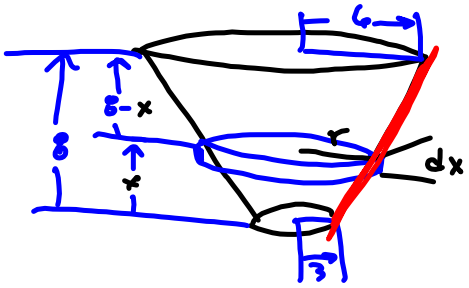
Confusing Work



Full of water
pump water out

(x, r)

$x=0, r=3$ $(0,3)$

$x=8, r=6$ $(8,6)$

Find r as a function of x.

$F \cdot D$

$\left(62.5\ lb/ft^3\right)(\text{Volume}) \cdot D$

$=$ Density · volume $\cdot D$

$= (62.5)(\pi r^2)(dx) \cdot D$

$= 62.5\pi \left(\frac{3}{8}x+3\right)^2 dx \cdot (8-x)$

$62.5\pi \int_0^8 \left(\frac{3}{8}x+3\right)^2 (8-x)\,dx$

y

$(x_1, r_1) = (0,3)$

$(x_2, r_2) = (8,6)$

$m = \frac{6-3}{8-0} = \frac{3}{8}$

$y = m(x-x_1)+y_1$

$r = m(x-x_1)+r_1$

$r = \frac{3}{8}(x-0)+3$

$r = \frac{3}{8}x+3$

$r(0) = 3$

$r(8) = \frac{3}{8}(8)+3 = 6$

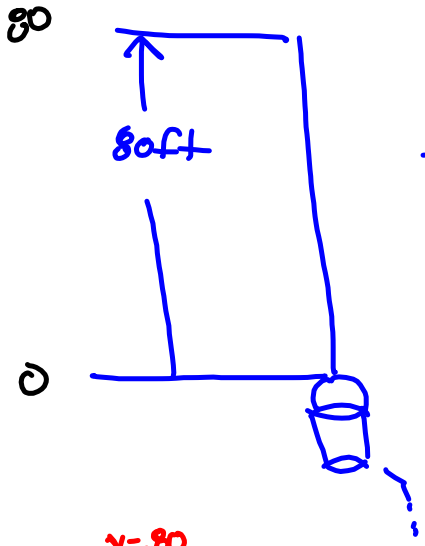
Leaky Bucket

4-lb bucket with 40 lbs of water

leaking @ .2 lbs/s

80-ft well

Lift @ 2 ft/s



work as function of t.

$W = F \cdot D$

$= \left(4 + 40 - (.2\text{lbs/s})\,t\right) dx$

$2\,dt$

Lift it a short distance

Notice t-variable & x-variable

$\int_{x=0}^{x=80} (44 - .2t)\,dx$

$\int_{t=0}^{t=40} (44 - .2t) \cdot 2\,dt$

$\int_{x=0}^{x=80} \left(44 - .2\left(\frac{x}{2}\right)\right) dx$

$\frac{dx}{dt} = 2\text{ ft/s}$

$dx = 2\,dt$

$\int dx = \int 2\,dt$

$x = 2t + C \Rightarrow t = \frac{x}{2}$

$x\big|_{t=0} = 0 = 2 \cdot 0 + C = C$

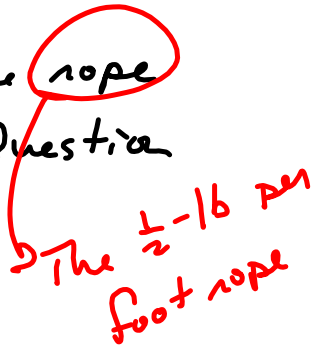
$x = 2t$

$80 = 2t$

$40 = t$

Work done lifting the rope

Good Final Exam Question



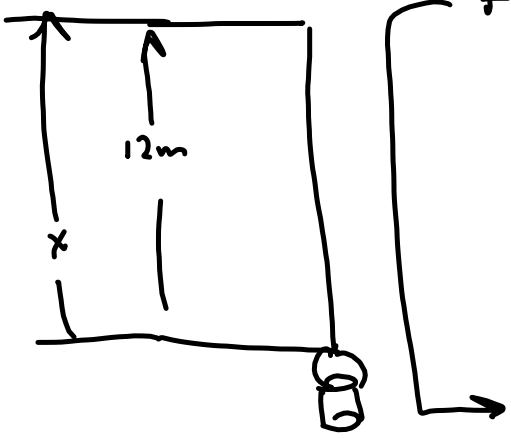
Leaky Bucket, MKS version

Bucket 10 Kg holds 36 Kg H_2O

0 to 12m

Leaks @ constant rate empties @ top.

Rope weighs .8 Kg/m



$F = 10 + 36 - ??$

(x, y)

(x, f(x))

$f(0) = 10 + 36 = 46$ (0, 46)

$f(12) = 10$ (12, 10)

$m = \frac{46-10}{0-12} = \frac{36}{-12} = -3\ kg/m$

x = dist

y = force

$y = m(x - x_1) + y_1$

$= -3(x-0) + 46$

$F = -3x + 46$

This is mass

need $9.8\ m/s^2$ times this!

$F \cdot D = (-3x + 46)\Delta x$

$\sum_{k=1}^{n} (-3x + 46)\Delta x$

$n \to \infty \longrightarrow \int_0^{12} (-3x + 46)\,dx$