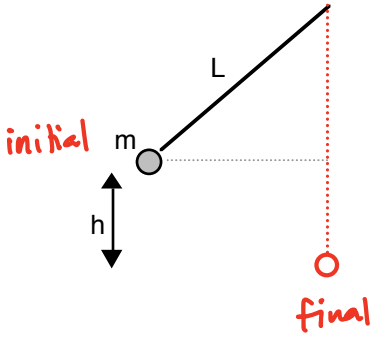
ABRHS PHYSICS NAME: KEY

Conservation of Energy 2

1. A pendulum of mass 1.5 kg and length 2 m is pulled back so that it is 50 cm up from its lowest point. It is then released. What is the tension in the string when the mass reaches its lowest point?



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

$mgh = \frac{1}{2}mv^2$

$v^2 = 2gh$

@ Bottom

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

$T - mg = \frac{mv^2}{L}$

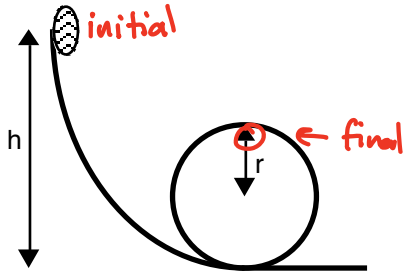
So $T = mg + \frac{mv^2}{L}$

$T = mg + \frac{m(2gh)}{L}$

$T = (1.5)(10) + \frac{(1.5)(2)(10)(.5)}{2}$

$T = 22.5\ N$

2. A Hot Wheels car is on a frictionless track with a loop-the-loop of radius 25 cm. From what minimum height must the car be released so that it makes the loop successfully?



@ top of loop:

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

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

Min speed to just make the loop is when $N = 0$,

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

$v^2 = rg$

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

$mgh = mg(2r) + \frac{1}{2}mv^2$

$mgh = mg(2r) + \frac{1}{2}m(rg)$

$h = 2r + \frac{1}{2}r$

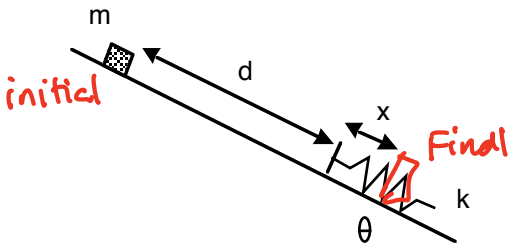
$h = \frac{5}{2}r$

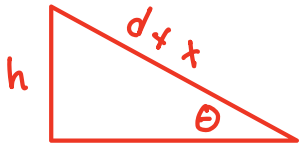
So $h = \frac{5}{2}(.25)$

$h = 0.63\ m$

Conservation of Energy 2

3. A block of mass 3 kg is released from rest on a frictionless incline of base angle 40°. It slides 75 cm before hitting a spring of spring constant 500 N/m. How much does the spring get compressed in stopping the mass?





$h = (d+x)\sin\theta$

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

$mgh = \frac{1}{2}kx^2$

$mg(d+x)\sin\theta = \frac{1}{2}kx^2$

$\frac{1}{2}kx^2 - (mg\sin\theta)x - mgd\sin\theta = 0$

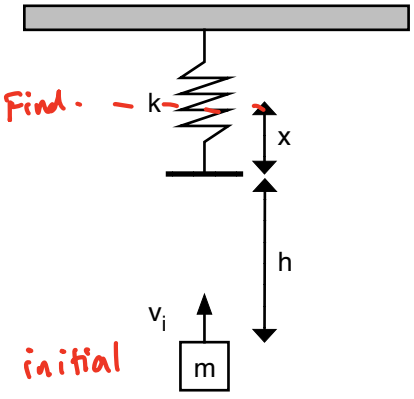
$\frac{1}{2}(500)x^2 - (3)(10)(\sin 40)x - (3)(10)(.75)\sin 40 = 0$

$250x^2 - 19.28x - 14.46 = 0$

$x = \frac{19.28 \pm \sqrt{(19.28)^2 - 4(250)(-14.46)}}{2(250)}$ ← + root

$x = \frac{19.28 \pm 121.8}{500} \rightarrow \boxed{x = 0.28\ m}$

4. A 3 kg mass is somehow launched up with an initial speed v_i. After it has gone up 90 cm (h) it hits a spring with a spring constant of 350 N/m. It goes up an additional 25 cm (compressing the spring) before coming to rest. What was the initial speed of the mass?



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

$\frac{1}{2}mv_i^2 = mg(h+x) + \frac{1}{2}kx^2$

$v_i^2 = 2g(h+x) + \frac{k}{m}x^2$

$v_i^2 = 2(10)(.9+.25) + \frac{350}{3}(.25)^2$

$v_i^2 = 23 + 7.29$

$v_i^2 = 30.29$

$\boxed{v_i = 5.5\ m/s}$

Answers: *1. 22.5 N* *2. 0.63 m* *3. 0.28 m* *4. 5.5 m/s*