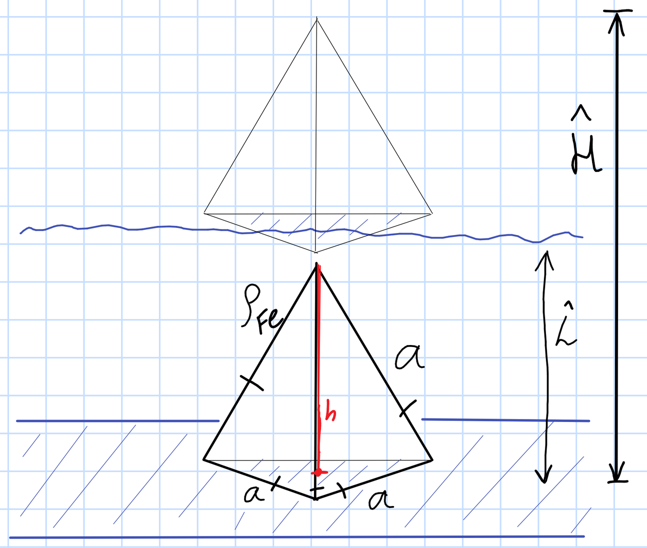


Given: $a,\ \rho_{Fe},\ L$ $\vdots$ $A_{tot} = ?$

ρ of iron

$h = \frac{\sqrt{6}}{3}a \qquad V = \frac{a^3}{6\sqrt{2}}$ $\qquad P_0 \equiv 1\ Atm \qquad S_1 \equiv$ proj. of 3 faces $= \frac{\sqrt{3}}{4}a^2$ (Without bottom)

Let, $L > h$

$\hat{H} = h + \hat{L}$

$\cancel{F_{S_1} = \rho\, gV \Rightarrow A = \rho\, gV\, \Delta_h}$

$\cancel{A_1 = \rho_{6y}\, gV(L-h) + mg(L-h) =}$

$\cancel{= \rho_{6y}\, gV(L-h) + \rho_{h_3} Vg(L-h) =}$

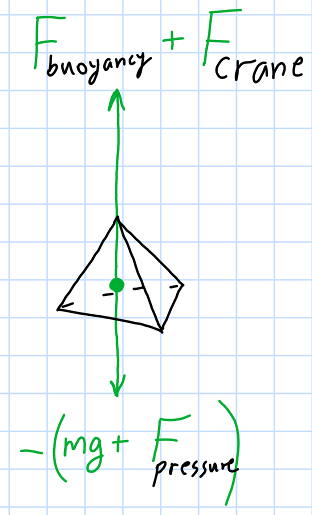
$\cancel{= gV(L-h)(\rho_{6y} + \rho_{h_3})}$

In water

$P_1 \equiv \text{in water} = \rho_w\, g\hbar \implies \overset{\text{in water}}{F_w} = -\underbrace{S_1(\rho_w g\hbar + P_0)}_{\text{tot. press. in wtr}} - mg + \rho_w gV + F_{crane}$

$$A_w = \hbar\Big[\overbrace{-S_1(\rho_w g\hbar + P_0) - mg + \rho_w gV}^{\equiv -\hat{F}_w} + F_{crane}\Big]$$

Let : $F_{crane} > \hat{F}_w$



1

$$\implies \boxed{I_{A_w}} = \int_0^{(\hat{L}-h)} \hbar\Big[-S_1(\rho_w g\hbar + P_0) - mg + \rho_w gV + F_{cr}\Big]\, d\hbar =$$

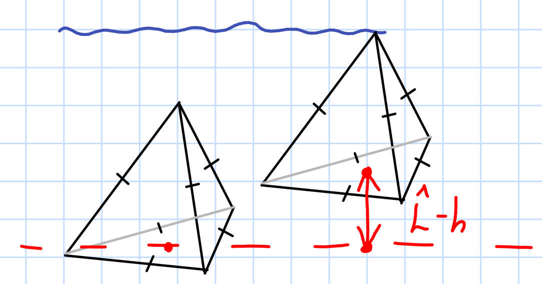
while it's in the water

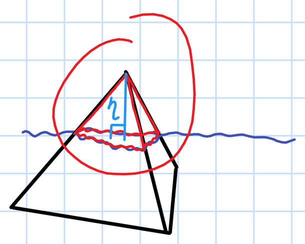
$$= \int_0^{(\hat{L}-h)} \left(-S_1\rho_w g\hbar^2 + P_0S_1\hbar - mg\hbar + \rho_w gV\hbar + F_{cr}\hbar\right) d\hbar =$$

$$= (\hat{L}-h)\left[\frac{-S_1\rho_w g(\hat{L}-h)}{2} - P_0S_1 - mg + \rho_w gV + F_{cr}\right] =$$

$$= (\hat{L}-h)\left[\frac{-S_1\rho_w g(\hat{L}-h)}{2} - P_0S_1 - \rho_{Fe}Vg + \rho_w gV + F_{cr}\right]$$

Pt. 1





$\because\ V_{tot} = \frac{a^3}{6\sqrt{2}}$ $\qquad \eta \equiv$ Tetrahedron height that came out from water $\leq h$ $\qquad \{0 \leq \eta \leq h = \frac{\sqrt{6}}{3}a\}$

$h = \frac{\sqrt{6}}{3}a$ $\qquad \eta = \frac{\sqrt{6}}{3}a' \qquad \{0 \leq a' \leq a\}$

$\eta \equiv \frac{\sqrt{6}}{3}a$

$\therefore\ \hat{V} \leq V_{tot}$ $\qquad a \equiv \frac{3}{\sqrt{6}}\eta$

$$\hat{V} = \frac{1}{6\sqrt{2}}\,\frac{27}{6\sqrt{6}}\,\eta^3 = \boxed{\frac{3\eta^3}{8\sqrt{3}}}$$

$A_{cfw} \equiv$ comes up from the water (h)

changes $V \equiv \hat{V}$ and $h \equiv \eta$

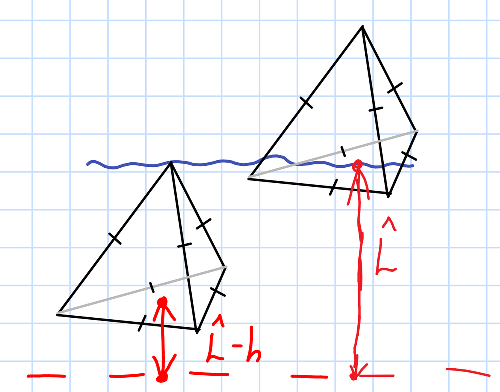
2

$$\implies \boxed{I_{A_{cfw}}} = \int_0^h \rho_w g\hat{V}\, d\eta - \int_{S_1}^0 P_0\, dS_1 \int_0^h dh - \int_0^h \rho_{Fe}Vg\, dh + \int_0^h \overset{\text{crane}}{F_{cr}}\, dh = \frac{9}{128}\rho_w g a^4 + P_0S_1h - \rho_{Fe}Vgh + F_{cr}h$$

Work <done by buoyancy>

$$I_{A_b} = \int_0^h \rho_w g\hat{V}\, d\eta = \rho_w g\frac{1}{8\sqrt{3}}\int_0^h \eta^3 d\eta = \rho_w g\frac{\eta^4}{32\sqrt{3}} = \rho_w g\frac{1}{32\sqrt{3}}\,\frac{81}{36}a^4 = \frac{9}{128}\rho_w g a^4$$

Pt. 2



$$A_{tot} = A_w + A_{cfw} = \frac{9}{128}\rho_w g a^4 + P_0S_1h - \rho_{Fe}Vgh + F_{cr}h + (\hat{L}-h)\left[\frac{-S_1\rho_w g(\hat{L}-h)}{2} - P_0S_1 - \rho_{Fe}Vg + \rho_w gV + F_{cr}\right] =$$

$$= \frac{9}{128}\rho_w g a^4 + P_0S_1h - \cancel{\rho_{Fe}Vgh} + \cancel{F_{cr}h} - \frac{S_1\rho_w g\hat{L}^2}{2} + \cancel{\frac{S_1\rho_w g\hat{L}h}{2}} - P_0S_1\hat{L} - \rho_{Fe}Vg\hat{L} + \rho_w gV\hat{L} + F_{cr}\hat{L} +$$

$$- \cancel{\frac{S_1\rho_w g\hat{L}h}{2}} - \frac{S_1\rho_w gh^2}{2} + P_0S_1h + \cancel{\rho_{Fe}Vgh} - \rho_w gVh - \cancel{F_{cr}h} =$$

$$= \frac{9}{128}\rho_w g a^4 + P_0S_1h - \frac{S_1\rho_w g\hat{L}^2}{2} - P_0S_1\hat{L} - \rho_{Fe}Vg\hat{L} + \rho_w gV\hat{L} + F_{cr}\hat{L} - \frac{S_1\rho_w gh^2}{2} + P_0S_1h - \rho_w gVh =$$

$$= \frac{9}{128}\rho_w g a^4 + P_0S_1(2h - \hat{L}) - \frac{1}{2}S_1\rho_w g(\hat{L}^2 - h^2) + gV\hat{L}(\rho_w - \rho_{Fe}) - \rho_w gVh + F_{cr}\hat{L}$$

A_{tot} ?