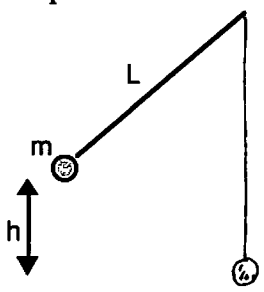
# Conservation of Energy (no friction)

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?




$E_i = E_f$

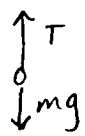
$mgh = \frac{1}{2}mv^2$

$v^2 = 2gh$

$v = \sqrt{2(10)(.5)}$

$v = 3.16$ m/s

@ bottom




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

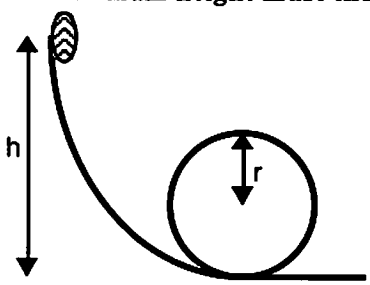
$T - mg = \frac{mv^2}{r}$

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

$= (1.5)(10) + \frac{(1.5)(3.16)^2}{2}$

$T = 22.5$ 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?




For minimum speed, @ top of loop


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

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

but $N = 0$ @ min speed

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

$v^2 = rg$

$(v = 1.58$ m/s$)$

$E_i = E_f$

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

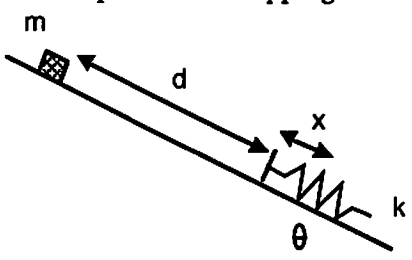
$h = \frac{v^2}{2g} + 2r$

$= \frac{rg}{2g} + 2r$

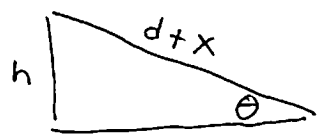
$= \frac{5}{2}r = \frac{5}{2}(.25)$

$h = 0.63$ m

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?




Note:




$E_i = E_f$

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

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

$\frac{1}{2}kx^2 - mgx\sin\theta - mgd\sin\theta = 0$

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

$250x^2 - 19.3x - 14.5 = 0$

$x = \frac{19.3 \pm \sqrt{(19.3)^2 - 4(250)(-14.5)}}{2(250)}$

$x = 0.283$

*Answers:* *1. 22.5 N* *2. 0.63 m* *3. 0.28 m*