PHY 116 From Newton to Einstein
Exercise Sheet 4: Circular Motion

Date issued: 17th October 2012 Hand in by 4pm, 22th October 2012

All questions are taken from Young and Freedman

A1) A stone with a mass 0.8 kg is attached to one end of a string 0.9m long. The string will break if the tension exceeds 600N. The stone is rotated in a horizontal circle on a frictionless tabletop; the other end of the string remains fixed. Find the maximum speed the stone can attain without breaking the string. [2]

A2) A flat (unbanked) curve on a highway has a radius of 180m. A car rounds the curve at a speed of 25.0 ms^{-1}. What is the minimum coefficient of friction that will prevent sliding? [2]

A3) Aircraft experience a lift force that is perpendicular to the plane of the wings and to the direction of flight. A small aircraft is flying at a constant speed of 240 km/h. At what banking angle from the horizontal must the wings of the aircraft be tilted for the aircraft to execute a horizontal turn with a radius of 1200m? [3]

A4) A circular space station rotates to provide an "artificial gravity" at the outside rim.

a) If the diameter of the space station is 600m, how many revolutions per minute are needed in order for the "artificial gravity" acceleration to be 10 ms^{-2}?
b) If the space station is a waiting area for travellers to Mars, it might be desirable to simulate the acceleration due to gravity of the Martian surface (3.70 ms^{-2}). How many revolutions per minute are needed in this case? [4]

B5) A rope is attached to a bucket of water which is swung in a vertical circle of radius 0.6 m. What must the minimum speed of the bucket be at the highest point if no water is to spill from it? [2]

B6) A bowling ball weighing 71.2 N is attached to the ceiling by a 3.8 m rope. It is pulled to one side and released to swing back and forth. As the rope swings through the vertical, the speed of the bowling ball is 4.2 $m.s^{-1}$.

a) What is the acceleration of the bowling ball, in magnitude and direction, at this instant?
b) What is the tension in the rope at this instant? [2]