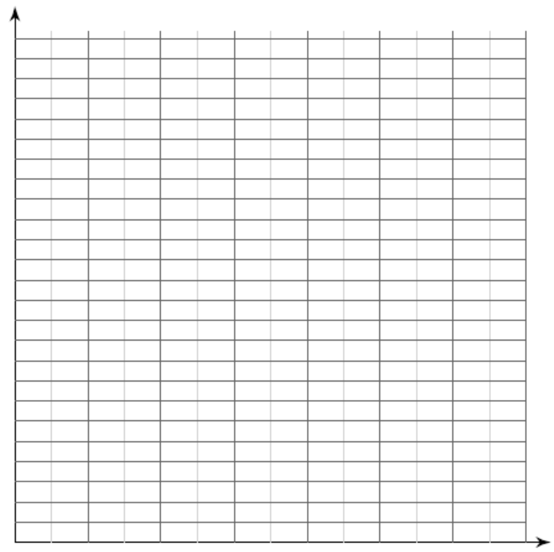
Maximization, Minimization … Set 2

Optimization

Solve each optimization problem. You may use the provided box to sketch the problem setup and the provided graph to sketch the function of one variable to be minimized or maximized.

1) A supermarket employee wants to construct an open-top box from a 14 by 30 in piece of cardboard. To do this, the employee plans to cut out squares of equal size from the four corners so the four sides can be bent upwards. What size should the squares be in order to create a box with the largest possible volume?



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Answers

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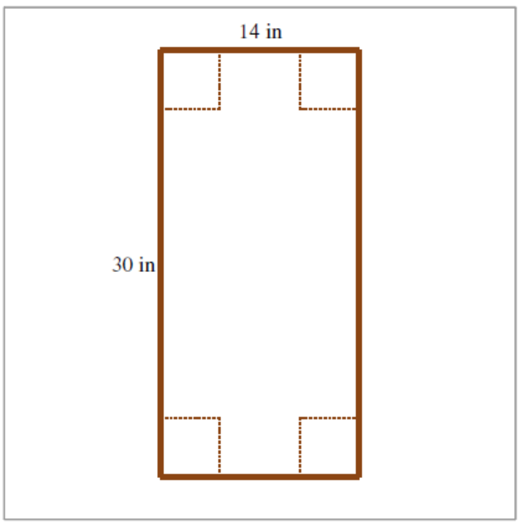

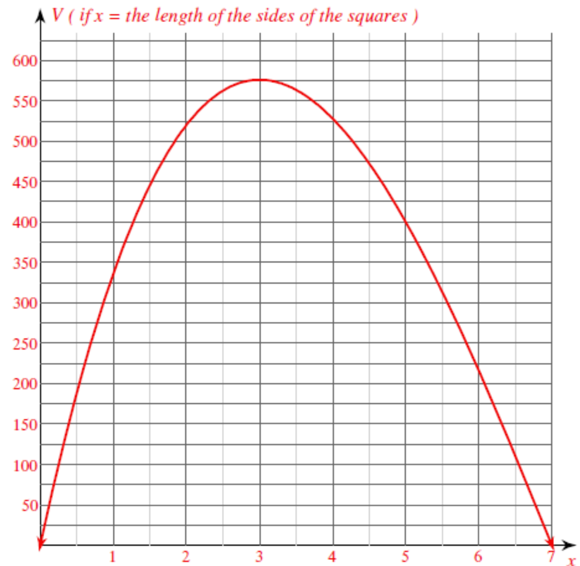

V = the volume of the box x = the length of the sides of the squares
Function to maximize: $V = (30 - 2x)(14 - 2x) \cdot x$ where $0 < x < 7$
Sides of the squares: 3 in

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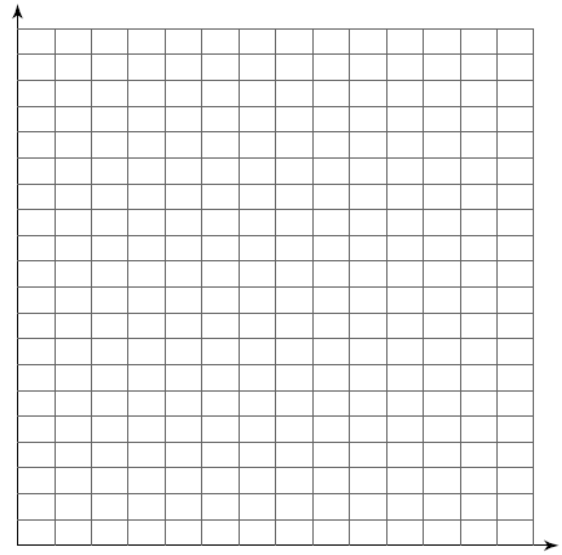

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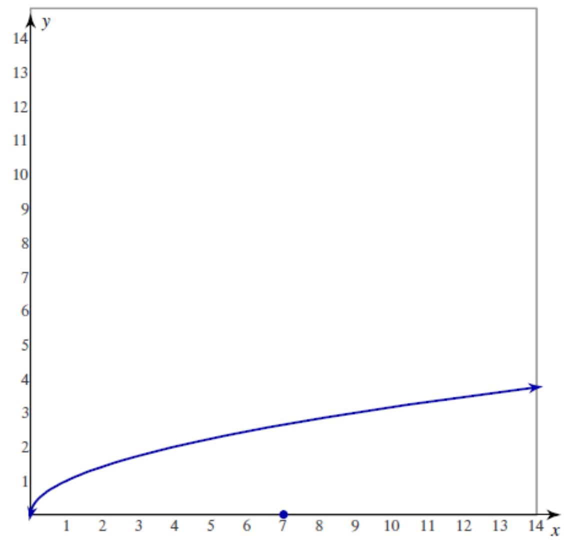

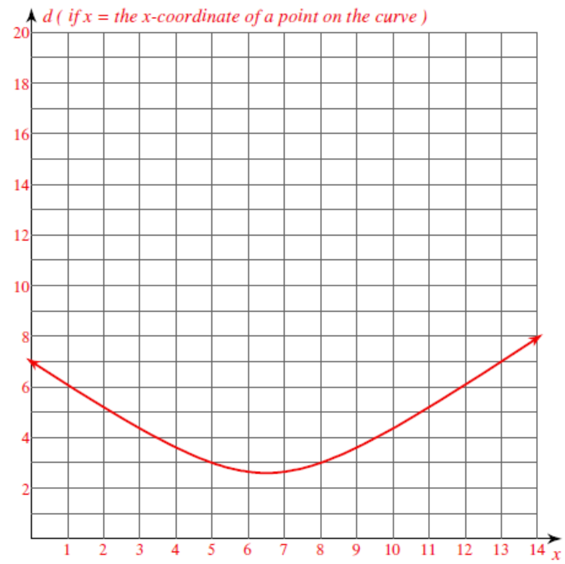

d = the distance from point $(7, 0)$ to a point on the curve x = the x-coordinate of a point on the curve

Function to minimize: $d = \sqrt{(x-7)^2 + \left(\sqrt{x}\right)^2}$ where $-\infty < x < \infty$

Point on the curve that is closest to the point $(7, 0)$: $\left(\frac{13}{2}, \frac{\sqrt{26}}{2}\right)$

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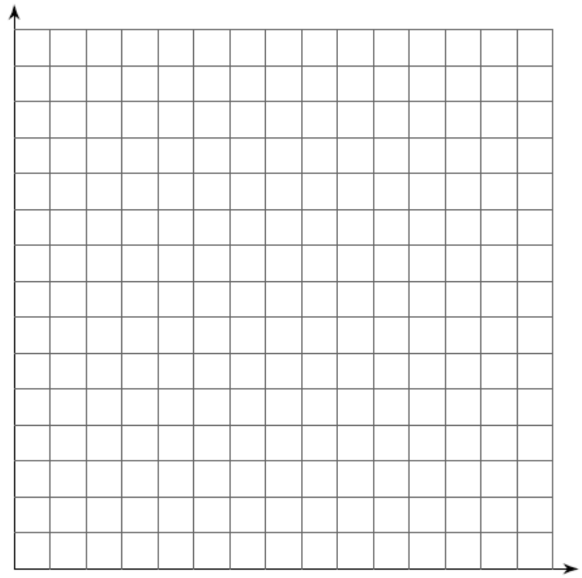
3) Two vertical poles, one 16 ft high and the other 24 ft high, stand 30 feet apart on a flat field. A worker wants to support both poles by running rope from the ground to the top of each post. If the worker wants to stake both ropes in the ground at the same point, where should the stake be placed to use the least amount of rope?



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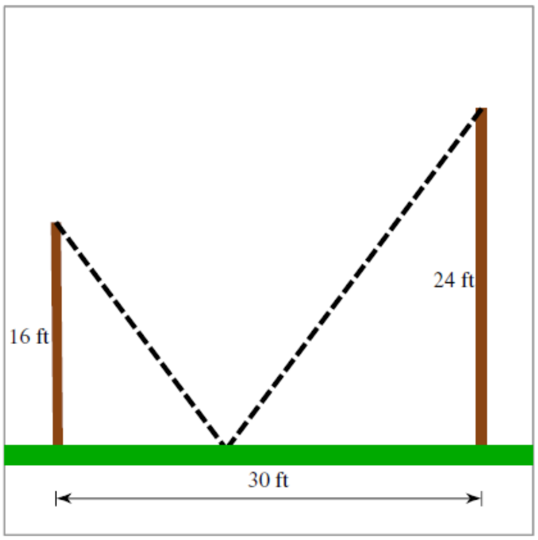

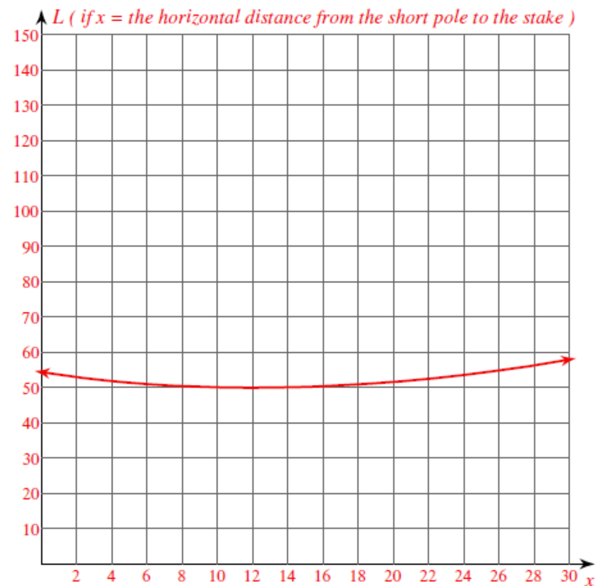

L = the total length of rope x = the horizontal distance from the short pole to the stake

Function to minimize: $L = \sqrt{x^2 + 16^2} + \sqrt{(30 - x)^2 + 24^2}$ where $0 \le x \le 30$

Stake should be placed: 12 ft from the short pole (or 18 ft from the long pole)