
Problem set 3

▪ Relative Velocity and Relative Acceleration

Duffy drives a red jeep traveling due east with a speed of 50.0 km/h. Raindrops are falling at a constant speed vertically with respect to the Earth. The traces of the rain on the side windows of the jeep make an angle of 60.0° with the vertical. Find the velocity of the rain with respect to

- (a). Duffy's jeep and
- (b). The Earth.

▪ Particle in Uniform Circular Motion

Astronaut *Mark Watney* orbiting the Earth is preparing to dock with his spacecraft *Hermes*. *Hermes* is in a circular orbit 600 km above the Earth's surface, where the free-fall acceleration is 8.21m/s^2 . Take the radius of the Earth as 6400 km. Determine the speed of *Hermes* and the time interval required to complete one orbit around the Earth, which is the period of *Hermes*.

▪ Newton's Second Law

1. The force exerted by the wind on the sails of Duffy's sailboat is 390N north. The ocean water exerts a force of 180 N east. If his boat (including Duffy) has a mass of 270 kg, what are the magnitude and direction of its acceleration?
2. Two adults and a child want to push a wheeled cart in the direction marked x in Fig p3.1. The two adults push with horizontal forces \vec{F}_1 and \vec{F}_2 as shown.
 - (a). Find the magnitude and direction of the smallest force that the child should exert. Ignore the effect of friction.
 - (b). If the child exerts the minimum force found in part (a), the cart accelerates at 2.0 m/s^2 in the $+x$ -direction. What is the weight of the cart? ($\text{weight} = \text{mass} \times g$)

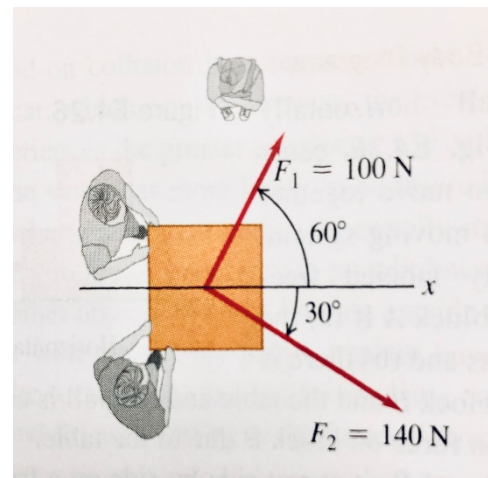


Figure p3.1