LESSON 5: WORK

Objectives:	1. To distinguish between constant-force and variable-force work problems 2. To solve a variety of applications that model physical situations 3. To learn and apply Hooke's Law for springs

Work

Constant Force	Variable Force
$W = Fd$	$W = \int_a^b F(x)dx$

Hooke's Law for Springs

The force needed to stretch a spring x units from its natural length is F = kx where K is a constant depending on the spring. A formula for the work done to stretch a spring x units is

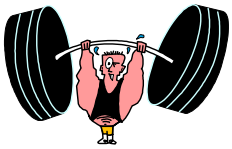
$$W = \int_0^x kxdx$$

Units of Measure

US System of Measurement: foot-pounds, inch-pounds, foot-tons

Metric System: The basic unit of force is the **dyne –** the force required to produce an acceleration of one centimeter per second per second in a gram mass. In this system work is expressed in dyne-centimeters (ergs) or newton-meters (joules). $1\,joule = 10^7\,ergs$.

App. Int. Lesson 5 cont.



Examples:

1. Determine the work done in lifting a 120-pound object 3 feet.

2. A particle is moving along the x-axis under the action of a force of F(x) pounds when the particle is x feet from the origin. If $F(x) = x^3 + 2x + 5$, find the work done as the particle moves from the point where x = 2 to the point where x = 6.

3. A 15-foot chain hangs from a winch 15 feet above ground level. Find the work done by the winch in winding up the required amount of chain, if the chain weights 3 pounds per foot. (Larson/Hostetler, p. 445)

   a. Wind up the entire chain.
   b. Wind up one-third of the chain.
   c. Run the winch until the bottom of the chain is at the 10-foot level.
   d. Wind up the entire chain with a 100-pound load attached.

4. Find the work done in lifting the bottom of the chain in problem (3) to the 15-foot level, leaving the chain doubled and still hanging vertically.

5. A force of 5 pounds compresses a 15-inch spring a total of 4 inches. How much work is done in compressing the spring 7 inches.