Non-AP Calculus 3.7 Optimization Quiz Review Worksheet #3

1) Farmers can get 2 dollars per bushel for their potatoes on July 1, and after that, the price drops by 2 cents per bushel per extra day. On July 1, a farmer had 80 bushels of potatoes in the field and estimates that the crop is increasing at the rate of 1 bushel per day. When should the farmer harvest the potatoes to maximize his revenue?

2) A landscape architect plans to enclose a 3000 square foot rectangular region in a botanical garden, She will use shrubs costing $25 per foot along three sides and fencing costing $10 per foot along the fourth side, Find the minimum total cost.

3) From a thin piece of cardboard, 8 in. by 8 in., square corners are cut out so that the sides can be folded up to make a box. What dimensions will yield a box of maximum volume? What is the maximum volume?

4) A box with a square base is to be made with a volume of $8m^3$. The top and bottom of the box is made with some material that has a cost of 8 dollars per square meter. The sides are made with another material that costs 1 dollar per square meter. What are the dimensions of the box that would minimize the total cost?

Non-AP Calculus 3.7 Optimization Quiz Review Worksheet #3 Key

1) Farmers can get 2 dollars per bushel for their potatoes on July 1, and after that, the price drops by 2 cents per bushel per extra day. On July 1, a farmer had 80 bushels of potatoes in the field and estimates that the crop is increasing at the rate of 1 bushel per day. When should the farmer harvest the potatoes to maximize his revenue?

x = # of crop increase

$R(x) = (\text{change in \# of bushels})(\text{change in amount per bushel})$

$R(x) = (80 + 1x)(2 - 0.02x)$

$R(x) = 160 - 1.6x + 2x - 0.02x^2$

$R(x) = -0.02x^2 + 0.4x + 160$

$R'(x) = -0.04x + 0.4$

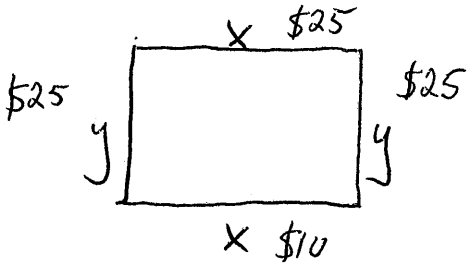
$0 = -0.04x + 0.4$

$0.04x = 0.4$

$x = 10$

To maximize revenue, the farmer should harvest potatoes 10 days after July 1st (July 11)

2) A landscape architect plans to enclose a 3000 square foot (Area) rectangular region in a botanical garden, She will use shrubs costing \$25 per foot along three sides and fencing costing \$10 per foot along the fourth side, Find the minimum total cost. (Optimize Perimeter (Cost))



$A = xy$ $\quad 3000 = xy$

$3000 = xy$

$\frac{3000}{x} = y$

* Perimeter (cost) $= 10x + 25x + 25y + 25y$

$P = 35x + 50y$

$C = 35x + 50y$

$C = 35x + 50\left[\frac{3000}{x}\right]$

$C = 35x + \frac{150000}{x}$

$C = 35x + 150000x^{-1}$

$C'(x) = 35 - 150000x^{-2}$

$0 = 35 - \frac{150000}{x^2}$

$\frac{150000}{x^2} = \frac{35}{1}$

$35x^2 = 150000$

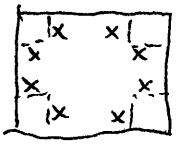
$x^2 = 4285.714$

$x = 65.465$

$C(65.465) =$

$\$4582.58$

3) From a thin piece of cardboard, 8 in. by 8 in., square corners are cut out so that the sides can be folded up to make a box. What dimensions will yield a box of maximum volume? What is the maximum volume?



$V=(x)(8-2x)(8-2x)$

$V=(8x-2x^2)(8-2x)$

$V=64x-16x^2-16x^2+4x^3$

$V=4x^3-32x^2+64x$

$V'(x)=12x^2-64x+64$

$0=4(3x^2-16x+16)$

$0=3x^2-16x+16$

$\frac{16\pm\sqrt{(16)^2-4(3)(16)}}{2(3)}$

$\frac{16\pm\sqrt{64}}{6}$

$\frac{16\pm 8}{6}$

$\frac{16+8}{6}, \frac{16-8}{6}$

$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

$x=4, x=\frac{4}{3}$

$V(\frac{4}{3})=4(\frac{4}{3})^3-32(\frac{4}{3})^2+64(\frac{4}{3})$

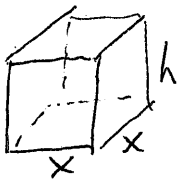
$V(\frac{4}{3})=37.926\ in^3$

Dimensions:

1.333 in x 5.333 in x 5.333 in.

4) A box with a square base is to be made with a volume of $8m^3$. The top and bottom of the box is made with some material that has a cost of 8 dollars per square meter. The sides are made with another material that costs 1 dollar per square meter. What are the dimensions of the box that would minimize the total cost?

optimize Surface Area (cost)



$V=8m^3$

$V=x^2h$

$8=x^2h$

$\frac{8}{x^2}=h$

* Surface Area (cost) $= \underbrace{x^2+x^2}_{\$8} + \underbrace{xh+xh+xh+xh}_{\$1}$

$C=8(2x^2)+1(4xh)$

$C=16x^2+4xh$

$C=16x^2+4x\left[\frac{8}{x^2}\right]$

$C=16x^2+\frac{32x}{x^2}$

$C=16x^2+\frac{32}{x}$

$C=16x^2+32x^{-1}$

$C'(x)=32x-32x^{-2}$

$0=32x-\frac{32}{x^2}$

$\frac{32}{x^2}=\frac{32x}{1}$

$32x^3=32$

$x^3=\frac{32}{32}$

$\sqrt[3]{x^3}=\sqrt[3]{1}$

$x=1$

Dimensions:

$\frac{8}{x^2}=h$

$\frac{8}{(1)^2}=8=h$

Dimensions:

1 m x 1 m x 8 m