Physics 12 Section 7.1
Momentum and Force

1. From Physics 11, linear momentum is defined as the product of mass and velocity.

2. Momentum

3. Newton's second law (F=ma) was originally stated as: "The rate of change in momentum of a body is equal to the net force applied to it."

$$\sum F = \frac{m(v_2 - v_1)}{\Delta t}$$

$$\sum F = ma$$

Physics 12 Section 7-2
Conservation of Momentum

1. The total momentum of an isolated system of bodies remains constant. If the system consists of two bodies then:

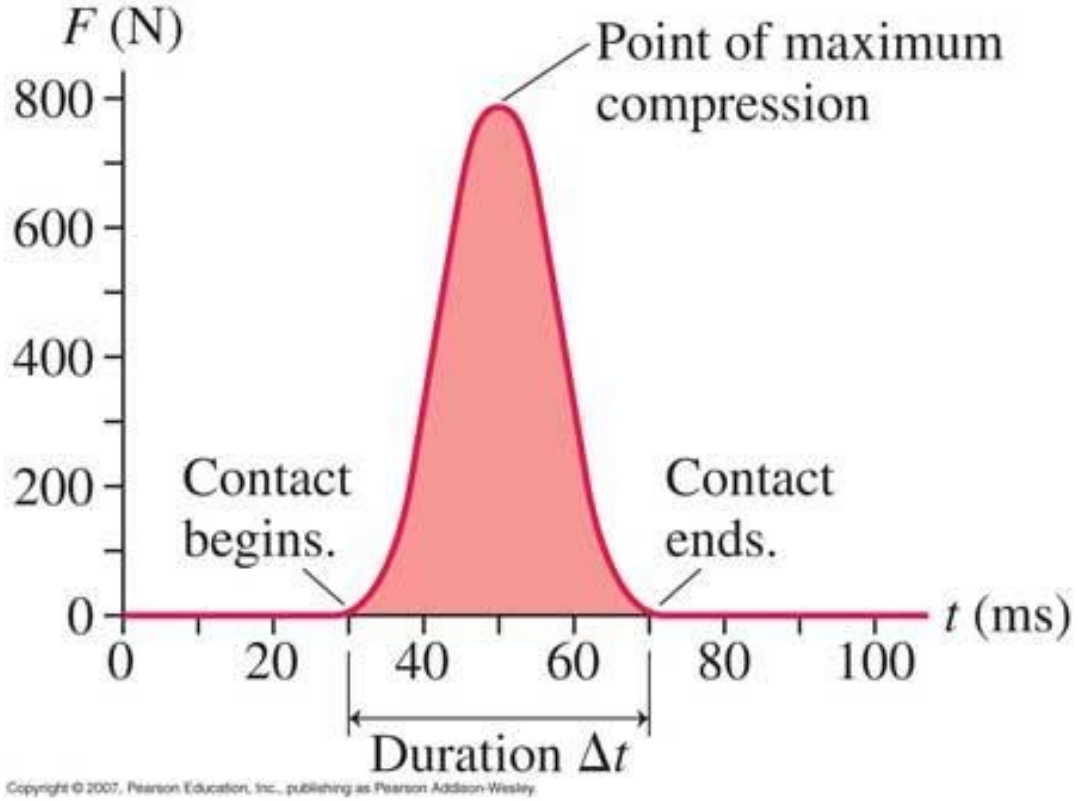
The total momentum before an interaction is equal to the total momentum after the interaction.

2. If there were more than two objects then you would have an additional term m_3v_3 and m_3v_3'.

Physics 12 Section 7-3
Impulse

1. If an object receives an impulse (force applied for a certain amount of time) then the object's momentum changes.

2. The change in momentum of the object is equal to the impulse the object receives.



Physics 12 Section 7-4 Conservation of Energy and Momentum in Collisions

1. There are two basic types of collisions, elastic and inelastic.

2. Elastic collisions conserve both momentum and energy.

$KE_{before} = KE_{after}$ $P_{before} = P_{after}$ 3. Inelastic collisions conserve only momentum.

$$P_{before} = P_{after}$$

Physics 12 Section 7-5
Elastic Collisions in one Dimension

1. Both momentum and kinetic energy is conserved.

2. Rearranging the two above equations and you get:

$$m_1v_1 - m_1v_1' = m_2v_2' - m_2v_2$$

and

$$\tfrac{1}{2}\, m_1v_1^2 - \tfrac{1}{2}\, m_1v_1'^2 = \tfrac{1}{2}\, m_2v_2'^2 - \tfrac{1}{2}\, m_2v_2^2$$

$$m_1v_1^2 - m_1v_1'^2 = m_2v_2'^2 - m_2v_2^2$$

The above has a difference of two squares so you can factor it using:
$(a - b)(a + b) = (a^2 - b^2)$

Take the above equations and divide it, yes you can divide it, by the rearranged momentum equation.

You will notice that the $(v_1 - v_1')$ on the left and the $(v_2' - v_2)$ on the right, as well as the m, divide out of the equation.

$$v_1 + v_1' = v_2' + v_2$$

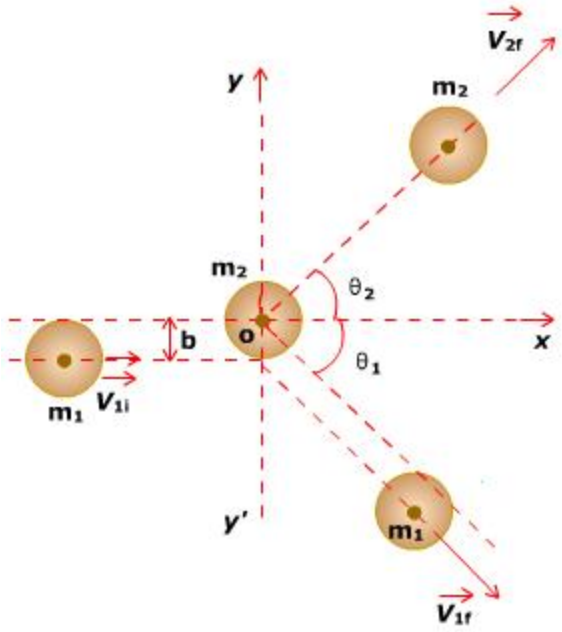
$$v_1 - v_2 = v_2' - v_1'$$

Example: A billiards ball of mass m moving with speed v collides head-on with a second ball of equal mass at rest ($v_2 = 0$). What are the speeds of the two balls after the collision, assuming it is elastic?

Physics 12
Collisions in Two Dimensions

1. In physics 11 the collisions of objects were in one dimension.

2. The same conservation of momentum technique is used for two dimensional analysis. The only challenge is to keep track of all the variables.



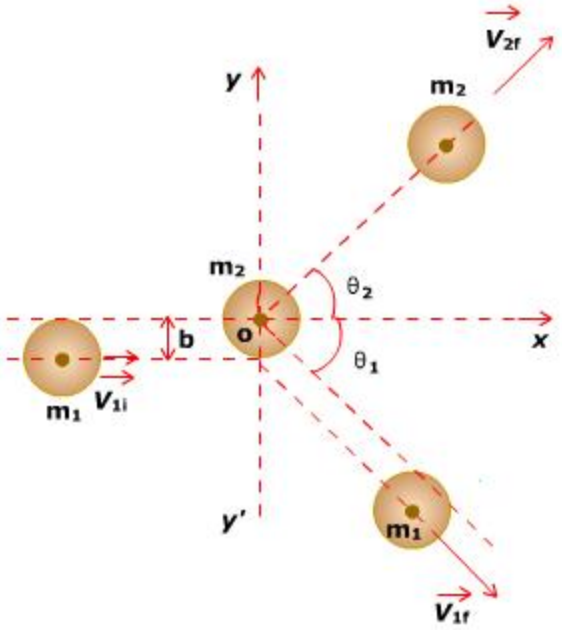
3. Use a table to keep track of the momentum of each object before and after the collision in each dimension.

	X Momentum before	X Momentum after	Y momentum before	Y momentum after
Object 1	m_1v_1	m_1v_1'		
Object 2	m_2v_2	m_2v_2'		
Total				

4. The above chart generates 4 equations that will allow you to solve for 4 variables.

Example: A billiard ball moving at 3.0 m/s in the x direction hits an equal mass ball initially at rest. The two balls move off at 45°, one above

the x axis and one below. What are the speeds of the two balls?



	X Momentum before	X Momentum after	Y momentum before	Y momentum after
Object 1	m_1v_1			
Object 2	m_2v_2			
Total				

Physics 12
Equilibrium

1.

2. Objects can be in translational equilibrium and/or rotational equilibrium.

3. Translational equilibrium results

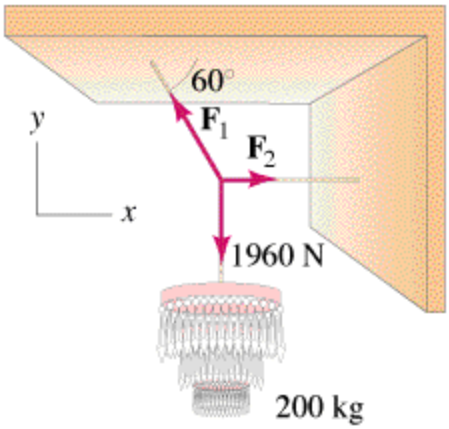
4. Rotational equilibrium results when the

7. Torque is

Example:
A a 90kg person stands on a scale and tries to pull himself up off the scale. The person is unable to pull himself off the scale but the scale reading decreases down to 23kg. What force is he exerting?

$F_p = 660N$

Example:



A chandelier hangs from the ceiling on two cords. Calculate the tension in the two cords (F_1 and F_2).

1130N

7. Torque is

8.

Example:
A board serves as a seesaw for two children. One child has a mass of 30 kg and sits 2.5m from the pivot point. At what distance from the pivot must a 25 kg child sit in order to balance the seesaw?