

Linear Momentum and Impulse

Linear Momentum

- Linear Momentum – a measure of how difficult it is to stop a moving object.

$$p = mv$$

p = momentum [kgm/s]

m = mass [kg]

v = velocity [m/s]

- Momentum is a vector quantity.
- A fast moving bullet and a slow moving semi-truck are both difficult to stop because the product of their mass and velocity is large.

Impulse

- Impulse (J) = change in momentum
- In order to change an object's momentum, an external force needs to be applied for a period of time.

$$J = \Delta p = \bar{F} \Delta t = \int F dt$$

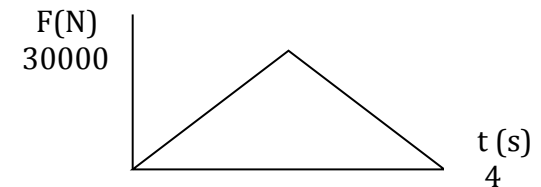
- If force is not constant, impulse is the area under the F vs t curve.

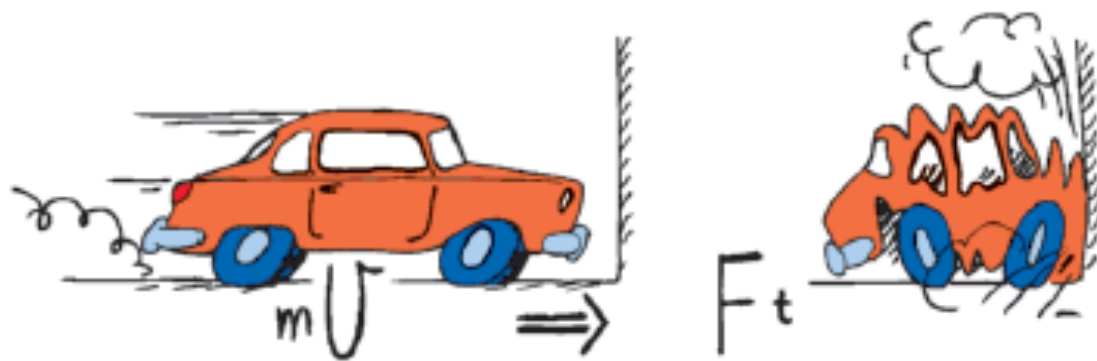
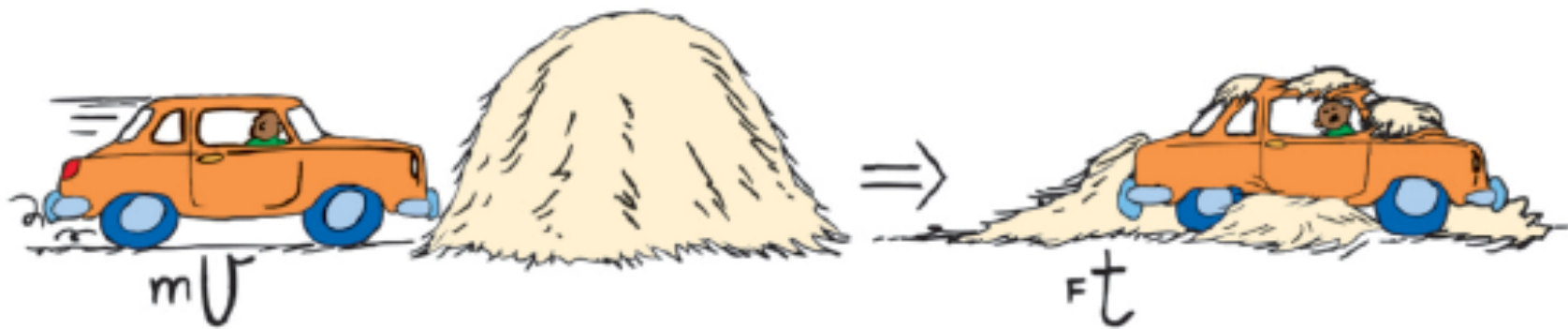
Ex 1:

A 2000 kg bus starts from rest and experiences a force given by the graph.

What is the impulse delivered to the bus?

What is the velocity of the bus at $t=4$ s?





Ex 2:

An 1800 kg truck traveling east at 7 m/s crashes into a wall and bounces off at 3 m/s. If the collision lasts for 50 ms, find the average force of the wall on the truck.

Ex 3:

A 2 kg object experiences a force given by $F(t) = 6t^3 - 5t$. At time zero, the object has a velocity of 3 m/s. What is the object's velocity at $t = 4$ s?