4.10 The Tension Force
- **Tension & ropes:**
  - **Example 1:** A 12.0 kg Lantern is suspended from the ceiling by two vertical wires. What is the tension in each wire?
  - **Example 2:** Ignoring friction, what would be the magnitude of the acceleration in this system?
- **Conceptual Question 1:** A rope is used in a tug-of-war between two teams of five people each. Both teams are equally strong, so neither team wins. An identical rope is tied to a tree, and the same 10 people pull just as hard on the loose end as they did in the contest. In both cases, the people pull steadily with no jerking. Which rope, if either, is more likely to break?

4.11 Equilibrium Applications of Newton’s Laws of Motion
- **Equilibrium**
- **Examples**
- **Equations**
  - **Conceptual Question 2:** Can an object ever be in equilibrium if the object is acted on by only (a) a single nonzero force, (b) two forces that point in mutually perpendicular directions, and (c) two forces that point in directions that are not perpendicular?
  - **Conceptual Question 3:** Imagine running a rope horizontally and hang a box from its middle. Can the rope be pulled tight enough to be completely horizontal?

Chapter 7. Impulse and Momentum
- **Compare with Force Approach**
- **The Law of Dynamics**
  - **Momentum**=
    - **Vector.**
    - **Math tool – Conceptual tool.**
    - **Example 3.** What’s the momentum of a 68 kg (150 lbs) adult walking (4mph) 7.2 m/s East?
    - **Example 4.** What’s the momentum of a 34 kg (75 lbs) kid running (8mph) 14.4 m/s West?
  - **Conceptual Question 4:** Two identical automobiles have the same speed, one traveling east and one traveling west. Do these cars have the same momentum? Explain.
  - **Ex 5.** Two arrows are fired horizontally with the same speed of 30.0m/s. Each arrow has a mass of 0.100 kg. One is fired due east and the other due south. Find the magnitude and direction of the total momentum of this two-arrow system. Specify the direction with respect to due east.
• Newton’s 1st Law in terms of Momentum

7.1 The Impulse – Momentum Theorem

• Newton’s Second Law In terms of Momentum
  o Rephrase Newton’s 2nd
  o Conceptual Question 5: You have a choice. You may get hit head-on either by an adult moving slowly on a bicycle or by a child that is moving twice as fast on a bicycle. The mass of the child and bicycle is half that of the adult and bicycle. Considering only the issues of mass and velocity, which collision do you prefer? Or doesn’t it matter?

  o Example 6: A 62.0 kg person, standing on a diving board, dives straight down into the water. Just before striking the water, her speed is 5.50 m/s. At a time of 1.65 s after entering the water, her speed is reduced to 1.10 m/s. What is the average net force (magnitude and direction) that acts on her when she is in the water?

7.2 The Principle of Conservation of Linear Momentum, Newton’s 3rd Law

• Principle of Mechanics:
  • I suggested this principle the first day of class.
    o Forces: Focus on the interaction
    o Momentum: Focus on the Motion
  • Points of note:
    ▪ Mass
    ▪ Vector

  • Ex. 7 In a ballistocardiograph a patient lies on a horizontal table which rests on a cushion of air (much like an air cart on the air track). With the beat of the heart, the patient’s blood rushes out, headward. The net motion of the blood is about 0.050 kg headward at 0.25 m/s. If the patient and table together have a mass of 85 kg, what is their recoil velocity?

Phys 220 HW13 Statement Ch7 Pr. 18
Problems from Cutnell & Johnson 6th Ed., solutions from accompanying source.

18. Consult Concept Simulation 7.1 (http://www3.interscience.wiley.com:8100/legacy/college/cutnell/0471151831/concepts/index.htm) in preparation for this problem. Two friends, Al and Jo, have a combined mass of 168 kg. At an ice skating rink they stand close together on skates, at rest and facing each other, with a compressed spring between them. The spring is kept from pushing them apart because they are holding each other. When the release arms, Al moves off in one direction at a speed of 0.90 m/s, while Jo moves off in the opposite direction at a speed of 1.2 m/s. Assuming that friction is negligible, find Al’s mass.