W - GP Week 27 (Ch 9.1 - 9.3)

Chapter 9 - Linear Momentum and Collisions

9.1 Linear Momentum and its Conservation

1.) Define linear momentum. Include the relevant equation.

2.) A 0.050 kg bullet travels 1,500 m/s. What is the momentum of the bullet?

3.) A wiseman once said everyone has a plan until they get punched in the face. That wiseman was Mike Tyson. In his prime, getting hit by Mike Tyson felt like getting hit by a mack truck. Let's put that to the test. A mack truck weighs 36,000 kg. How fast would Mike Tyson's 4 kg fist have to travel to emulate a mack truck traveling 30 m/s?

4.) At the NFL combine college players must each record a 40 meter sprint time. The table below shows the times and weights of four different players.

Player	Position	Weight	Time
Jonathan Taylor	RB	226 lbs	4.39 s
Henry Ruggs III	WR	188 lbs	4.27 s
Tristan Wirfs	OL	320 lbs	4.85 s
Isaiah Simmons	LB	238 lbs	4.39 s

If there is 2.2 lbs per 1 kilogram, find the linear momentum of each player.

5.) How does linear momentum relate to force?

6.) Define the law of conservation of linear momentum. Write the relevant equation.

7.) How fast would a 80 kg individual travel if Mike Tyson's 4 kg fist punches them in the face travelling 40 m/s?

8.) How fast would a 65 kg individual recoil upon firing a 0.040 kg bullet at a speed of 1,200 m/s?

9.) An astronaut is thrown into outer space. With all of her equipment, she weighs 220 kg. How fast would she have to throw a 1.5 kg wrench to travel at a rate of 0.20 m/s back toward the shuttle?

9.2 Impulse & Momentum

10.) Define impulse.

11.) Demonstrate impulse within a force vs time curve.

12.) What is the equation(s) for impulse?

13.) What does impulse suggest about force?

14.) What is the impulse of an object when a constant force of 85 N is applied for 2 seconds?

15.) What is the “impulse approximation”?

16.) What is the impulse of a baseball when struck by a baseball bat exerting a constant force of 7,000 N for 0.02 s?

17.) A golf ball of mass 50 g is struck with a club. The force exerted by the club on the ball varies from zero, at the instant before contact, up to some maximum value and then back to zero when the ball leaves the club. Assuming that the ball travels 200 m, estimate the magnitude of the impulse caused by the collision if the ball is launched at an angle of 45°. (Note: use range formula, max range = $(v^2/g) \sin 2\theta$)

18.) In a particular crash test, a car of mass 1,500 kg collides with a wall. The initial and final velocities of the car are **v***i* □ □15.0**i** m/s and **v***f* □ -2.60**i** m/s, respectively. If the collision lasts for 0.150 s, find the impulse caused by the collision and the average force exerted on the car.

9.3 Collisions in One Dimension

19.) What is a “collision”?

20.) With respect to a collision, explain the difficulties regarding the phrase “physical contact”.

21.) Define elastic collision.

22.) Why is a completely elastic collision unlikely?

23.) What is kinetic energy?

24.) Define inelastic collision.

25.) What is a perfectly inelastic collision?

26.) Write the equation for elastic collisions. Include both momentum and kinetic energy equations.

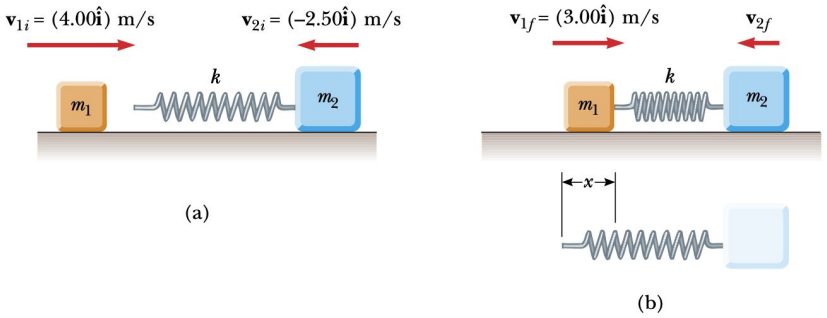
27.) Write the equation for inelastic collisions.

28.) A truck with a mass of 3,200 kg travelling 35 m/s collides with a 2,300 kg car travelling 40 m/s. If the crash is a perfectly rigid, elastic collision, how fast will the car be travelling if the truck is moving at 24 m/s after the collision?

29.) A truck with a mass of 3,800 kg travelling 42 m/s collides with a 2,600 kg car travelling 38 m/s. If the two vehicles smash together within the collision, how fast will they be moving after the collision?

30.) An 1,800 kg car stopped at a traffic light is struck from the rear by a 900 kg car, and the two become entangled, moving along the same path as that of the originally moving car. If the smaller car were moving at 20.0 m/s before the collision, what is the velocity of the entangled cars after the collision?

31.) A block of mass m_1 1.60 kg initially moving to the right with a speed of 4.00 m/s on a frictionless horizontal track collides with a spring attached to a second block of mass m_2 □ 2.10 kg initially moving to the left with a speed of 2.50 m/s. The spring constant is 600 N/m.



a) Find the velocities of the two blocks after the collision.

b) During the collision, at the instant block 1 is moving to the right with a velocity of □3.00 m/s Determine the velocity of block 2.

c) Determine the distance the spring is compressed at that instant.