

Physics 151 Class Exercise: Centripetal Acceleration

For each of the following situations, draw a free body diagram showing all of the forces acting on the object. Then write an equation expressing the sum of forces in the radial direction – along the line from the object to the center of the circle and **write an algebraic expression for the centripetal acceleration a_c in terms of the given variables.**

Situation #1 – A boy ties a ball to the end of a string (length L) and swings the ball in a vertical circle. Consider the ball when it is at the lowest point in its swing, the tension in the string is T at that moment.

Situation #2 – The boy then attempts to swing the ball (mass m) in a horizontal circle (radius R) about his head. (Hint: How does gravity affect the direction of the tension in the string?)

Situation #3 – A bug sits on the edge of a 45 record being played on a turntable, the coefficient of the static friction between the bug and a record is μ .

Situation #4 -- A car moves on a circular exit ramp banked at angle α to the horizontal. Neglect friction. (Hint: Draw the car so that you are looking at the back or the front.)

Situation #5 – A “corkscrew” roller coaster does a loopy-loop. Consider the situation of a man of mass m riding in the roller coaster when he is upside-down, the normal force acting on the man is N .

Situation #6 - A daredevil stunt involves riding a motorcycle around the vertical inside wall of a cylindrical structure. The coefficient of friction between motorcycle and a wall is μ (Hint: How big does the normal force have to be?)