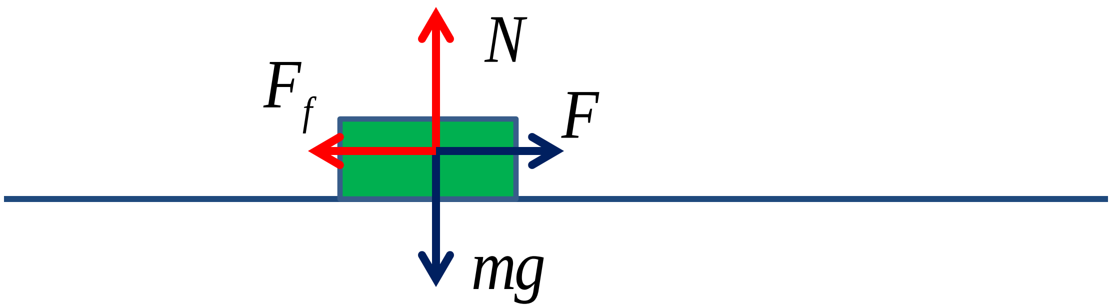
Friction Force



- **STATIC FRICTION** Imagine that you try to move a block on a floor by pushing it with force F. The block does not move because of static friction with the floor. That force oppose motion, and will be equal to F to make sure that the block is at rest. However it cannot be bigger than certain maximum value:

$$F_f^{(static)} < \mu_s N$$

Here *N* is the Reaction Force, and μ_s is called static friction coefficient (normally, μ_s <1).

- **KINETIC FRICTION** Once the block starts moving, the friction force will stay nearly constant, and equal to $\mu_k N$ (μ_k is called kinetic friction coefficient, it is smaller than μ_s):

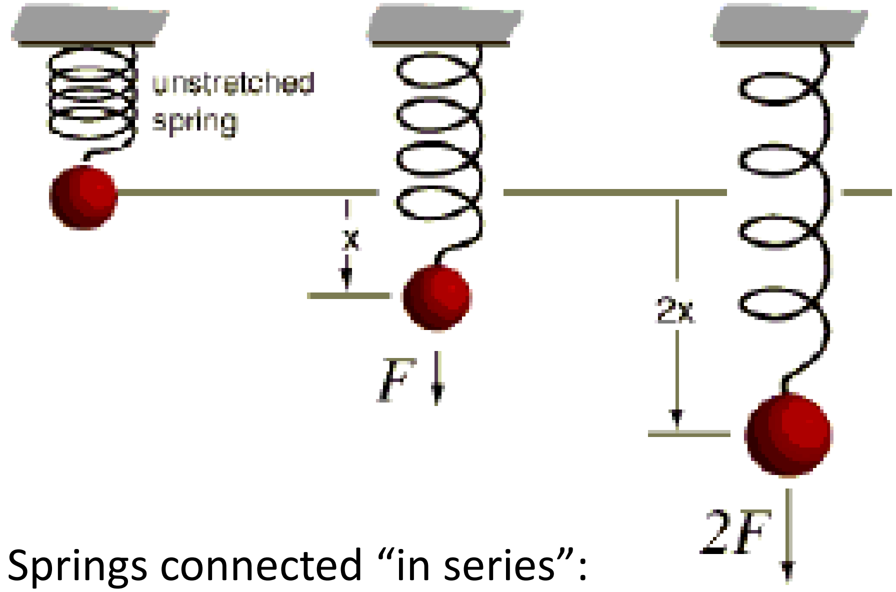
$$F_f^{(kinetic)} = \mu_k N$$

Hooke's Law

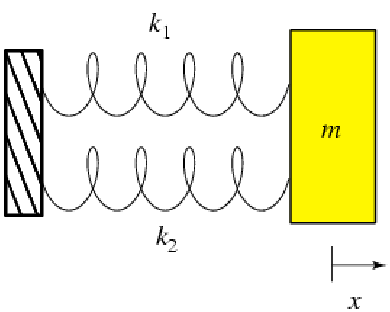
When a spring is stretched or compressed, the *restoring force* ***F*** is proportional to its *deformation*, ***x***:

$$F = kx$$

Here ***k*** is called *spring constant.*

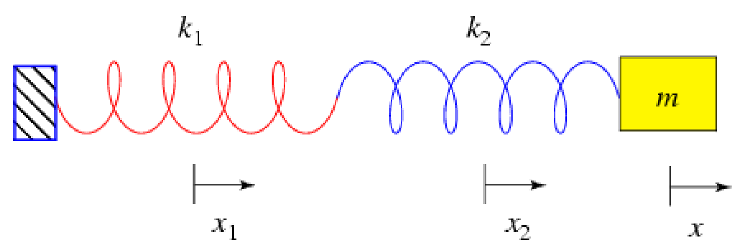


Springs connected "in parallel":



$$k = k_1 + k_2$$

Springs connected "in series":

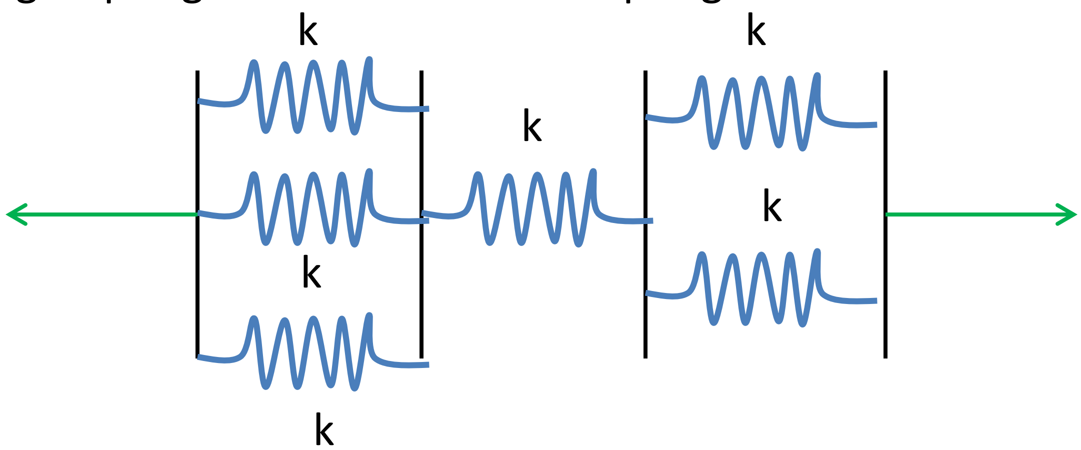


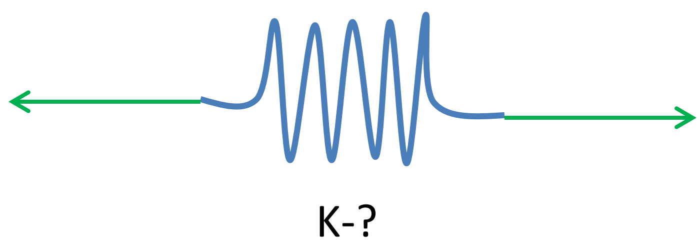
$$\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2}$$

Homework

Problem 1.

All springs on the picture have the same spring constant, k. You need to replace them all with a single spring. What should be its spring constant K?





Problem 2

Let the friction coefficient (both static and kinetic) between car tires and the road surface be μ. Find the minimal time that the car would need to reach speed v, starting from rest. Get the general formula, and compute this time for $\mu=0.7$ (dry road), and $\mu=0.4$ (wet road), if v=100km/hr. Assume a four-wheel-drive car (all wheels are rotated by the motor and pushing the car forward).