### 4.5 The Gravitational Force

- **Newton’s Universal Gravitation Law:**
  - In English
  - Separation
  - G
  - Universality
    - Where in a body does it apply?
    - Weight
- **Example 1:** What’s the percent difference between your weights in L.A. and on top of a 14,000 ft peak?
- **Example 2:** What is the ratio of forces exerted by the Sun on you and by the Moon on you?
- **Example 3:** What is the net force exerted on the moon when it is in position for a solar eclipse? (be careful about signs)
- **Example 4:** What is the net force on the Earth in this configuration?

### Other, everyday forces
- Normal Force, Tension, Friction

#### 4.6 The Normal Force

- **On the level**
  - Case: \( a = 0 \)
  - Case: \( a > 0 \)
    - Common experience
  - Case \( a < 0 \)
    - Common experience
  - **Example 5.** A 230 kg pool table is set up in a second story room.
    - A) What is the normal force that the table exerts on the floor? B) If a 90 kg person lays across it to make a hard shot, what now is the normal force exerted by the table on the floor?
    - Apparent Weight
    - Inclined plane
Phys 220

HW11 Statement

Problems from Cutnell & Johnson 6th Ed., solutions from accompanying source.

18. A bowling ball (mass = 7.2 kg, radius = 0.11 m) and a billiard ball (mass = 0.38 kg, radius = 0.028 m) may each be treated as uniform spheres. What is the magnitude of the maximum gravitational force that each can exert on the other?

34. A 35-kg crate rests on a horizontal floor, and a 65-kg person is standing on the crate. Determine the magnitude of the normal force that (a) the floor exerts on the crate and (b) the crate exerts on the person.

98. The drawing shows three particles far away from any other objects and located on a straight line. The masses of these particles are \( m_a = 363 \) kg, \( m_B = 517 \) kg, and \( m_c = 154 \) kg. Find the magnitude and direction of the net gravitational force acting on (a) particle A, (b) particle B, and (c) particle C.