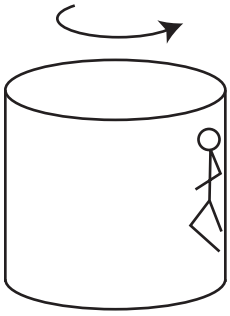
## Sample Midterm 2

**1.** A canon on flat ground is aimed at 45° above the horizontal. What is the minimum initial speed that the canonball must have in order to make it over a wall that is 3 m high and 10 m away?

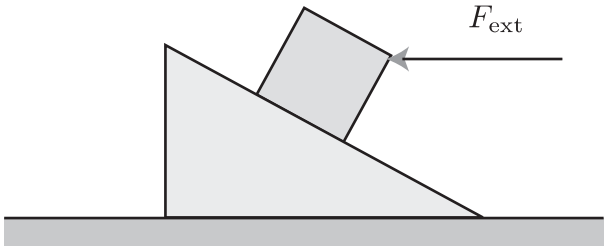
**2.** A girl of mass 20 kg is riding in a "barrel of fun." This is an amusement park ride in which a large hollow cylinder with inner radius 3 m rotates at a rate of 0.5 rotations per second. The girl inside the cylinder finds herself "stuck to the wall," with her feet dangling off the floor.



**(a)** (10 points) Draw a free-body diagram for the girl showing all forces acting on her. Clearly indicate the physical origin of each of the forces.

**(b)** (23 points) Find the minimum coefficient of static friction between the girl and the wall of the cylinder so that she can remain stuck to the wall without sliding down.

**3.** A block of mass 1 kg is on an inclined plane of mass 3 kg that makes an angle 30° with the horizontal. The inclined plane is free to slide on a horizontal surface. All surfaces are frictionless. A horizontal external force $F_{\text{ext}}$ acts on the block.




**(a)** (10 points) Draw free-body diagrams for the block and the inclined plane, showing all forces acting on them. Clearly indicate the physical origin of each of the forces.

**(b)** (23 points) Find the value of $F_{\text{ext}}$ such that the block and the inclined plane move together, without the block sliding up or down the plane.