M-GP General Physics Week 28 4/29

Momentum

$p = mv$

$m = 220\ kg \quad v = 8.00\ m/s$

$p = mv$

$(220\ kg)(8.00\ m/s) = 1760\ kg\ m/s$

Thought experiment

Bullet $m = 0.015\ kg \quad v = 900\ m/s$

Football player $m = 103.9\ kg \quad v = 8.34\ m/s$

Momentum of bullet: $p = mv$

$= (0.015\ kg)(900\ m/s) = 13.5\ kg\ m/s$

Momentum of player: $p = mv$

$= (103.9\ kg)(8.34\ m/s) = 866.5\ kg\ m/s$

Momentum is conserved.

Bullet

$m_2 = 0.040\,kg$

$V_2 = 1200\ m/s$

Person

$m_1 = 80\,kg$

What is the velocity of the recoil?

$$\frac{m_1 V_1}{m_1} = \frac{m_2 V_2}{m_1}$$

$$V_1 = \frac{m_2 V_2}{m_1} = \frac{(0.040\,kg)(1200\,m/s)}{80\,kg}$$

$$= \boxed{0.6\ m/s}$$

Elastic collision — kinetic energy and momentum is conserved.

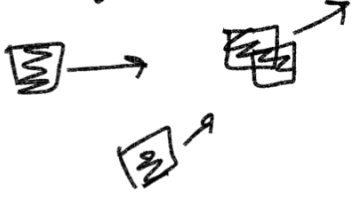
$$M_1 V_{1_i} + M_2 V_{2_i} = M_1 V_{1_f} + M_2 V_{2_f}$$

Only exists with molecules

Perfectly Inelastic Collisions

Two masses collide and form a single mass.

$$M_1 V_1 + M_2 V_2 = (M_1 + M_2) V_f$$



$m_1 = 2,030,000\ kg$

$V_1 = \oplus 8,000\ m/s$

space shuttle

$m_2 = 550,000\ kg$

$V_2 = -1,000\ m/s$

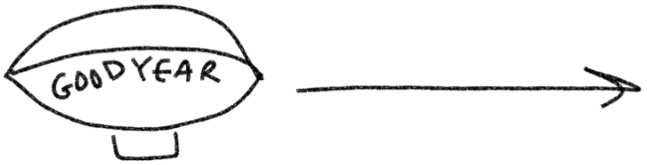
Nate's tombstone

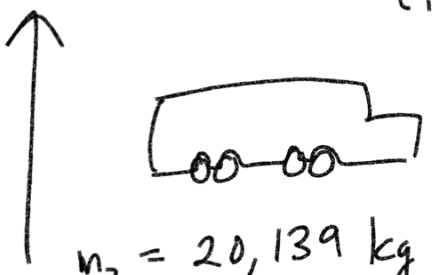
$$\frac{m_1 V_1 + m_2 V_2}{(m_1 + m_2)} = \frac{(m_1 + m_2) V_f}{(m_1 + m_2)}$$

$$V_f = \frac{m_1 V_1 + m_2 V_2}{(m_1 + m_2)} = \frac{(2,030,000\ kg)(8,000\ m/s) + (550,000\ kg)(-1000\ m/s)}{2,030,000 + 550,000}$$

$$= \boxed{6081.4\ m/s}$$

BLIMP Vs. CHARTER BUS (Full)





$m_1 = 5,824\ kg$

$V_1 = 15.65\ m/s$

$m_2 = 20,139\ kg$

$V_2 = 31.3\ m/s$

x-direction

Blimp

$p = m_1 V_1$

$(5,824\ kg)(15.65\ m/s)$

$= 91,145.6\ kg\ m/s$

y-direction

Bus

$p = m_2 V_2$

$(20,139\ kg)(31.3\ m/s)$

$= 630,351\ kg\ m/s$

$$r = \sqrt{x^2 + y^2} = \sqrt{(91,145.6)^2 + (630,351)^2} =$$

$$\text{tot momentum} = 636,906\ kg\ m/s$$

$$\text{resulting velocity} = \frac{\text{tot. momentum}}{\text{tot. mass}} = \frac{636,906\ kg\ m/s}{(5,824 + 20,139)\ kg}$$

$$= 24.5\ m/s$$

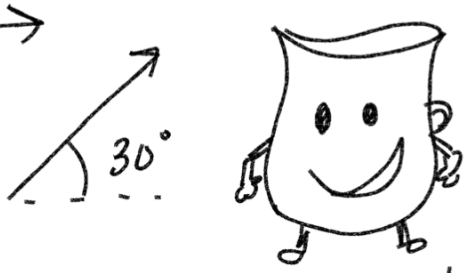
$$\theta = \tan^{-1}\frac{y}{x} = \tan^{-1}\left(\frac{630,351}{91,145.6}\right) = 81.8^\circ$$

$\boxed{24.5\ m/s,\ 81.8^\circ}$

Density of Potato → 1.59 g/metric cup

$D = \frac{M}{V}$ $M = DV$

$1000\ ft^3 \rightarrow$ met cup



Frankie D' Kool.

Mr. Potato Head

$m_1 = 6,080\ kg$

$v_1 = 17.9\ m/s$

Kool-Aid Man

$m_1 = 13,227\ kg$

$v_1 = 4.98\ m/s$

	X-momentum	y-momentum
PH	$(6080\ kg)(17.9\ m/s)$ $108,832\ kg\ m/s$	0
FDK	$(13,227)(4.98)\cos 30$ $57,045\ kg\ m/s$	$(13,227)(4.98)\sin 30$ $32935\ kg\ m/s$
Tot	$165,877\ kg\ m/s$	$32935\ kg\ m/s$

total momentum $\sqrt{x^2+y^2} = \sqrt{(165,877)^2 + (32,935)^2}$

$= 169,115\ kg\ m/s$

$\frac{169,115\ kg\ m/s}{6080 + 13227} = 8.8\ m/s$

$\theta = \tan^{-1}\left(\frac{32935}{165,877}\right)$

$\theta = 11.2°$

$8.8\ m/s,\ 11.2°$