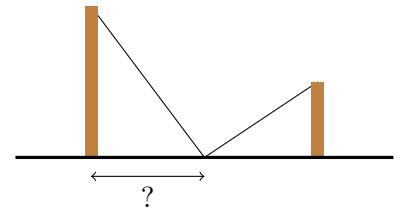


**Math 141 - Homework 11**

**Name:** \_\_\_\_\_

*Solve each of the following optimization problems. Be sure to include confirmation that your solution is really the maximum or the minimum (use the first or second derivative test).*

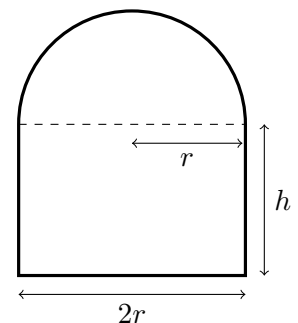
- Two poles are connected by a wire that is also connected to the ground. The first pole is 20 ft tall and the second pole is 10 ft tall. There is a distance of 30 ft between the two poles. Where should the wire be anchored to the ground to minimize the amount of wire needed?



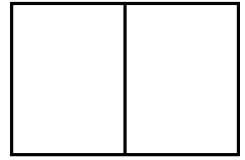
- The sum of two positive numbers is 10. Find the values of the numbers that maximize their product.

- What point on the line  $3x + 4y = 50$  is closest to the origin?

- A Norman window is a rectangle with a half-circle on top. If the perimeter of the window is 20 feet, find the dimensions  $r$  and  $h$  for the Norman window that has the largest possible area.

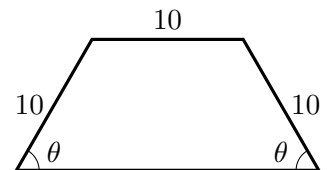


5. A farmer has 600 feet of fencing and wants to create a rectangular enclosure with a fence dividing the middle. Find the dimensions of the enclosure that maximize the area.



6. In economics, if  $C(x)$  is the cost to produce  $x$  units of a commodity, then  $\frac{C(x)}{x}$  is the **average cost** per unit produced. The derivative  $C'(x)$  is the **marginal cost** of each extra item. Use calculus to show that the average cost is minimized at a level of production  $x$  where the average cost is equal to the marginal cost.

7. The trapezoid shown below has 3 short sides that are all 10 cm long and one long base. Find the angle  $\theta$  that maximizes the area of the trapezoid. Recall that the area of a trapezoid is  $A = \frac{1}{2}(a+b)h$  where  $a$  is the length of the top side,  $b$  is the length of the base, and  $h$  is the height (the distance from the top to the bottom).



8. A rectangle is inscribed in a quarter circle of radius 2 (shown below). Use calculus to show that the area of the rectangle is maximized when  $\theta = \frac{\pi}{4}$ .

