Impulse & Momentum Calculations

IB PHYSICS | ENERGY & MOMENTUM

Impulse Review

Work → Change in Energy

Impulse → Change in Momentum

$$Impulse = F\Delta t = \Delta p$$

Impulse Slowing Down

Same Mass

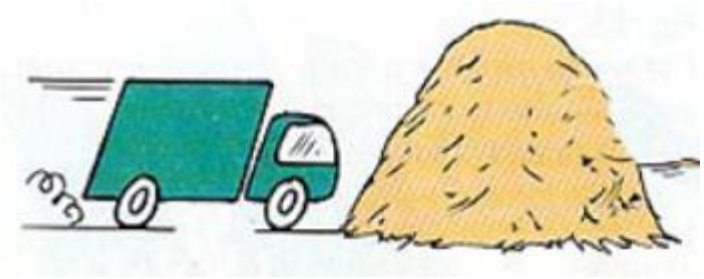
Same Momentum

Short Time

Large Force

$F \times \Delta t$

Same Impulse

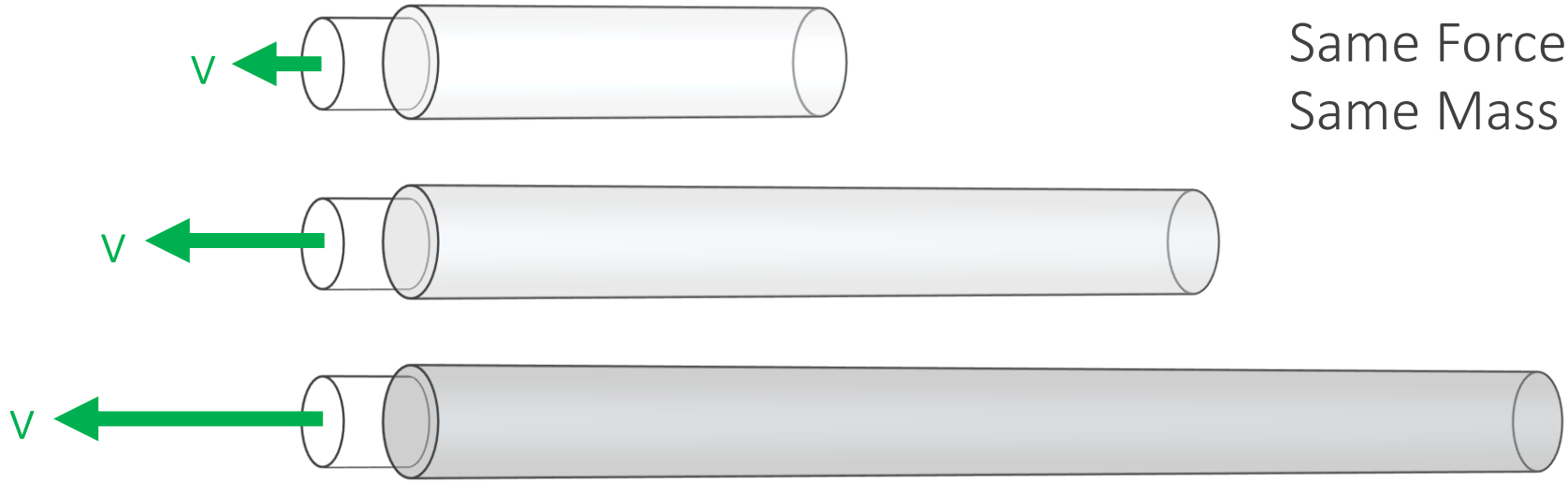


Long Time

Small Force

Impulse Speeding Up

$$Impulse = F\Delta t = \Delta p = m\Delta v$$



Same Force
Same Mass

More Time → More Velocity

Slapshot!

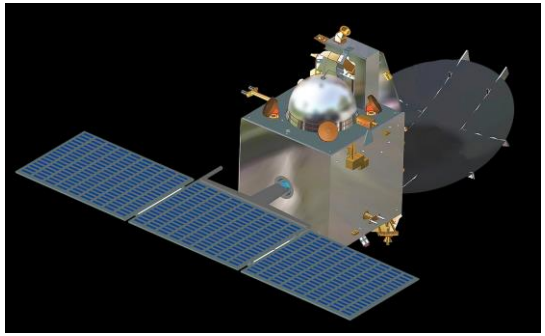
A hockey puck has a mass of 0.115 kg. A player takes a slap shot which exerts a force of 31.0 N for 0.15 sec. How fast will the puck be moving?

Initial Momentum → Impulse Added → Final Momentum

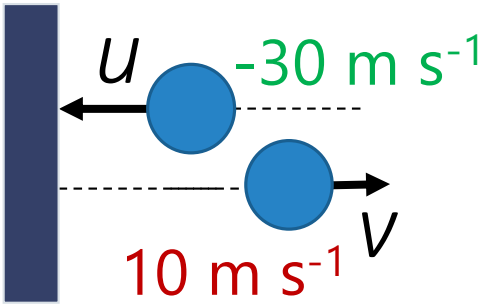
Impulse and Momentum

The 440 newton Liquid Apogee Motor (LAM) of India's Mars Orbiter Spacecraft, was successfully fired for a duration of 3.968 seconds on September 22, 2014. This operation of the spacecraft's main liquid engine was also used for the spacecraft's trajectory correction and changed its velocity by 2.18 m s^{-1}. What was the mass of the spacecraft at the time of this engine firing?

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



Direction Matters



Assume u is 30 m s^{-1} to the left and v is 10 m s^{-1} to the right.

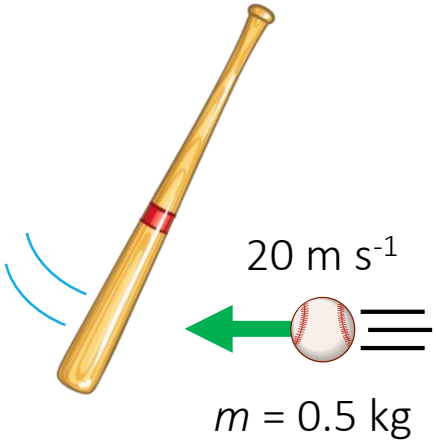
What is the change in velocity?

Try This…

A **500 g** baseball moves to the left at **20 m s^{-1}** striking a bat. The bat is in contact with the ball for **0.002 s**, and it leaves in the opposite direction at **40 m s^{-1}**. What was average force on ball?

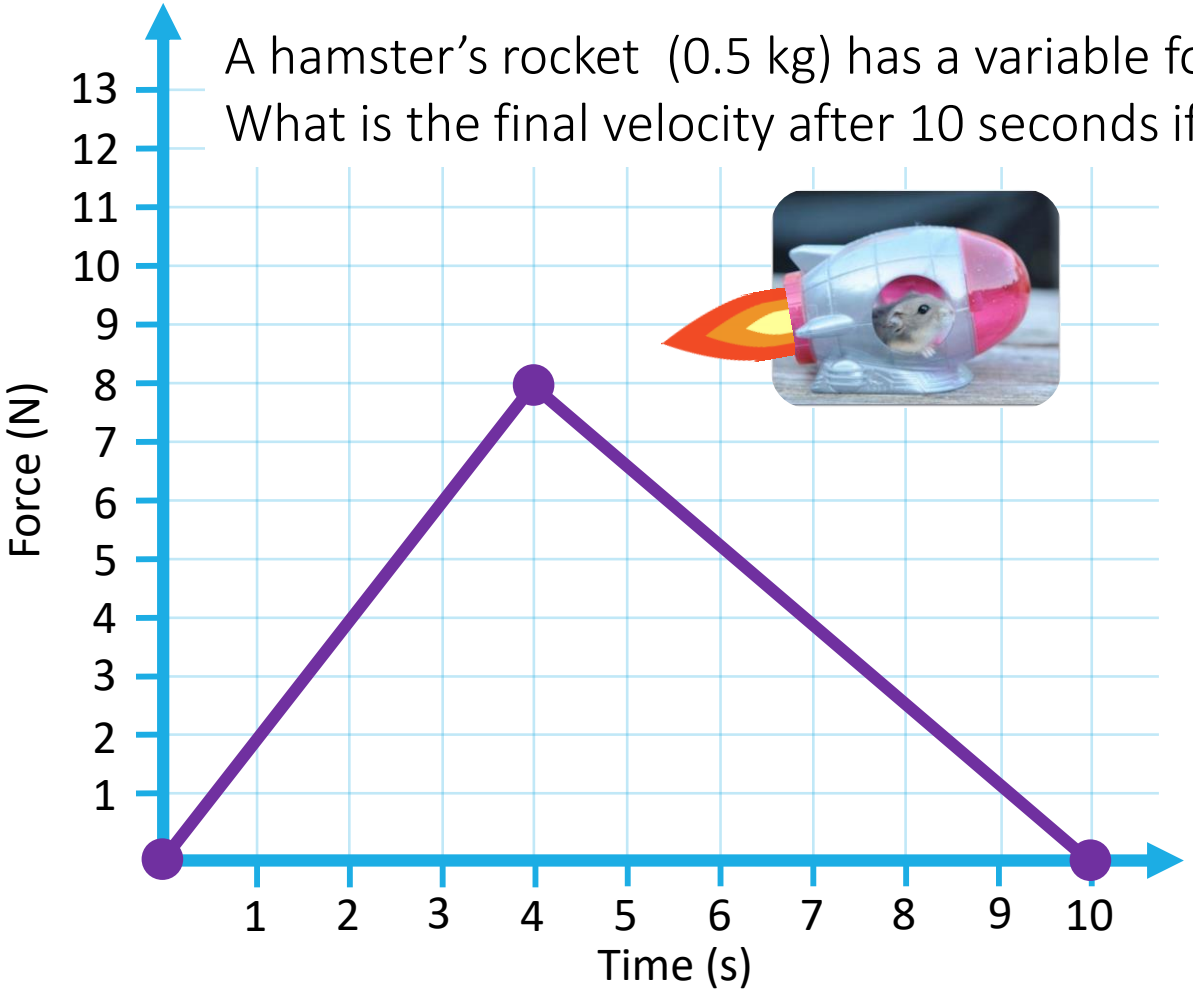
Initial Momentum → Final Momentum

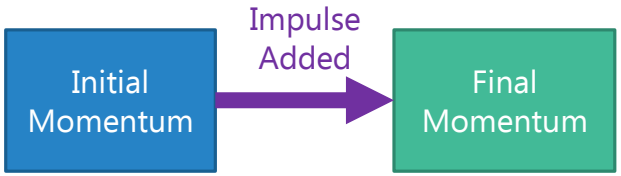
Impulse Added



Impulse from a Graph

A hamster's rocket (0.5 kg) has a variable force as shown in the graph. What is the final velocity after 10 seconds if it starts from rest?





Try This...

Kara Less was applying her makeup when she drove into South's busy parking lot last Friday morning. Unaware that Lisa Ford was stopped in her lane, Kara rear-ended Lisa's rental car. Kara's 1300-kg car was moving at 5 m s^{-1} and stopped in 0.4 seconds. What was the force?

Lesson Takeaways

- ❑ I can use impulse and momentum to solve for an unknown **force**
- ❑ I can use impulse and momentum to solve for an unknown **velocity**
- ❑ I can calculate the change in velocity when there is a direction change
- ❑ I can calculate change in momentum from a Force vs Time graph