Announcements 15 Apr 09

- **Homework #10**
  - **Written homework due on Wednesday at the start of class**
  - **Online Homework due on Wednesday by 8 am**
- **Monday April 20**
  - **Patriots' Day holiday**
  - **Monday schedule will be observed on Tuesday April 21:**
    - **Lecture at 9:05 am**
    - **Early office hours (2:00 to 3:30 pm)**

Conceptual example

A skier stands at rest at the top of a hill. A small push sends the skier down the hill. After her height has dropped by 5.0 m, she is moving at a good clip. Write down the equation for conservation of energy, noting the choice of system, the initial and final states, and what energy transformation has taken place.

Choosing the system

TACTICS BOX 10.1 Choosing the system for conservation-of-energy problems Exercise 6

The system should include all of the objects identified as follows:

1. If the speed of an object or objects is changing, the system should include these moving objects because their kinetic energy is changing.
2. If the height of an object or objects is changing, the system should include the raised object(s) *plus* the earth. This is because potential energy is stored via the gravitational interaction of the earth and object(s).
3. If the compression or extension of a spring is changing, the system should include the spring because elastic potential energy is stored in the spring itself.
4. If kinetic or rolling friction is present, the system should include the moving object and the surface on which it slides or rolls. This is because thermal energy is created in both the moving object and the surface, and we want this thermal energy to all be within the system.

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Mechanical energy

Motion of ordinary objects can usually be described using solely their mechanical energy:

$$K + U = K + U_g + U_s$$

Law of conservation of energy becomes:

$$\Delta K + \Delta U + \Delta E_{th} = W$$

If no external forces do work (W = 0) and if no kinetic friction is present:

$$\left(K_f - K_i\right) + \left(U_f - U_i\right) = 0$$

$$\Rightarrow \boxed{K_f + U_f = K_i + U_i}$$

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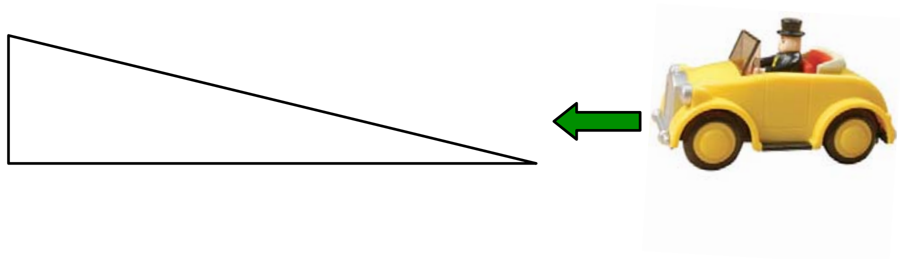
Conceptual example: DEMO

Consider a toy car going up a ramp. The toy starts at rest then finishes up the ramp. What energy transformations take place?



Work

Work done by a constant force F in the direction of the displacement d

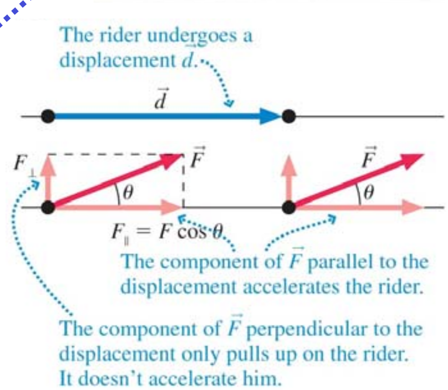
$$W = Fd$$

Unit of work:

1 joule = 1 J = 1 N·m

Work done by a constant force F at angle θ to the displacement d

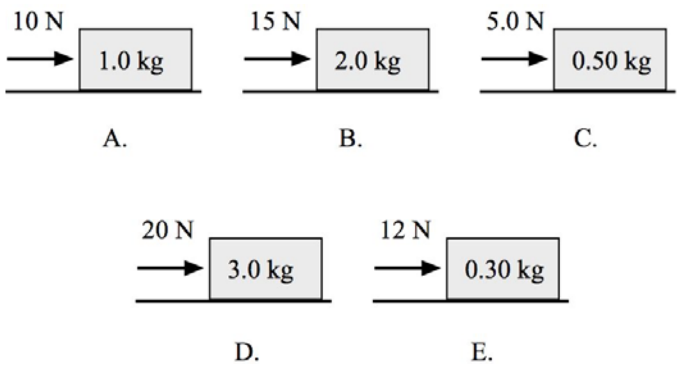
$$W = Fd\cos\theta$$



Conservation of energy question

PRS

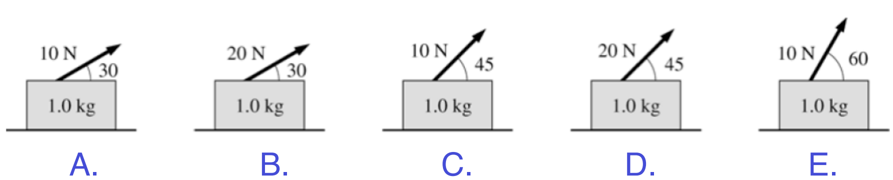
Each of the boxes, with masses noted, is pushed for 10 m across a level, frictionless floor by the noted force. Which box experiences the largest change in kinetic energy?



Conservation of energy question

PRS

Each of the boxes, with masses noted, is pulled for 10 m across a level, frictionless floor by the noted force at the noted angle. Which box has the highest final speed?



Kinetic energy and potential energy

An object of mass m moving at a speed v has kinetic energy

$$K = \frac{1}{2}mv^2$$

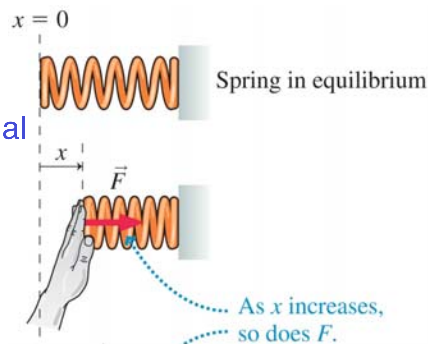
Energy unit: 1 J = 1 N·m

An object of mass m at a height y has gravitational potential energy

$$U_g = mgy$$

A spring displaced a distance x from equilibrium has elastic potential energy

$$U_s = \frac{1}{2}kx^2$$

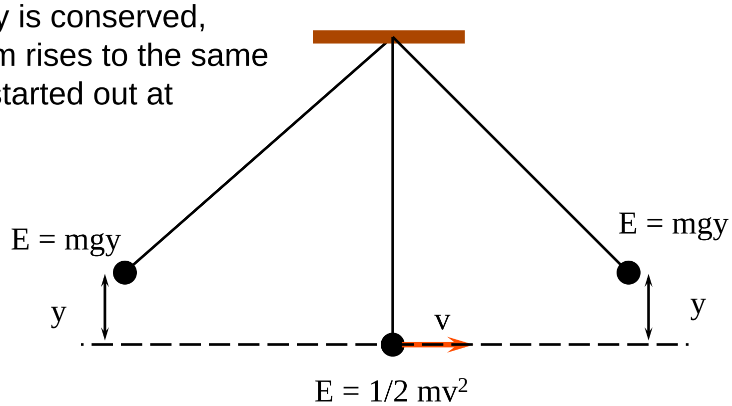


Energy conservation in a pendulum

We're considering kinetic energy and gravitational potential energy

$E = K + U = ½\ mv^2 + mgy$

Since energy is conserved, the pendulum rises to the same height as it started out at



Demo

Nose-basher Pendulum

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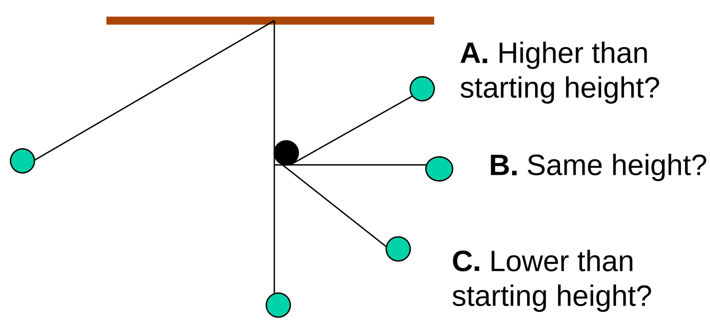
Pendulum question

PRS

A pendulum is pulled back and let go. When the pendulum reaches the bottom of its motion the string that holds the pendulum makes contact with a peg. How far will the pendulum rise after making contact with the peg?



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