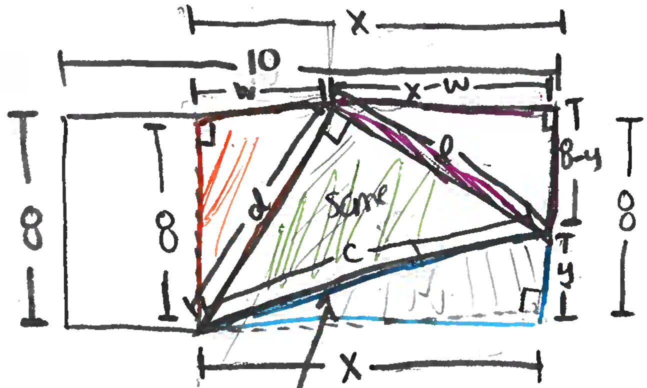
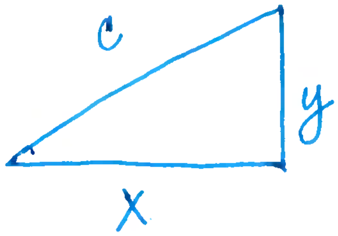
Ex:

$PV = nRT$

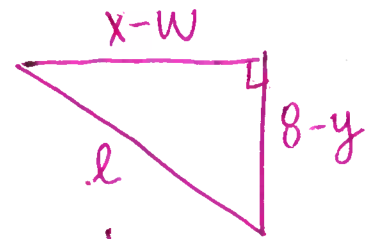


$\boxed{\text{Area} = \frac{1}{2}xy}$

need this to be a one-variable function!!



$\boxed{x^2+y^2=c^2} \to c = \sqrt{x^2+y^2}$



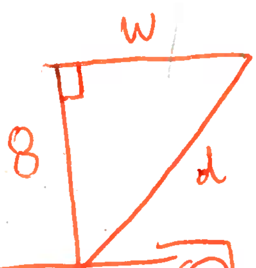
$\boxed{(8-y)^2+(x-w)^2=\ell^2}$

$(64-16y+y^2)+(x^2-2xw+w^2)$

$=$

ℓ^2

$64-16y-2xw+w^2+\boxed{x^2+y^2}=\ell^2$



$\boxed{8^2+w^2=d^2}$

$\boxed{\ell^2+d^2=c^2}$

$\ell^2+d^2=x^2+y^2$

$(8-y)^2+(x-w)^2+d^2=x^2+y^2$

$64-16y+\cancel{y^2}+\cancel{x^2}-2xw+w^2+64+w^2=\cancel{x^2}+\cancel{y^2}$

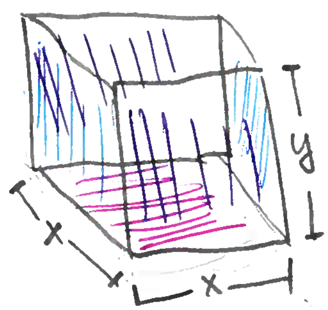
Next time

<u>Ex</u>: A box w/ open top has vertical sides, square bottom, + volume of $8m^3$.

If box has least possible surf. area, find its dimensions.

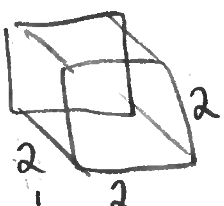
optimize surf. area

<u>Soln</u>:

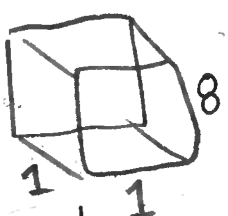


Vol = 8

$$\text{Vol} = \boxed{x^2 y = 8}$$ relates x + y ✓



SA=20



SA = 32+1 = 33

to optimize: $S_A = 2xy + 2xy + x^2$

$$\boxed{S_A = 4xy + x^2}$$ subject to constraint

volume cond.

$$\boxed{x^2 y = 8} \Rightarrow \boxed{y = \frac{8}{x^2}}$$

need to write in one-var

$$S_A = 4x\left(\frac{8}{x^2}\right) + x^2 = \frac{32}{x} + x^2$$

$$\boxed{\frac{32}{x} = 32x^{-1}}$$

$$\frac{dS_A}{dx} = \boxed{-\frac{32}{x^2} + 2x \overset{\text{set}}{=} 0}$$ $x \neq 0$

$$-32 + 2x^3 = 0 \to 2x^3 = 32$$
$$\to x^3 = 16$$
$$\to x = \sqrt[3]{16}$$ c.p.

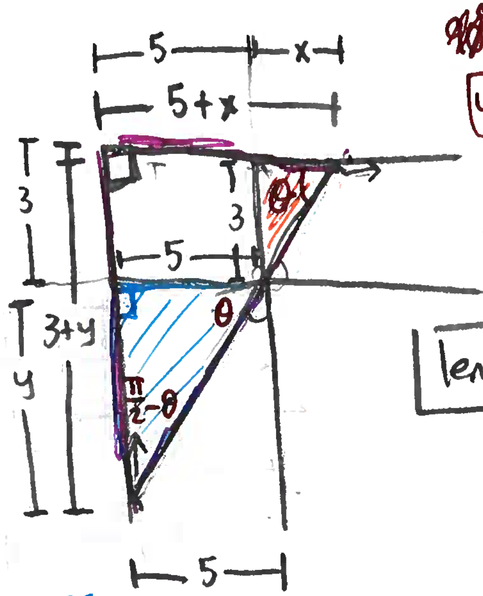
$$S_A''(x) = \frac{d^2 S_A}{dx^2} = \frac{64}{x^3} + 2$$

$$S_A''(\sqrt[3]{16}) = \frac{64}{16} + 2 > 0 \Rightarrow$$ local min of $S_A(\sqrt[3]{16}) = \underline{19.05\ m^2}$ at $x = \sqrt[3]{16}$

Ex: Pipe carried down hallway that is 5 ft wide. At end of hall there is a right-angled turn into a hallway that is 3ft wide.

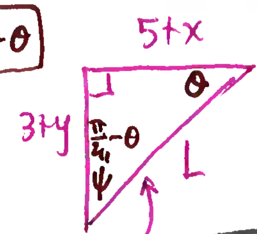
What is length of longest pipe that can be carried around the corner?

optimize length of pipe



$\frac{\pi}{2}+\theta+\psi=\pi$

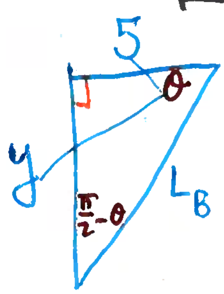
$\boxed{\psi=\frac{\pi}{2}-\theta}$

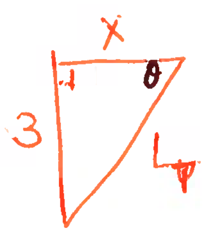


$(5+x)^2+(3+y)^2=L^2$

$$\boxed{\text{length of pipe} = \sqrt{(5+x)^2+(3+y)^2}}$$

two vars





$\boxed{\tan(\theta)=\frac{y}{5}}$ $\boxed{\tan(\theta)=\frac{3}{x}}$

$\frac{y}{5}=\frac{3}{x} \rightarrow \boxed{y=\frac{15}{x}}$

to opt: $L=\sqrt{(5+x)^2+\left(3+\frac{15}{x}\right)^2}$