5.11 Solving Optimization Problems

Calculus Name: _____ **CA #1**

1. A particle is traveling along the y-axis and it's position from the origin can be modeled by $y(t) = t^3 + \frac{9}{2}t^2 - 12t + 4$ where y is meters and t is seconds for $t > 0$.
   a. On the interval $0 \leq t \leq 5$, find when the particle is farthest below the origin.

   b. On the same interval, what is the particle's maximum speed?

2. Which points on the graph of $y = 3 - x^2$ are closest to the point $(0, 1)$?

3. A power station is on one side of a river that is ½ mile wide, and a factory is 6 miles downstream on the other side. It costs $60,000 per mile to run power lines over land and $85,000 per mile to run them underwater. How far from the factory should the power line come to shore to make the most economical path for the transmission line from the power station to the factory. *Hint*: Total Cost = (on land cost)(distance on land) + (underwater cost)(distance in water)

4. A particle is traveling along the x-axis and it's position from the origin can be modeled by $x(t) = -t^3 + 6t^2 - 9t + 7$ where x is feet and t is days for $t > 0$.
   a. Find when the particle is farthest to the right.

   b. What is the particle's maximum speed on the interval $0 \leq t \leq 4$?

5. You are creating an open-top box with a piece of cardboard that is 16×30 inches. What size square should be cut out of each corner to create a box with the largest volume?

6. A rectangle is formed in Quadrant I with one corner at the origin and the other corner on the line $y = 8 - 2x$. What dimensions would give you the rectangle of the largest area?

Answers to 5.11 CA #1

1a. $t = 1$ 1b. 108 meters per second	2. Optimize the equation: $D = \sqrt{x^2 + (2 - x^2)^2}$ Answer: $\left(-\sqrt{\frac{3}{2}}, \frac{3}{2}\right)$ and $\left(\sqrt{\frac{3}{2}}, \frac{3}{2}\right)$	3. Optimize the equation: $C = 85{,}000\sqrt{x^2 + \frac{1}{4}} + 60{,}000(6 - x)$ Answer: 5.5017 miles from the factory.
1a. $t = 3$ 1b. 9 feet per day	5. Optimize the equation: $V = (30 - 2x)(16 - 2x)x$ $V = 4x^3 - 92x^2 + 480x$ Answer: $3\frac{1}{3} \times 3\frac{1}{3}$ inches	6. Optimize the equation: $A = 8x - 2x^2$ Answer: 2×4