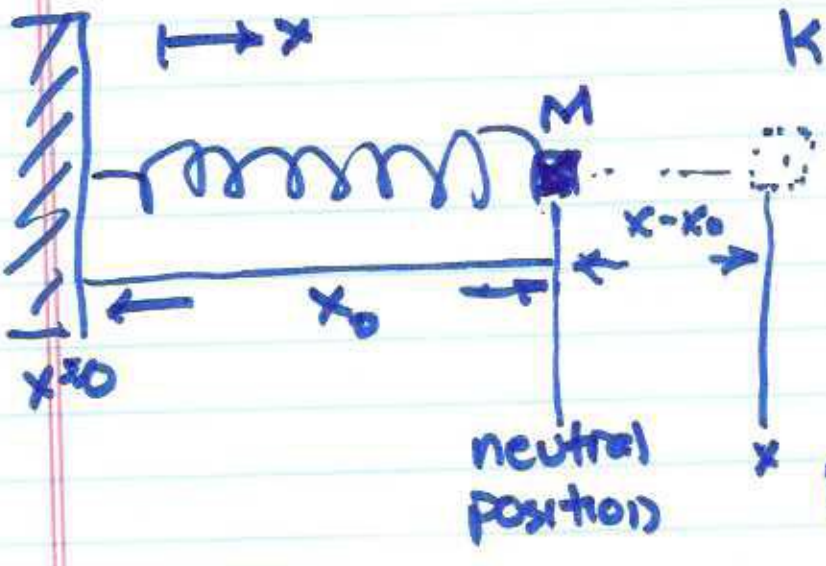
SRM6 W

9/1 early

WORK: Force × Displacement (in direction of force)

Work = 0

$$dW(x) = F(x) \cdot dx$$



k is "spring constant"

$$F = -k(x - x_0)$$

$$F(x) = -k(x - x_0)$$

spring eqn

$$dW(x) = -k(x - x_0)\,dx$$

$$W = \int_{x_0}^{x} -k(x-x_0)\,dx$$

$$\int_{x_0}^{x} (-kx + kx_0)\,dx$$

$$\left[-\frac{kx^2}{2} + kxx_0 \right]_{x_0}^{x}$$

$$\frac{-kx^2}{2} - \frac{kx_0^2}{2} + kxx_0 - kx_0^2$$

$$\frac{-kx^2}{2} + kxx_0 - \frac{3}{2}kx_0^2$$

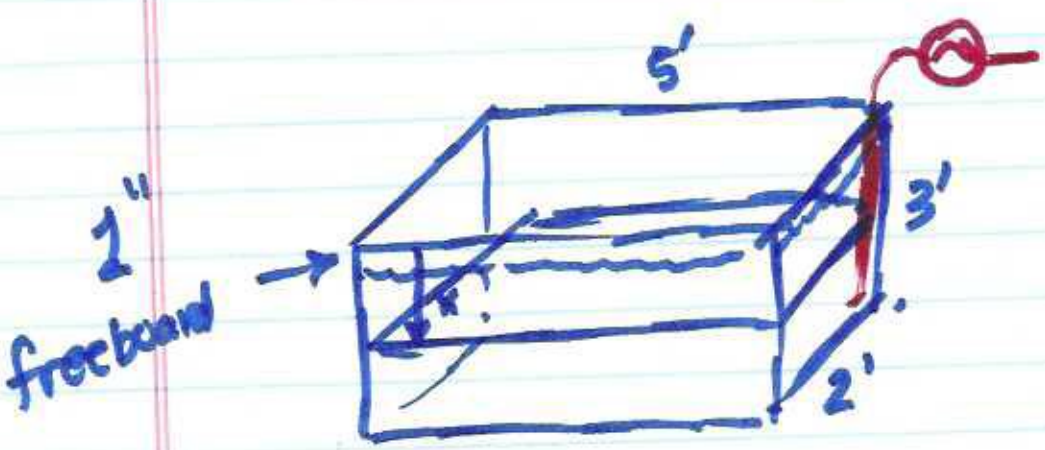
N-m = Joule

Newton meter

Spring Formula

$$W = \frac{1}{2}kx^2$$

(3)



62.4 lbs/cf

measure x in ft.

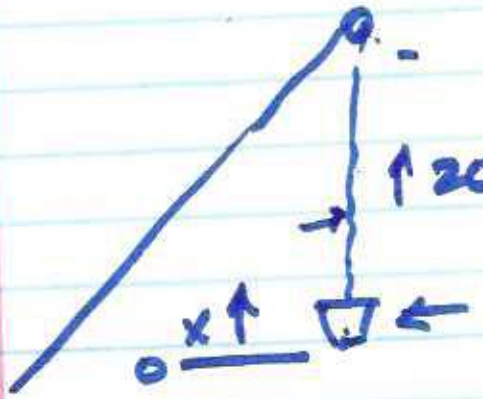
$dV(x) = 2.5 \cdot dx$

$dF(x) = 62.4\,dx$ ft-lbs

$dW(x) = (62.4\,dx)(x)$

$$62.4\int_{.08}^{3} x\,dx = 62.4\left[\frac{x^2}{2}\right]_{.08}^{3}$$ = work done by pump to drain

④



Cable weighs .08 kg/m

bucket weighs 49 N

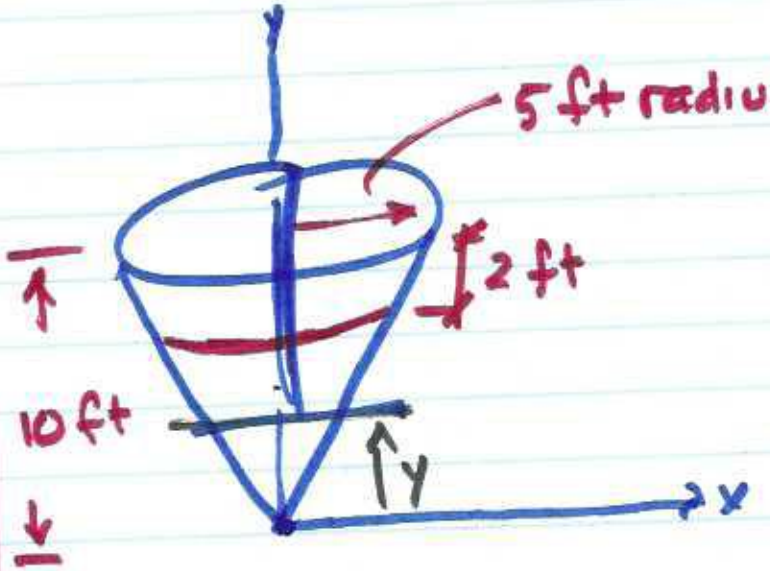
work done to lift bucket = 980 J

$dx\left(.08(20-x)(9.8)\right) = dW(x)$

$W_{bucket} = 980 J.$

$W_{cable} = \int_0^{20} (.08)(9.8)(20-x)\,dx = 156.8 J$

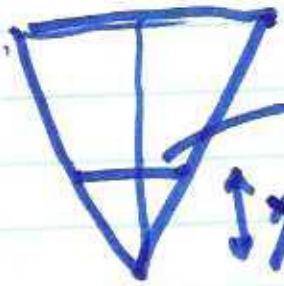
(5)



olive oil weighs 57 pcf

Q: how much work to drain over top

By similar triangles



$$\frac{\text{diam}(y)}{y} = \frac{10}{10}$$

Area of oil sheet @ height y is $\pi\left(\frac{y}{2}\right)^2$

$$= \frac{\pi}{4}y^2$$

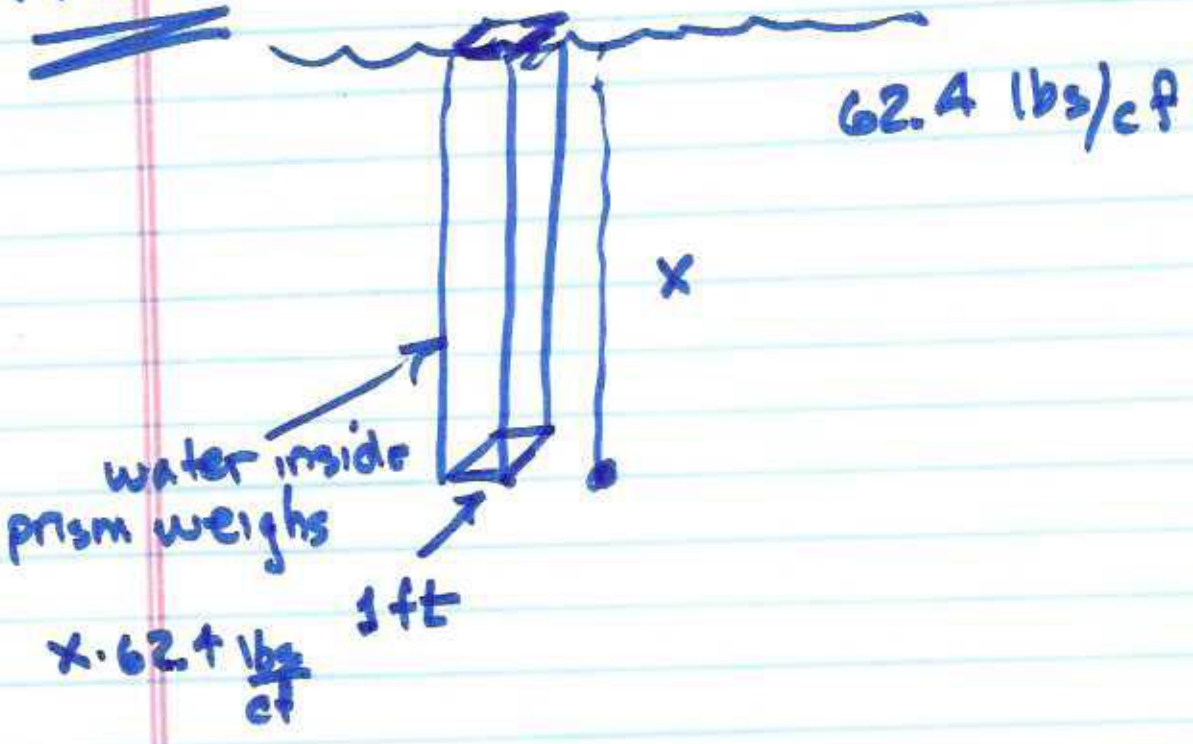
Volume @ y is $\frac{\pi}{4}y^2 dy$

Differential force req'd to lift oil sheet @ y is $\left(\frac{\pi}{4} y^2 dy\right)(57)$

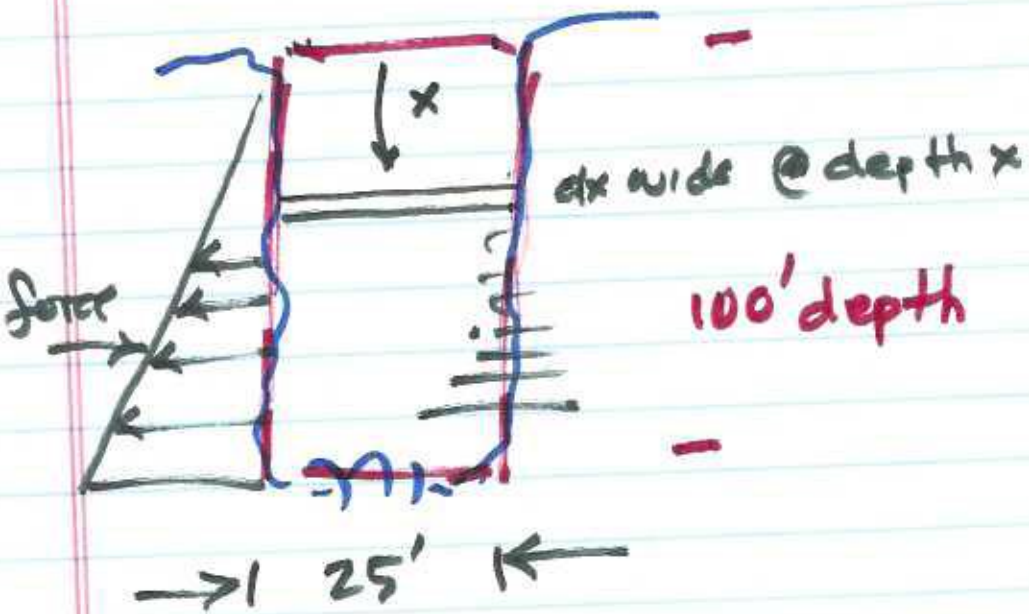
$$dW(y) = \frac{57\pi}{4} y^2 (10-y)\, dy$$

$$W = \int_0^8 \frac{57\pi}{4} y^2 (10-y)\, dy$$

Pressure



(7)



Area of strip @ depth x is $25\,dx$

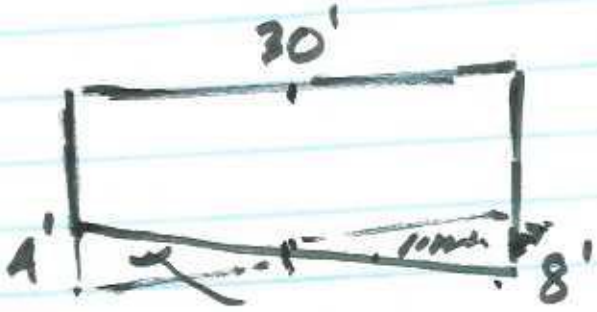
Force on strip then is $(62.4x)(25\,dx)$

Total force on dam is

$$62.4 \cdot 25 \int_0^{100} x\,dx = 1550 \left[\frac{x^2}{2}\right]_0^{100}$$

$5000 \cdot 1550$ lbs overall

(8)

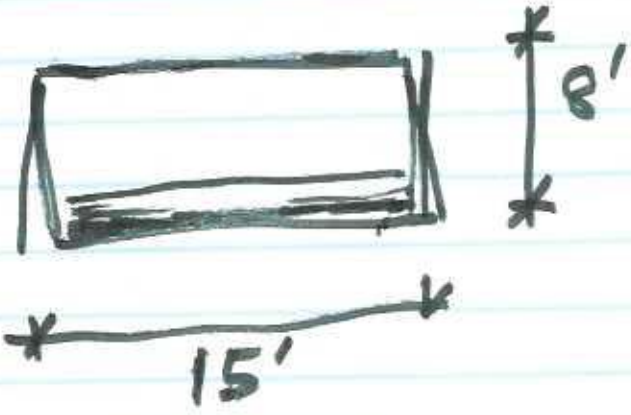


side view

plan view

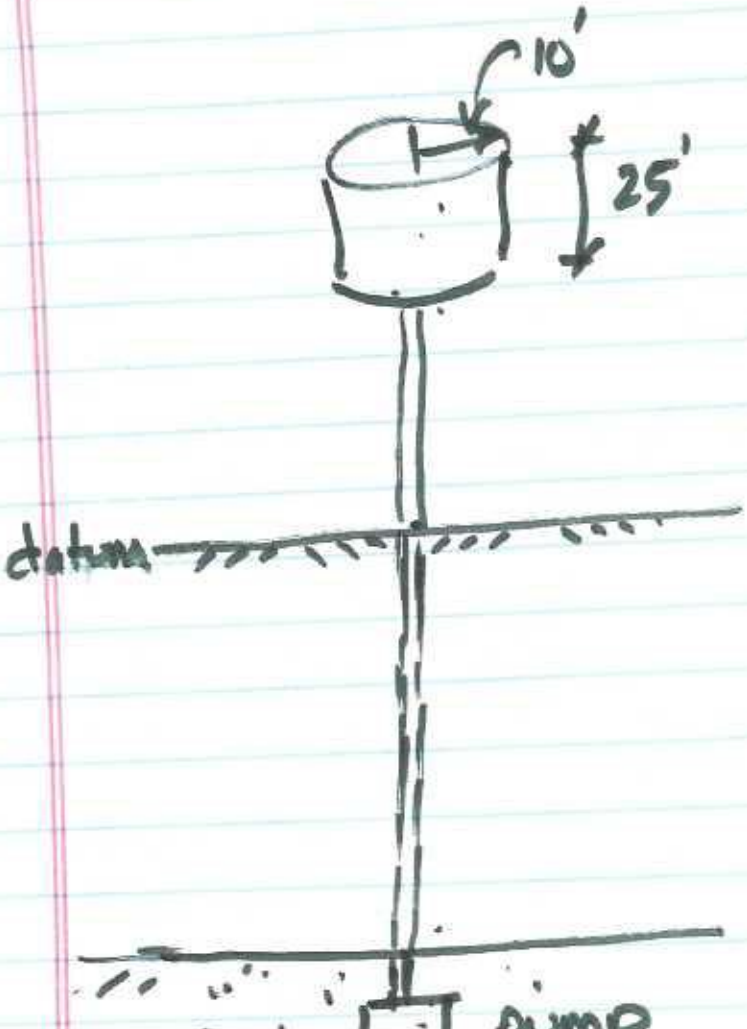
$30 \cdot 6 \cdot 15 = 2700$ cf

$2700 \cdot 62.4$ pcf = _____ total weight of H_2O



pressure @ bottom is $62.4 \cdot 8' \cdot 1'$

(9)



$\pi \cdot 10^2 \cdot 25 =$ cf

7853 cf

Seconds Needed

10692839 sec.

2970 hrs

62.4 lbs/cf

1650 ft·lb/sec

$7853 \cdot 62.4 =$ lbs of water

490,088 lbs

WORK / TIME = POWER

TOTAL WORK $490{,}088 \cdot 360' = 176{,}431{,}843$