Lesson 10.2: Design Problems

A local department store sells marbles that come in small boxes, 15 marbles to a box. You want to design a larger container, similar to the small one that can hold more marbles. If you doubled the dimensions of the box from the department store, how many marbles would your new box hold?

$15(2)(2)(2) = 120$ marbles

L W H

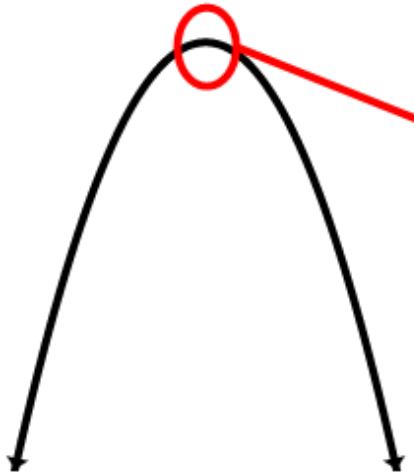
Your Turn: #3

An embroidered placemat costs $3.95. An embroidered tablecloth is similar to the placemat, but four times as long and four times as wide. How much would you expect to pay for the tablecloth?

$3.95 (4)(4)
L W

$63.20

Maximizing Data:



Vertex

$$x = -\frac{b}{2a}$$

$$ax^2 + bx + c$$

Maximizing Revenue

$x = \frac{-b}{2a}$

A baseball stadium normally can sell 2,000 hot dogs at a game if they charge $2.50 each. They also notice that if they raise the price by $0.25, they sell 100 fewer hotdogs. Determine the price they should charge to maximize the revenue.

Revenue = (Quantity)(Price)

x - the number of times the price is increased

(1) Set up the equation:

$y = (2000 - 100x)(2.5 + 0.25x)$

Quantity: $2000 - 100x$ — Price: $2.5 + 0.25x$

(2) FOIL

$5000 + 500x - 250x - 25x^2$

$-25x^2 + 250x + 5000$

(3) Use $x = -\frac{b}{2a}$

$x = -\frac{250}{(2(-25))} = 5$

Price: $2.5 + .25(5)$

$= \$3.75$

Your Turn #8

You run a canoe-rental business on a small river in Ohio. You currently charge $12 per canoe and average 36 rentals a day. An industry journal says that, for every fifty-cent increase in rental price, the average business can expect to lose two rentals a day. Use this information to attempt to maximize your income. What should you charge?

$$y = (36 - 2x)(12 + .5x)$$

$$-1x^2 - 6x + 432$$

$$x = -\frac{b}{2a} = +\frac{+6}{2(-1)} = \boxed{-3}$$

Price: $12 + 0.5(-3) = \boxed{\$10.50}$

Setting Up #10

A rain gutter is to be made of aluminum sheets that are 16 inches wide by turning up the edges 90°. What depth will provide maximum cross-sectional area and hence allow the most water to flow?

$A = (16 - 2x)x$

Formula Help (#13)

Volume of Sphere $= \frac{4}{3}\pi r^3$

Minimizing Data (Using Desmos.com)

You want to manufacture soup cans in the shape of a cylinder. Each can will have a volume of 1099 cubic centimeters. You want to choose the dimensions so that the surface area is minimized. What dimensions should you choose for the cans?

$V = \pi r^2 \cdot h$

$1099 = \pi r^2 \cdot h \rightarrow h = \frac{1099}{\pi r^2}$

Surface Area: $2\pi r^2 + 2\pi r \cdot h$

$2\pi r^2 + 2\pi r \left(\frac{1099}{\pi r^2}\right)$

↓ Graph

$r = 5.592$ cms

$h = \frac{1099}{\pi (5.592)^2} = 11.19$ cms