MATH 205 – Calculus I **SQ 4.5**

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Instructions: Though calculators can be used for this daily question, you are required to show your work. To receive full credit, answers must have proper justification. Round dimensions to 2 decimal places as needed.

1. Suppose you are using two different materials to make a rectangular box with a square base. The material for the top and the four sides costs \$1 per square foot. The material for the base of the box costs \$2 per square foot. Find the dimensions of the box that maximizes volume if you are allowed \$144 for the materials.

$D: [0, \sqrt{48}]$

$V = LWH$

$V = xxy$

$V = x^2 y$

$V = x^2\left(\frac{144-3x^2}{4x}\right)$

$V = \frac{144x - 3x^3}{4}$

$V' = \frac{4(144 - 9x^2)}{16}$

$V' = \frac{576 - 36x^2}{16}$

$V' = \frac{288 - 18x^2}{8}$

$0 = 288 - 18x^2$

$18x^2 = 288$

$x^2 = 16$

$x = 4$

1 5
+ 4 −
max

base: \$2 ft^2
side & top: \$1 ft^3

$C = \underbrace{2x^2}_{\text{base}} + \underbrace{4(1xy)}_{\text{sides}} + \underbrace{1(x^2)}_{\text{top}}$

$144 = 2x^2 + 4xy + x^2$

$144 = 3x^2 + 4xy$

$-4xy = 3x^2 - 144$

$y = \frac{-3x^2 - 144}{4x}$

$y = \frac{144 - 3x^2}{4x}$

$V = \frac{144(4) - 3(4)^3}{4}$

$V = 96$

$0 = 144x - 3x^3$

$0 = 144 - 3x^2$

$3x^2 = 144$

$x^2 = 48$

$x = \sqrt{48}$

$96 = x^2 y$

$96 = 16y$

$6 = y$

$V'' = \frac{8(-36x)}{64}$

$V'' = \frac{-288x}{64}$

$V'' = \frac{-9x}{2}$

$x = 0$

−1 1
+ 0 −

To maximize the volume of the container with a budget of \$144 the lengths of the base should be 4ft and the height should be 6ft.