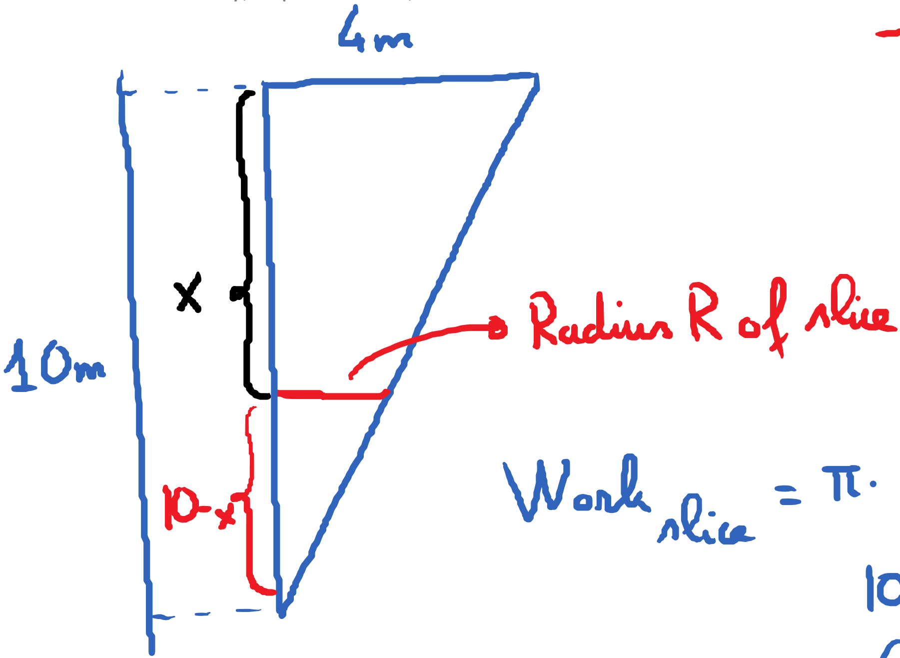


$$\frac{R}{4} = \frac{10-x}{10}$$

$$\rightarrow \boxed{R = \frac{2(10-x)}{5}}$$

$$\text{Work}_{\text{slice}} = \pi \cdot \left(\frac{2(10-x)}{5}\right)^2 \cdot 9800x\,dx$$

$$\text{Total work} = 9800\pi \cdot \int_2^{10} \left(\frac{2(10-x)}{5}\right)^2 x\,dx$$

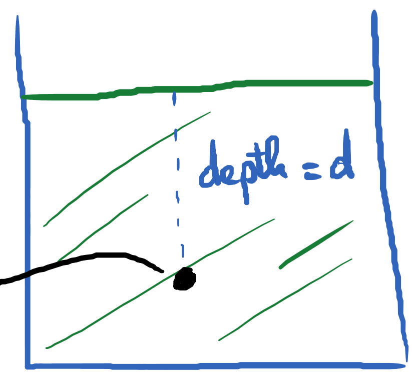
$$= \ldots$$

* Hydrostatic Pressure and Force

Basic Physics:

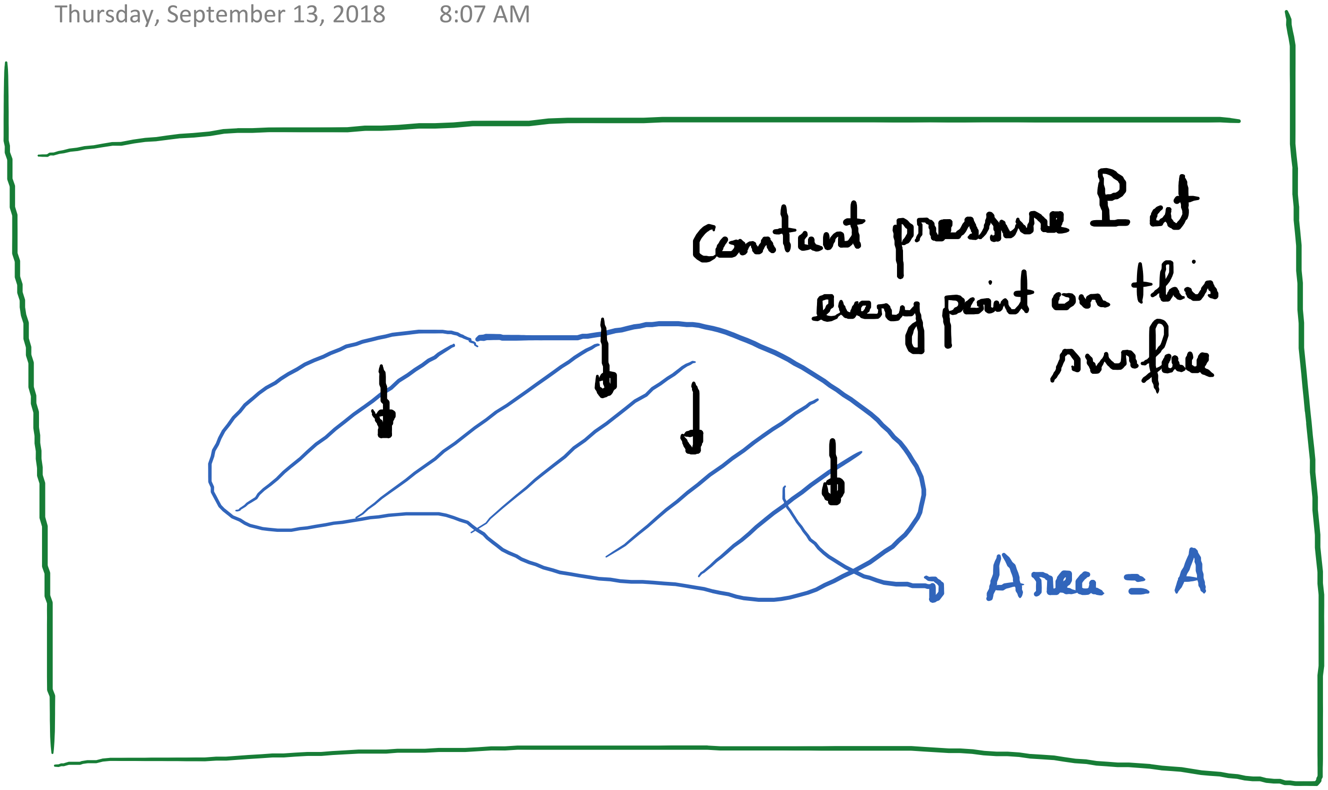
$$\boxed{\text{Pressure} = \rho \cdot g \cdot d}$$

(at depth d)



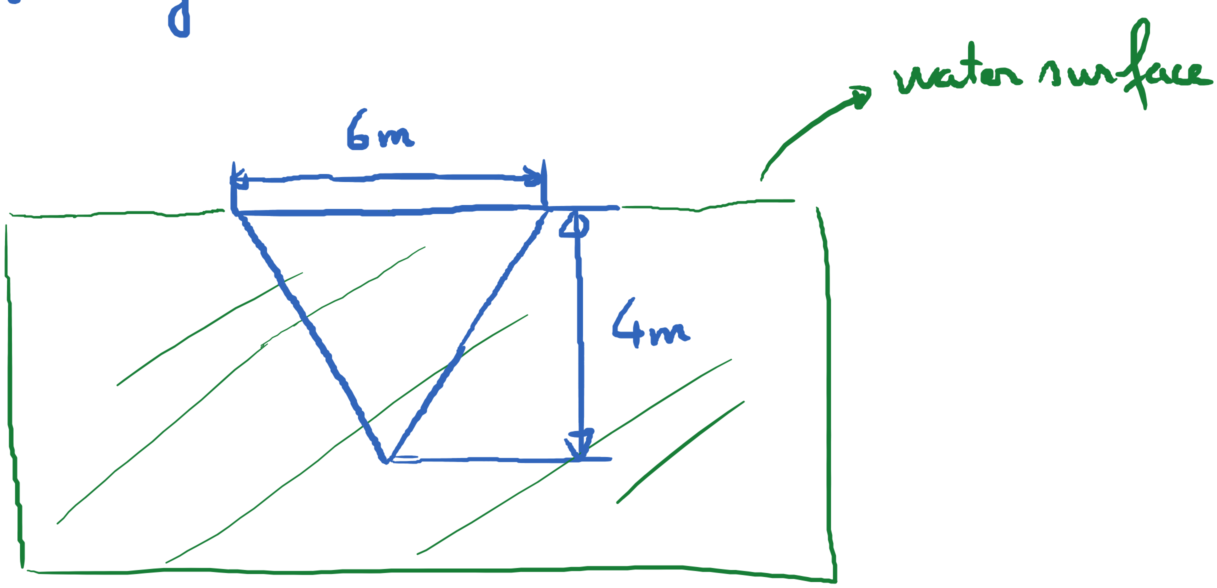
ρ: density of liquid ($\rho = 1000\ kg/m^3$ for water)

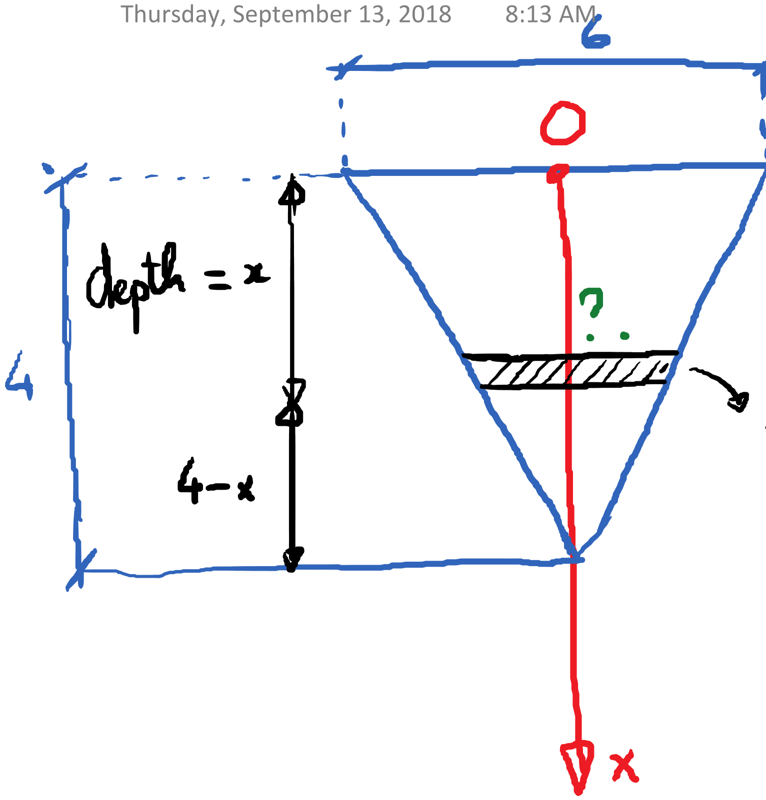
$g = 9.81\ m/s^2$



Hydrostatic force acting on this area = $P \cdot A$

E.g. Find the hydrostatic force on a thin triangular plate submerged in water as in the picture





By Similar triangles:

$$\frac{6}{4} = \frac{?}{4-x}$$

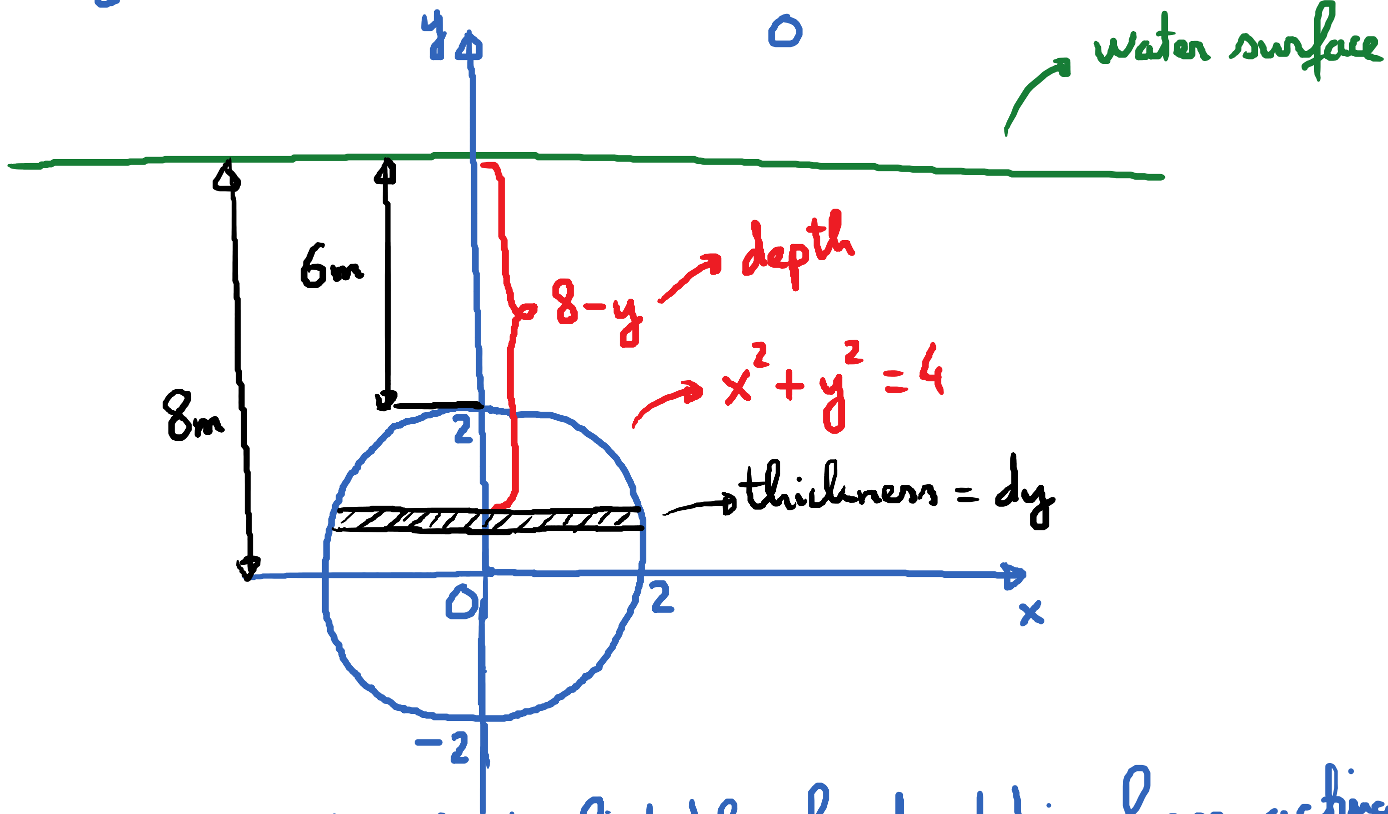
$$\rightarrow ? = \frac{3}{2}(4-x)$$

Slice plate into very thin rectangular strips. For a strip of thickness dx, the pressure at every point on it is constant and it is $P = \rho \cdot g \cdot \underbrace{x}_{\text{depth}} = 9810x$

$$\text{Hydrostatic force on strip} = P \cdot A_{strip}$$
$$= (9810x) \cdot (\text{Area}_{strip})$$
$$= (9810x) \cdot \left(\frac{3}{2}(4-x) \cdot dx\right)$$

→ Hydrostatic force on plate $= \int_0^4 (9810x) \cdot \frac{3}{2}(4-x) \cdot dx$

Ex.



Set up the integral to find the hydrostatic force acting on this circular plate.

$$\text{Pressure}_{\text{strip}} = \rho \cdot g \cdot (8-y) = 9810(8-y)$$

$$\text{Force}_{\text{strip}} = P_{\text{strip}} \cdot A_{\text{strip}}$$

$$= 9810(8-y) \cdot \left(2\sqrt{4-y^2}\right) dy$$

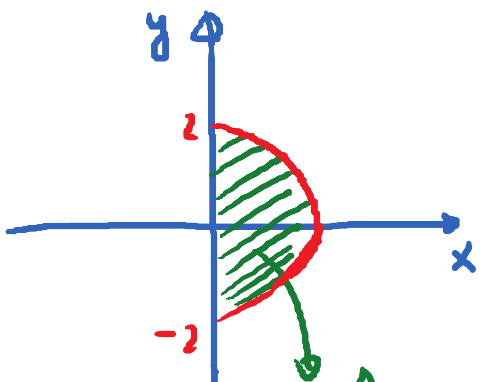
$$\text{Force}_{\text{plate}} = 19620 \int_{-2}^{2} (8-y)\cdot\sqrt{4-y^2}\,dy$$

$$= 19620 \int_{-2}^{2} \left(8\cdot\sqrt{4-y^2} - y\cdot\sqrt{4-y^2}\right) dy$$

$$= 19620\cdot\left(8\int_{-2}^{2}\sqrt{4-y^2}\,dy - \underbrace{\int_{-2}^{2} y\cdot\sqrt{4-y^2}\,dy}\right)$$

Let $u = 4-y^2$

$du = -2y\,dy$



Area $= 2\pi$