 Name: KEY

Conservation of Energy 3

1. You hold a ball of clay above a table and then drop it. It splats on the table without bouncing. What happened to the potential energy the ball had while you were holding it?

RTE = Random Thermal Energy

$U_g \rightarrow K +$ tiny RTE $\rightarrow$ { Sound Energy $\rightarrow$ RTE; Breaking bonds & changing shape $\rightarrow$ RTE; RTE in table }

2. You are carrying a heavy bag of lime with a constant speed at a constant height. You get very tired, yet you are doing essentially no work on the bag. How can this be so?

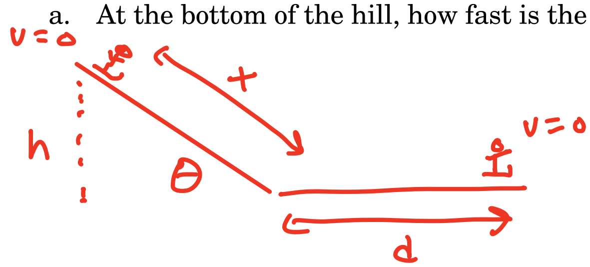
Because energy of lime did not change and there are no other forces trying to slow it down (i.e. friction)

3. What is meant by the term "potential energy?" Why do some forces have a potential energy associated with them, e.g. gravity, and others do not, e.g. friction?

Conservative Forces are the special forces that "store" the negative work they do. So we say that "the negative work done by a conservative force has the "potential" to be released

So $U = -W$ (other forces don't have this property, so there is no potential energy.)

4. Starting from rest, a skier slides down a 1000 m long hill that has a constant base angle of 15°. The coefficient of friction between the skier and the snow is 0.2. At the bottom of the hill, the ground is level, and the skier slows to a stop in a distance d.
   a. At the bottom of the hill, how fast is the skier going?



$$\Sigma E_i + \Sigma W = \Sigma E_f$$

$$mgh - fx = \tfrac{1}{2}mv^2 \text{ (@ bottom)}$$

$$\cancel{m}g\,x\sin\theta - \mu \cancel{m}g\cos\theta\, x = \tfrac{1}{2}\cancel{m}v^2$$

$$(10)(1000)\sin 15 - (.2)(10)(\cos 15)(1000) = \tfrac{1}{2}v^2$$

$$v^2 = 1313$$

$$\boxed{v = 36.2\ m/s}$$

   b. What is the distance d?

Again, conservation of Energy

So $\tfrac{1}{2}mv^2 - fd = 0$

$$\tfrac{1}{2}\cancel{m}v^2 - \mu\cancel{m}g d = 0$$

$$d = \frac{v^2}{2\mu g} = \frac{1313}{2(.2)(10)} = \boxed{328\ m}$$

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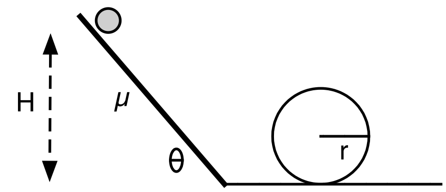
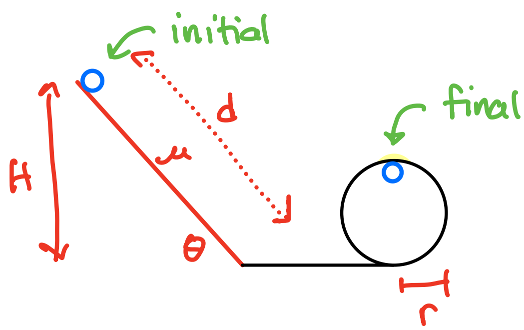
5. A mass is released from a height H on an inclined plane with base angle 50° and coefficient of friction of 0.25. The mass slides down the incline, and then onto a flat frictionless track with a loop-the-loop of radius 15 cm. What must be the minimum height H so that the mass just barely makes the loop-the-loop? (Assume the mass is much smaller than the radius of the loop.)





Note: MUST be moving @ top of loop!

OLD IDEA FIRST: @ top of loop

mg
N

$\Sigma F = \frac{mv^2}{r}$

$N + mg = \frac{mv^2}{r}$

N=0 for the minimum v to make the loop, so

$mg = \frac{mv^2}{r}$

$\boxed{v^2 = rg}$

min. speed @ top of loop

2nd

$\Sigma E_i + \Sigma W = \Sigma E_f$

$mgH - fd = \frac{1}{2}mv^2 + mg(2r)$

$\cancel{m}gH - \mu \cancel{m}g\cos\theta\, d = \frac{1}{2}\cancel{m}v^2 + \cancel{m}g(2r)$

$\cancel{g}H - \mu \cancel{g}\cos\theta\left(\frac{H}{\sin\theta}\right) = \frac{1}{2}r\cancel{g} + \cancel{g}(2r)$

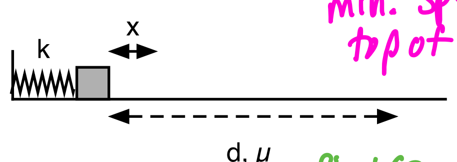
oops

$H\left(1 - \frac{\mu}{\tan\theta}\right) = \frac{5}{2}r$

$H = \frac{\frac{5}{2}r}{1 - \frac{\mu}{\tan\theta}} = \frac{\frac{5}{2}(.15)}{1 - \frac{.25}{\tan 50}}$

$\boxed{H = 0.475\ m}$

6. A 50 gram mass is attached to a spring. The spring is compressed 9 cm. The mass and spring are on a horizontal table, and there is a coefficient of friction of 0.3 between the mass and the table. The spring is released, and the mass slides a total of 24 cm before stopping. What was the spring constant of the spring?



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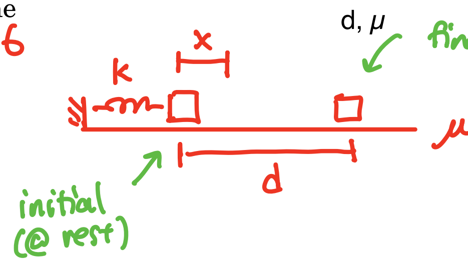

$\Sigma E_i + \Sigma W = \Sigma E_f$

$\frac{1}{2}kx^2 - fd = 0$

$\frac{1}{2}kx^2 - \mu mgd = 0$

$k = \frac{2\mu mgd}{x^2}$

$k = \frac{2(.3)(.05)(10)(.24)}{(.09)^2}$

careful with units!

$\boxed{k = 8.9\ N/m}$