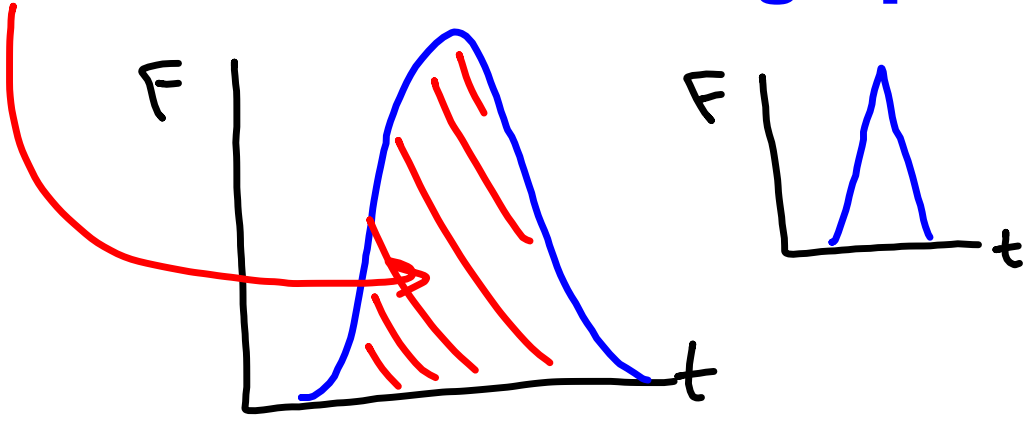
Impulse

Impulse = $F_{avg}t$

Impulse = area on F vs t graph



Momentum

$$p = mv$$

kg

m/s

kg m/s

Momentum is a vector - direction matters

Calculate the momentum of each.

1. A 0.001 kg ant traveling at 0.1 m/s. 0.0001 kgm/s
2. A 60 kg human running at 10 m/s. 600 kgm/s
3. A 1,000 kg car moving at 30 m/s. 30,000 kgm/s
4. A 400,000 kg jet flying at 250 m/s. 100,000,000 kgm/s
5. The 500,000 kg ISS at orbital speed: 8,000 m/s

~~1~~,000,000,000 kgm/s

4

1. A 0.001 kg ant traveling at 0.1 m/s.

0.0001 kg m/s

2. A 60 kg human sprinting at 10 m/s.

600 kg m/s

3. A 1,000 kg car moving at 30 m/s.

30,000 kg m/s

4. A 400,000 kg jet flying at 250 m/s.

100,000,000 kg m/s

5. The 500,000 kg ISS at orbital speed: 8,000 m/s

4,000,000,000 kg m/s

2ND LAW OF MOTION

$$F = ma$$

$$F = m\left(\frac{\Delta v}{t}\right)$$

$$Ft = m\Delta v = m(v_f - v_i) = mv_f - mv_i$$

impulse = change in momentum

$$N_s = kg\frac{m}{s}$$

$$kg\frac{m}{s^2} \cdot s = kg\frac{m}{s}$$

Impulse - Change in Momentum Relation

$$Ft = m(v_f - v_i)$$

Impulse

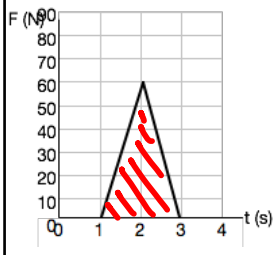
Either area on the graph

or $(F_{avg})t$

Change in momentum

Δp

Impulse on a ball



a) Find the total impulse on the ball.
b) Find the average force on the ball.
c) What was the change in momentum of the ball?
d) If the ball had an initial velocity of 1 m/s and a mass of 0.5 kg, find its final velocity.

a) Impulse = area
$= \frac{1}{2}bh = \frac{1}{2}(2\,sec)(60\,N)$
$= +60\,Ns$

b) $Impulse = F_{avg}\,t$
$60\,Ns = F_{avg}(2\,sec)$
$30\,N = F_{avg}$

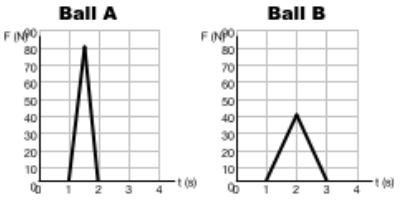
c) $Impulse = \Delta p$
$\Delta p = 60\,kg\,m/s$

d) $\Delta p = m\Delta v$
$= m(v_f - v_i)$
$60 = (0.5)(v_f - 1)$
$120 = v_f - 1$
$121\,m/s = v_f$

Cycle 25 Momentum

1. Impulse & Momentum

selected answers



1. Two identical balls receive the impulses shown in the graphs.

a) What all can you calculate, just from the graphs?
b) What can you say about Ball A compared to Ball B?

Both Impulses = 40 Ns

(there's more)

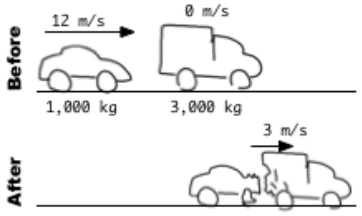
2. A 100 kg quarterback collides with a defensive end, going from 6 m/s down to 2 m/s.

a) What is the change in momentum of the quarterback?
b) What impulse was delivered to the quarterback?
c) If the collision lasted 1.2 seconds, what was the average force delivered to the quarterback?

a) -400 kgm/s

b) -400 Ns

c) -333 N



3. The car collides with the truck, as shown. Afterward, they are moving at the same speed.

a) Calculate the change in momentum of the car.
b) What Impulse was delivered to the car?
c) Calculate the change in momentum of the truck.
d) What Impulse was delivered to the truck?

a) -9,000 kgm/s

b) -9,000 Ns