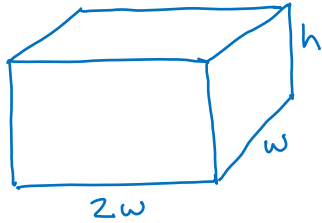


MATH 1501 Lab 5 – Optimization Problems

You may work in groups of 2 or 3 to complete this lab. Be sure to include the names of each member in your group the top of any work submitted. This may consist of work that you do in MAPLE or by hand.

- 1) Albert's Aquariums, Inc. is planning to produce an 8 cubic foot rectangular aquarium. The base is to have a length that is twice its width. Find the dimensions that minimize the amount of glass needed for the aquarium.



$$V = 2w \cdot w \cdot h = 8$$

$$2w^2h = 8$$

$$h = \frac{4}{w^2} \text{ constraint}$$

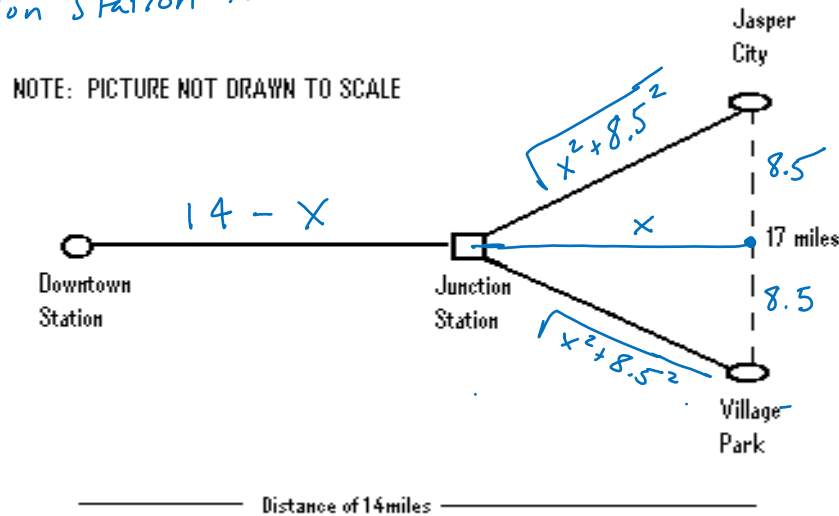
$$\begin{aligned} A &= 2(wh) + 2(2w \cdot h) + 2w \cdot w \\ &= 2wh + 4wh + 2w^2 \\ &= 6wh + 2w^2 \\ &= 6w \cdot \frac{4}{w^2} + 2w^2 \\ A &= \frac{24}{w} + 2w^2 \\ A' &= \frac{-24}{w^2} + 4w \end{aligned} \left. \begin{array}{l} 0 = \frac{-24 + 4w^3}{w^2} \\ 0 = -24 + 4w^3 \\ 24 = 4w^3 \\ 6 = w^3 \\ \sqrt[3]{6} = w \end{array} \right\}$$

So the width should be $\sqrt[3]{6} \approx 1.817$ ft
and the length should be $2 \cdot \sqrt[3]{6} \approx 3.634$ ft

and the height should be $\frac{4}{(\sqrt[3]{6})^2} \approx 1.211$ ft

- 2) In order to help ease traffic congestion in the city of Metropolis, the Metro Transportation Authority (MTA) wants to build a new monorail system that connects the two suburban communities of Jasper City and Village Park to a Downtown Station. The two communities are 17 miles apart on a line that is 14 miles due east of the downtown station as shown. Part of the proposed plan is to build an intermediate monorail station called Junction Station at which passengers can transfer to another monorail to take them along a direct route to their respective communities. Your group has been asked to act as consultants for the MTA. Your job is to determine where Junction Station should be located relative to the Downtown Station so that the length of monorail track to complete the project is minimized.

Let x be the distance from Junction Station to the point between Jasper City and Village Park. The distance from this point to either community is 8.5 miles. Using the Pythagorean Theorem we can find the length of the track from Junction Station to each community in terms of x .



So we have that $L(x) = 14 - x + 2\sqrt{x^2 + 8.5^2}$

See the work done in MAPLE.

To minimize the amount of track needed, Junction Station should be built 9.093 miles east of the Downtown Station.