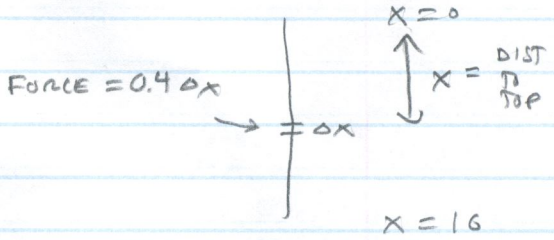
Lifting a Chain/Cables (

Spr. 10 **TRUE** If all 4 pounds was lifted 10 ft then the work would be 40 ft-lbs.
But not all of the rope goes up 10 feet.

Going further: Density $= \frac{4 \text{ lbs}}{10 \text{ ft}} = 0.4 \text{ lbs/ft}$

$$\text{Work} = \int_0^{10} 0.4x\,dx = 0.2x^2\Big|_0^{10} = 0.2(10)^2 = 20 \text{ ft-lbs}$$



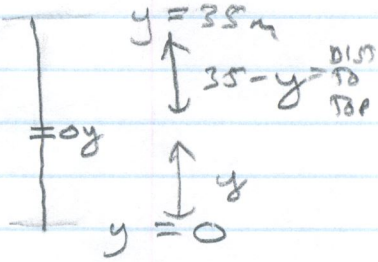
Fall 10 Split up the problem!

Rope DENSITY $= \frac{0.2 \text{ kg}}{\text{m}} \cdot 9.8 \text{ m/s}^2 = 1.96 \text{ N/m}$

$$\int_0^{35} 1.96y\,dy = 0.98y^2\Big|_0^{35} = 0.98(35)^2 = 1200.5 \text{ J}$$

1200.5 J: work to lift rope

FORCE $= 1.860y$



Bucket ← losing weight at a constant rate ⇒ LINE EQUATION

$20 \text{ kg} \cdot 9.8 \text{ m/s}^2 = 196 \text{ N}$
$2 \text{ kg} \cdot 9.8 \text{ m/s}^2 = 19.6 \text{ N}$

y	FORCE (BUCKET ↓ + WATER ↓)
0	19.6 + 196 = 215.6 N
35	215.6 − 68.6 = 147 N

$\frac{35 \text{ m}}{0.5 \text{ m/s}} = 70$ sec to get to the top

$0.1 \text{ kg/s} \cdot 70 \text{ s} = 7 \text{ kg}$ will be lost due to leaking

$7 \text{ kg} \cdot 9.8 \text{ m/s}^2 = 68.6 \text{ N}$

$\text{slope} = \frac{215.6 - 147}{0 - 35} = -1.96$

$$F(y) = -1.96y + 215.6$$

← weight of bucket at y (force) in Newtons

↖ ANSWER TO PART (a)

$$\text{work} = \int_0^{35} -1.96y + 215.6\,dy$$

$$= -0.98y^2 + 215.6y \Big|_0^{35}$$

$$= -0.98(35)^2 + 215.6(35)$$

$$= \underbrace{6345.5 \text{ J}}_{\text{WORK DONE TO LIFT BUCKET}}$$

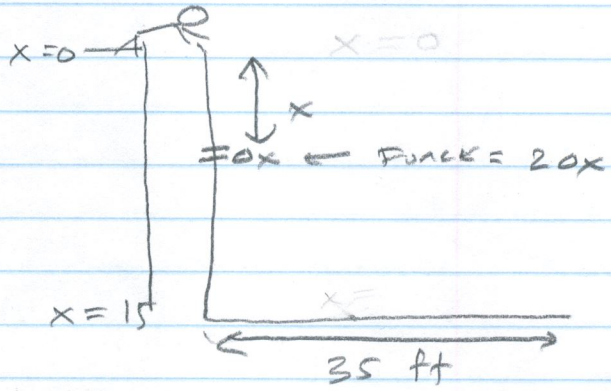
(b) TOTAL WORK $= 1200.5 + 6345.5$

$= \boxed{7546 \text{ J}}$

Spr. 12

NOTE: ALL BITS OF ROPE ON THE GROUND WILL BE LIFTED 15 feet!

SPLIT UP THE PROBLEM!



ROPE ON GROUND

$35 \text{ ft} \cdot 2 \frac{\text{lbs}}{\text{ft}} = 70 \text{ lbs} = \text{FORCE}$

$15 \text{ ft} = \text{DISTANCE}$ ← SAME FOR ALL ROPE ON GROUND

$\text{work} = 70 \cdot 15 = \boxed{1050 \text{ ft-lbs}}$

ROPE LIFTED UP

$$\int_0^{15} 2x\,dx = x^2 \Big|_0^{15} = (15)^2 = \boxed{225 \text{ ft-lbs}}$$