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1. Each box/rectangular prism has the same volume $\qquad$ . Calculate the surface area of each box. Include the bottom of each box. List them in order from greatest to least surface area. Which is the optimum shape (minimum surface area for the given volume)?


Summary: Optimizing the dimensions of a rectangular prism.
Among all rectangular prisms with a given volume, a cube has the minimum surface area. Among all rectangular prisms with a given surface area, a cube has the maximum volume.
$\therefore$ The minimum surface area occurs when the height is equal to the $\qquad$ of the base.

Special Case: When the bottom is not included, the minimum surface area for a given volume occurs when the side length of the base is equal to twice the height of the square-based prism.

Optimizing with constraints
There may be constraints on the prism you are optimizing:

- The dimensions may have to be whole numbers, or
- The dimensions may have to be multiples of a given number.

In these cases it may not be possible to form a cube. The maximum volume or minimum surface area occurs when the dimensions are closest in value.
2. Each cylindrical container has the same surface area. Calculate the volume of each. List them in order from minimum to maximum volume. Which cylinder is the optimum shape (maximum volume for a given surface area)?


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Summary: For a cylinder, the maximum volume for a given surface area occurs when the height is equal to the diameter.
For a cylinder, the minimum surface area for a given volume occurs when the height is equal to the diameter.

Ex. 1 A rectangular prism has a maximum volume and uses $384 \mathrm{~m}^{2}$ of cardboard. What are the dimensions and volume?

Ex. 2 A rectangular prism has a volume of $1331 \mathrm{~m}^{3}$. What dimensions give a minimum surface area? Calculate the surface area.

Ex. 3 What are the optimum dimensions ( eg. minimum surface area ) for a can that can hold 750 mL of juice?

