

## Law of Conservation of Momentum

"Law of Interaction"

$$\rho = \rho' \quad \text{prime mean after the interaction}$$

$$\rho_{\text{before}} = \rho'_{\text{after}}$$

Two types of interactions (collisions)

Elastic

"bouncy"

$$p = p'$$

Inelastic

"sticky"

$$p \neq p'$$

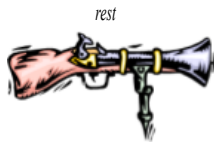
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$$KE = KE'$$

$$KE \neq KE'$$

$$KE = KE' + E$$

What is the recoil velocity of a 3.3 kg rifle if a 45g bullet is shot out at 450 m/s?



$$M_g = 3.3 \text{ kg} \quad v_b = 0$$

$$v_g = 0$$

$$m_b = .045 \text{ kg}$$

$$v_b' = 450 \text{ m/s}$$



$$p = p'$$

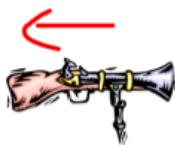
objects:  $m v_b + m v_g = m v_b' + m v_g'$

$$3.3 \text{ kg} (0 \text{ m/s}) + .045 \text{ kg} (450 \text{ m/s}) = m v_b' + m v_g'$$

$$0 = m v_b' + m v_g'$$

$$v_g' = -\frac{m v_b'}{m_g} = -\frac{[.045 \text{ kg} (450 \text{ m/s})]}{3.3 \text{ kg}}$$

$$v_g' = -6.1 \text{ m/s}$$



$$m v_g$$

$$3.3 \text{ kg} (-6.1 \text{ m/s})$$

$$-20 \text{ kg m/s}$$

$$.045 \text{ kg} (450 \text{ m/s})$$

$$+20 \text{ kg m/s}$$

$$0$$

A 250 g ball traveling at 0.20 m/s eastward strikes a second ball of mass 100 g also traveling eastward at 0.10 m/s. After they collide the first ball continues to travel eastward, but at 0.14 m/s. What is the velocity of the second ball after the collision?

"+" east

$$m_1 = .25 \text{ kg}$$

$$v_1 = +.20 \text{ m/s}$$

$$m_2 = .10 \text{ kg}$$

$$v_2 = .10 \text{ m/s}$$

$$v_1' = +.14 \text{ m/s}$$

$$v_2' = ?$$

$$p = p'$$

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

$$\frac{m_1 v_1 + m_2 v_2 - m_1 v_1'}{m_2} = v_2'$$

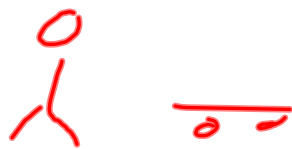
$$\frac{.25 \text{ kg} (.20 \text{ m/s}) + .10 \text{ kg} (.10 \text{ m/s}) - (.25 \text{ kg}) (.14 \text{ m/s})}{.10 \text{ kg}} = v_2'$$

$$v_2' = .25 \text{ m/s}$$

A 55 kg boy runs at 12 km/hr and jumps on a 9.0 kg stationary wagon. What is their velocity after the daring maneuver?

$\rightarrow 3.3 \text{ m/s}$

$$m v_b + m v_w = m v_b' + m v_w'$$



$$v_b' = v_w' = v'$$

$$m v_b + m v_w = v' (m_b + m_w)$$

$$v' = \frac{m v_b + \cancel{m v_w}}{(m_b + m_w)}$$

$$v' = \frac{55 \text{ kg} (3.3 \text{ m/s}) + 0}{(55 \text{ kg} + 9 \text{ kg})}$$

$$v' = 2.9 \text{ m/s}$$