

## Additional Problems (not currently used)

Problem	Problem Outline	Further details
Trig. #2	The tangent function.	Describe how to create a table of tangent values (without using a calculator!)
Geometry #4	Surface area of a sphere	Choose the correct formula from a list, and give a convincing argument for the choice.
Math Terms #3	Linearly related	Define in 3 forms: words, equation, and graph.
Math Terms #4	Function	Define in 3 forms: words, equation, and graph.
Eqn. Check #2:	$(a^2 + (b^4 + 2d^4)^{1/2})^{1/2} = a + (ab)^{1/2} + \sqrt{2}d + (ad)^{1/2}$	Is the equation valid? Give a convincing argument.
Volume #1	Definition of volume.	Define volume in words so that it enables an alien in a distant galaxy to measure volume.
Volume #2	Measuring the volume of liquids	Describe how to calibrate a cylinder so that it can be used to measure the volume of liquids.
Density #1	Definition of density.	Define density in words so that it enables an alien in a distant galaxy to measure density.
Density #2	Density of distilled water	Describe how to determine the density of distilled water.
Puzzle #3		Weight or mass of a 1 m cube filled with human bodies.

### Problem - Trig #2:

Your group has become stranded on a planet with no books or calculators. It is the task of your group to create tables of values for various trig. functions.

For example, consider a table which gives the tangent of angles from  $0^\circ$  to  $90^\circ$ , in  $1^\circ$  increments. Describe a plan for creating this table; this plan should not make use of trig. tables or the trig. functions of a calculator.

### Problem - Geometry #4: Surface area of a sphere

You have written a number of mathematical expressions in your notes, namely:

$$2\pi r; \quad \pi r^2; \quad 4\pi r^2; \quad \left(\frac{4}{3}\right)\pi r^3$$

You know one of these represents the surface area of a sphere, but you can't remember which one. Which of these is the correct expression, and construct an argument stating why your choice is the only one that can possibly be correct.

Problem - Mathematical terminology #3

The term "linearly related".

You are stranded on a planet without books or calculators; in particular there are no math books.

The first book to be published on this planet is a math book. The publisher of the math book asks you for a definition of the term "linearly related", as in the sentence, "The temperature in degrees Fahrenheit is linearly related to the temperature in degrees Celsius".

State the definition of "linearly related" in three forms, namely, in words, as an equation, and as a graph.

Problem - Mathematical terminology #4

The mathematical term "function".

You are stranded on a planet without books or calculators; in particular there are no math books.

The first book to be published on this planet is a math book. The publisher of the math book asks you for a definition of the term "function", as in the sentence, "The mass of a solid sphere is a function of the radius of the sphere".

State the definition of the word "function" in this context. State it in three forms, namely, in words, as an equation, and as a graph.

Problem - Equation checking #2:

You are stranded on a planet without books or calculators; in particular there are no math books.

The first book to be published on this planet is a math book, and you are asked to review it (for accuracy). The publisher asks if the following equation found in the book is valid or not.

$$\left(a^2 + (b^4 + 2d^4)^{1/2}\right)^{1/2} = a + (ab)^{1/2} + \sqrt{2}d + (ad)^{1/2}$$

Is this complicated equation valid or not? What is your opinion, and give your best argument for your position.

Problem - Volume #1:

In words, what is meant by the volume of an object? Your definition should be complete and explicit enough to enable an alien being to estimate or determine the volume of various objects.

Problem - Volume #2:

Consider a vertical, transparent cylinder which is closed at the bottom. Describe a method by which you can calibrate this cylinder so that it could be used to measure the volume of liquids. Assume that this must be done without pouring any substance into the cylinder (say because the inner walls of the cylinder must not be contaminated).

Problem - Density #1:

In words, what is meant by the density of an object? Your definition should be complete and explicit enough to enable an alien being in a distant galaxy to determine the density of various objects.

Problem - Density #2:

Using simple materials and equipment available commonly available in a chemistry lab, describe a method by which you could determine a value for the density of distilled water.

Puzzle #3:

Consider a meter stick. Now consider constructing a cardboard box in the shape of a cube, with dimensions of 1m x 1m x 1m.

If this box is filled completely with material that just barely floats (like human bodies!), estimate the mass and/or weight of the cardboard box when so filled. Justify your estimate completely.