1. A helical spring is an elastic material wound in the shape of a helix.

2. Compression Spring - Ex. Car Spring
   Tension Spring - Ex. Trampoline Spring.
   Torsion Spring - Ex. Closes door.

3. The compression spring acts in Compression.
   The tension spring acts in tension.

4. • The flexibility of the material.
   • Shape of the coil.

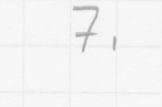
5. The restoring force is in a direction that will return the spring to its neutral length

6.

$k = 48\ N/m$

$F_e = -k\Delta x = -\left(\frac{48\ N}{m}\right)(0.55\ m)$

$\boxed{|F| = 26.4\ N}$

7. 

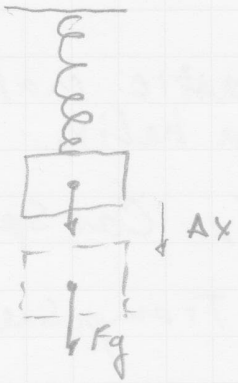
$\Delta x = 0.04m$
$F_e = 100\ N$

$F_e = -k\Delta x$

$k = \frac{-F_e}{\Delta x} = -\frac{(-100\ N)}{0.04m}$

$\boxed{k = 2500\ \frac{N}{M}}$

8.



$\Delta x = 0.500\,m$

$m = 0.510\,kg$

$F = k\Delta x$

$k = \frac{F}{\Delta x} = \frac{F_g}{\Delta x} = \frac{mg}{\Delta x}$

$k = \frac{(0.510\,kg)(9.8\,m/s^2)}{0.500\,m}$

$\boxed{k = 10.0\ N/m}$

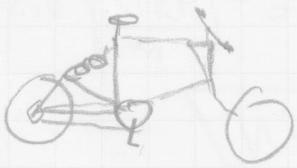
9.

$k_A = 68\,N/m$

$k_B = 48\,N/m$

Spring A is more difficult to compress.

10.



$\Delta x = 0.0185\,m \quad F_e = 85.5\,N$

$F = k\Delta x$

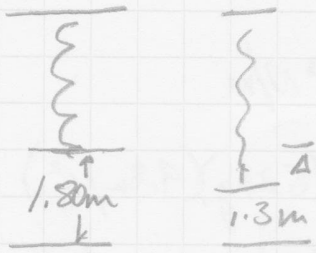
$k = \frac{F}{\Delta x} = \frac{85.5\,N}{0.0185\,m} = 4622\,\frac{N}{m}$

$\Delta x = 4.95\,cm = 0.0495\,m$

$F_e = k\Delta x = \left(4622\,\frac{N}{m}\right)(0.0495\,m)$

$\boxed{F_e = 229\,N}$

11.



$m = 0.100\,kg$

$F_e = F_g = mg = (0.100\,kg)(9.8\,m/s^2)$

$F_e = 0.980\,N$

a) $F_e = k\Delta x$ $\quad k = \frac{F_e}{\Delta x} = \frac{0.980\,N}{0.50\,m} = 1.96\,N/m$

b)

F_p - person pulling.

Δx increases by $0.20\,m$

$\Delta x = 0.50\,m + 0.20\,m$

$\Delta x = 0.70\,m$

$\sum F_y = 0$ Equilibrium $\quad F_e - F_p - F_g = 0$

$F_p = F_e - F_g = k\Delta x - mg$

$F_p = (1.96\,N/m)(0.7\,m) - (0.100\,kg)(9.8\,m/s^2)$

$\boxed{F_p = 0.392\,N}$

c) Now $m = 0.300\,kg$

$F_g = mg = (0.300\,kg)(9.8\,m/s^2)$

$F_g = 2.94\,N$

$F_g = F_e = k\Delta x$

$\Delta x = \frac{F_g}{k} = \frac{2.94\,N}{1.96\,N/m} = 1.5\,m$

$\boxed{\text{This mass is } 0.300\,m \text{ above the floor}}$

12.

$m = 62kg$

$k = 2.4 \times 10^3 N/m$

$F_g = mg = (62kg)(9.8m/s^2)$

$F_g = 607.6N$

This force is evenly distributed so each spring receives 1/6 the force

Per Spring | $F_e = \frac{607.6N}{6} = 101.27N$

$F = k\Delta x \qquad \Delta x = \frac{F}{k} = \frac{101.27N}{2,400N/m}$

$\boxed{\Delta x = 0.042m = 4.2cm}$

13.

$\Delta x = 0.3m \qquad F = 365N$

$F = k\Delta x \qquad k = \frac{F}{\Delta x} = \frac{365N}{0.3M} = 1217N/m$

a) $\Delta x = \frac{F}{k} = \frac{400N}{1217N/m}$; $\boxed{\Delta x = 0.329m}$

b) $\Delta x = \frac{223N}{1217N/m}$ $\boxed{\Delta x = 0.183m}$

c) $\Delta x = \frac{2.0N}{1217N/m}$ $\boxed{\Delta x = 1.64 \times 10^{-3} m}$

14. pencil:

$\Delta x = 0.015\,m$ $\quad F = 0.18\,N$

a) $F = k\Delta x \qquad k = \frac{F}{\Delta x} = \frac{0.18\,N}{0.015\,m}$

$$\boxed{k = 12\,N/m}$$

b) The spring pulls back on the student by the same magnitude, 0.18 N, but in the opposite direction.

15.

$k = 48\,N/m$

$F = 2.4\,N$ $\quad \Delta x = \frac{F}{k} = \frac{2.4\,N}{48\,N/m} = 0.05\,m$

$$\boxed{\Delta x = 0.05\,m}$$

16.

$k = 600\,N/m$

$\Delta x = 0.075\,m$

$F_e = F_g \qquad mg = k\Delta x$

$$m = \frac{k\Delta x}{g} = \frac{(600\,N/m)(0.075\,m)}{9.8\,m/s^2}$$

$$\boxed{m = 4.59\,kg}$$

But you should have seen the one that got away!

17. k has units of $\frac{N}{m} = \frac{kg \cdot m/s^2}{m} = \boxed{\frac{kg}{s^2}}$