AP Objectives for Chapter 9 - Linear Momentum

D. Systems of particles, linear momentum

1. Center of mass

a) Students should understand the technique for finding center of mass, so they can:

(1) Identify by inspection the center of mass of a symmetrical object.

(2) Locate the center of mass of a system consisting of two such objects.

(3) Use integration to find the center of mass of a thin rod of non-uniform density

b) Students should be able to understand and apply the relation between center-of-mass velocity and linear momentum, and between center-of-mass acceleration and net external force for a system of particles.

c) Students should be able to define center of gravity and to use this concept to express the gravitational potential energy of a rigid object in terms of the position of its center of mass.

2. Impulse and momentum

Students should understand impulse and linear momentum, so they can:

a) Relate mass, velocity, and linear momentum for a moving object, and calculate the total linear momentum of a system of objects.

b) Relate impulse to the change in linear momentum and the average force acting on an object.

c) State and apply the relations between linear momentum and center-of-mass motion for a system of particles.

d) Calculate the area under a force versus time graph and relate it to the change in momentum of an object.

e) Calculate the change in momentum of an object given a function $()Ft$ for the net force acting on the object.

3. Conservation of linear momentum, collisions

a) Students should understand linear momentum conservation, so they can:

(1) Explain how linear momentum conservation follows as a consequence of Newton's Third Law for an isolated system.

(2) Identify situations in which linear momentum, or a component of the linear momentum vector, is conserved.

(3) Apply linear momentum conservation to one-dimensional elastic and inelastic collisions and

two-dimensional completely inelastic collisions.

(4) Apply linear momentum conservation to two-dimensional elastic and inelastic collisions.

(5) Analyze situations in which two or more objects are pushed apart by a spring or other agency, and calculate how much energy is released in such a process.