Prof. Anchordoqui

Problems set # 3 **Physics 168**

1. You are stranded in space away from your spaceship. Fortunately, you have a propulsion unit that provides a constant force $\vec{F}$ for 3 s. After 3 s, you have moved 2.25 m. If your mass is 68 kg, find $\vec{F}$.

2. A particle of mass 0.4 kg is subjected simultaneously to two forces $\vec{F}_1 = -2.00\ \text{N}\,\hat{i} - 4.00\ \text{N}\,\hat{j}$ and $\vec{F}_2 = -2.60\ \text{N}\,\hat{i} + 5.00\ \text{N}\hat{j}$. If the particle is at the origin and starts from rest at $t = 0$, find (a) its position $\vec{r}$ and (b) its velocity $\vec{v}$ at $t = 1.60$ s.

3. What is the acceleration of an object at the altitude of the space shuttle's orbit, above 400 km above the Earth surface.

4. You are working for a big delivery company, and must unload a large, fragile package from your truck, using a delivery ramp. If the downward component of the velocity of the package when it reaches the bottom of the ramp is greater than 2.50 m/s, the package will break. What is the largest angle at which you can safely unload? The ramp is 1.00 m high, has rollers (i.e, the ramp is approximately frictionless), and is inclined at an angle θ to the horizontal.

5. As your plane speeds down the runway on takeoff, you decide to determine its acceleration, so you take out your yo-yo and note that when you suspended it, the string makes and angle of 22 degrees with the vertical. (a) What is the acceleration of the plane? (b) If the mass of the yo-yo is 40.00 g, what is the tension in the string?

6. Suppose that your mass is 80 kg and your are standing on a scale fastened to the floor of an elevator. The scale measures force and is calibrated in newtons. What does the scale reads when (a) the elevator is rising with upward acceleration of magnitude a; (b) the elevator is descending with downward acceleration of magnitude a'; (c) the elevator is rising at 20 m/s and its speed is decreasing at a rate of 8.0 m/s^2?

7. You are an astronaut constructing a space station, and you push a box of mass m_1 with force $\vec{F}_{A1}$. The box is in direct contact with a second box of mass m_2. (a) What is the acceleration of the boxes? (b) What is the magnitude of the force each box exerts on the other?

8. A hard cover book is resting on a tabletop with its front cover facing upward. You place a coin on this cover and very slowly open the book until the coin starts to slide. The angle θ_{max} (known as the angle of repose) is the angle the front cover makes with the horizontal just as the coin starts to slide. Find the coefficient of the static friction μ_s between the book cover and the coin in terms of θ_{max}.

9. A train locomotive is pulling two cars of the same mass behind it. Determine the ratio of the tension in the coupling between the locomitive and the first car (F_{T1}) to that between the first car and the second car (F_{T2}), for any non-zero acceleration of the train. (See Fig. 1)

10. (a) If the horizontal acceleration produced by an earthquake is a, and if an object is going to "hold its place" on the ground, show that the coefficient of static friction with the ground must be at least $\mu_s = a/g$. (b) The famous Loma Prieta earthquake that stopped the 1989 World Series produced ground accelerations of up to 4 m/s^2 in the San Francisco Bay Area. Would a chair have started to slide on a linoleum floor with coefficient of static friction 0.25?

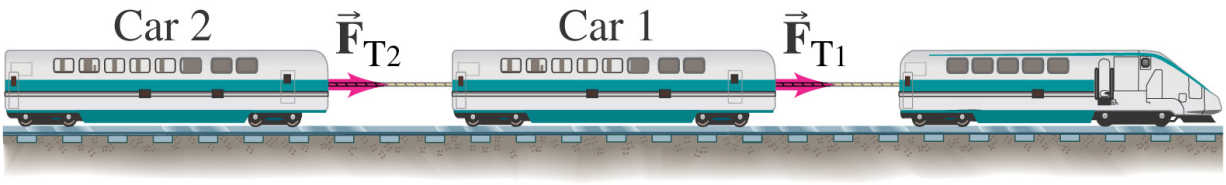

Figure 1: The situation in problem 9.