5.4 Work

Constant Force

When a body moves a distance d along a straight line as a result of being acted on by a force of constant magnitude F in the direction of motion, we define the work W done by the force on the body with the formula

$$W=Fd$$

In the SI system, units of force are kg-m/sec^2 or Newtons (N). The units of work are N-m or Joules.
In the British System, units of force are pounds(lbs). The units of work are ft-lbs.

Ex.

(b) How much work is done if a constant force of 50-lb is used to pull a cart 25 ft?_____

(a) How much work is done lifting a 20 kg box 2 meters off the ground? _____

Variable Force

Suppose a particle moves along the x-axis from a to b acted upon by a continuous, variable force f(x).

Example: When a particle is located a distance x feet from the origin, a force of x^2+2x pounds acts on it. How much work is done in moving it from x=1 to x=3?

HOOKE'S LAW for SPRINGS

Hooke's Law states that the force required to maintain a spring stretched x units beyond its natural length is proportional to x, that is

$f(x) = kx$

where k, the constant of proportionality is called the spring constant.

Example:

A spring has a natural length of 0.2 m. A 40 N force is required to stretch (and hold the spring) to a length of 0.3 m. How much work is done in stretching the spring from .35 m to .38 m??

Ex: A 5-lb bucket is lifted from the ground into the air by pulling in 20 feet of rope at a constant speed. The rope weighs 0.08 lb/ft. How much work was spent lifting the bucket and rope?

Suppose that the bucket is leaking. It starts with 2 gallons (16 lb) of water in it and leaks at a constant rate. It finishes draining just as it reaches the top. How much work was spent lifting the water alone (neglect the rope and bucket.)