Common Exam, Friday, April 13, 2007

8:30 – 9:45 A.M. at KUPF 205

Chaps. 6, 7, 8

Bring calculators

Arrive by 8:15

Power

Work doesn't depend on the time interval

Work to climb a flight of stairs~3000 J — 10 s, 1 min, 1 hour

Power is work done per unit time

Average Power $P_{\text{avg}} = \frac{W}{\Delta t}$

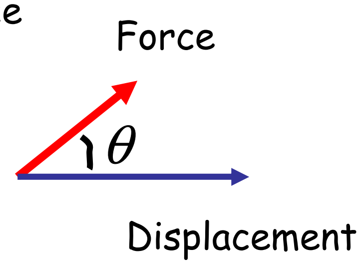
Instantaneous Power P = dW/dt = F dx/dt = Fv (in 1D)

Units $\frac{\text{Work}}{\text{time}}$ $\frac{1\ \text{J}}{1\ \text{s}} = 1$ Watt 1 hp = 746 W

In 2D & 3D, Power: $P = \vec{F} \cdot \vec{v} = Fv\cos\theta$

Work done by a constant force

$$W = Fd\cos\theta \equiv \vec{F} \bullet \vec{d}$$



Power done by a constant force

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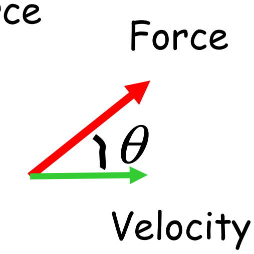
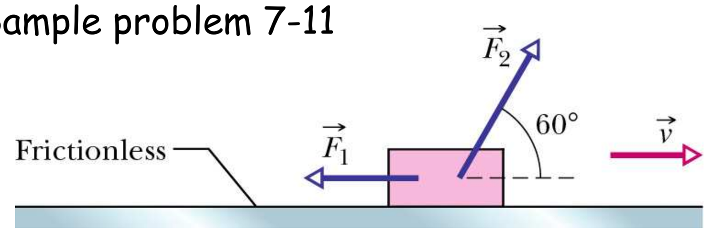


Sample problem 7-11



Two constant forces $\boldsymbol{F_1}$ and $\boldsymbol{F_2}$ acting on a box as the box slides rightward across a frictionless floor. Force $\boldsymbol{F_1}$ is horizontal, with magnitude *2.0 N*, force $\boldsymbol{F_2}$ is angled upward by *60º* to the floor and has a magnitude of *4.0 N*. The speed *v* of the box at a certain instant is *3.0 m/s*.

a) What is the power due to each force acting on the box? Is the net power changing at that instant?

b) If the magnitude $\boldsymbol{F_2}$ is, instead, *6.0 N*, what is now the net power, and is it changing?

So far, we learned

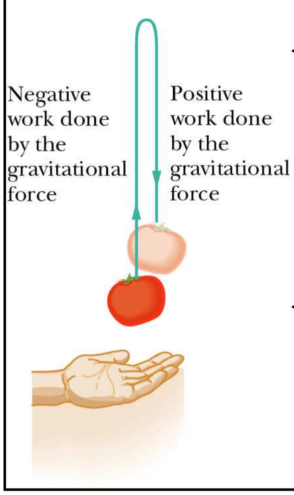
Ch.7, Kinetic Energy and Work

During the next two weeks, we learn

Chapter 8. Potential Energy and Conservation of Energy

Concept of Potential Energy

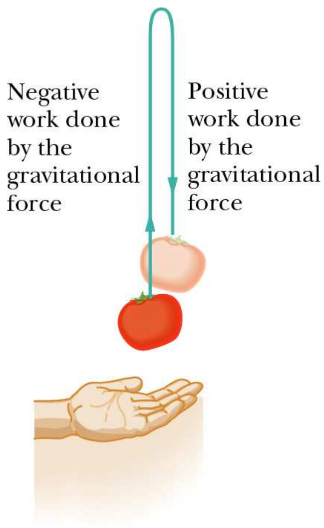
Potential Energy: Hidden energy associated with the position of objects



Less kinetic energy, but More potential energy

More kinetic energy, but Less potential energy

Definition of Potential Energy



Potential energy change

$$U_f - U_i \equiv -W$$

General Form:

$$W = \int_{x_i}^{x_f} F(x)\, dx$$

$$\Delta U = -\int_{x_i}^{x_f} F(x)\, dx$$

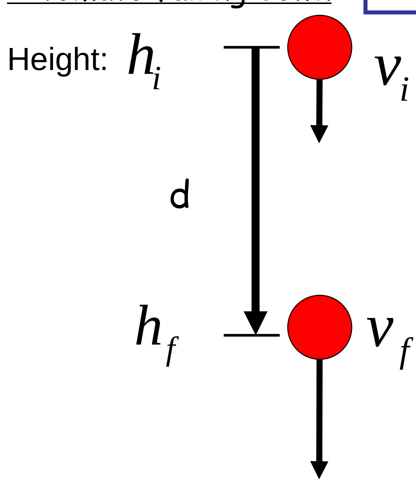
Example:

Gravitational potential energy

Spring potential energy

A tomato falling down

Gravitational Potential Energy



Gravitational force

$$F_g = mg$$

Gravitational potential energy difference:

$$U_f - U_i = -W = -mg(h_i - h_f) = mgh_f - mgh_i$$

Gravitational Potential Energy: $U_g(h) = mgh$

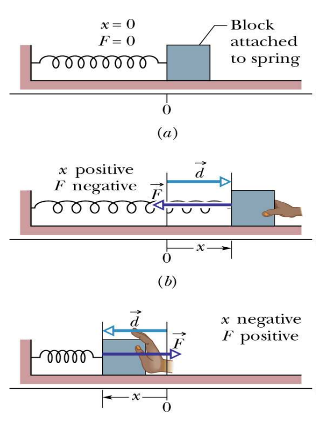
Elastic (or, Spring) Potential Energy

Elastic Potential Energy Difference

$$U_f - U_i = -W = -\left(\frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2\right) = \frac{1}{2}kx_f^2 - \frac{1}{2}kx_i^2$$

Elastic Potential Energy

$$U_{elastic}(x) = \frac{1}{2}kx^2$$

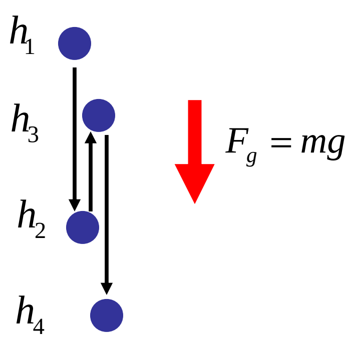


Can we define potential energy for ***any*** force?

Potential Energy: Hidden energy associated with the position of objects

$$U_f - U_i = -W = -\int_{x_i}^{x_f} F(x)dx$$

Example 1: Gravitational force



$$\int_{\text{along path}} F(x)dx = mgh_1 - mgh_4$$

→Work depends only on initial and final positions, independent of path

→ Potential energy at *h* can be defined

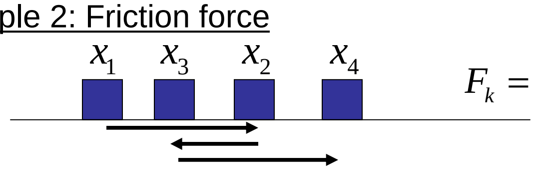
→ Conservative force

Can we define potential energy for ***any*** force?

Potential Energy: Hidden energy associated with the position of objects

$$U_f - U_i = -W = -\int_{x_i}^{x_f} F(x)dx$$

Example 2: Friction force



$$F_k = \mu_k F_N$$

$$\int_{\text{along path}} F(x)dx = -\mu_k F_N \left(x_4 - 2x_3 + 2x_2 - x_1\right)$$

→Work depends on path, as well as initial and final positions

→ Potential energy at *x* cannot be defined.

→ Non-conservative force