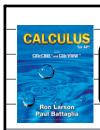


3.6 (Day 1) Optimization Problems

Objective: 1. Solve Optimization Problems

GLOBAL MAX/MIN POINTS OCCUR AT CRITICAL NUMBERS AND END POINTS

CRITICAL NUMBERS OCCUR WHERE $f'(x) = 0$ OR $f'(x)$ = UND

WE ARE LOOKING FOR GLOBAL MAX/MIN POINTS!

1. FIND THE MAXIMUM AREA OF A RECTANGLE WHEN THE PERIMETER IS 100 ft.

PRIMARY EQUATION: THE EQUATION YOU WANT TO MAXIMIZE OR MINIMIZE

SECONDARY EQUATION: NEEDED IF YOU HAVE MORE THAN ONE INDEPENDENT VARIABLE

$A = xy$

$P = 2x + 2y$

$100 = 2x + 2y$

$50 = x + y$

$50 - x = y$ SUBSTITUTE

$A = x(50 - x)$ SIMPLIFY!!

$A = 50x - x^2$ ← CRITICAL NUMBER IS A MAX.

$A' = 50 - 2x$

$0 = 50 - 2x$

$2x = 50$

$x = 25$ $\quad y = 50 - x = 25$

ANSWER THE PROBLEM:

$A = xy$

$A = (25)(25)$

$A = 625\ ft^2$

2. FIND TWO POSITIVE NUMBERS WHOSE PRODUCT IS 16 AND WHOSE SUM IS A MINIMUM

PRIMARY EQUATION: $S = x + y$

SECONDARY EQUATION: $P = xy$

$16 = xy$

$\frac{16}{x} = y$

SUBSTITUTE

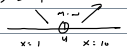
$S = x + \frac{16}{x}$

$S' = 1 - \frac{16}{x^2}$

$0 = 1 - \frac{16}{x^2}$

$\frac{16}{x^2} = 1$

$x = 4$

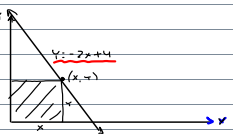


$x = 4 \quad y = \frac{16}{x}$

$y = 4$

(4, 4)

3.



MAXIMIZE THE AREA OF THE RECTANGLE

PRIMARY EQUATION: $A = xy$

SECONDARY EQUATION: $y = -2x + 4$

SUBSTITUTE

$A = x(-2x + 4)$ SIMPLIFY

$A = -2x^2 + 4x$ ← MAX

$A' = -4x + 4$

$0 = -4x + 4$

$4x = 4$

$x = 1 \quad y = -2x + 4$

$y = 2$

$AREA = xy$

$AREA = 2$

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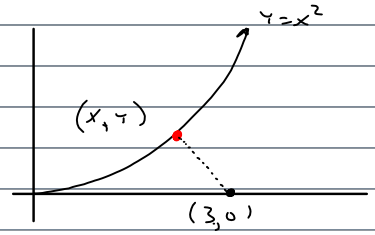
Possible Steps To Solve Optimization Problems

1. If possible, draw a picture and assign variables.
2. Find the primary equation
3. If needed, find a secondary equation
4. Substitute the secondary equation into the primary equation so that you are left with one independent variable
5. If needed, simplify!!!
6. Find the critical numbers
7. Determine the endpoints
8. Find the global max/min that is needed to solve the problem
9. Solve the problem!!

4.



Find the point that will minimize the distance from $y=x^2$ to the point $(3, 0)$

Primary equation: $d = \sqrt{(x-3)^2+(y-0)^2}$

Secondary equation: $y = x^2$

$$d = \sqrt{(x-3)^2+(x^2)^2}$$
$$d = \sqrt{(x-3)^2+x^4}$$
$$d' = \frac{1}{2}\left((x-3)^2+x^4\right)^{-\frac{1}{2}}\left(2(x-3)+4x^3\right)$$
$$0 = \frac{(x-3)+2x^3}{\sqrt{(x-3)^2+x^4}} \quad \sqrt{(x-3)^2+x^4}$$
$$0 = 2x^3+x-3$$
$$1 = x$$

$x = 1 \quad y = 1$

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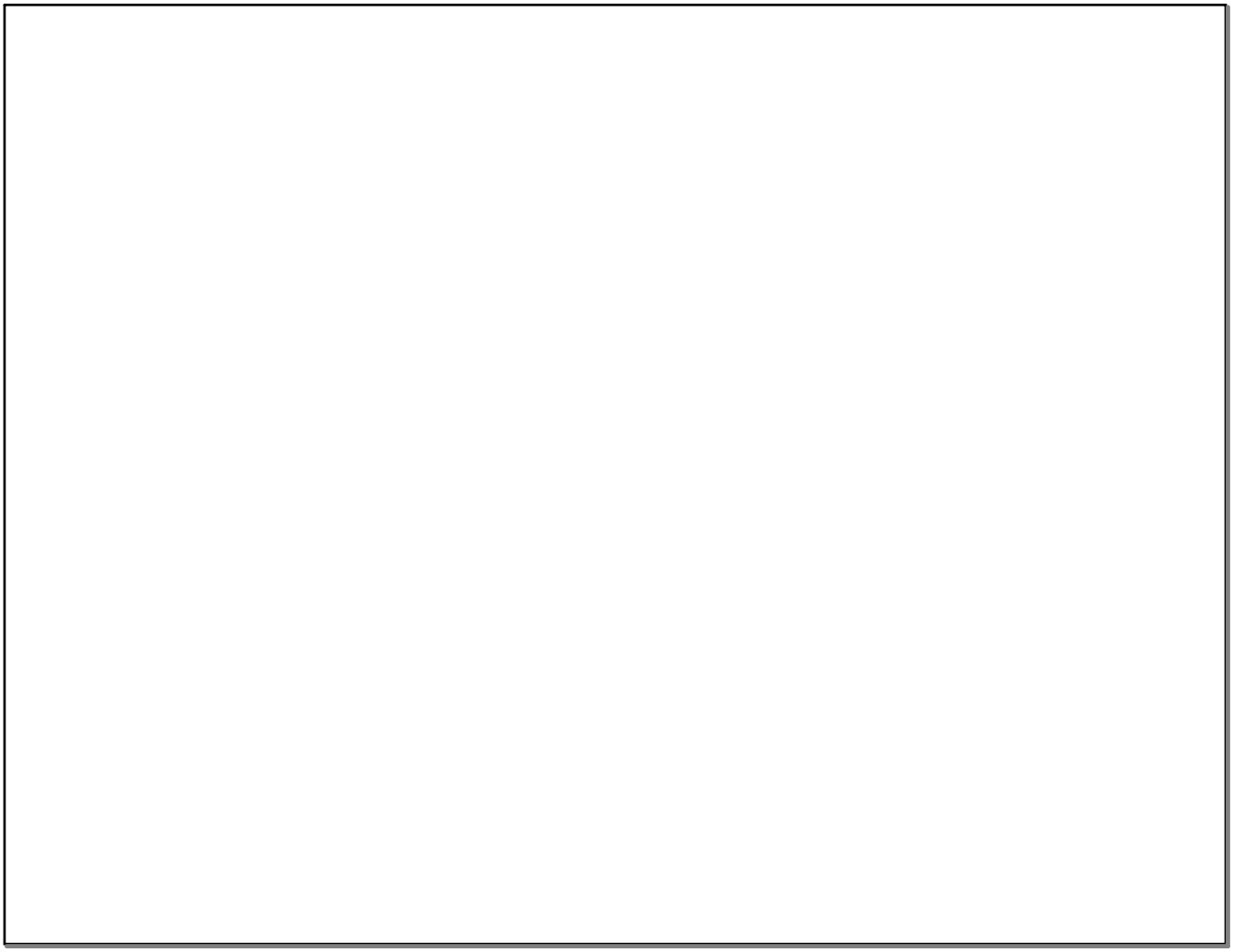

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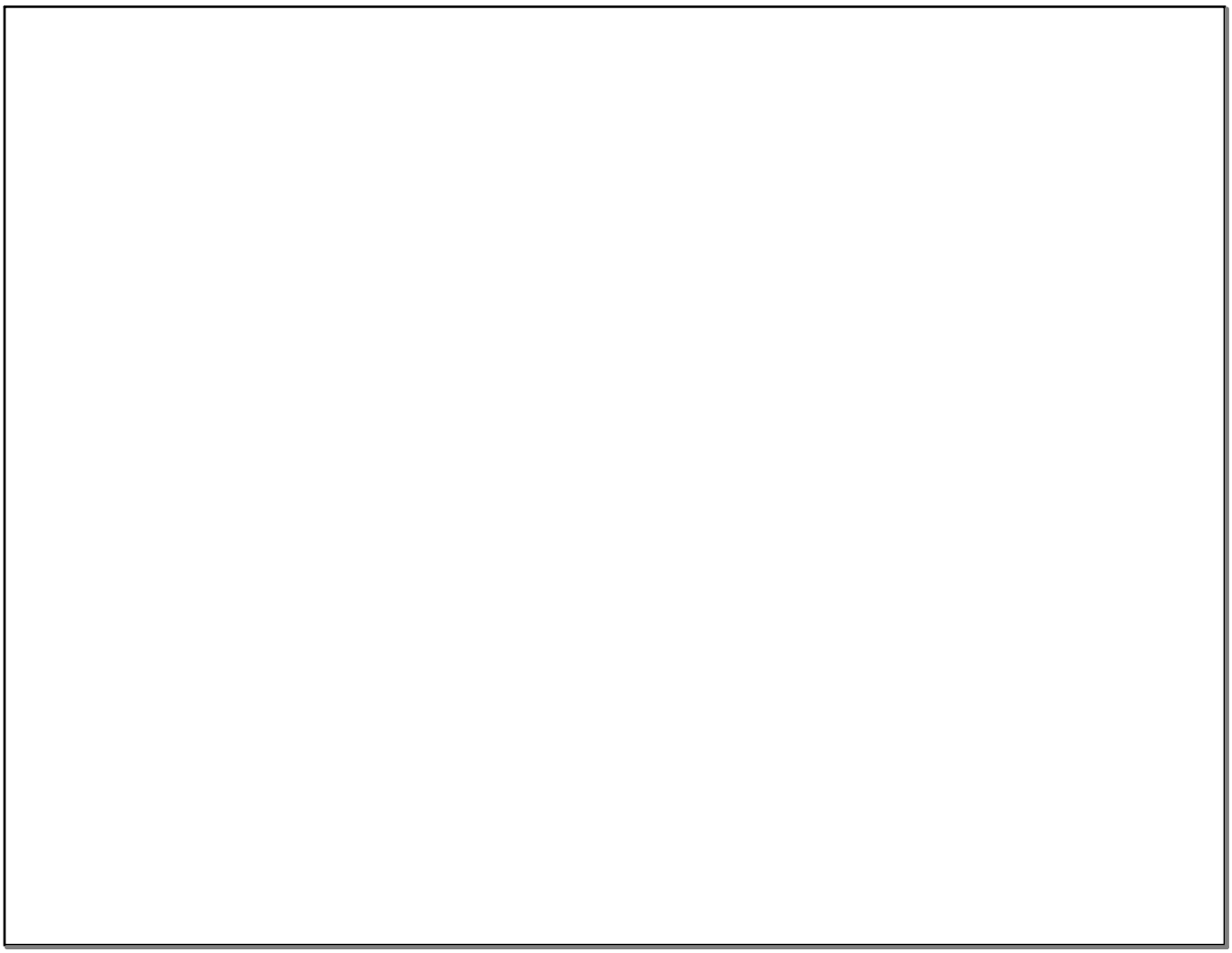

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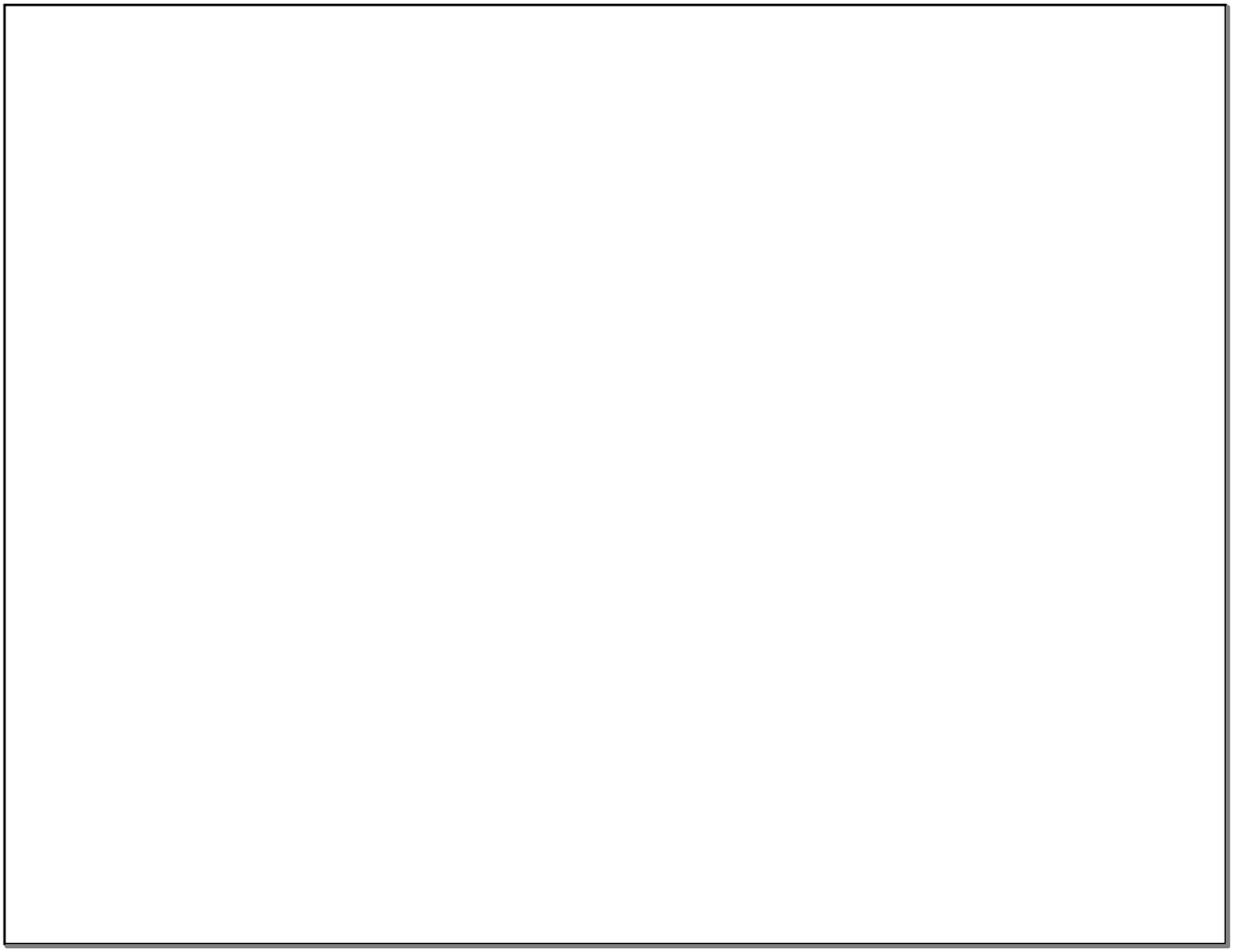

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