Chapter 9 Momentum

Basketball & ping pong ball

What happens at different times:

1) When falling together

2) When hits the ground

3) After hits the ground.

p = Mass · Velocity

momentum

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9.1 Impulse and Momentum

baseball: squishing of the ball + recoil takes 3.0ms (milliseconds)

1. Newton's 2nd law says:

$$F = ma \quad \text{or}$$

$$\Delta t \cdot F = m \frac{\Delta v}{\Delta t} \cdot \Delta t$$

$$F \cdot \Delta t = m \Delta v$$

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2. Impulse - $F\Delta t$ = the product of

Force & change over time

Def. Vector

The average force on an object and the time interval over which it acts. $F\ \Delta t$

a) units: $N \cdot s$

b) + / − will be important

Impulse is a vector!

+/− shows direction.

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3) Momentum - $m\ \Delta v$ = the product of

mass & change in velocity

$m\ \Delta v$

b) units = $kg\ m/s$

c) + / − will be important

Momentum is a vector.

d) $p = mv$ ∴ p = momentum

Trivia: why p? momentum originally was impetus which comes from the Latin word petere and m was already used for mass.

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4) Impulse - momentum theory -

a) $F \Delta t = p_f - p_i$

$\frac{P_f - P_i}{\Delta t} = F$

b) note: $F \Delta t$ = impulse

c) pf - pi = change in momentum

d) P = mv so $P_f - P_i$

can be $mv_f - mv_i$

$F \Delta t = mv_f - mv_i$

$\frac{F \cdot \Delta t + mv_i}{m} = v_f$

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Ex: 1

A 2000 kg car is traveling at 90 km/hr can be stopped in 18s by gentling applying the brakes. It can be stopped in 3.2s by slamming on the brakes. It can also be stopped in 0.20s by hitting a big tree. What is the average force exerted on the vehicle in each type of stop?

$m = 2000\,kg$

$V_i = 90\,km/hr \cdot \frac{1000m}{1\,km} \cdot \frac{1hr}{60min} \cdot \frac{1min}{60sec} = 25\,m/s$

$V_f = 0\,m/s$ $\Delta t_{gentle} = 18s$ $\Delta t_{slam} = 3.2s$ $\Delta t_{Tree} = 0.2s$

F_{gentle}

F_{slam}

F_{Tree}

$F \Delta t = P_f - P_i$

$P_f = m \cdot v_f = 0$

$2000kg \cdot 0 = 0$

$P_i = 2000kg \cdot 25\,m/s$

$F = \frac{mv_f - mv_i}{\Delta t}$

$0 - 5.0 \times 10^4$

$F_{gentle} = \frac{0 - 50{,}000}{18s} = -2{,}777.8\,N$

$F_{slam} = \frac{0 - 50{,}000}{3.2} = -15{,}625\,N$

$F_{Tree} = \frac{0 - 50{,}000}{0.20s} = -250{,}000\,N$

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Why do air bags work?

Read bottom paragraph on pg. 231

1. pg. 233
   1-5 all
   Due Wed.
2. Ch 9 Vocab. - Due Wed.
   Def, word & Example

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