

Name: _____ Date: _____ Period: _____

Cape Florida Lighthouse: Lore and Calculations

Summative Assessment

Given: Jupiter Inlet Lighthouse located in Jupiter, Florida is approximately 100 miles north of Cape Florida Lighthouse. It was designed in 1854, also by George G. Meade, and completed in 1860 by Edward A. Yorke. It is described as a 108 feet tall conical tower. Blueprints located in the State Archives of Florida and The Jupiter Inlet Lighthouse and Museum fact-sheet both indicate the outer walls are conical and taper from 31 inches thick at the base to 18 inches thick near the top. The circumference of the base is about 65 feet and 43 feet at the top.

Tasks:

1. Use the description, graph paper, and a ruler to create and label a scale drawing of the Jupiter Inlet Lighthouse tower.
2. Identify a common three-dimensional geometric solid that best represents the described lighthouse tower.
3. Ignore the fact there are windows and a door, estimate the volume of the bricks and mortar in the described lighthouse tower.
4. Suppose the bricks measure $7\frac{3}{4}$ " \times $3\frac{3}{8}$ " \times 2" and have $\frac{3}{8}$ " mortar joints, approximate the number of bricks used to construct the described lighthouse tower.
5. Determine the lateral surface area, in square feet, of the exterior of the lighthouse tower.
6. The exterior of the Jupiter Inlet Lighthouse tower was originally left unpainted for the first fifty years, but became so weathered it was painted red around 1910. Suppose one gallon of paint covers approximately 350 square feet. Calculate the number of gallons of paint needed to cover the exterior of the lighthouse tower with one coat of paint.

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Tasks:

1. Use the description, graph paper, and a ruler to create and label a scale drawing of the Jupiter Inlet Lighthouse tower. See last page
2. Identify a common three-dimensional geometric solid that best represents the described lighthouse tower. A truncated cone, a cone with a portion of the pointed part removed, or a conical frustum
3. Ignore the fact there are windows and a door, estimate the volume of the bricks and mortar in the described lighthouse tower.

$$\text{Volume of lighthouse tower} = V_{\text{outer frustum}} - V_{\text{inner frustum}}$$

$$\text{Vol. of outer frustum} = \frac{1}{3}\pi h(r_1^2 + r_1r_2 + r_2^2)$$

$$V = \frac{1}{3}\pi(108)(10.35^2 + (10.35)(6.85) + 6.85^2)$$

$$V = \frac{1}{3}\pi(108)(224.9425)$$

$$V = 8,097.93\pi$$

$$V \approx 25,440.397 \text{ cubic feet}$$

$$\text{Vol. of inner frustum} = \frac{1}{3}\pi h(r_1^2 + r_1r_2 + r_2^2)$$

$$V = \frac{1}{3}\pi(108)(7.72^2 + (7.72)(5.35) + 5.35^2)$$

$$V = \frac{1}{3}\pi(108)(129.5229)$$

$$V = 4,662.8244\pi$$

$$V \approx 14,648.694 \text{ cubic feet}$$

$$\text{Volume of lighthouse tower} \approx 25,440.397 - 14,648.694 \approx \mathbf{10,791.703 \text{ cubic feet}}$$

4. Suppose the bricks measure $7\frac{3}{4}$ " \times $3\frac{3}{8}$ " \times 2" and have $\frac{3}{8}$ " mortar joints, approximate the number of bricks used to construct the described lighthouse tower.

$$10,791.703 \text{ cubic feet} \times 1,728 \text{ cubic inches per cubic foot} = 18,648,062.780 \text{ cubic inches}$$

$$18,648,062.780 \div 72.363 \text{ cubic inches per brick (as determined in Activity 1)} = 257,701.6263 \approx$$

257,702 bricks

5. Determine the lateral surface area, in square feet, of the exterior of the lighthouse tower.

$$\text{Lateral Surface Area of Tower} = F = \pi(r_1 + r_2)\sqrt{h^2 + (r_1 - r_2)^2}$$

$$F = \pi(10.35 + 6.85)\sqrt{108^2 + (10.35 - 6.85)^2}$$

$$F = \pi(17.2)\sqrt{11676.25}$$

$$F \approx 1,858.575\pi \text{ square feet} \approx \mathbf{5,838.886 \text{ square feet}}$$

6. The exterior of the Jupiter Inlet Lighthouse tower was originally left unpainted for the first fifty years, but became so weathered it was painted red around 1910. Suppose one gallon of paint covers approximately 350 square feet. Calculate the number of gallons of paint needed to cover the exterior of the lighthouse tower with one coat of paint.

$$5,838.886 \div 350 = 16.682 \approx \mathbf{17 \text{ gallons}}$$

Profile of Jupiter Inlet Lighthouse Tower

