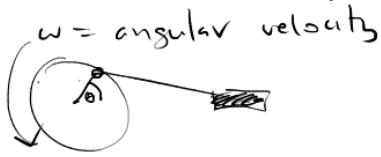
The acceleration of the piston



$$a(\theta) = 2w^2(\cos\theta + .5\cos(2\theta))$$

If w = constant

Find which angle (what position) gives max/min acceleration.

$$a'(\theta) = -2w^2\left(\sin\theta + \tfrac{1}{2}(-\sin(2\theta)\cdot 2)\right)$$

$$= -2w^2(\sin\theta - \sin 2\theta)$$

$$a'(\theta) = -2w^2(\sin\theta - 2\sin\theta\cos\theta) = 0$$

$$-2w^2\sin\theta(1 - 2\cos\theta) = 0$$

$= 0$ $\quad$ $= 0$

$$\frac{-2w^2\sin\theta}{-2w^2} = \frac{0}{-2w^2}$$

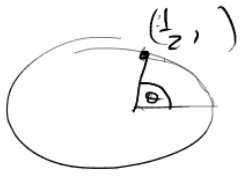
$$\sin\theta = 0$$

$$\boxed{\theta = 0, \pi}$$

$$1 - 2\cos\theta = 0$$

$$1 = 2\cos\theta$$

$$\frac{1}{2} = \cos\theta$$



$$\boxed{\theta = \frac{\pi}{3}}$$

$$\boxed{\sin 2\theta = 2\cos\theta\sin\theta}$$

Why?

Basic Fact:

$\sin(A+B) = \sin A\cos B + \cos A\sin B$

$A = \theta$

$B = \theta$

$\sin(2\theta) = \sin\theta\cos\theta + \cos\theta\sin\theta$

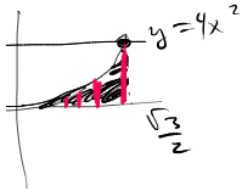
$y = 4x^2$

$x = 0$

$x = 3$

$y = 3$

x – axis



$4x^2 = 3$

$x = \pm\frac{\sqrt{3}}{2}$

1. washer or (disk)

$A = \pi r^2$

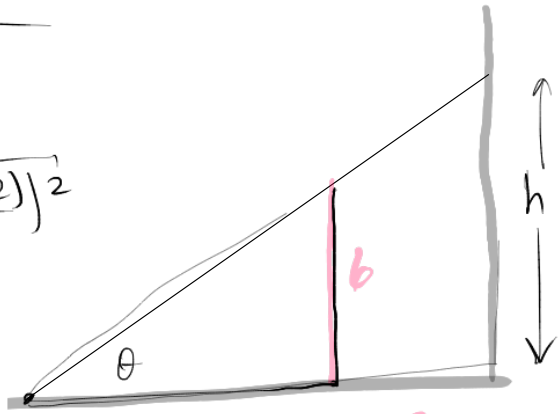
$= \pi 16x^4$

$$\int_0^3 \pi 16x^4\,dx = \pi \cdot \frac{16x^5}{5}\Big|_0^3 = \pi\frac{16(3)^5}{5} - \frac{16(0)^5}{5}$$

$= 0$

$$\ell = \sqrt{(x+2)^2 + h^2}$$

$$= \sqrt{(x+2)^2 \left(\frac{6(x+2)}{x}\right)^2}$$



$$\frac{6}{x} = \frac{h}{x+2}$$

$$\frac{6(x+2)}{x} = h$$

Do

$\ell(4.1)$

$=$

$$\left(\frac{6(x+2)}{x}\right)' = \frac{6x+12}{x} = \left(6 + \frac{12}{x}\right)' = \frac{-12}{x^2}$$

Minimize ℓ.

B/c ℓ is strictly increasing, we can minimize ℓ^2 instead, getting same x.

Minimize ℓ^2 instead. : $\left((x+2)^2 + \left(\frac{6(x+2)}{x}\right)^2\right)' = 0$

$$2(x+2) + 2\left(\frac{6(x+2)}{x}\right)'\left(\frac{-12}{x^2}\right)$$

$$2(x+2)\left(1 + \frac{6}{x}\left(\frac{-12}{x^2}\right)\right) = 0$$

$2(x+2) = 0$; $1 + \frac{6}{x}\left(\frac{-12}{x^2}\right) = 0$

$x = -2$

$$1 - \frac{72}{x^3} = 0$$

dist. $= 4$.

$$x = \sqrt[3]{72} \approx 4.1$$