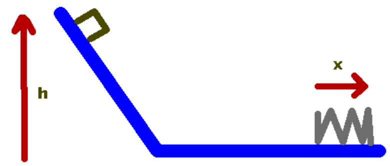
Friday, September 19, 2014	Physics 210: UnQuiz03	Name:_______________

A piece of dry ice is allowed to slide down a frictionless surface, starting at a height h above a table. The dry ice has a mass m.



(1) How fast is the dry ice moving when it reaches that table?
(2) Suppose the dry ice moves onward to strike, and compress a spring of spring constant k. How much does the spring compress when the dry ice stops moving?

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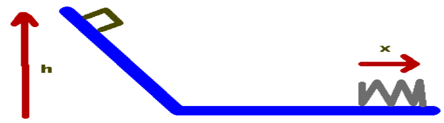

(1) How fast is the dry ice moving when it reaches that table?
(2) Suppose the dry ice moves onward to strike, and compress a spring of spring constant k. How much does the spring compress when the dry ice stops moving?
(1) Let the coordinates be (0,0) at the intersection of the table and the plane. Then the mass is at an initial y-coordinate of h. Apply the conservation of energy:

$$\Delta E=0 \Rightarrow 0=\Delta U+\Delta K$$

Now calculate each of the quantities:

$$U_i=mgh : U_f=0$$

$$K_i=0 : K_f=\frac{1}{2}mv^2$$

$$\Delta U=U_f-U_i=0-mgh=-mgh$$.

$$\Delta K=K_f-K_i=+\frac{1}{2}mv^2$$

Now put everything together in the energy equation:

$$0=-mgh+\frac{1}{2}mv^2 \Rightarrow v=\sqrt{2gh}$$

(2) There are several ways to solve the second part. Probably the easiest way is to consider the initial state and the final state only without regard to what happens between those two states. Again, Apply the conservation of energy:

$$\Delta E=0 \Rightarrow 0=\Delta U+\Delta K$$

Here, however $\Delta K=0$ because initially the mass is not moving and at the end the mass is also not moving. Thus:

$$\Delta U=\Delta U_s+\Delta U_g$$

Calculate each quantity:

$$\Delta U_s=U_{s\ final}-\Delta U_{s\ initial}=+\frac{1}{2}kx^2-0=\frac{1}{2}kx^2$$

$$\Delta U_g=U_{g\ final}-\Delta U_{g\ initial}=0-mgh=-mgh$$

Place into the energy equation and solve:

$$0=\frac{1}{2}kx^2-mgh \Rightarrow \frac{1}{2}kx^2=mgh \Rightarrow x^2=2\frac{m}{k}gh \Rightarrow x=\pm\sqrt{\left(2\frac{m}{k}gh\right)}$$

The physical solution is the positive result. So the compression is:

$$x=\sqrt{\left(2\frac{m}{k}gh\right)}$$