WELCOME TO 1103 PERIOD 7

Homework Exercise #6 is due today.

Please watch video 2, ***America Revealed: Electric Nation,*** for class discussion this Thursday or Friday.

PHYSICS 1103 – PERIOD 6

- How much energy is required to do work?
- How can gravitational potential energy be used to do work?
- What is the relationship between potential and kinetic energy?

Work

Work is done when a force moves an object over some distance in the direction of the force.

Work = Force x Distance

$$W = F \times D$$

W **= work (joules or foot-pounds)**

F **= force applied (newtons or pounds)**

D **= distance moved in the direction of the force (meters or feet)**

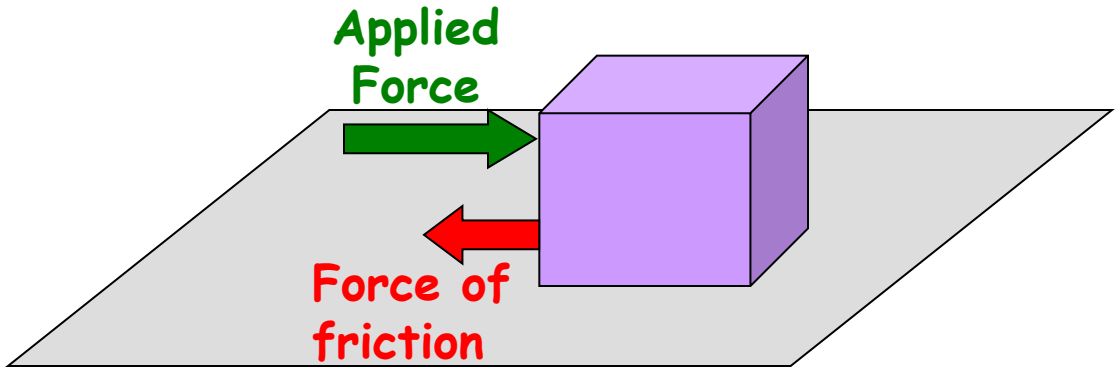
Work and energy are measured in units of joules.

1 joule = 1 kg m^2/s^2

Work done against friction

- **Work is done to move the box horizontally against the force of friction.**

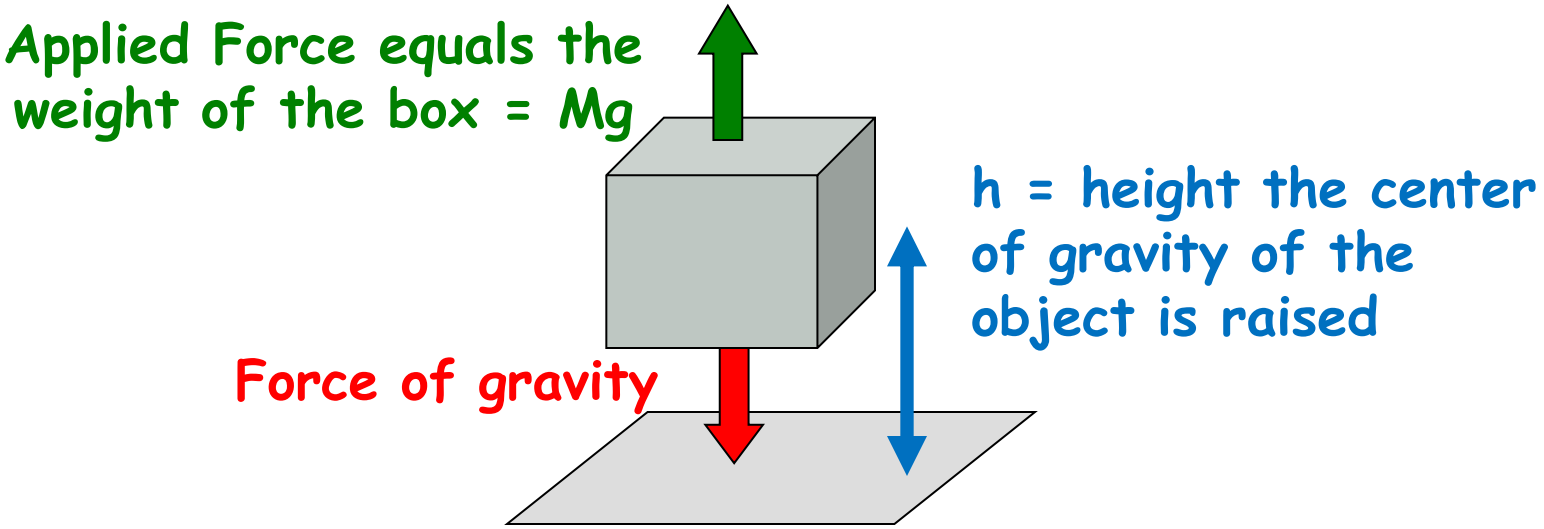
- **The work done goes into thermal energy.**



$$W = F \times D$$

Work done against gravity

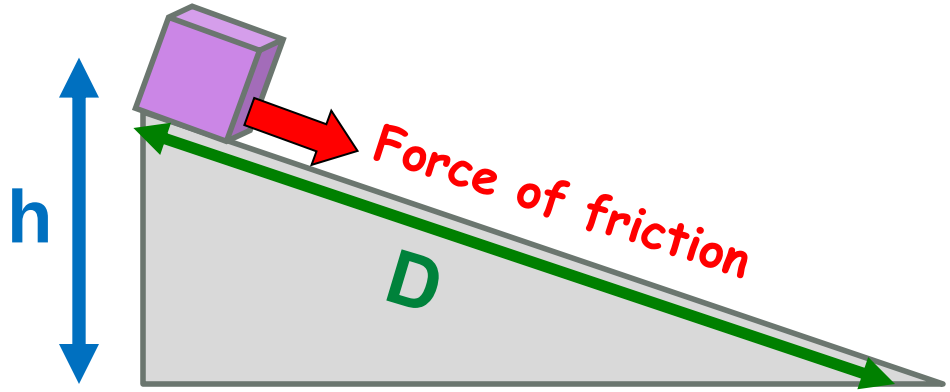
- **Work is done to raise the box vertically against the force of gravity.**
- **The work done goes into gravitational potential energy.**



$W = F \times D$ **can be written** $W = M g \times h$

Work done against friction and gravity

When an object is raised by pushing it up a ramp, work is done against friction AND gravity.



W = F (friction) x D (length of ramp)

W = M g (weight of box) x h (height box is raised)

The total work is the sum of the work done against friction and against gravity.

Work to raise an object vertically

The weight of an object equals the object's mass times the acceleration of gravity (g)

$$Weight = F_{gravity} = M\,g$$

The work required to lift an object equals the object's weight times the vertical distance it moves.

$$W = M\,g\,h$$

W **= work (joules)**

M **= mass of object (kilograms)**

g = acceleration of gravity = 9.8 m/s^2

h **= vertical height it moves (meters)**

Work and gravitational potential energy

- **Potential energy is stored energy, which can be used to do work.**
- **Gravitational potential energy = weight of object times vertical change in its height**

$$E_{pot} = M\ g\ h$$

M **= mass of object (kilograms)**

g **= acceleration of gravity = 9.8 m/s^2**

h **= change in vertical height (meters)**

- **Neglecting the energy wasted by friction, the gain in gravitational potential energy from raising an object equals the work done to raise it.**

Potential energy ⟷ kinetic energy

Gravitational potential energy is most useful when it is converted into the kinetic energy of motion.

$$E_{kin} = \tfrac{1}{2} M v^2$$

E_{kin} = kinetic energy (joules)

M = mass (kilograms)

v = velocity (meters/sec)

Kinetic energy example

What is the kinetic energy of a 1,000 kg car moving at 30 miles per hour?

1) Convert miles per hour into meters per second.

$$\frac{30 \text{ miles}}{1 \text{ hour}} \times \frac{1609 \text{ m}}{1 \text{ mile}} \times \frac{1 \text{ hour}}{3600 \text{ sec}} = \frac{13.4 \text{ m}}{\text{sec}}$$

2) Substitute values into the kinetic energy equation.

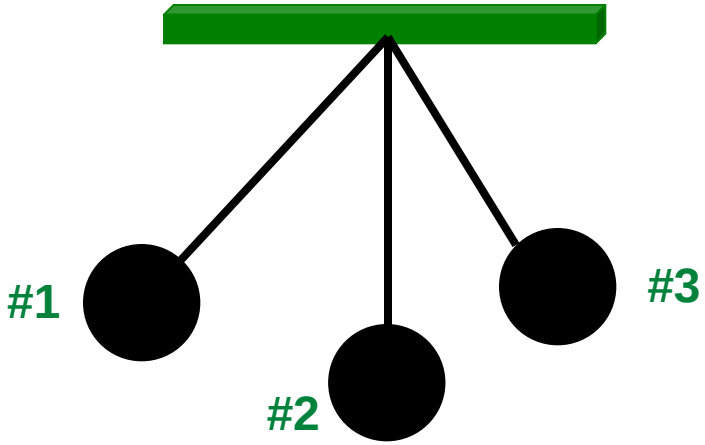
$$E_{kin} = (1/2)\, M\, v^2 = \tfrac{1}{2} \times 1000 \text{ kg} \times (13.4 \text{ m/s})^2$$

$$= 500 \text{ kg} \times 180 \text{ m}^2/\text{s}^2 = 90{,}000 \text{ kg m}^2/\text{s}^2 = 9 \times 10^4 \text{ J}$$

Swinging ball pendulum

As the ball swings, identify the point(s) at which its

- **Potential energy is at its maximum and minimum**
- **Velocity is at its maximum and minimum**
- **Kinetic energy is at its maximum and minimum**



BEFORE THE NEXT CLASS…

- ✓Read textbook chapter 8
- ✓Complete Homework Exercise 7
- ✓Bring a blank Activity Sheet 8 to class.
- ✓Watch the video, American Revealed: Electric Nation