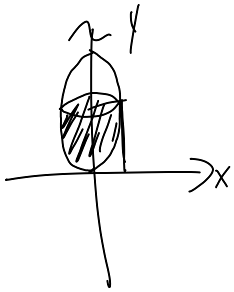
$x = \sin\left(\frac{\pi y}{3}\right)$, $[0, 3]$ revolved about y-axis

A of one circular cross-section $= \pi \sin^2\left(\frac{\pi y}{3}\right)$



$= \int_0^3 \pi \sin^2\left(\frac{\pi y}{3}\right) dy$

$= \pi \int_0^3 \sin^2\left(\frac{\pi y}{3}\right) dy$ let $w = \frac{1}{3}\pi y$

$= \pi \int_0^3 \sin^2(w) \frac{dw}{\frac{1}{3}\pi}$ $\frac{dw}{dy} = \frac{1}{3}\pi$

$= 3 \int_0^3 \sin^2(w) dw$ $dw = \frac{1}{3}\pi dy$ $\frac{dw}{\frac{1}{3}\pi} = dy$

$= 3\left(-\frac{1}{2}\sin(w)\cos w + \frac{1}{2}\int \sin^0 w \cdot dw\right)$

$= 3\left(-\frac{1}{2}\sin w \cos w + \frac{1}{2}w\right)$

$= -\frac{3}{2}\sin\left(\frac{\pi y}{3}\right)\cos\left(\frac{\pi y}{3}\right) + \frac{\pi y}{2}$

Convert to liters

1) $Z\Big|_0^d = \left(-\frac{3}{2}\sin\frac{\pi d}{3}\cos\left(\frac{\pi d}{3}\right) + \frac{\pi d}{2}\right) \cdot 1000$

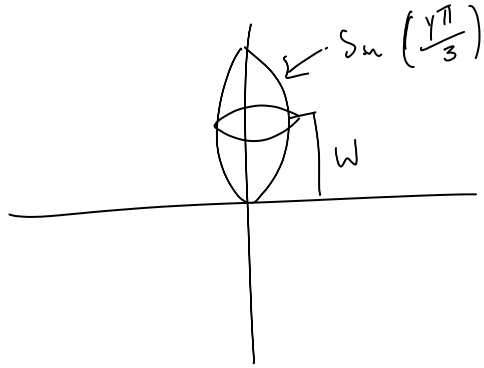
2) $\frac{d(\text{Volume})}{d(\text{time})} = \frac{d(\text{Volume})}{d(\cancel{\text{depth}})} \times \frac{d(\cancel{\text{depth}})}{d(\text{time})} = \frac{\Delta \text{Volume}}{\Delta \text{depth}} \times \frac{\Delta \text{depth}}{\Delta \text{time}}$

$\frac{3\pi}{2} - 0.1t = \frac{dV}{dw} \times \frac{dw}{dt}$

$$\frac{\Delta V_{olume}}{\Delta T_{ime}} = -0.1\ m^3/min = \frac{\Delta V_{olume}}{\Delta D_{epth}} \times \frac{\Delta D_{epth}}{\Delta T_{ime}} \rightarrow \frac{\Delta D}{\Delta t}\Big|_w$$

$$\frac{\Delta D_{epth}}{\Delta T_{ime}} = \frac{\Delta D_{epth}}{\Delta V_{olume}} \times \frac{\Delta V_{olume}}{\Delta T_{ime}} \qquad \frac{\Delta V}{\Delta t} = -0.1$$

$$\frac{\Delta D}{\Delta T} = \frac{\Delta D}{\Delta V} \times 0.1\ m^3/min$$



$$\frac{\Delta w}{\Delta t} = \frac{\Delta w}{\Delta V} \times -0.1 = \frac{\Delta V}{\Delta w}^{-1} \times 0.1$$

$$= \left(\frac{\pi}{2} + \right.$$

$$\frac{dV}{dw} = \left(-\frac{3}{2}\sin\left(\frac{\pi d}{3}\right)\cos\left(\frac{\pi d}{3}\right)\right)' + \left(\frac{\pi d}{2}\right)'$$

$$= -\frac{\pi}{2}\cos\left(\frac{2\pi d}{3}\right) + \frac{\pi}{2}$$

$$\frac{\Delta V}{\Delta t} = \frac{3\pi}{2} - 100t$$

$$\frac{dw}{dt} = \frac{dw}{dV} \cdot \frac{dV}{dt}$$

$$\frac{dw}{dt} = \frac{dw}{dV} \cdot (-0.1) \longrightarrow V(w) = -\frac{3}{4}\sin\left(\frac{2\pi d}{3}\right) + \frac{\pi d}{2} \qquad V_i = \frac{3\pi}{2}$$

$$\frac{dw}{dt} = (V'(w))^{-1} \cdot -0.1 \qquad V_t = \frac{3\pi}{2} - 0.1(t)$$

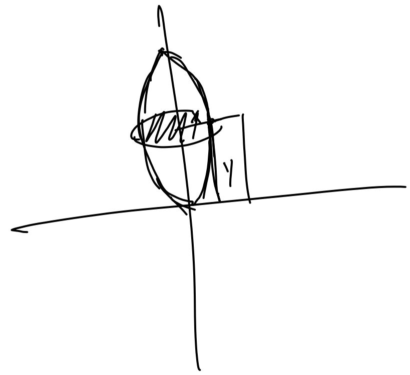
$$= \left(-\pi\cos\left(\frac{2\pi d}{3}\right) + \frac{\pi}{2}\right)^{-1} \cdot -0.1$$

$$= \frac{-0.1}{\left(-\pi\cos\left(\frac{2\pi d}{3}\right) + \frac{\pi}{2}\right)}$$

$$= \pi\int_0^3 \sin^2\left(\frac{\pi y}{3}\right) dy = \frac{3\pi}{2}\ m^3$$

at 2m, depth is changing at -0.032

W at any given point is y



How can I relate volume to depth

Total volume when depth = 3 is $\frac{3\pi}{2}$

$V(t) = \frac{3\pi}{2} L - 100 \cdot t \; (L/m)$

$\frac{\Delta V}{\Delta t} = -100 \, L/min$

$t(d) =$

$V_{t=0} = \frac{3\pi}{2} \, m^3$

$V(t) = \frac{3\pi}{2} - 0.1t$, t in minutes

$x = \sin\left(\frac{\pi x}{3}\right)$

$\frac{dV}{dt} = \frac{dV}{dw} \frac{dw}{dt}$

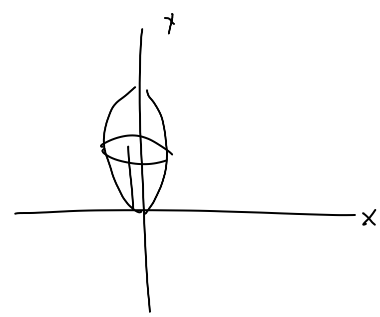
$\frac{dw}{dt} = \frac{dw}{dV} \frac{dV}{dt}$

$= \frac{dw}{dV} \cdot -0.1$

$\frac{3}{\pi} \sin^{-1}(x) = W$

$\frac{dV}{dt}$ is the rate

they 1 have and are using.

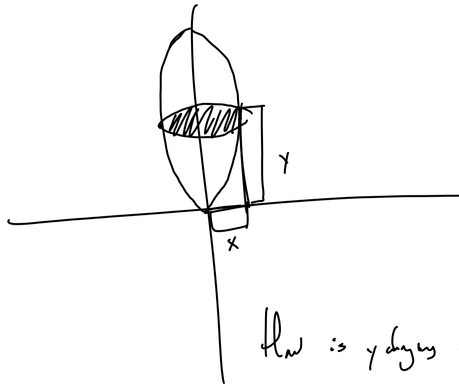


depth $= W = y = \frac{3}{\pi} \sin^{-1}(x)$

$W = 2\,m$

$$\frac{dV}{dt} = -100\ L/min$$

How is the depth w changing at $w = 2$



How is y changing at $y=2$

$$\frac{dw}{dt} = \frac{dw}{dV} \times \frac{dV}{dt}$$

$$\frac{dw}{dx} = \frac{3}{\pi} \cdot \frac{1}{\cos\left(\frac{\pi w}{13}\right)}$$

$$\frac{dw}{dt} = \frac{dw}{dV} \times (-100\ L/min)$$

Change in depth with respect to volume

$$\parallel$$

$$\frac{dw}{dV}$$

But how to express that without answer to q.1? Find an expression for depth in terms of volume ... wtf?