1) A cannon shoots a ball at an angle θ above the horizontal ground. (a) Neglecting air resistance, use Newton's Second Law to find the ball's position as a function of time. (Use axes with x measured horizontally and y vertically.) (b) Let $r(t)$ denote the ball's distance from the cannon. What is the largest possible value of θ if $r(t)$ is to increase throughout the ball's flight? [Hint: Using (a)'s solution you can write down r^2 as $x^2 + y^2$, and then find the condition that r^2 is always increasing.]

2) An astronaut in gravity-free space is twirling a mass m on the end of a string of length R in a circle, with constant velocity w. Write down Newton's second law in polar coordinates and find the tension in the string.

3) A slab of mass M1 = 40.0 kg rests on a frictionless floor, and a block of mass M2 = 10.0 kg rest on top of this slab. Between the block and slab, the coefficient of static fraction is 0.60, and 0.40 is the coefficient of kinetic friction. A horizontal force of 100 N is applied to the block (on top of slab). What are the resulting accelerations of the block and slab? You must draw pictures and Free Body Diagrams to get full credit.

4) A student wants to determine the coefficients of static friction and kinetic friction between a box and a plank. She places a box on the plank and gradually raises one end of the plank. When the angle of inclination with the horizontal reaches 30°, the box starts to slip, and it then slides 2.5 m down the plank in 4.0 s at constant acceleration. What are (a) the coefficient of static fraction and (b) the coefficient of kinetic fraction between the box and the plank? You must draw pictures and Free Body Diagrams to get full credit.