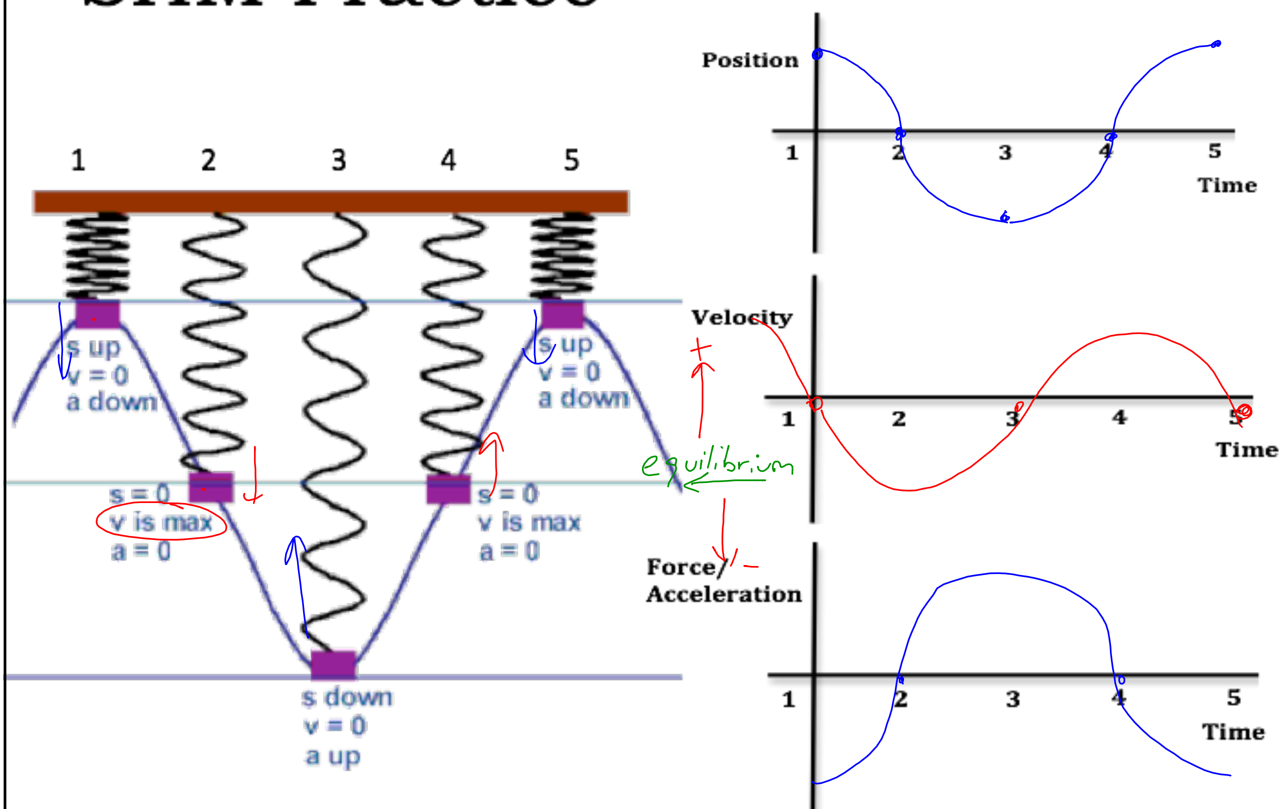
February 22, 2017

SHM Practice



Hooke's Law – Graphical Analysis

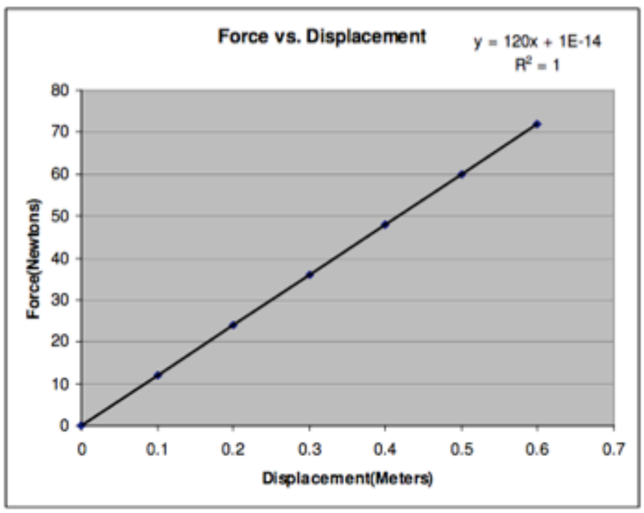
- Suppose we had the data below

$$F_s = kx$$

$$k = \frac{F_s}{x}$$

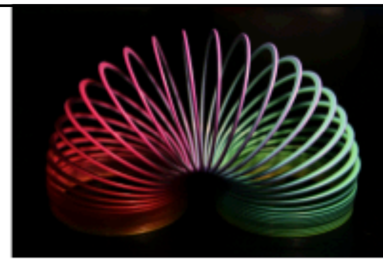
$$k = \text{Slope of a F vs. x graph}$$

x(m)	Force(N)
0	0
0.1	12
0.2	24
0.3	36
0.4	48
0.5	60
0.6	72

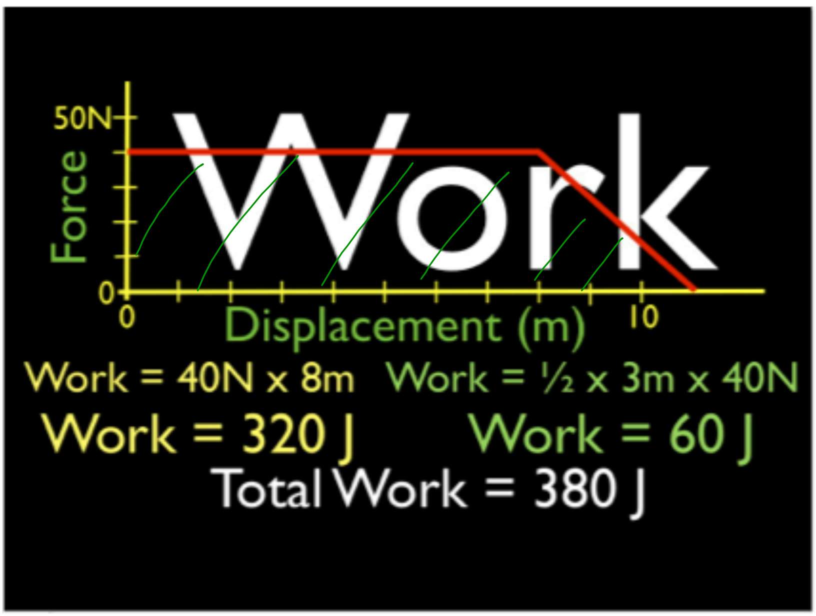


k =120 N/m

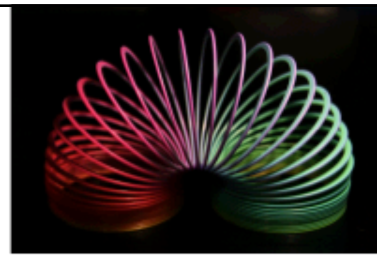
Hooke's Law
Graphical Analysis



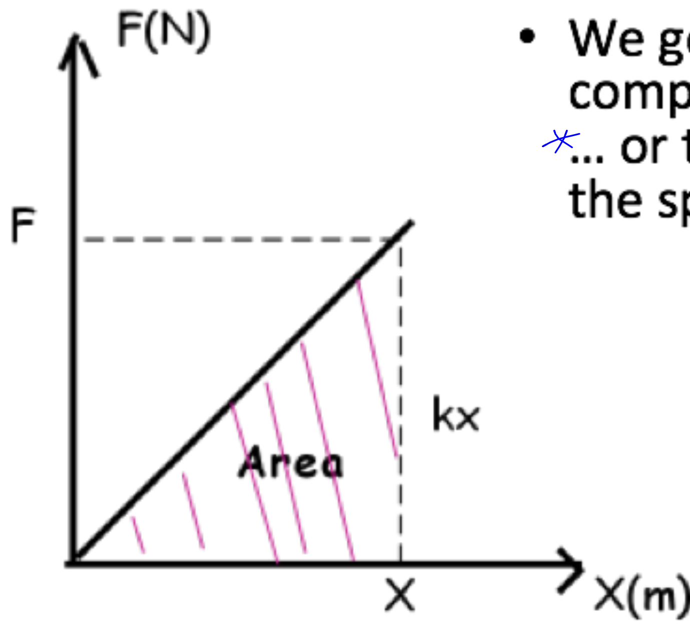
- We've actually seen with force vs. displacement graphs before.....



Hooke's Law
Graphical Analysis



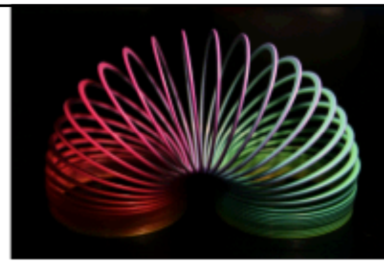
- Now looking at data from a spring.....



- We get the work done to compress or stretch the spring, *... or the potential energy of the spring....

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

Energy of a Spring



- We now have **another** form of energy to keep track of ……

$U_g = mgh$

$KE_{trans} = \frac{1}{2}mv^2$

$KE_{rot} = \frac{1}{2}I\omega^2$

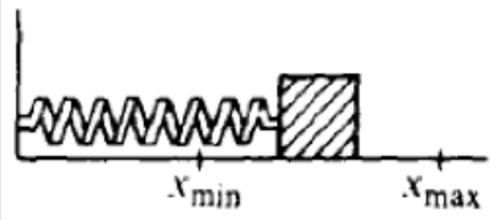
$U_s = \frac{1}{2}kx^2$

- Is this a conservative or non-conservative form of energy?

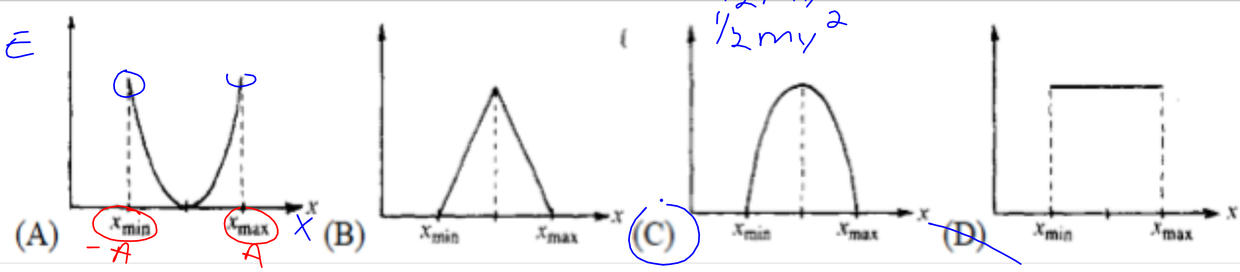
$\frac{1}{2}kx^2$

mgh

Example 2

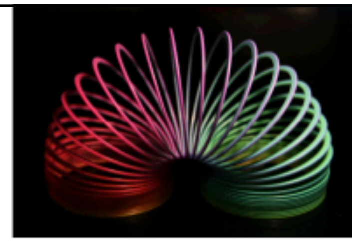


A block oscillates without friction on the end of a spring as shown. The minimum and maximum lengths of the spring as it oscillates are, respectively, x_{min} and x_{max} . The graphs below can represent quantities associated with the oscillation as functions of the length x of the spring.



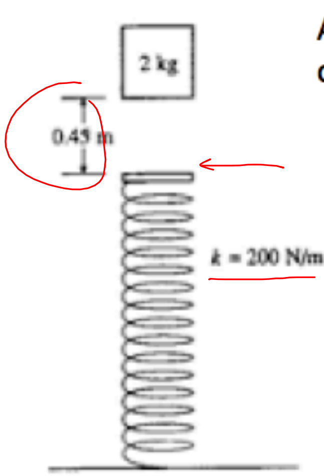
A. Which graph can represent the total mechanical energy of the block-spring system as a function of x?

B. Which graph can represent the kinetic energy of the block as a function of x?



Example 3

A 2.00 kg block is dropped from a height of 0.45 m above an uncompressed spring, as shown. The spring has an elastic constant of 200 N/m and negligible mass. The block strikes the end of the spring and sticks to it.



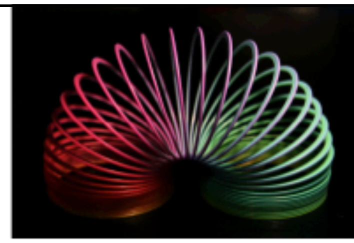
A. Determine the speed of a block at the instant it hits the end of the spring.

$v^2 = v_0^2 + 2ax$

$v = +/- 2.97 \text{ m/s}$

B. Determine the force of the spring when the block reaches its equilibrium position.

Example 3



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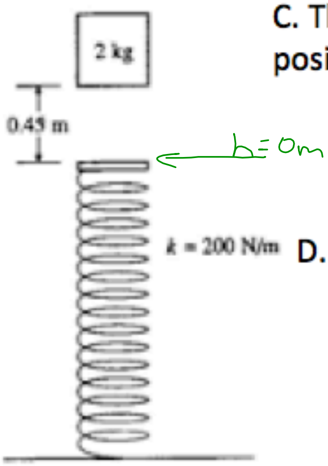
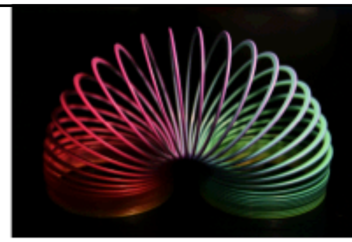


C. The distance the spring is compressed at the equilibrium position.

D. Determine the speed of the block at the equilibrium position

Example 3



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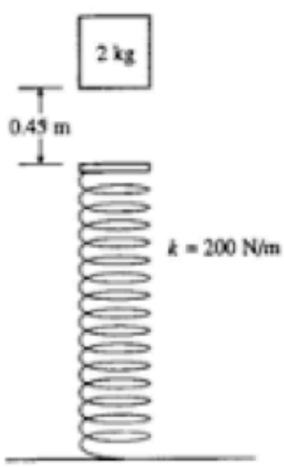

E. Determine the resulting amplitude of the oscillation that ensues.