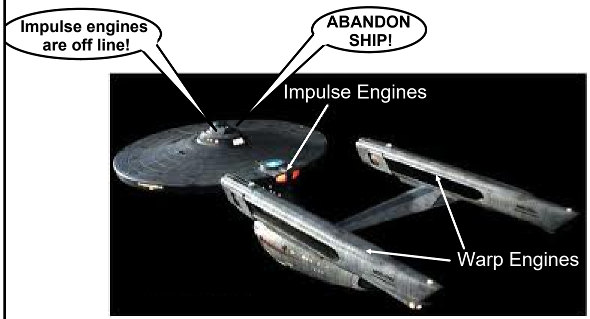
8.2 – Impulse



In case you ever wondered what they were talking about.

Impulse

We calculated momentum change: $\Delta p = p_2 - p_1$

If time factors in, we get <u>impulse</u>: a short period during which a force is applied:

$\Delta\vec{p} = \vec{F}\Delta t$ AP Equation	F = <u>average</u> force (N) t = time (s) Δp = impulse (N·s)

Historically, impulse was denoted by the symbol "I".

To conform to AP standards, it is shown as 'Δp'.

Analysis: $F\Delta t = N \bullet s = \frac{kg \bullet m}{s^2} \bullet s = kg\frac{m}{s}$

Streamline!

Since we now have two ways of expressing change in momentum, it is convenient to merge them:

$$\Delta\vec{p} = \vec{F}\Delta t \qquad \Delta\vec{p} = \vec{p}_2 - \vec{p}_1$$

$$F\Delta t = p_2 - p_1$$

$$\boxed{F\Delta t = m\left(v_2 - v_1\right)}$$

1. Example

A golfer hits a 0.046 kg ball from rest 40.0 m/s.

A. Find the club's average force in 1.0 ms of contact.

Convert 1.0 ms to seconds: 0.0010 s.

$$F\Delta t = p_2 - p_1$$

$$F = \frac{p_2 - p_1}{\Delta t} = \frac{0.046\,kg \bullet 40.0\frac{m}{s} - 0\,kg \bullet \frac{m}{s}}{0.0010\,s} = 1{,}800\,N$$

B. What impulse is applied during contact?

$$\Delta\vec{p} = \vec{F}\Delta t = 1800\,N \bullet 0.0010\,s = 1.8\,N \bullet s$$

2. Example

A 950 kg car decelerates at a rate of 1.2 m/s^2. How long does it take to slow from 12.8 m/s to 2.3 m/s?

Note: you <u>could</u> use kinematics, but please use momentum instead.

$$F = ma$$
$$= 950\,kg \bullet -1.2\,m/s$$
$$= -1{,}140\,N$$

$$F\Delta t = m\left(v_2 - v_1\right)$$

$$\Delta t = \frac{m\left(v_2 - v_1\right)}{F} = \frac{950\,kg\left(2.3\frac{m}{s} - 12.8\frac{m}{s}\right)}{-1{,}140\,N} = 8.8\,s$$

Homework

8.2 Problems in your Booklet
Due: next class