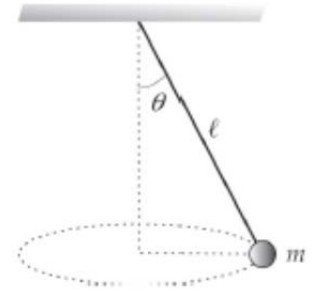


SN: \_\_\_\_\_, Name: \_\_\_\_\_

*Note: You can use pencil or any pen in answering the problems. Dictionary, calculators and mathematics tables are allowed. Please hand in both solution and this problem sheet. ABSOLUTELY NO CHEATING!*

**Problems (total 5 problems, 100%)**

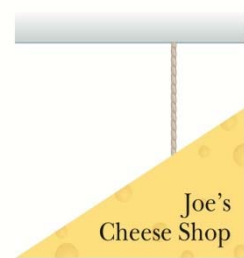
1. **Power:** (20%) An elevator car, has a mass of 1600 kg and is carrying passengers having a combined mass of 200 kg. A constant friction of 4000 Newton retards its motion. (a) How much power must a motor deliver to lift the elevator car and its passengers at a constant speed of 3.00 m/s? (b) What power must the motor deliver at the instant the speed of the elevator is  $v$  if the motor is designed to provide the elevator with an upward acceleration of  $1.00 \text{ m/s}^2$ ? Express the answer as a function of instant speed  $v$ . (c) In (b), if the speed is 3.00 m/s, what will be the power at that instant? (d) What is the difference between the answers in (a) and (c)? why?



2. **Angular moment-1:** (15%) A conical pendulum consists of a bob of mass  $m$  in motion in a circular path in a horizontal plane as shown in the figure to the right. During the motion, the supporting wire of length  $l$  maintains a constant angle  $\theta$  with the vertical. Show that the magnitude of the angular momentum of the bob

about the vertical dashed line is  $L = \left( \frac{m^2 g l^3 \sin^4 \theta}{\cos \theta} \right)^{1/2}$ .

3. **Angular moment-2:** In the Bohr-atom model an electron of mass  $9.11 \times 10^{-31} \text{ kg}$  revolves in a circular orbit about the nucleus. It completes an orbit of radius  $0.53 \times 10^{-16} \text{ second}$ . What is the angular momentum  $L$  of the electron in this orbit?



4. **Moment of Inertia:** (15%) What is the moment of inertia of a spherical shell of mass  $M$ , radius  $R$  rotating about any of its diameter?
5. **Center of Mass:** (10%) If you were to hang a triangular metal sign from a vertical string as shown in the figure. The bottom of the sign is to be parallel to the ground. At what distance from the left end of the sign should you attach the support string?

