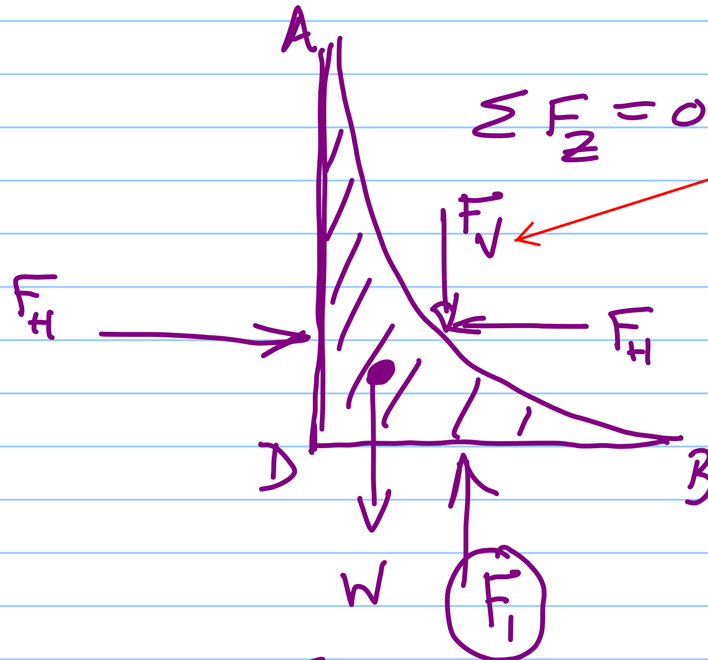
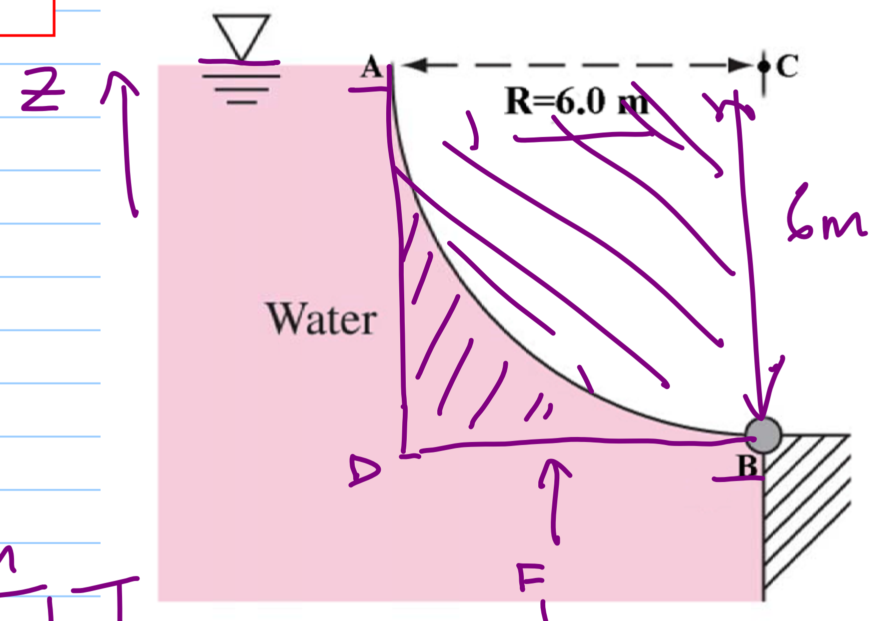
Example: Calculate the total hydrostatic force on the curved gate AB per meter of depth (into the page). Find the line of action. The gate has a radius of R=6m.

F.B.D.

Note: I show F_v as down here. But this is the reaction of the gate. The vertical force of the water is up.

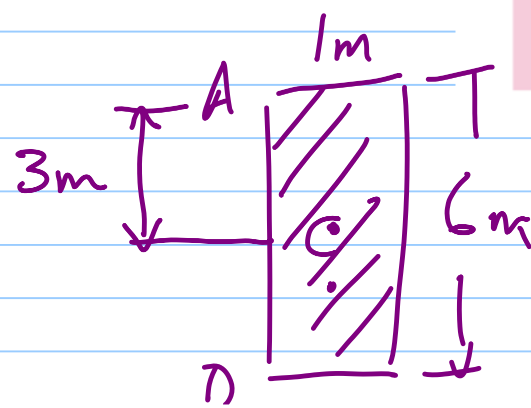
$$\Sigma F_z = 0$$





HORIZONTAL FORCE

$$F_H = \gamma h_{CG} A_{AD}$$

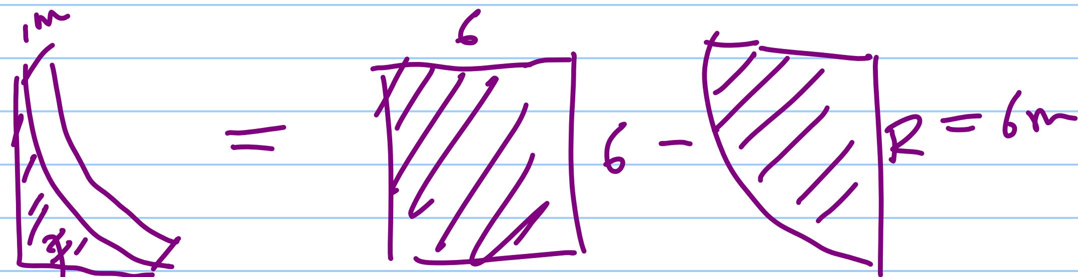


$$A_{AD} = 6m(1m) = 6m^2$$

$F_H = (9800\,N/m^3)\,3m\,(6m^2) = 176.4\,kN \rightarrow$

<u>VERTICAL FORCE</u> $\Sigma F_z = 0$ $\boxed{F_V = F_1 - W}$

$F_1 = \gamma h A_{BD} = (9800\,N/m^3)\,6m\,(6m \times 1m) = 352.8\,kN \uparrow$



$A = (6 \cdot 6) - \frac{\pi R^2}{4} = 7.726\,m^2$ $\qquad \forall = 7.726\,m^2$

Should be m^3

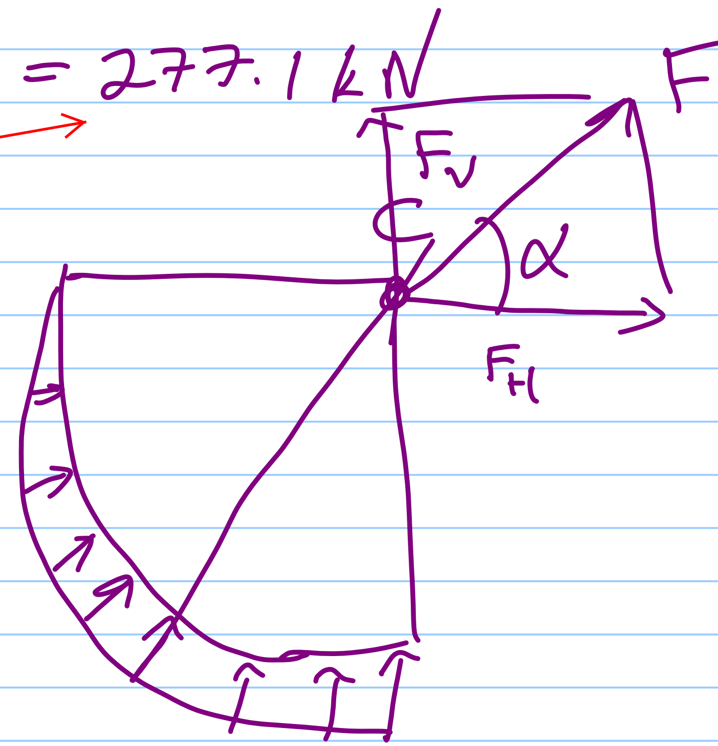
Should be m^3

$$W = \forall\gamma = 7.726\ m^2\ (9800\ N/m^3) = 75.71\ kN \downarrow$$

$$F_V = F_1 - W = 352.8\ kN - 75.71\ kN = 277.1\ kN$$

Note: I show F_v as down in the FBD. But this is the reaction of the gate. The vertical hydrostatic force of the water is up.

LINE OF ACTION



$$F = \sqrt{F_H^2 + F_V^2}$$

$$= \sqrt{176.4^2 + 277.1^2} = 328\ kN$$

$$\alpha = \tan^{-1}\left(\frac{F_V}{F_H}\right) = \underline{57.5^\circ}$$ ANS