MA205

Board Sheet - 11 September 2007, Application Physics, Lesson 14

Admin: Engineering Expo - Bonus Points for Expo
Project team and choice of project due.

Understanding Work

- Work is simply computed as a definite integral of a force, $f(x)$, over an interval.
- Work done by a constant force (lifting a textbook off the desk) is simply the weight of the object times the distance moved: Where the units are in foot-pounds or Newton-meters.
- If we attach a chain to the book and lift it the same distance. Now we have to lift the chain and the book.
- We will incrementally pull the chain a link at a time. If we break the chain up into infinitely many sections we get integration like area under the curve and arc length.
- Physics uses only metric so here is a table to help.

Units	**Work**	**Mass**	**Distance**	**Acceleration**	**Force**
English	ft-lbs	Slug	ft; miles; inches	ft/s^2	lbs
Metric	N-m; J	kg	m; km; cm	m/s^2	N

- 1 ft-lb $\approx$ 1.36 Joules
- 1 J = 1 N-m
- 1 N = (kg-m)/s^2

A Few Good Problems:

1. Consider a 15 foot chain that weighs 3 pounds per foot. How much work is done lifting the entire coiled chain 15 feet into the air?
2. Take the same chain, uncoiled, and lift one end 15 feet into the air. How much work have you done?

Steps to determine Work

1. Determine Force: In English units Force equals Weight. In Metric Force equals mass times acceleration $F = ma$ or $F = m\frac{d^2s}{dt^2}$
2. In two dimensions Work equals Force times distance $W = Fd$.
3. Determine "slice" of object lifting and sum slices over distance giving us a definite integral.