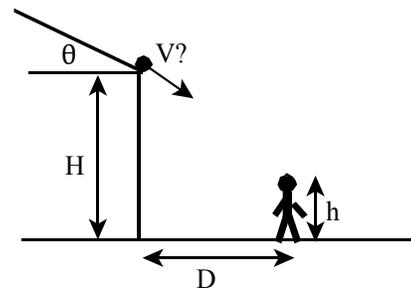**Physics 1135 Test 1 Preparation Homework**

1. Students roll a snowball from a roof that makes an angle θ with respect to the horizontal. The snowball leaves the roof with speed V, at height H above the ground. A physics professor is standing a horizontal distance D away from the building; the professor's head is at height h above the ground.
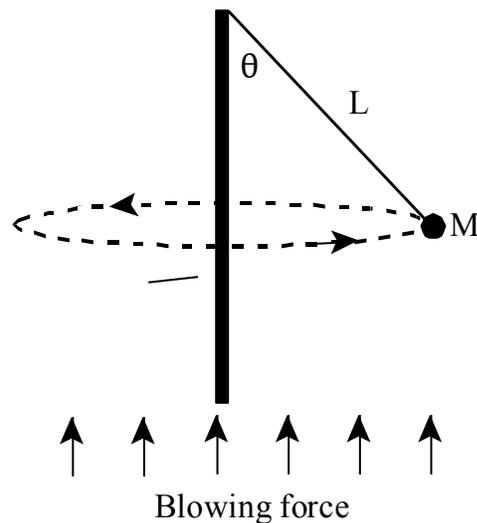
a) Complete the diagram with all information necessary for the task below.
b) Derive an expression for the initial speed V the snowball must have in order to hit the professor's head.
c) Derive an expression for the speed with which the snowball hits the professor's head. You may use V as a system parameter for this part.

2. A block of mass $2M$ is moving to the left on a rough horizontal surface because a constant pulling force of magnitude P is applied to the block at an angle θ with respect to the horizontal. The block remains in contact with the surface at all times, and the coefficient of kinetic friction between block and surface is μ. The block is connected to the end of a massless string that runs over a massless frictionless pulley. A block of mass M is suspended from the other end of the string.
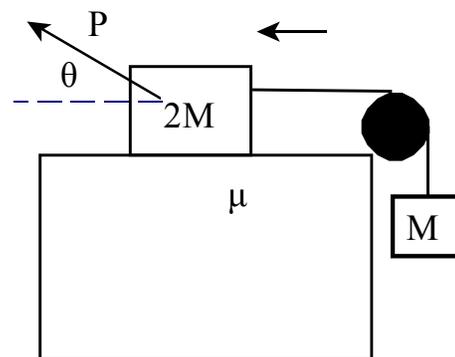
a) On the figure, superimpose fully labeled free-body diagrams for each block, including all information that you need to solve the task below.

b) (OSE) Derive an expression for the tension in the string in terms of relevant system parameters.

3. A tether-ball of mass M is suspended from a pole by a cord of length L. This particular tether ball court is located directly above a very large fan which cools the players by providing a wind that blows with a constant upward force on the ball with a magnitude that is one-half of the ball's weight magnitude.
a) On the diagram, superimpose a fully labeled free-body diagram for the ball.
b) Derive an expression, in terms of relevant system parameters, for the speed V of the ball when the ball is revolving at constant speed in a horizontal circle such that the cord makes an angle θ with the pole.

Blowing force