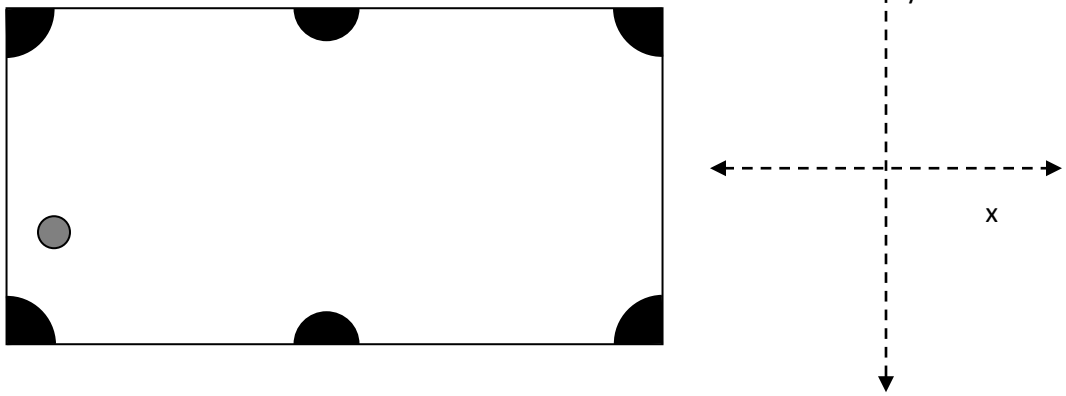
1. A train accelerates at a constant rate of $a = 3\ {}^{m}/_{s^2}$ in a constant direction along a region of perfectly smooth, horizontal track. In the train, a bowling ball with a mass of 6 kg hangs from a 2 meter long piece of string attached to the ceiling. In the reference frame of the train, draw a free body diagram for the bowling ball and identify the fictitious force(s) acting on it. What angle does the string make with respect to the vertical direction?

2. A car traveling at 15 m/s exits a freeway along a horizontal, flat, smooth, curved ramp with a radius of 500 meters. A cup of coffee with a mass of 200 grams sits on the dash of the car. What force of friction (size and direction) is necessary to ensure that the cup of coffee remains motionless in the non-inertial frame of reference of the car? What fictitious force (size and direction) does the cup seem to experience?



(An exam question from a past semester of this course. Enjoy!)

3. A man is playing pool inside of an accelerating train. The pool table is oriented as shown and the train is accelerating in the $\hat{y}$ direction at $0.6\,{}^{m}/_{s^2}$ relative to the outside world. The man hits the ball with an initial velocity oriented purely in the $\hat{x}$ direction in *his* frame of reference (i.e., the train). The ball's initial position is 1 meter from the hole in the $-\hat{x}$ direction and 15 cm from the hole in the $\hat{y}$ direction, as shown.

   a) On the picture above, make a sketch of the path of the ball on the table. (5 points)
   b) What are the size and direction of the fictitious force experienced by the ball? (Consider the ball to have a mass "m".) (5 points)
   c) What initial speed must the ball have to make it into the hole indicated in the picture? (20 points)