PHY 140Y – FOUNDATIONS OF PHYSICS
2001-2002
Tutorial Questions #4
October 9

Note: October 8th is a holiday. Students from a Monday tutorial may attend one of the Tuesday October 9th tutorials, at 2-3 in UC 67, 2-3 in RW 141, 4-5 in LM 157, or 4-5 in MP 408.

Non-Uniform Circular Motion

1. After takeoff, a plane makes a three-quarter circle turn of radius 7.1 km, maintaining constant altitude but steadily increasing its speed (at a constant rate) from 390 to 740 km/hr. Midway through the turn, what are (a) the magnitude of the plane's acceleration, and (b) the angle between the plane's velocity and acceleration vectors?

Relative Motion

2. An airplane with an air speed of 370 km/hr flies perpendicular across the jet stream. To achieve this flight, the airplane must be pointed into the jet stream at an angle of 35° from the perpendicular direction of its flight. What is the speed of the jet stream?

Newton's Laws of Motion

3. (a) What is the normal force felt by a person of mass 60.0 kg standing on the Earth's equator? By what percentage does the Earth's rotation reduce the normal force from that due to gravity? (b) What would happen to this force if the Earth's rotation rate increased (or, alternatively, if the period elapsed in a "day" decreased)? (c) How long would the Earth's day have to be in order to make the normal force zero. In this case, what would the person feel? The equatorial radius of the Earth is 6378 km.

4. Consider the conical pendulum shown in the figure. The pendulum consists of a mass m on the end of a massless string of length L. The other end of the string is fixed to a ceiling. Given the proper push, this pendulum can swing in a circle at a given angle θ, maintaining the same height h throughout its swing. (a) What is the force diagram for such a pendulum? (b) If the mass of the pendulum is m = 0.2 kg, the length of the pendulum is L = 0.5 m, and the angle at which it swings is θ = 10°, what is the speed of the mass as it swings? (c) Returning to general expressions, what is the angular velocity ω of the mass in terms of the string angle θ and string length L?