intensity at a particular spot in the school playground might vary over the course of a day. Can this relationship be expressed using one or more functions? Note these function(s) probably cannot be expressed using simple algebraic formulas. Explain the units in which each of the quantities involved is measured.

10. **If you teach AP Calculus**, then answer the questions at the end of the material on differentiation in the module.

11. **If you teach AP Calculus**, then answer the questions at the end of the material on integration in the module.