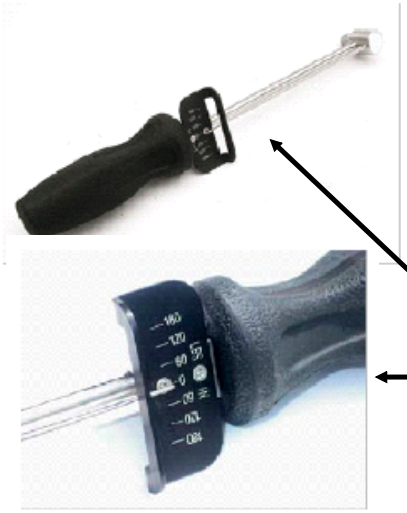
7.5 Work

Defn. If an object is moved a distance D in the direction of an applied force F, then the **work** done by the force is W=FD.

ex. Find the work done lifting a 50 pound object 48 inches.



torque wrenches

Variable force

$W_1=F_1D_1$

$W_2=F_2D_2$

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$W_n=F_nD_n$

$$W=\sum_{i=1}^{n} W_i=\sum_{i=1}^{n} F_iD_i=\sum_{i=1}^{n} F_i\Delta x$$

If we let n approach ∞, then

$$W=\int_a^b F(x)dx$$

where a is the starting location and b is the ending location, so |b-a| is the distance moved.

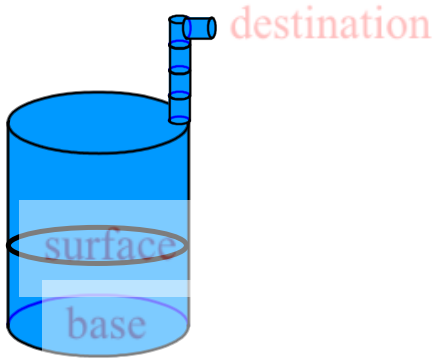
Hooke's Law: The force required to stretch or compress a spring the distance d is F=kd, where k is the spring constant.

ex. The force of 750 pounds compresses a spring 3 inches from its length of 15 inches. Find the work done in compressing it 3 more inches.

Ex. A space module weights 15 tons on earth. How much work is done to propel it to a height of 800 miles? Assume that the earth's radius is 4000 miles and that $F(x)= c/x^2$ relates the force of gravity F to the distance x between the centers of two objects.

Work in pumping a liquid:

$$\int_{\text{base}}^{\text{surface}} (\text{destination}-y)\cdot w\cdot v(y)\,dy$$

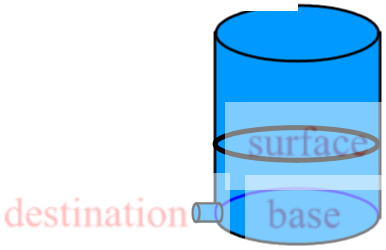


w=weight density of fluid

v(y)=volume of a disk of fluid
(might vary, might not)

dy=thickness of disk of fluid

$$\int_{\text{base}}^{\text{surface}} (y-\text{destination})\cdot w\cdot v(y)\,dy$$



ex. An upright cylindrical tank has a radius of 10 meters and a height of 15 meters.

a. Find the work done in pumping all of the water out of the top of the tank, assuming that water weights 1000 Newtons/cubic meter.

b. Find the work done in pumping water into the tank to a depth of 6m.