Newton's Laws

Physics 513

As Told to Us by Newton …

- Every body perseveres in its state of being at rest or of moving uniformly straight forward except insofar as it is compelled to change its state by forces impressed

- ***Philosophiæ Naturalis Principia Mathematica***

Let's Give This One a Whirl…

- Three professional wrestlers are fighting over a champion's belt. The first wrestler applies a force of 250 N 53° NW. The second wrestler applies a force of 50 N East. And the third wrestler applies a force of 120 N South. Find the force a fourth wrestler must apply to the belt to bring it into a state of equilibrium

Newton's First Law

Physics 513

Compatriots, What Say You All?

- In which of the following situations is there zero net force on the body?
- (i) an airplane flying due north at a steady 120 m/s and at a constant altitude;
- (ii) a car driving straight up a hill with a 3° slope at a constant 90 km/h;
- (iii) a hawk circling at a constant 20 km/h at a constant height of 15 m above an open field;
- (iv) a box with slick, frictionless surfaces in the back of a truck as the truck accelerates forward on a level road at 5 m/s^2

Newton's Second Law

Physics 513

As Told to Us by Newton …

- A change in motion is proportional to the motive force impressed and takes place along the straight line in which that force is impressed

- ***Philosophiæ Naturalis Principia Mathematica***

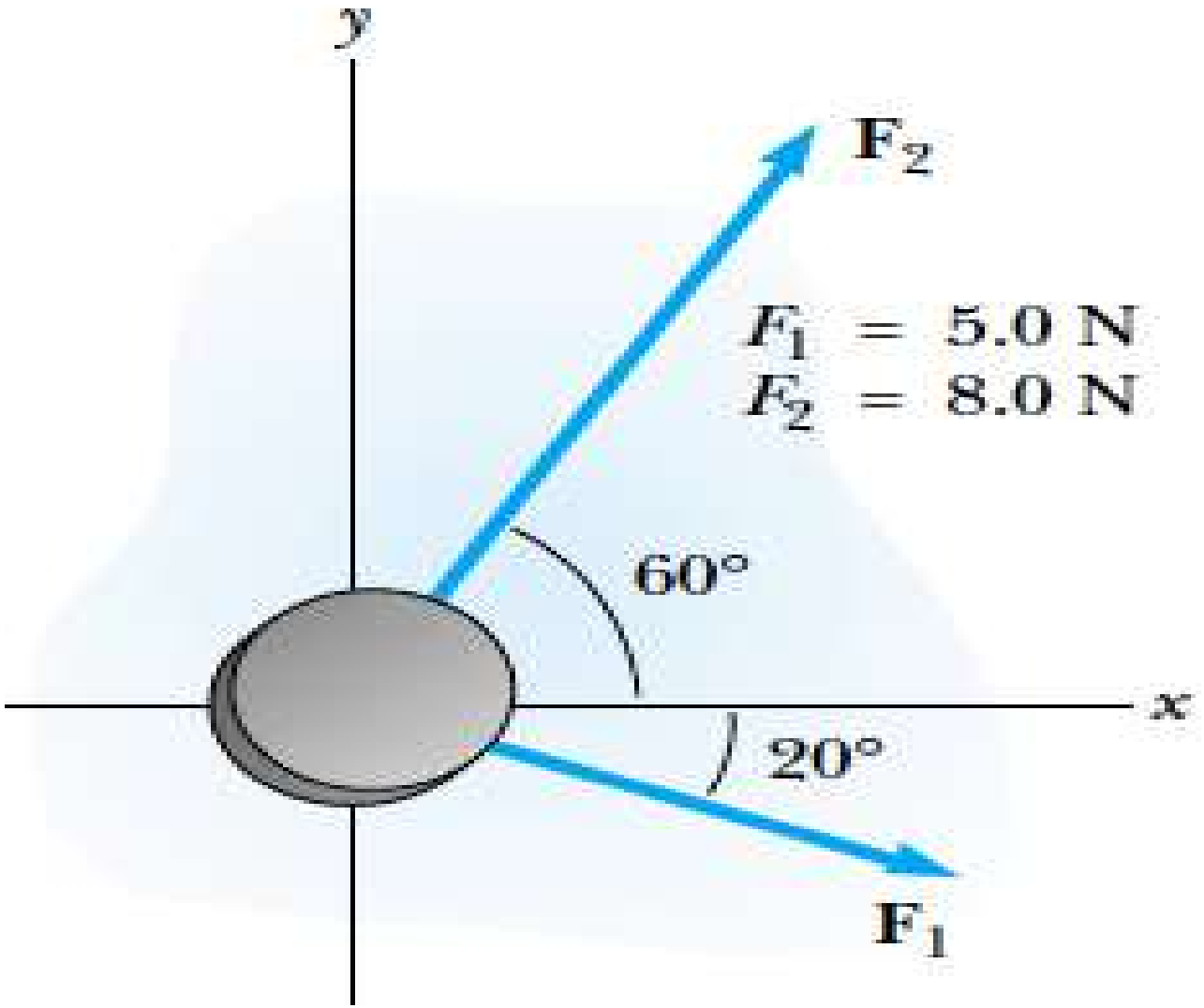
Let's Work on a Second Law Problem

- A waitress shoves a ketchup bottle with mass 0.45 kg to her right along a smooth, level lunch counter. The bottle leaves her hand moving at 2.8 m/s, then slows down as it slides because of a constant horizontal friction force exerted on it by the countertop. It slides for 1.0 m before coming to rest. What are the magnitude and direction of the friction force acting on the bottle?

This One is a Bit Trickier…

- A hockey puck having a mass of 0.30 kg slides on the horizontal, frictionless surface of an ice rink. Two hockey sticks strike the puck simultaneously, exerting the forces on the puck shown in the figure on the next slide. Determine both the magnitude and the direction of the puck's acceleration

Figure



Weight vs. Mass

Physics 513

Let's "Munch" on This One

- A Rolls-Royce Phantom weighing (magnitude) 2.49 x 10^4 N traveling in the +x-direction makes an emergency stop; the net force acting on the car is 1.83 x 10^4 N West. What is the car's acceleration?

Penny for Your Thoughts…

- Suppose an astronaut landed on a planet where $a_g = 19.6\ m/s^2$.
- Compared to earth, would it be easier, harder, or just as easy for her to walk around?
- Would it be easier, harder, or just as easy for her to catch a ball that is moving horizontally at 12 m/s? (Assume that the astronaut's spacesuit is a lightweight model that doesn't impede her movements in any way.)