

# OPTIMIZING VOLUME

MAP 4C

- For these questions, you will be given the surface area of a rectangular prism

# Given the Surface Area of a Rectangular Prism

Example: What rectangular prism will give the maximum volume, when you have a surface area of  $81 \text{ m}^2$ .

Answer: A cube!

The formula for the surface area of a cube is:

$$SA = 6L^2$$

Therefore, to solve for the dimensions and maximum volume:

$$\sqrt{\frac{SA}{6}} = L = \sqrt{\frac{81}{6}} = 3.7 \text{ m} \quad V = L^3 = (3.7)^3 = 51 \text{ m}^3$$

# Given the Surface Area of a Rectangular Prism

Example: You have 40 m<sup>2</sup> of plastic sheeting to build a greenhouse in the shape of a rectangular prism. What dimensions will provide the maximum volume?

$$\sqrt{\frac{40}{6}} = L = 2.6$$

$$V = (2.6)^3 = 17.6 \text{ m}^3$$

# Given the Surface Area of a Rectangular Prism

Example: You have 6000 m<sup>2</sup> of materials to build a bunker in your back yard, in the shape of a rectangular prism. What dimensions will provide the maximum volume?

$$\sqrt{\frac{6000}{6}} = 31.6$$

$$V = (31.6)^3 = 31554 \text{ m}^3$$
$$= L \times W \times H$$

# Given the Volume of a Prism

Example: A can needs to hold a volume of  $350 \text{ cm}^3$ . Determine the dimensions that minimize the surface area.

1. Draw a picture and label it

# Given the Volume of a Prism

Example: A can needs to hold a volume of  $350 \text{ cm}^3$ . Determine the dimensions that minimize the surface area.

2. Set up a table with  $A$ ,  $SA$ , and the variables from the picture

# Given the Volume of a Prism

Example: A can needs to hold a volume of  $350 \text{ cm}^3$ . Determine the dimensions that minimize the surface area.

3. Radius is now 'x'; write an equation for the height using Volume

# Given the Volume of a Prism

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4. Write the equation for surface area

# Given the Volume of a Prism

Example: A can needs to hold a volume of  $350 \text{ cm}^3$ . Determine the dimensions that minimize the surface area.

5. Sub the Height equation into the Surface Area equation

# Given the Volume of a Prism

Example: A can needs to hold a volume of  $350 \text{ cm}^3$ . Determine the dimensions that minimize the surface area.

6. Now graph that equation. You can read the radius ( $x$ ) and surface area ( $y$ ) on the graph.

# Given the Volume of a Prism

Example: A can needs to hold a volume of  $350 \text{ cm}^3$ . Determine the dimensions that minimize the surface area.

7. Sub your radius ( $x$ ) into the height equation, and solve for the height.

# Given the Surface Area of a Rectangular Prism

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Answer: A cube!

# Situation 2 – Surface Area of a Prism

- To solve this type of question, we use the same steps as when given the volume of a prism

# Situation 2 – Surface Area of a Prism

Example: A candleholder is to be made in the shape of a rectangular prism, with an open top. The base will be a square, and it will have a surface area of  $225 \text{ cm}^2$ . Determine the dimensions.

# Situation 2 – Surface Area of a Prism

Example: A candleholder is to be made in the shape of a rectangular prism, with an open top. The base will be a square, and it will have a surface area of  $225 \text{ cm}^2$ . Determine the dimensions.