AY2009-1 MA205 Section 36 | MAJ DeGregory, Keith
Lesson 18 | 19 SEP 08

Name: Solution | Hour:_____

Quiz 3: Physics Application: Work

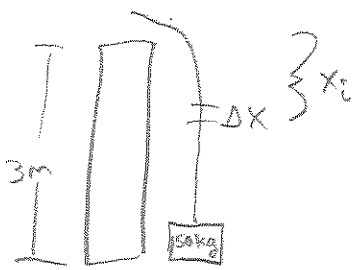
Time: 15 Minutes	References: Basic Calculator and Ref. Sheet	Based out of 100%

Situation: A squad of Cadets at Buckner is negotiating the Leadership Reaction Course (LRC). The equipment for one of the obstacles includes an ammo box weighing 50 kilograms and 4 meters of 3/4" rope weighing a total of 10 kilograms. One of the subtasks is to use the rope to lift the ammo box from the ground to a 3 meter high platform. Find the total work required to lift the ammo box and any rope used to the top of the platform.

a. Identify the system of measurement presented in this problem and describe how it affects your solution approach when compared to the alternative measurement system.

metric, there will be more calculations because I will have to account for gravity using $F = ma$

b. Model the situation by drawing a picture, defining all variables, and stating any assumptions necessary for solving the problem.



assume: we only need 3 meters of the rope

$\rho = \frac{10}{4}$ kg/m

$g = 9.8$ m/s^2

x_i = distance the ith slice has to travel

Δx = height of each slice

c. Solve the problem. *For full credit demonstrate the steps of the "slice approach."*

$W = Fd$

$W_{tot} = W_{box} + W_{rope}$

$= 1470 + 110.25$

$= 1580.25$ N·m

ANS.

Rope:

$W_i = f_i d_i$

$W_i = \rho \cdot \Delta x \cdot g \; x_i$

$W_i = \frac{10}{4} \Delta x (9.8) x_i$

$W_{rope} = \lim_{n \to \infty} \sum_{i=1}^{n} \frac{98}{4} x_i \Delta x = \int_0^3 \frac{49}{2} x \, dx = \frac{49}{2(2)} x^2 \Big]_0^3 = \frac{49}{4}(3^2) - 0$

$= 110.25$ N·m

Box: $W_{box} = Fd$

$F_{box} = 50 kg (9.8 m/s^2)$

$= 490N$

$d_{box} = 3m$

$W_{box} = 1470$ N·m

d. Characterize the force and distance components in your model as either variable or constant.

	force	distance
box →	constant	constant
rope* →	constant	variable

* can be formulated as variable/constant, but the work must follow from your picture and variable definitions