



FEB. 21, 2022 ● SOLUTIONS TO GEOMATICS ENGINEERING PROBLEM SET

1.1 In order to determine the height of the monument to Mayor Rockstone, we can use the provided information about the telephone pole and the monument's shadow to set up and solve a proportion, where x is the height of the monument in feet: $35 \text{ ft}/x = 15 \text{ ft}/257 \text{ ft} \rightarrow 15x = 8995 \rightarrow x \approx$ **600 feet**.

1.2 Substituting 4.03×10^{-7} for t in the formula $d = (t \times 983,571,056)/2$, we find that the length of the plot is $(4.03 \times 10^{-7})(983,571,056)/2 \approx$ **198 feet**.

1.3 We are given that the width of the plot is 110 feet. We know that 30% is equivalent to 0.30, so across the width, the land rises $0.30(110) =$ **33 feet**. Alternatively, since we know the slope of the increase in height is $3/10$, we can use the linear equation $y = (3/10)x$ to determine the height y the land has risen over a given distance x across the width of the plot. Consider the lowest point along the width of the plot to be at $(0, 0)$. Then the highest point will be at $(110, y)$. Substituting for x in the linear equation, we see that the land rises to a height of $y = (3/10) \times 110 =$ **33 feet**.

1.4 We know that $1 \text{ yd} = 3 \text{ ft}$. To find the number of cubic feet in a cubic yard, we can cube each side to get $1 \text{ yd}^3 = 27 \text{ ft}^3$. So, the amount of dirt that needs to be removed is $135,000/27 = 5000 \text{ yd}^3$. At a cost of \$125 per cubic yard, the total cost to remove the necessary amount of dirt to level the plot of land will be $5000 \times 125 =$ **\$625,000**.

GEOMATICS

MONDAY, FEBRUARY 21

BAE SYSTEMS

MATHCOUNTS®

E-WEEK ● GEOMATICS ENGINEERING

Geomatics engineering is all about geographic information. *Geomatics engineers collect this data (such as dimensions of plots of land, details of natural land formations, elevation, angles and boundaries), then analyze and interpret it to find solutions to measurement-related issues and design mapping solutions. They also distribute this information to others who may be building on, using or studying specific land. Geomatics engineering plays an important role in construction, transport, communication, mapping and research.*

1.1 In Rockstone City, no building is permitted to be taller than the monument to the city's first mayor, Mayor Rockstone. A new developer wants to build an apartment building in Rockstone City, but does not know how tall the monument to Mayor Rockstone is. A 35-foot telephone pole next to the monument casts a shadow that is 15 feet long. If the monument's shadow is 257 feet long at the same time of day, how tall is the monument to Mayor Rockstone? Express your answer to the nearest whole number of feet.

1.2 **LiDAR**, or **L**ight **D**etection and **R**anging, is a method used in geomatics engineering to determine distances and other measurements of natural formations either on land or underwater. To measure distance using LiDAR, a laser light source is shot from one point to another and bounces back. The distance d , in feet, between the two points is calculated by multiplying the time t , in seconds, it takes the laser light to travel from one point to another and back by the speed of light c , in feet per second, and then dividing the result by 2. Since the light travels at a constant speed of 983,571,056 ft/s, we can use the following formula:

$$d = \frac{t \times 983,571,056}{2}$$

The developer uses LiDAR to determine the length of the rectangular plot of land on which she plans to build the apartment building. If the time it took the laser light to travel the length of the plot and back was 4.03×10^{-7} seconds, how long is the plot of land? Express your answer to the nearest whole number of feet.

1.3 The rectangular plot of land, which has a width of 110 feet, has a **grade** (or slope) of 30%, which means over 100 feet, the land rises 30 feet. Assuming the land rises across the width of the plot, how many total feet does the land rise?

1.4 Before beginning construction, the ground must be leveled in order to build on a flat surface. If the company contracted by the developer charges \$125 per cubic yard for dirt removal, what will be the total charge to remove $135,000 \text{ ft}^3$ of dirt to level this plot of land?