Physics 200 (Stapleton) Name: Key School
Notes: Springs + Odds and Ends

Springs Notes:

1. We will be solving problems with two kinds of springs compression springs and extension springs.

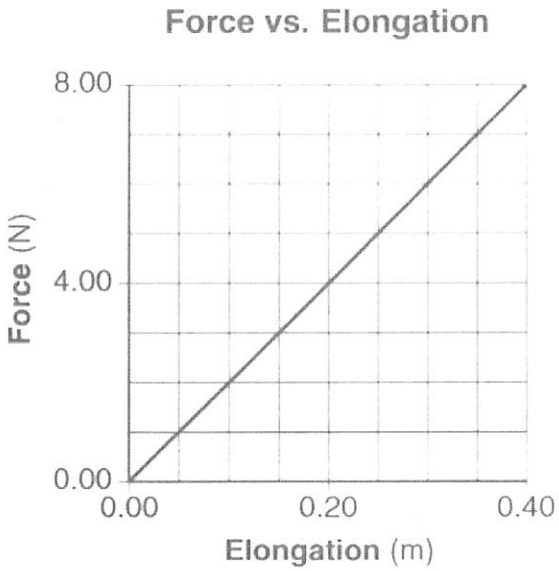
2. The *spring constant* (**k**) tells us how much force is exerted by a stretched or compressed spring. It is represented by the letter k. — Konstant Units ⇒ $\frac{N}{m}$

3. The force exerted by a spring that is stretched or compressed a distance of x is...

$$F_{spring} = -kx$$

The force that must be applied to the spring to stretch it a distance x equals...

$$F = kx$$



4. What is the spring constant of the spring represented by the graph on the right?

$$k = \frac{8N}{0.4m} = 20\ N/m$$

5. How much work must be done to stretch the spring from 0m of elongation to 0.4m of elongation?

$$W = F_{ave}\,d = \left(\frac{8N+0N}{2}\right)(0.4m) = 1.6\ J$$

6. How much work must be done to stretch or compress a spring with a spring constant of k through a distance x?

$$W = F_{ave}\,d = \left(\frac{kx + 0}{2}\right)(x) = \frac{kx^2}{2} = \frac{1}{2}kx^2$$

(Final force; Initial Force)

7. How much energy is stored in a spring with a spring constant of k that is stretched or compressed a distance x?

$$PE_0 + KE_0 + W_{NC} = PE_f + KE_f$$

$$0 + 0 + \frac{1}{2}kx^2 = PE_f + 0$$

Other Forms of Energy (other than mechanical energy):

8. **Law of Conservation of Energy** with other energy forms (OE): $KE_i + PE_i + W_{nc} = KE_f + PE_f + OE_f$

9. List some other (non-mechanical) forms of energy
Electrical, Chemical, Thermal, Nuclear, Sound

10. If you drop a tennis ball on a level surface and let it bounce until it comes to rest, what types of *non-conservative work* and *other energy* might be involved in this process?

W_{nc}: Friction, Sound production

OE_f: Heat
- In ball
- In surface

Sound
- Surface material
- Air

Electrical Energy Units:

11. The so-called *power company* sells us energy, not power. The unit that they use for the energy that they sell is the **kiloWatt-hour (kWh)**.

Describe a kiloWatt-hour: The amount of energy used when something is powered at 1000 W for one hour.

How many joules equals one kiloWatt-hour?

$P = \frac{W}{t}$ ← equivalent to energy $\quad W = Pt$

$W = (1000W)(3600s) = 3.6 \times 10^6 J$

12. Green Mountain Power sells some of their energy at a rate of \$0.169/kWh. At this rate, how much does it cost to leave a 10W LED lightbulb turned on for an entire week?

$$\left(\frac{\$0.169}{kWh}\right)\left(\frac{1kW}{1000W}\right)(10W)(168h) = \$0.284$$

Efficiency: Ratio of output energy to input energy, usually expressed as a percentage.

$$\% \text{ Efficiency} = \left(\frac{\text{Energy output}}{\text{Energy Input}}\right) \times 100\%$$

13. Starting from rest, a 10kg 'possum climbs a 5m tall tree, using 1000J of food energy in the process. How efficient was this event?

$$\%\text{Effic} = \frac{mgh}{1000J} \leftarrow \text{Energy at top} = \frac{10kg(9.8m/s^2)(5m)}{1000J} = 49\%$$