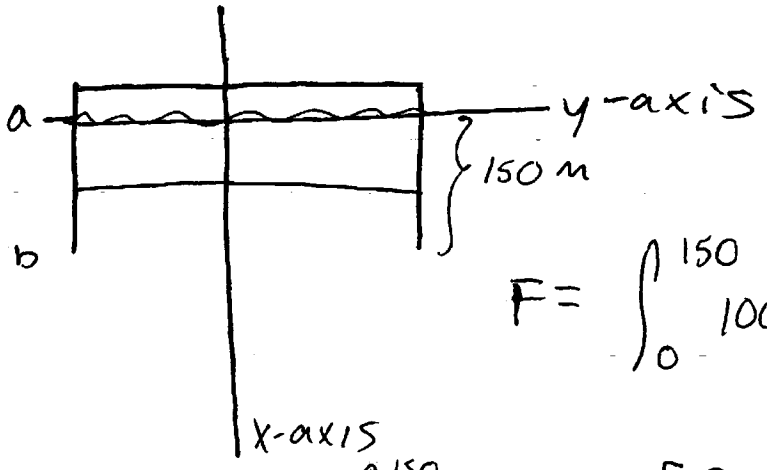
More Hydrostatic Force Problems

Find the hydrostatic force on the Grand Coulee Dam if the water in the reservoir is 150m deep and the width of the dam is 1200m.

Hint: The Grand Coulee Dam is rectangular.



$$F = \int_0^{150} 1000\,kg/m^3 \cdot 9.8\,m/s^2\,(1200\,m)\,x\,dx$$

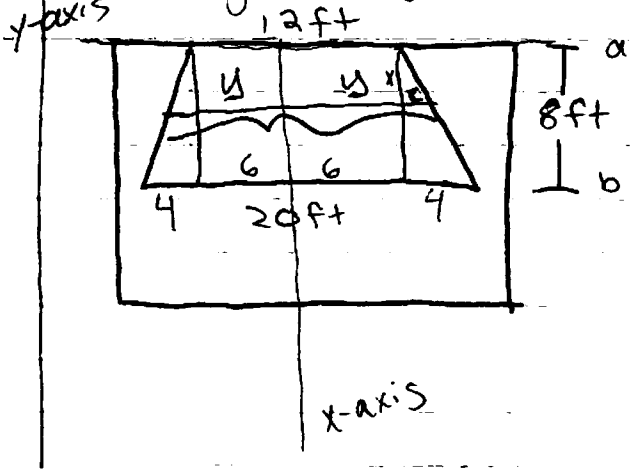
(x: depth)

$$= 1176000 \int_0^{150} x\,dx = 5880000x^2\Big|_0^{150}$$

$$= 1.323 \times 10^{11} \text{ Newtons}$$

p481 #25

Find the hydrostatic force on the submerged plate shown.



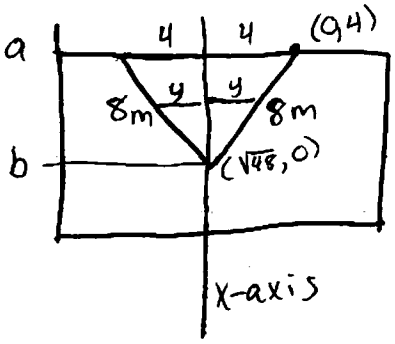
$$F = \int_0^8 62.5\,lb/ft^3\,(12+x)\,x\,dx$$

$$\frac{8}{4} = \frac{x}{c} \qquad c = \frac{1}{2}x$$

$$y = 6 + c = 6 + \frac{1}{2}x$$

$$L(h) = 2y = 12 + x$$

p481 27. A trough is filled with liquid of density 840 kg/m³. The ends of the trough are equilateral triangles with sides 8m long and vertex at the bottom. Find the hydrostatic force on one end of the trough.



$b = \sqrt{64-16} = \sqrt{48}$

$\text{slope} = \frac{0-4}{\sqrt{48}-0} = \frac{-4}{\sqrt{48}}$

$F = \int_0^{\sqrt{48}} (9.8)(840\ kg/m^3)\, L(h)\, h\, dh$ $\quad y = \frac{-4}{\sqrt{48}}x + 4$

$L(h) = 2y$

$= \int_0^{\sqrt{48}} (9.8)\, 840 \left(2\left(\frac{-4}{\sqrt{48}}x + 4\right)\right) x\, dx$

$= 6720 \int_0^{\sqrt{48}} (9.8) \frac{-1}{\sqrt{48}} x^2 + x\, dx$

$= 65856 \left[\frac{-1}{3\sqrt{48}} x^3 + \frac{1}{2}x^2\right]\Big|_0^{\sqrt{48}}$

$= 65856 \left[\frac{-48}{3} + \frac{48}{2}\right] = 526848\ N$