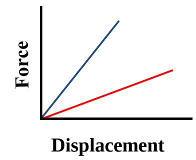
HOOKE'S LAW

- The restoring force of a spring is proportional to and in the opposite direction of the displacement of the spring.
  - $F = -KX$
- F = restoring force (N)
- K = spring constant (N / m). . .the larger the spring constant the stronger the spring
- X = displacement of the spring from its normal resting position (m)

If you were to graph the Force applied to a spring vs. the displacement the graph would be a straight line:



By calculating the slope of the line (rise over run) you would get F / d. . .which gives you the spring constant of the spring (K)

COE & Spring Potential Energy

PE_s

- A spring can store energy if it is stretched or compressed from its normal resting position.

$PE_S = 1/2\ K\ X^2$

PE_S = spring potential energy (J)
K = spring constant (N/m)
X = displacement (m)

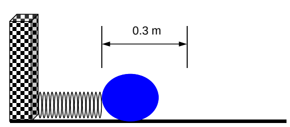
Solving COE Problems

- At the "start"
- Can it ***Fall***
  - Yes add **PE_G**
- Is it Moving
  - Yes add **KE**
- Is work being done
  - Yes add **W**
- Is there a spring
  - Yes add **PE_s**

- At the "end"
- Can it ***Fall***
  - Yes add **PE_G**
- Is it Moving
  - Yes add **KE**
- Is there ***Friction***
  - Yes add ***Q***
- Is there a spring
  - Yes add **PE_s**

Sample Problem

A pinball (mass = .05 kg) is resting on a spring (k = 60 N/m) which is compressed by .3 meters. Ignoring friction, how fast will the pinball be traveling once it is launched by the spring?



COE: $PE_S = KE$

Formula substitution:

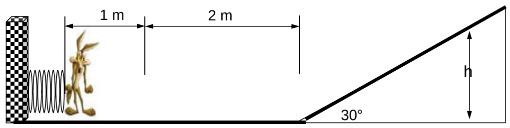
$1/2\ KX^2 = 1/2\ mv^2$

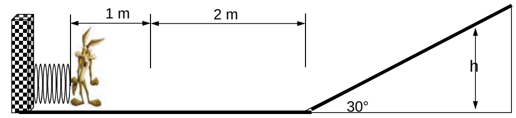
Number substitution: $(60N/m)(.3m)^2 = (.05kg)v^2$

$v = 10.4\ m/s$

Practice

Wyle E. Coyote (m = 60 kg) on his ACME roller skates uses an ACME spring (K = 6000 N/m) to launch himself after the Roadrunner. If the relaxed spring is 2 meters from the base of a 30° hill and Wyle E. compresses it by 1 meter, how high (h not d) will he be on the hill when he rolls to a stop? The coefficient of friction between the ACME skates and the ground is 0.5.





COE: $PE_S = PE_G + Q_{level} + Q_{incline}$

Formula sub.: $1/2\ KX^2 = mgh + mg\mu d + mg\cos\theta\mu d$

Number sub.:

$.5*6000*1^2 = (60*9.8)h + (60*9.8*.5*(1+2)) + (60*9.8\cos30°*.5)(h/\sin30°)$

$3000 = 588h + 882 + 509.223h$

h = 1.93 meters

Solving COE Problems

- At the "start"
- Can it ***Fall***
  - Yes add $\mathbf{PE_G}$
- Is it Moving
  - Yes add **KE**
- Is work being done
  - Yes add **W**
- Is there a spring
  - Yes add $\mathbf{PE_s}$

- At the "end"
- Can it ***Fall***
  - Yes add $\mathbf{PE_G}$
- Is it Moving
  - Yes add **KE**
- Is there ***Friction***
  - Yes add ***Q***
- Is there a spring
  - Yes add $\mathbf{PE_s}$