

CONSERVATION OF MOMENTUM

Note Taking Guide - Episode 602

Name _____

Before

All conservation problems are solved using: $p_{initial} = p_{final}$

After car truck

Example Problems:

A 1200 kg car is stopped at a traffic light when a 3500 kg truck moving at 8.4 m/s hits it from behind. If the bumpers lock, how fast will the two vehicles move?

$$p_{car} + p_{truck} = p_{both}$$

$$0 + 3500 \text{ kg} \cdot 8.4 \text{ m/s} = 4700 \text{ kg} \cdot v$$

$$v = 6.3 \text{ m/s}$$

A 0.0050 kg bullet is fired at a velocity of 320 m/s from a 2.0 kg gun. What is the recoil velocity of the gun?

$$p_{initial} = p_{final}$$

$$0 = 0.005 \text{ kg} \cdot 320 \text{ m/s} + 2 \text{ kg} \cdot (-v)$$

$$v = 0.80 \text{ m/s backwards}$$

Physics Challenge:

The system formed of gun and ^{the} person using the gun is heavier than the gun alone and will move slower, with a smaller recoil velocity.

Use the impulse equation to answer:

Which is greater?

(car, bug, or =)

State your reason here.

Force	=	Newton's third Law
Time	=	the contact time is the same
Impulse	=	$F \cdot t = \text{impulse}$
Change in Momentum	=	change in momentum = $\Delta p = F \cdot t$
Mass	car	the car is heavier
Change in Velocity	bug	the change in velocity for the bug is bigger because the mass of the bug is smaller

Show What You Know: 1-5 (on back)

①

$$m_1 = 65 \text{ kg}$$

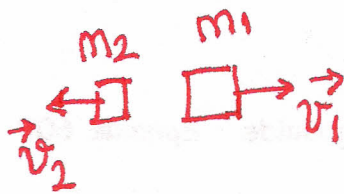
$$m_2 = 12 \text{ kg}$$

$$v_2 = 2.2 \text{ m/s}$$

$$v_1 = ?$$



Before



After

$$P_{\text{Before}} = 0 \text{ kg} \cdot \text{m/s}$$

$$P_{\text{After}} = P_{\text{Before}} = 0 = m_1 v_1 - m_2 v_2$$

$$m_1 v_1 = m_2 v_2$$

$$v_1 = \frac{m_2 v_2}{m_1}$$

$$v_1 = \frac{12 \text{ kg} \cdot 2.2 \text{ m/s}}{65 \text{ kg}} = 0.41 \text{ m/s}$$

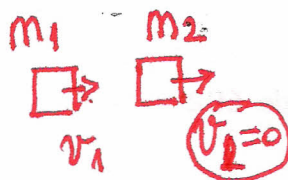
②

$$m_1 = 14000 \text{ kg}$$

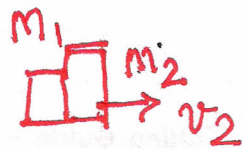
$$v_1 = 5.2 \text{ m/s}$$

$$v_2 = 3.6 \text{ m/s}$$

$$m_2 = ?$$



Before



After

$$P_{\text{Before}} = m_1 \cdot v_1$$

$$P_{\text{After}} = (m_1 + m_2) \cdot v_2$$

$$P_{\text{Before}} = P_{\text{After}}$$

$$\Rightarrow m_1 v_1 = (m_1 + m_2) \cdot v_2$$

$$m_1 v_1 = m_1 \cdot v_2 + m_2 v_2$$

$$m_2 = \frac{m_1 (v_1 - v_2)}{v_2}$$

$$m_2 = \frac{14000 \text{ kg} (5.2 \text{ m/s} - 3.6 \text{ m/s})}{3.6 \text{ m/s}}$$

$$m_2 = 6222 \text{ kg} \approx 6200 \text{ kg}$$

- 1) A collision in which the objects stick together or are deformed is...
 - a. elastic.
 - b. inelastic.

- 2) The only perfectly elastic collision is between...
 - a. billiard balls.
 - b. bumper cars.
 - c. gas molecules.
 - d. none of these.

- 3) Momentum is...
 - a. conserved in elastic collisions only.
 - b. conserved in inelastic collisions only.
 - c. conserved in explosions only.
 - d. conserved in all collisions and explosions.

- 4) A gun will kick with less velocity if the mass of the gun is...
 - a. increased.
 - b. decreased.
 - c. neither, because mass does not effect momentum.

- 5) When a ball and bat collide, the ball experiences the greater...
 - a. force.
 - b. impulse.
 - c. change in momentum.
 - d. change in velocity.

Answers:

1. b
2. c
3. d
4. a
5. d