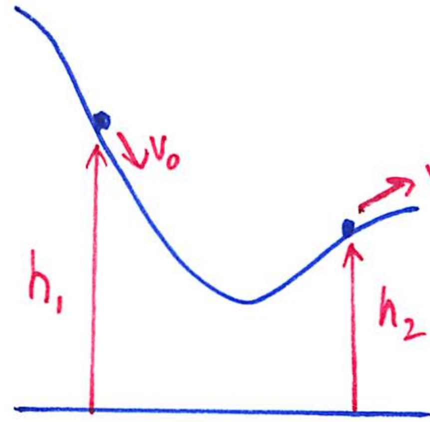
• A small object is sliding with negligible friction along a roller-coaster-like track on a table. At one moment the object is a distance h_1 above the table, travelling at speed v_0. At a later instant it is a distance h_2 above the table, travelling at speed v. Use Conservation of energy to show $v = \sqrt{v_0^2 + 2g(h_1 - h_2)}$. What is strange about this equation?



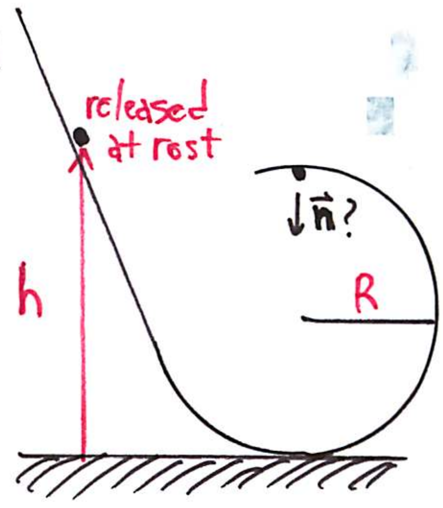
• A block of mass m moving at speed v_0 on a level, frictionless surface collides with a spring fixed to a wall. The spring has force constant k and is compressed a distance d by the collision that brings the block to momentary rest. Show that $d = v_0\sqrt{m/k}$.

• A block is placed on a ramp and is initially at rest. It slides down the ramp a distance L (measured along the ramp). What is its speed at that point? Kinetic friction acts with coefficient μ_k, the ramp makes an angle θ with the horizontal, the vertical distance through which the block moves is $h = L\sin\theta$. Show that $v = \sqrt{2gh[1 - (\mu_k)/(\tan\theta)]}$.

• In a certain region of space, objects have a potential energy given by $U(r) = A/\sqrt{r}$. A is a constant with appropriate units. What force $\mathbf{F}(r)$ acts on objects in this region?

• An object of mass m is hung from a vertical spring with force constant k which is initially unstretched, and allowed to fall from rest. Show that when the object comes to momentary rest again it has fallen a distance $\ell = (2mg)/k$.

• In a loop-the-loop like the one we played with in class, an object is placed a distance h above the table and slides without friction into a loop of radius R. What normal force n acts on the object when it is precisely at the top of the loop? Answer: $n = 2mg[(h/R) - (5/2)]$.



• A tennis ball of mass m is being swung in a vertical circle, at the end of a string, as in class. Show that the tension in the string when the ball is at the top of the circle, T_t, and the tension when the ball is at the bottom, T_b, satisfy $T_b = T_t + 6mg$.