Wed. Wk 13

Applications

differential $\leftrightarrow$ integral :

most
least
min
max
optimization
related rates
how fast is
x changing
when y is
doing z.

area
volume
(avg. value)
(work)

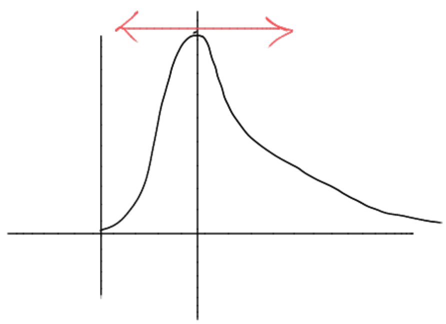
4-7

Question 3 of 10

The concentration of a drug in the bloodstream t hours after injection into the body is given by the function C.

$$C(t) = \frac{4t}{0.9 + t^2}$$

When is the concentration of a drug in the bloodstream the greatest? Round your answer to two decimal places.



$t = ?$

Every optimization Problems,

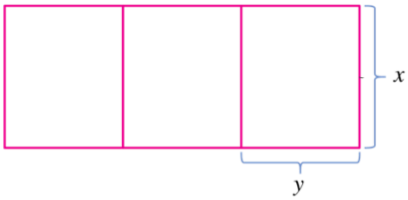
① take deriv.

② set $= 0$, solve.

(here, need quotient rule)

Question 1 of 10

Your task is to design a rectangular industrial warehouse consisting of three separate spaces of equal size as in the figure.



$7{,}200{,}000$ = total \$ available

wall cost: Amount · Cost

$$\text{Amount} = (4x+6y)\cdot 500$$

☆ $\boxed{(4x+6y)5\cancel{00} = 72000\cancel{00}}$

Solve for x:

$$4x + 6y = \frac{72000}{5} = 14400$$

$$x = \frac{14400 - 6y}{4}$$

$$\boxed{x = \frac{7200 - 3y}{2}}$$

☆ The wall materials cost \$500 per linear meter and your company allocates \$7,200,000 for that part of the project involving the walls.

Which dimensions maximize the area of the warehouse?

(Give exact answers. Use symbolic notation and fractions where needed.)

Goal:

dimensions: length ($=x$) & width ($=3y$) that maximize area

① get an function for area: (rectangle: $A = 3xy$

② take deriv. set $= 0$,

two variables ⇒ need 1 (constraint ☆)

$$A = 3\left(\frac{7200 - 3y}{2}\right)y$$

$$A = \frac{3}{2}y(7200 - 3y)$$

$$A = \frac{21600}{2}y - \frac{9}{2}y^2$$

$$A' = 10800 - 9y = 0$$

$$10800 = 9y$$

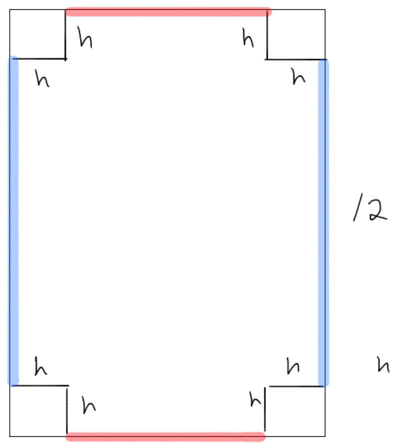
$$y = \frac{10800}{9}$$

$$\boxed{y = 1200}$$

dims: $x = \dfrac{7200 - 3(1200)}{2} = \dfrac{3600}{2} = 1800$

$y = 1200$

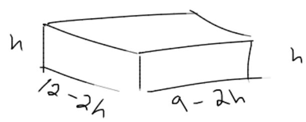
Start w/ 9x12 sheet: remove square from each corner, fold corners up into a box.



what's the volume of largest box? dimensions? $V = (12-2(2.2))(9-2(2.2))(2.2)$

① $V = l \cdot w \cdot h$

② assign variable h to length of cut



③ $V = (12-2h)(9-2h)h$

$= (108 - 24h - 18h + 4h^2)h$

$V = 4h^3 - 42h^2 + 108h$

④ $V' = 12h^2 - 84h + 108$

$= 6h^2 - 42h + 54$

$= 3h^2 - 21h + 27 = 0$

$= h^2 - 7h + 9 = 0$

$$h = \frac{7 \pm \sqrt{49 - 4 \cdot 9}}{2} = \frac{7 \pm \sqrt{13}}{2} \approx \frac{7 \pm 3.5}{2} \approx \frac{10.5}{2} \approx 5.2$$

$$\approx \frac{4.5}{2} \approx 2.2$$

can't cut 2(5.2) from 9

Question 2 of 10

$l \cdot w \cdot h = V = 60$

A jewelry box with a square base is to be built with silver plated sides, nickel plated bottom and top, and a volume of 60 cm^3. If nickel plating costs \$1 per cm^2 and silver plating costs \$10 per cm^2, find the dimensions of the box to ~~minimize the cost~~ of the materials.

mult

(Use decimal notation. Give your answers to three decimal places.)

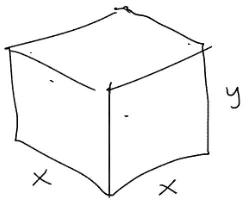
assign variable C to cost, $x =$ length

$$C = \text{price} \times \text{amount} + \text{price} \times \text{amount}$$

$$C = \$1 \cdot (2x^2) + \$10\,(4xy)$$

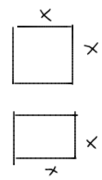
total square cm of nickel

total sq. cm of silver



$2x^2$

Base: Nickel



Silver $4\left(x \times y\right)$

$4xy$

$V = x \cdot x \cdot y$

$60 = x^2 y$

$y = 60/x^2$

deriv. of this

$$C = 1 \cdot 2x^2 + 10 \cdot \left(4x\left(60/x^2\right)\right)$$