| NAME | DATE | BAND |
|---|---|---|

**INTRODUCTION TO OPTIMIZATION**
CALCULUS | PACKER COLLEGIATE INSTITUTE

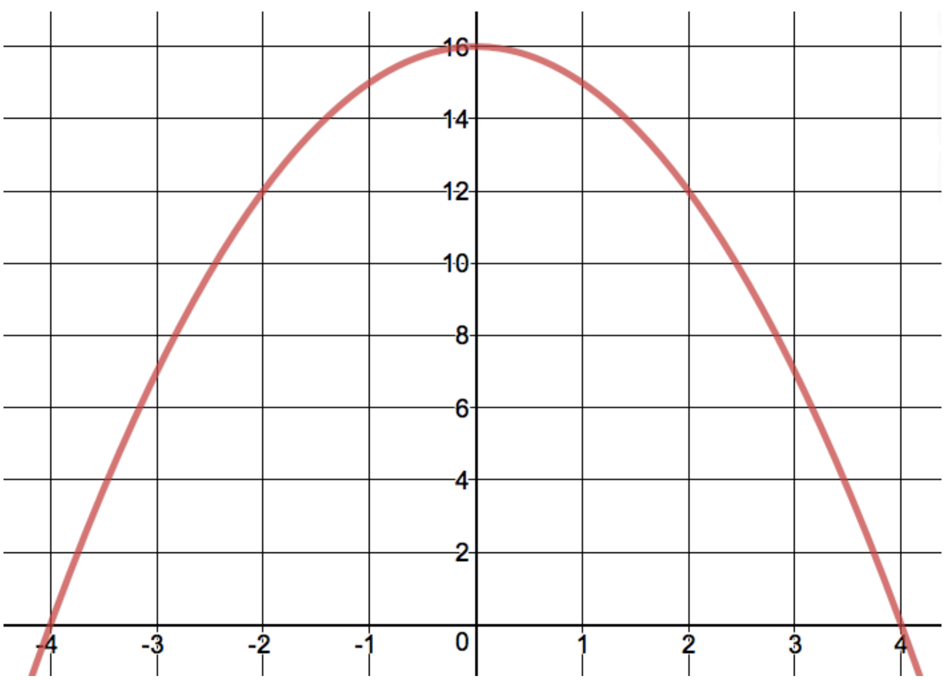
## Challenge #1

Draw the rectangle you came up with in Desmos. (The equation of the line was $x + 5y = 10$.)


Width: ____________ Height: ____________ Area: _____________

## Challenge #2

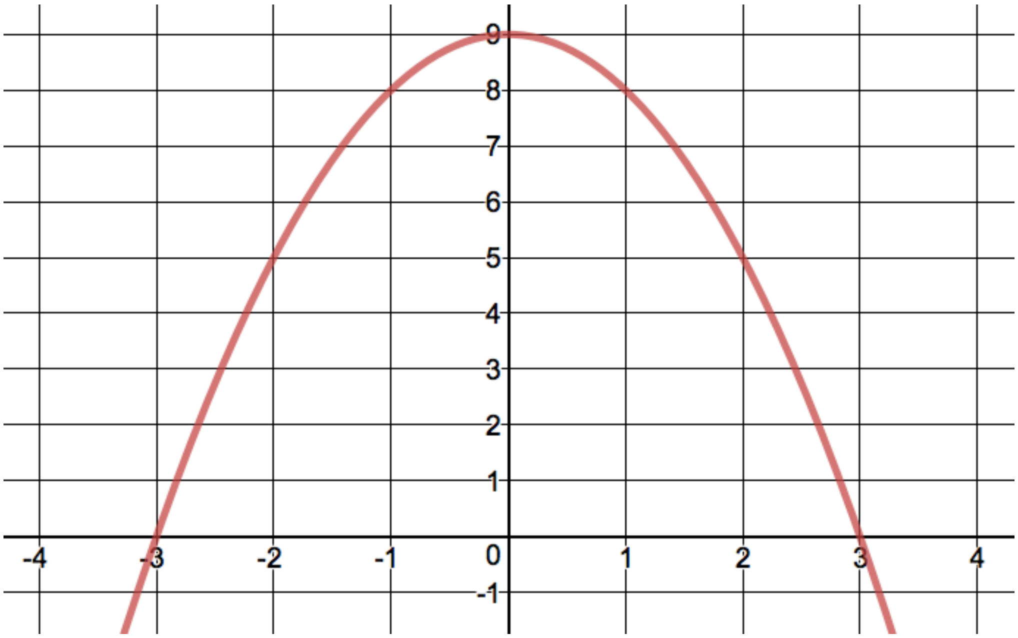
Draw the rectangle you came up with in Desmos. (The equation of the parabola was $y = 16 - x^2$.)




Width: ____________ Height: ____________ Area: _____________

Challenge #3

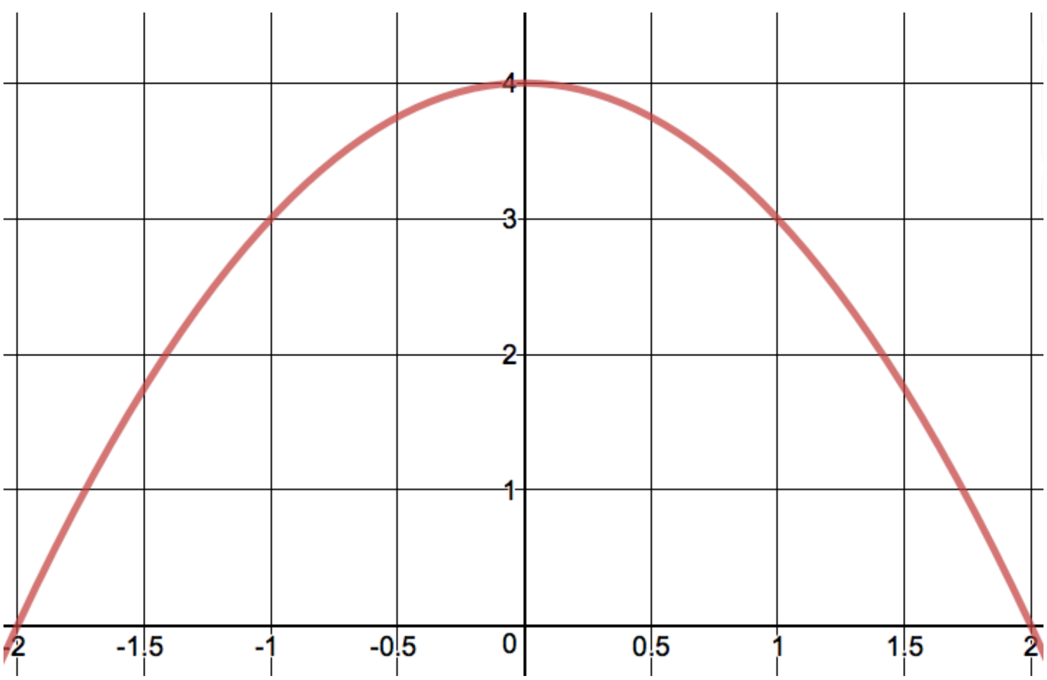
Draw the isosceles triangle you came up with in Desmos. (The equation of the parabola was $y = 9 - x^2$.)




Width: ____________ Height: ____________ Area: ______________

Challenge #4

Draw the isosceles trapezoid you came up with in Desmos. (The equation of the parabola was $y = 4 - x^2$.)




Width: ____________ Height: ____________ Area: ______________

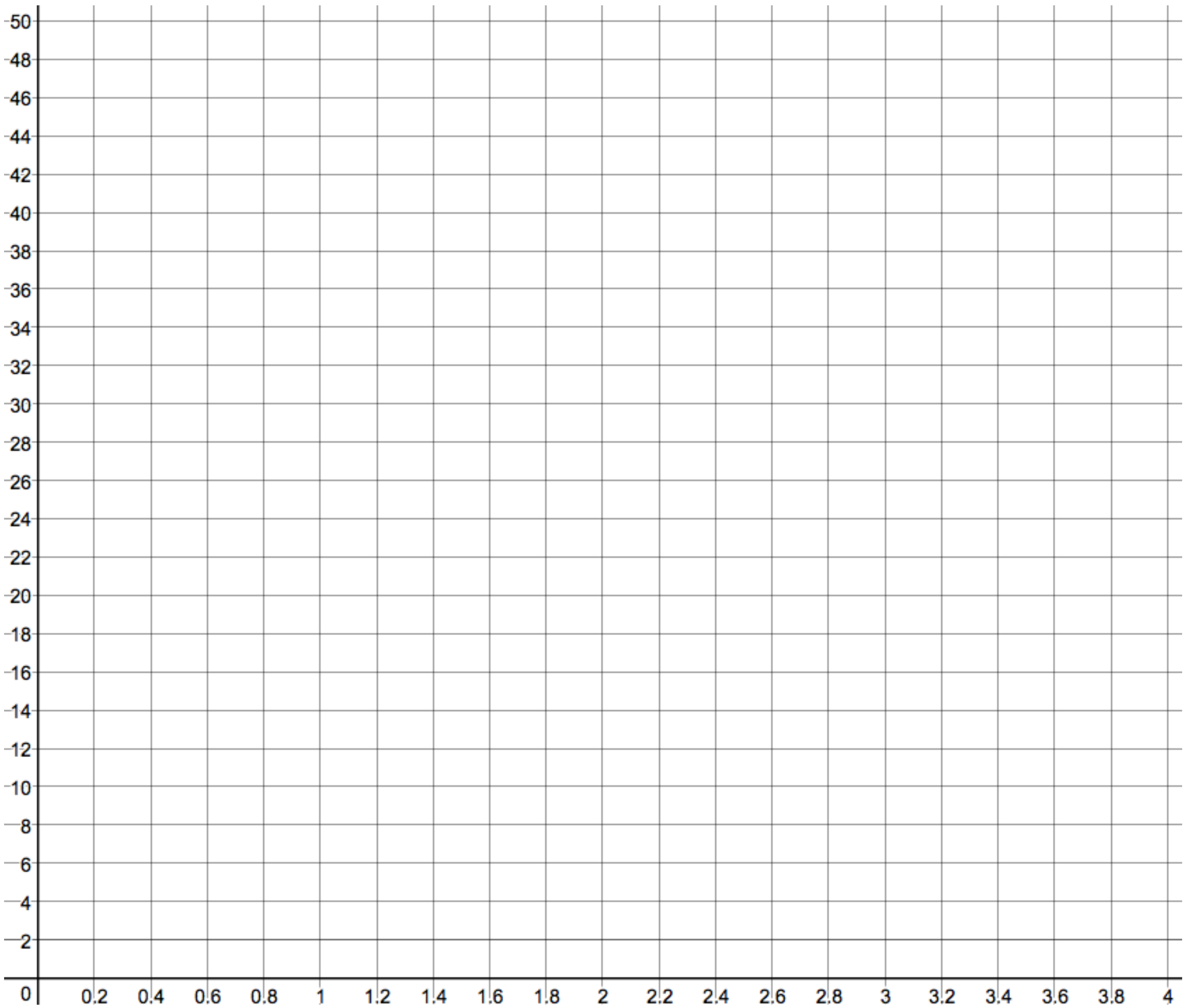
Challenge #2 (reprise)

Now let's plot the area of each rectangle as a function of the $x$-coordinate of its corner in Quadrant I.

a) To get started, let's revist the rectangle you drew for Challenge #2 the first time. Record the following:

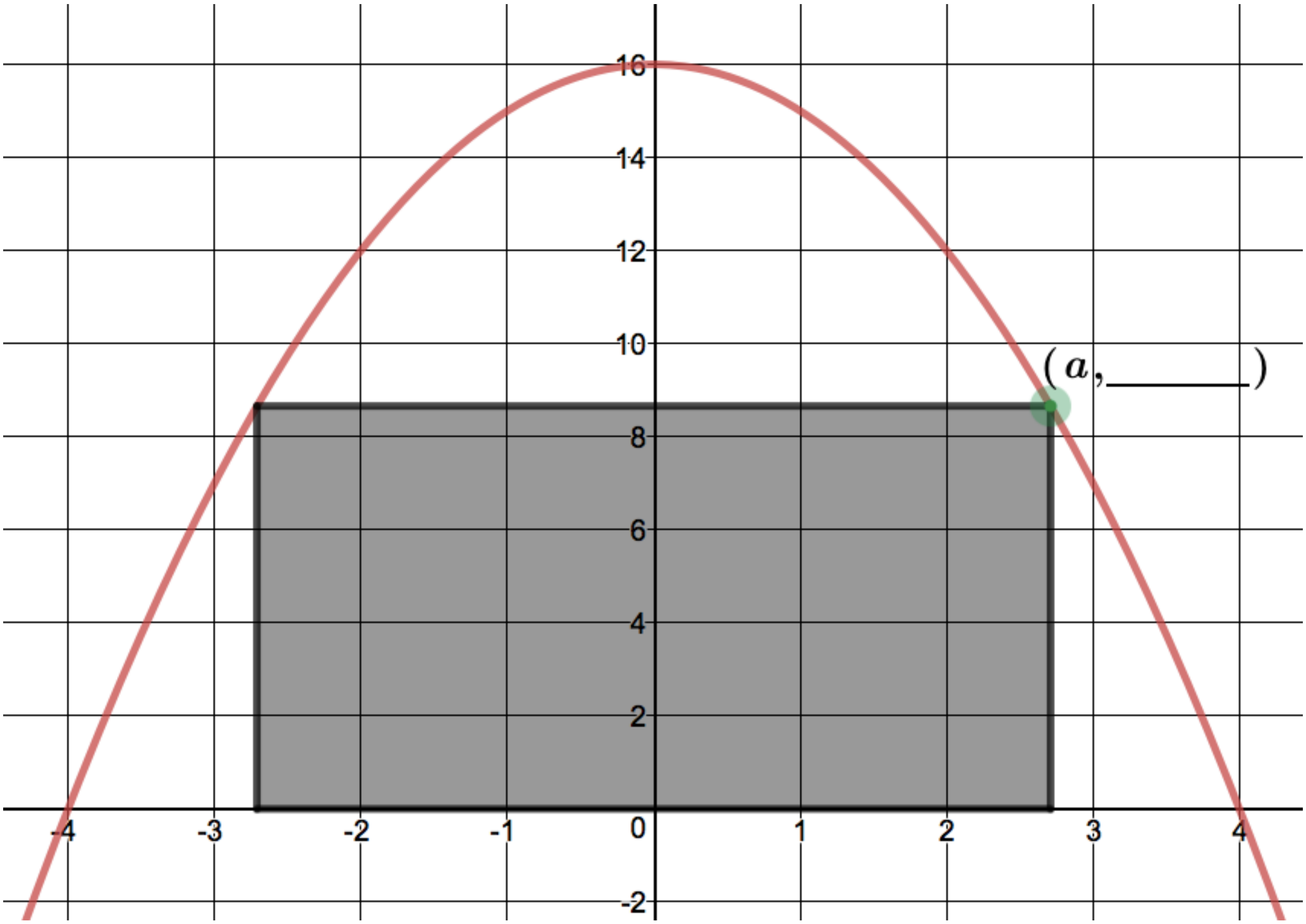
The $x$-coordinate of the corner in Quadrant I: ____________ The area of the rectangle: _________

b) Plot this point below. Then, use Desmos to help you plot any eight additional points.



c) These points seem to outline a curve. Gosh, wouldn't it be great if we could figure out an equation for this curve? (Yes / No / Maybe So )

d) Fill in the blank below. Then, label all of the sides of the rectangle in terms of $a$.




e) Write down a function for the area of the rectangle as a function of $a$:

$\text{RectArea}(a) =$ ________________________

f) Plot your function in Desmos! Then, fill in the blank:

The maximum possible area was approximately __________, and this occurred when $a$ was approximately _____________.

g) Sketch the best rectangle below, labeling its width, height, and area:

**Calculus to the rescue!**

Our next question is this—how could we have determined the dimensions of this rectangle without Desmos?

a) Remind me—if $f(x)$ has a maximum (a peak) at a certain $x$-value—like $x = a$, for example—what must be the value of $f'(a)$?

b) Determine RectArea'$(x)$.

c) Let's figure out what our candidate points are by setting RectArea'$(x) = 0$ and solving for $x$.

d) Finally, determine the best rectangle's <u>exact</u> dimensions and area.