6 | Momentum

IB Physics Content Guide

Big Ideas

- The total momentum of an isolated system is always constant
- The force on an object when speeding up or slowing down can be affected by changing the time for the force
- The impulse of a collision is equal to the change in momentum

Content Objectives

6.1 – Conservation of Momentum

p. 92, 96-101

I can define and calculate momentum			
I can calculate "before" and "after" momentums for multiple objects			
I can use the conservation of momentum to solve for missing variables in linear collisions			
I can describe the process required for explosion, hit and bounce, and hit and stick scenarios			
I can describe the difference between elastic and non-elastic collisions			
I can describe how energy is not always conserved within a system			
I can calculate the amount of energy retained in a non-elastic collision			

6.2 – Momentum and Impulse

p. 93-95

I can describe the meaning of impulse and how it is related to momentum change			
I can use impulse and momentum to solve for an unknown in a collision problem			
I can conceptually describe how to decrease the force experienced in a collision			
I can determine the impulse of a collision from a force vs time graph			

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Shelving Guide

	Variable Symbol	Unit
Momentum	p	kg m s^{-1}
Mass	m	kg
Velocity	v	m s^{-1}
Time	t	s
Kinetic Energy	E_K	J
Impulse	Impulse	N s or kg m s^{-1}

Data Booklet Equations:

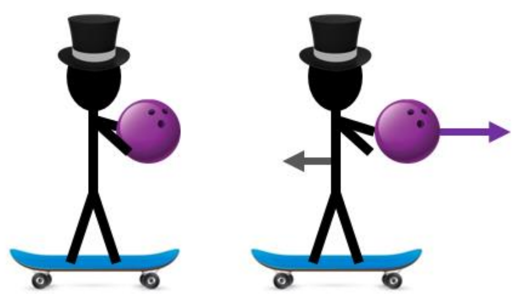
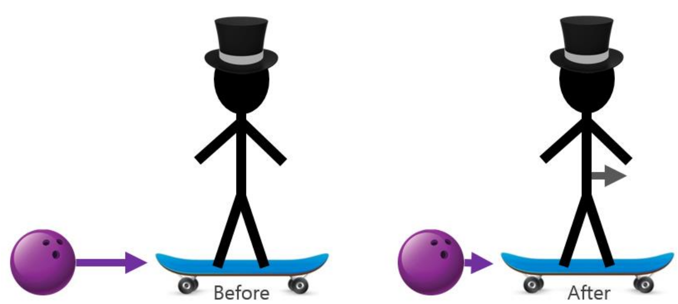
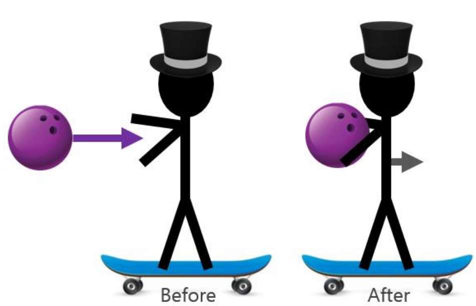
$$p = mv$$

$$F = \frac{\Delta p}{\Delta t}$$

$$E_K = \frac{p^2}{2m}$$

$$\text{Impulse} = F\Delta t = \Delta p$$

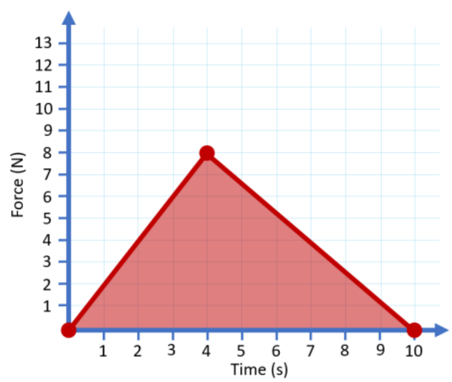
Conservation of Energy Problems

	"Explosion" $p_{AB} = p_A + p_B$
	"Hit and Bounce" $p_A + p_B = p_A + p_B$
	"Hit and Stick" $p_A + p_B = p_{AB}$

Types of Collisions

Elastic	Kinetic Energy is conserved (perfect hit and bounce) *Typically just found in particle collisions
Inelastic	Kinetic Energy is not conserved

Calculating Impulse

Constant force: Force × Time $F\Delta t$	
Varying Force: Area under a Force vs Time Graph	

Impulse-Momentum Equation

$$F\Delta t = \Delta p = m\Delta v = mv - mu$$

Collision Safety

Explain (using impulse, force, and time) how to decrease the force acting on an object undergoing a collision:

Impulse is the same overall regardless of the impact style because the object has a set mass and impact velocity. The force can be decreased by increasing the time of the impact.

Impulse = F$_{\Delta t}$ or Impulse = $_{F}\Delta$t