AP Forces Problem Set 1

Akhil Waghmare

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1. A person with mass m weighs himself by standing on a force scale mounted on a skateboard that is rolling down an incline of angle θ with the horizontal. Assume there is no friction on the surface of the incline. What is the reading on the scale in terms of θ?

2. A small object of mass m_1 moves in a circular path of radius r on a frictionless horizontal tabletop. It is attached to a string that passes through a small frictionless hole in the center of the table. A second object with a mass of m_2 is attached to the other end of the string. Derive an expression for r in terms of m_1, m_2, and the time T for one revolution.

3. A child of mass m slides down a slide inclined at angle θ in time t_1. The coefficient of kinetic friction between her and the slide is μ_k. She finds if she sits on a small sled (also of mass m) with frictionless runners, she slides down the same slide in time $\frac{1}{2}t_1$. Find μ_k.

4. A block of mass 2 kg sits on a block of mass 4 kg that is on a frictionless table. The coefficients of frictioin between the blocks are μ_s and μ_k.
   (a) What is the maximum horizontal force F that can be applied to the 4 kg block if the 2 kg block is not to slip?
   (b) If F has half this value, find the acceleration of each block and the force of friction acting on each block.