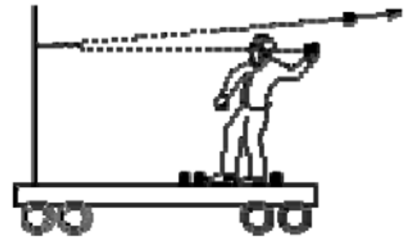
Practical Discussion Problems (7)

Applications to Dynamics & Impulse



Q1: Suppose you are on a cart, initially at rest on a track with very little friction. You throw balls at a partition that is rigidly mounted on the cart. If the balls bounce straight back as shown in the figure, is the cart put in motion?

1. Yes, it moves to the right. 2. Yes, it moves to the left.
3. No, it remains in place. 4. Not enough information is given to decide.

Q2: A block of mass m is tied to two strings as shown in the figure below. Each string has a length L. The angle $\theta = 30^\circ$. Assume the strings are massless. If we cut one string and the block starts to swing down, the tension in the string when the block reaches the lowest point is

1.less than mg 2.mg 3.greater than mg
4.zero 5.insufficient information

Q3: A car of mass m is going around a circular turn of radius R which is banked at an angle θ with respect to the ground. Assume there is a coefficient of static friction μs between the wheels and the road. Let g be the magnitude of the acceleration due to gravity. You may neglect kinetic friction. In each part below show your force diagrams.

a) Describe the motion of the car if the car is traveling very slowly or extremely fast. Is it possible for the car to travel at speeds such that it can undergo circular motion? If so, what coordinate system best suits this problem. In particular, describe the acceleration vector in terms of your coordinate system unit vectors.

b) Derive an expression for the minimum velocity necessary to keep the car moving in a circle without slipping down the embanked turn. Express your answer in terms of the given quantities.

c) Derive an expression for the maximum velocity necessary to keep the car moving in a circle without slipping up the embanked turn. Express your answer in terms of the given quantities.

d) Derive an expression for the velocity necessary to keep the car moving in a circle without slipping up or down the embanked turn such that the static friction force vanishes. Express your answer in terms of the given quantities.