Activity 1: Fishing Rod Problem

Keith has just purchased a new fishing rod. When he starts to board the bus to go home with it the bus driver tells him that you cannot take anything on the bus which is over 7 feet long. His new fishing rod is 7.5 feet long and it is designed in one piece which cannot be taken apart. Keith also notices that the bus door is 3 feet wide and 6.5 feet high. Keith thinks for a while and then goes back into the store and purchases a container for the rod which will allow him to take it on the bus. What does he buy? Explain.

What dimensions are required to create a possible container for the rod? Keith can purchase a box into which he can place the fishing rod diagonally so that the rod forms the diagonal of a rectangular prism (or, in other words, the hypotenuse of a right triangle.) By placing it diagonally inside the box, the width and length of the box will not be over the size limit to take on the bus.
One edge of the box (or prism) is one leg of a right triangle, while the diagonal of the base forms the other leg. The fishing rod will be the hypotenuse.
To find possible dimensions for the box:

$$(7.5)^2 < x^2 + y^2 + z^2$$

$$56.25 < x^2 + y^2 + z^2$$

The sum of the squares of x, y, and z must be greater than 56.25 (and x, y, and z must each be less than 7).
Some possible answers for dimensions of the box are 6x5x1, 5x5x3, 5x5x4, or 4x4x5, but some of these would not work because they would not fit through the bus door. (5x5x4 and 4x4x5 would not fit, for example.)

Could the container be a cube?

$$x^2 + x^2 + x^2 > 56.25$$

$$3x^2 > 56.25$$

$$x > 4.3$$

The container cannot be a cube because the sides would be 4.3 ft which would not fit through the doorway.

Another possibility is that he might buy another shape box such as a cylinder or sphere.
Could the container be a cylinder?
Let x represent the height of the cylinder and y represent the Diameter of the base (or vice versa):

$$x^2 + y^2 > 56.25$$

Some possible solutions that satisfy this inequality:
1 and 7.5, 2 and 7.3, 3 and 6.9, 4 and 6.3, 5 and 5.6.
The solution that satisfies the conditions of our problem is 3 and 6.9.
Of course 2.9 and 6.95, etc. also work, as well as many others in that range.
Could the container be a sphere?
No. The diameter of the sphere would have to be at least 7.5 ft.

How would reducing the length requirement to five feet change the dimensions of your container?
Answers will vary. The other dimensions width, depth, or both must be increased in order to compensate for the decrease in length.

If you limit yourself to rectangular prisms what is the range of dimensions for the container?

In considering which container to use for the fishing rod, Keith must also consider the width of the door to the bus. If the bus door is 3 feet wide, how will that affect Keith's choice of containers?
Keith cannot use any container which has <u>all</u> dimensions greater than 3 feet because it would not fit through the door even though it fits the other requirements. This would eliminate several possibilities which seem at first to work.

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Use your group's materials to create the best container possible to allow Keith to take his new fishing rod on the bus. Be prepared to give your container's dimensions as well as the calculations used to justify them and explain why your container is ideal to solve Keith's problem.

Could the container be a cube? Why or why not?

Could the container be a cylinder? Why or why not?

Could the container be a sphere? Why or why not?

How would reducing the length requirement to five feet change the dimensions of your container?

If you limit yourself to rectangular prisms what is the range of dimensions for the container?