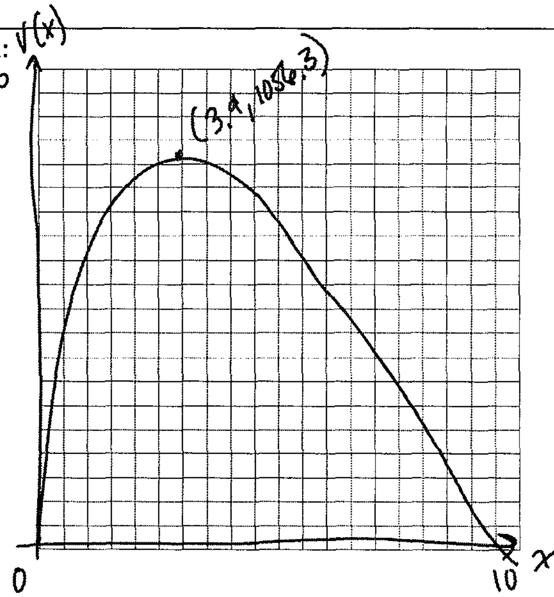
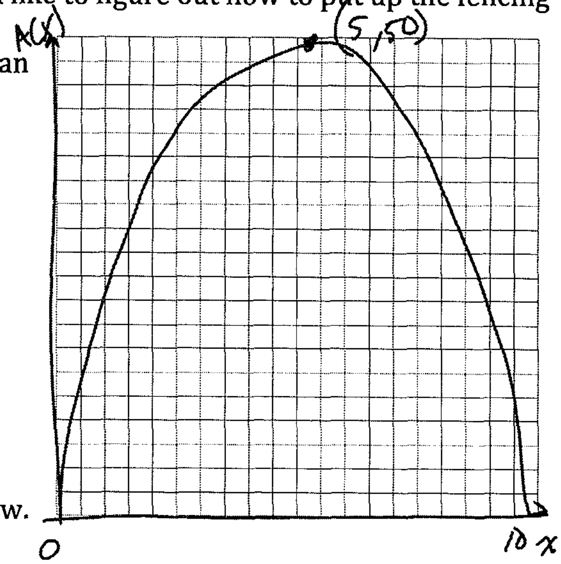
Name: ____________________ Period: _____ Date: ____________________ Gold

1. Now repeat the process above to determine the maximum volume, and the dimensions that would give that volume, if the paper is 20" by 30".

Formula for volume: $V(x) = x(20-2x)(30-2x)$	Graph: 
"Real life" domain: $[0, 10]$	
Viewing window: $[0, 10] \times [0, 1200]$	
Maximum volume: 1056.3 in^3	
Dimensions that give the maximum volume: height: 3.9 in. length: $20-2(3.9) = 12.2$ in. width: $30-2(3.9) = 22.2$ in.	

2. I would like to build a little rectangular pen for Sognefjord in my backyard, adjacent to the house, so she has a place to play with the local birds and eat grass. I have a total of 20 feet of fencing which will make up 3 sides of the pen; the last side will be the outside of the house. I'd like to figure out how to put up the fencing so as to maximize the area of the enclosure.



a. Let x be the width of the pen. Explain why the length can be expressed as 20-2x.

20 is total
$-2(x)$.

b. Hence, write down a formula for the area of the pen:
$A(x) = x(20-2x)$

c. Write down the "real life" domain of this problem.

$[0, 10]$

d. Sketch a graph using an appropriate viewing window. Write down your window here:

$[0, 10] \times [0, 50]$

e. Hence find the maximum area of the pen, as well as the dimensions that result in that area.

50 $\quad$ $x = 5$ $\quad$ Width $= 5$
length $= 20-2(5) = 10$

f. (You could have found the maximum of this one algebraically instead! How?)

$A(x) = x(20-2x)$
$= 20x - 2x^2$

vertex: $\left(-\frac{b}{2a}, A\left(-\frac{b}{2a}\right)\right)$

Parabola!

$\frac{-b}{2a} = \frac{-20}{2(-2)} = \frac{-20}{-4} = 5$. $\quad A(5) = 20(5) - 2(5)^2 = 50$

vertex: $(5, 50)$

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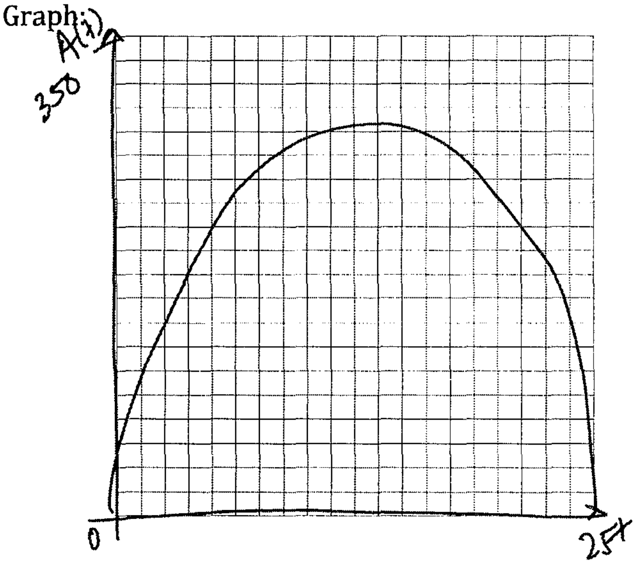
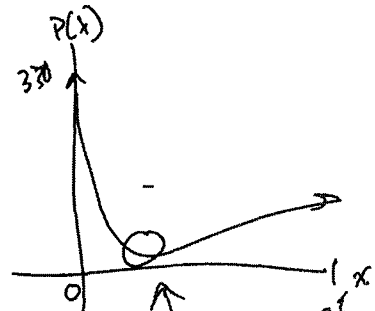
3. Now repeat the process above to determine the maximum area, and the dimensions that would give that area, if I have 50 feet of fencing.

Formula for area: $A(x) = x(50-2x)$	Graph: 
"Real life" domain: $[0, 25]$	
Viewing window: $[0,25] \times [0,350]$	
Maximum volume: 312.5 ft^2	
Dimensions that give the maximum area: $12.5' \times 25'$	

4. Challenge: We can use a similar process to *minimize* something. For example, let's say I want the 3-sided pen for Sognefjord to have an area of 100 square feet. What is the *minimum* amount of fencing that I need to accomplish this?

$\frac{100}{x}$ (since $x \cdot \frac{100}{x} = 100$)

$P(x) = x + x + \frac{100}{x}$
$= 2x + \frac{100}{x}$



minimum = (7.1, 28.3)

so to minimize perimeter,
$x = 7.1$
$P(7.1) = 2(7.1) + \frac{100}{7.1} \approx \boxed{28.3' \text{ ft. of fencing}}$