Homework Problems:

1. Which force(s), electromagnetic(E), gravitational(G), weak nuclear(WN) or strong nuclear(SN), is(are) primarily responsible for the following (100% correct for credit):

color of a flower. E	thinking about life. E
exposure of photo film by X-rays E	calling using a cellular phone. E
evaporation of sweat. E	bouncing of light off a mirror. E
decay of Carbon-14 to Nitrogen-14 WN	rotation of our galaxy. G
reading a CD by a computer. E	sensing motion using infrared. E
rotting of a banana. E	floating of a nuclear submarine E & G

2. Four force vectors act on an object: $\mathbf{F}_1 = +A$, $\mathbf{F}_2 = +3A$, $\mathbf{F}_3 = -2A$, and $\mathbf{F}_4$. If the forces balance, $\mathbf{F}_{\text{Net}} = 0$, including all four forces, what is $\mathbf{F}_4$? $\mathbf{F}_4 = -2A$

(show work here)

To balance means that the force vector sum is zero.

$$\mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 + \mathbf{F}_4 = 0 = \left(+A + 3A - 2A\right) + \mathbf{F}_4$$

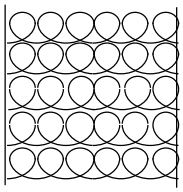
$$+2A + \mathbf{F}_4 = 0$$

$$\mathbf{F}_4 = -2A$$

3. A rope, considered massless, has a length, L = 10 m , and a tension, T = 50 N. What is the tension at the middle of the rope? $T = 50$ N

4. How should I connect 5 weak springs, spring constant, k, to make a spring five times stronger and what will be the new spring constant. $k' = 5k$

(Draw the connected springs here)

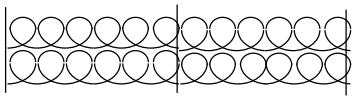


5. I have one spring but need one twice as strong. How can I get it from what I have?

Cut it in half. Each half has a spring constant $k' = 2k$

6. I have four identical springs and would like to make a longer spring with the same spring constant. How should I connect them to accomplish this?

(Draw the connected springs here)



7. Complete this sentence: springs generate forces and store energy.

8. From the formulas that predict the spring constants of parallel and series connected springs, describe why each piece of a material cut into shorter pieces, has a larger spring constant, or cut into narrow strips, each strip has a smaller spring constant.

A series combination of n identical objects, each with spring constant k, has a new spring constant, $k' = \frac{k}{n}$, smaller by a factor of n. If this object is separated into n equal length segments, each segment will again have a spring constant k, larger than the combination by a factor of n,

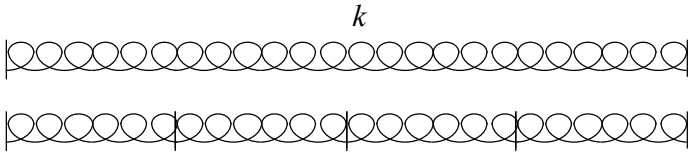
$$k = nk'.$$

A parallel combination of n identical objects, each with spring constant k, has a new spring constant, $k' = nk$, larger by a factor of n. If this object is slit into n equal width segments, each segment will again have a spring constant k, smaller than the combination by a factor of n

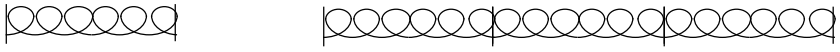
$$k = \frac{k'}{n}.$$

9. A spring, spring constant, k, is cut into two shorter pieces. One piece is 1/4 of the original length. What are the spring constants of both pieces?

See the diagram below, to determining the spring constants of the two segments.



$k' = 4k$ use three k' springs in series $k'' = \frac{k'}{3} = \frac{4k}{3}$



($\frac{1}{4}$ of the spring) ($\frac{3}{4}$ of the spring)