The Work-Energy Theorem

Pre-Lecture Questions

Problem Set #20 (due next time)

Lecture Outline

1. The Work-Energy Theorem
2. Applications

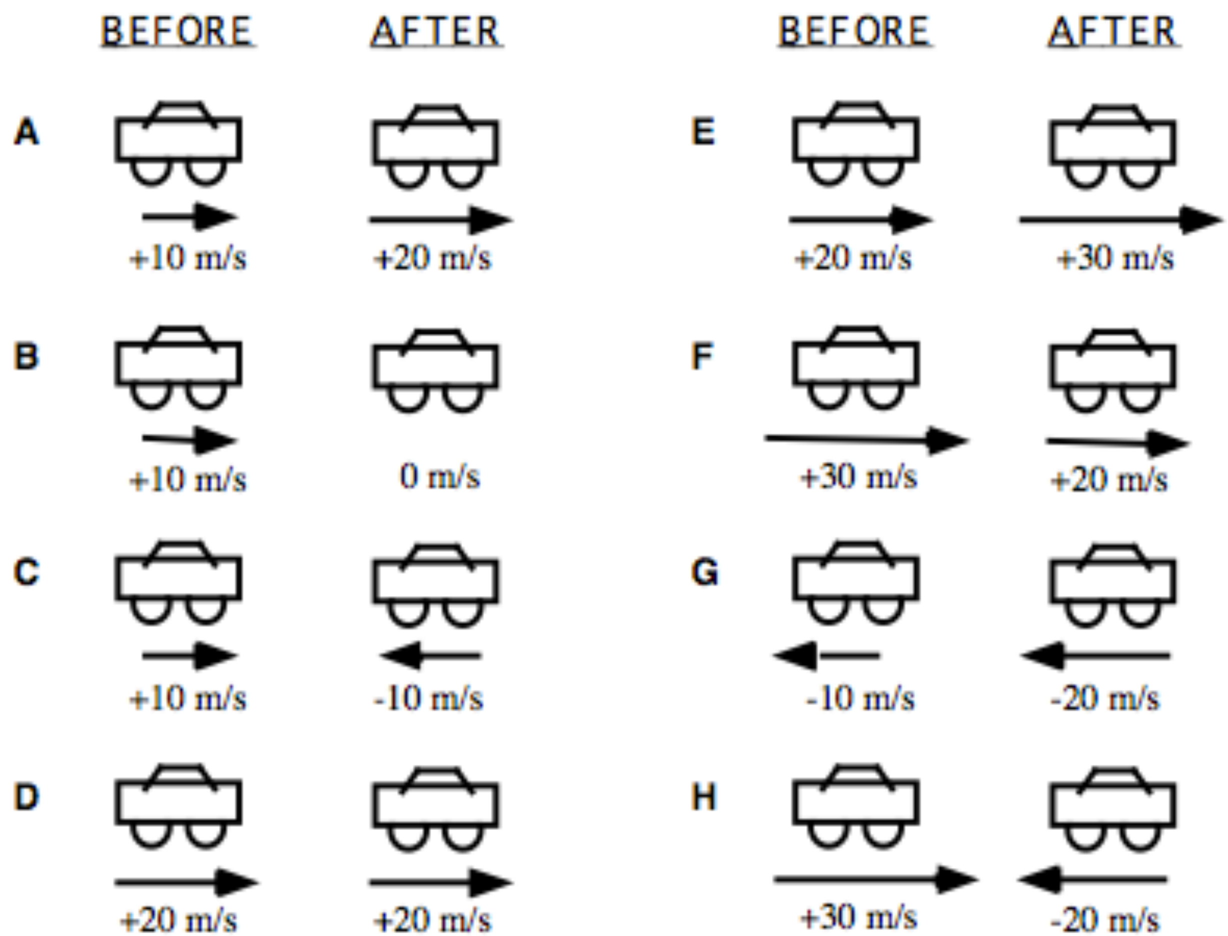
Pre-Class Summary:

The Definition of Kinetic Energy $K \equiv \frac{1}{2}mv^2$

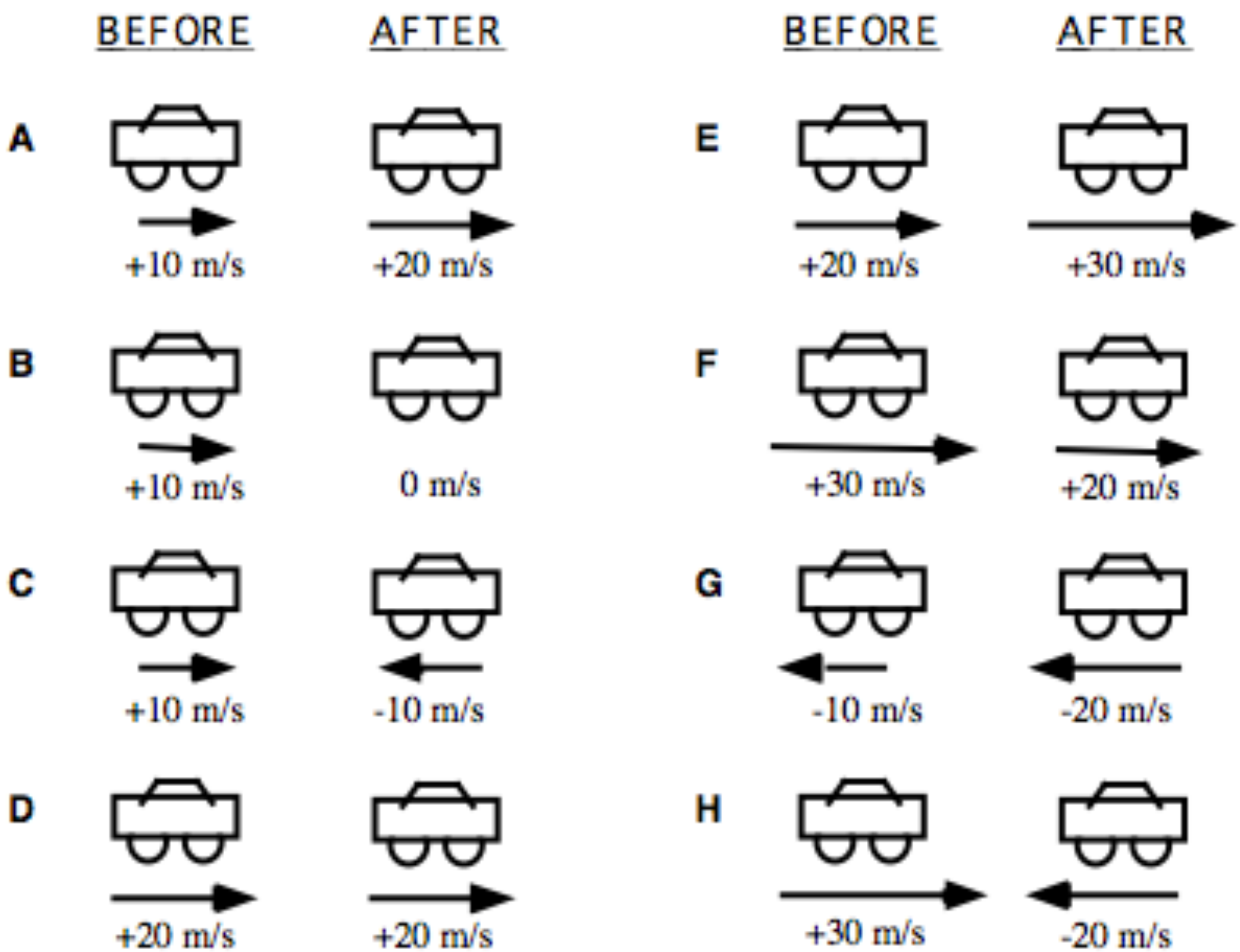
Work-Energy Theorem $W_{net} = \Delta K$

For an object to increase its speed, net work must be done to it. If the net work is negative, the object will slow down.

The eight situations below show *before* and *after* "snapshots" of a car's velocity. Rank these situations, in terms of the change in kinetic energy of these cars, from most positive to most negative. All cars have the same mass and have traveled the same distance during this change. Negative numbers, if any, rank lower than positive ones (-20 m/s < -10 m/s < 0 < 5).



The eight situations below show *before* and *after* "snapshots" of a car's velocity. Rank these situations, in terms of work done on the car, from most positive to most negative, to create these changes in velocity for the same distance traveled. All cars have the same mass. Negative numbers, if any, rank lower than positive ones (-20 m/s < -10 m/s < 0< 5).

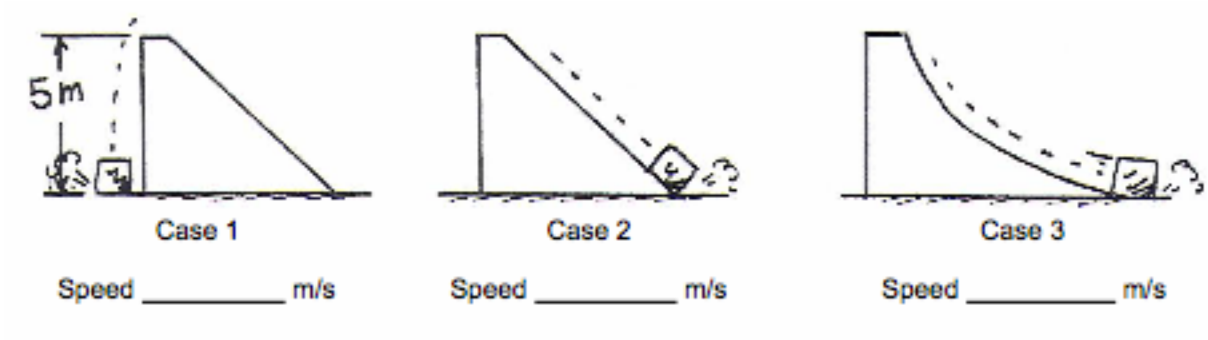


The Impulse-Linear Momentum Theorem explains that a force acting over time creates an impulse that changes the linear momentum of an object, while the Work-Energy Theorem states that a force acting over a distance does work that changes the kinetic energy of an object.

Impulse-Momentum Theorem $\Delta\vec{p} = \vec{J}$	Definition of Impulse $\vec{J} \equiv \int_{t_o}^{t} \vec{F}dt$
Work-Energy Theorem $\Delta K = W$	Definition of Work $W \equiv \int_{\vec{s}_o}^{\vec{s}} \vec{F} \bullet d\vec{s}$

Example 1: A stone falls off a 12m high cliff. Find the speed just before it strikes the ground without using the kinematic equations.

Example 2: A 5.0N mass is hung gently on a spring with a spring constant of 250N/m. Find the stretch of the spring when the mass is again at rest (at least momentarily).



Above are three situations involving ramps of the same height. In case 1, a 1.0kg block is dropped from the top of the ramp. In the other two cases, the 1.0kg block slides down the ramp. The goal is the find the speed of the block at the bottom. Fill in the tables below:

Numbers

Case	Force Acting	Work Done by Force
1		
2		
2		
3		
3		

Names

Case	Net Work Done	Speed at Bottom
1		
2		
3		

Lecture 20 - Summary

The Definition of Kinetic Energy $K \equiv \frac{1}{2}mv^2$

Work-Energy Theorem $W_{net} = \Delta K$

For an object to increase its speed, net work must be done to it. If the net work is negative, the object will slow down.