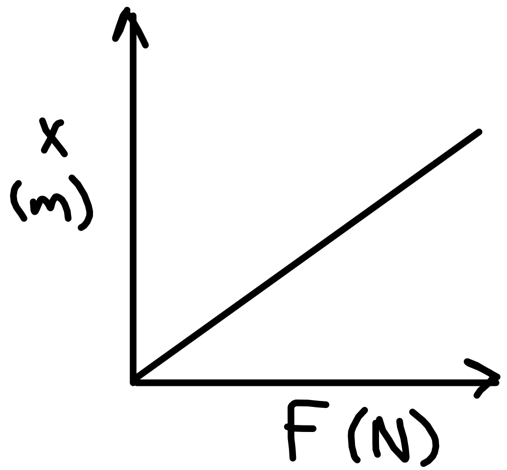
Forces from Springs

All objects deflect (stretch or compress) when forces are applied to them.

When the deflection is directly proportional to the size of the applied force, the object is said to behave like an ideal spring.

Almost everything behaves like a spring to some extent. Therefore, springs are worth talking about.



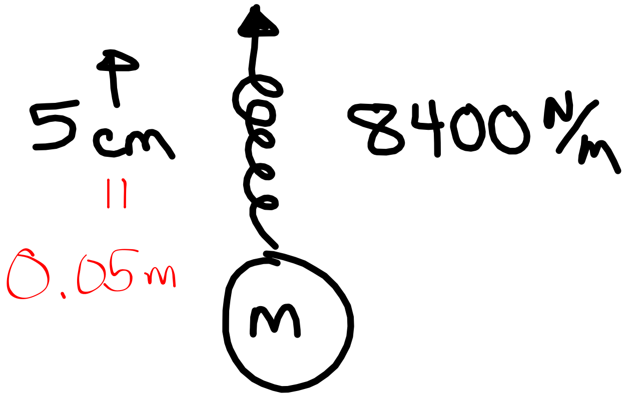
An ideal spring behaves in a linear fashion. The greater the applied force, the greater the deflection.

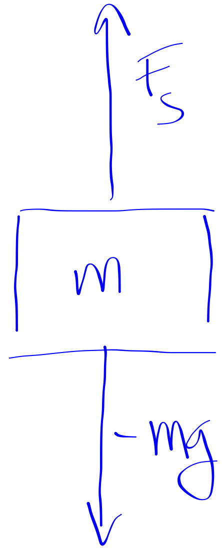
$$\boxed{\mathbf{F_{spring} = kx}}$$

x = the deflection (in m, or ft) of spring from its non-deflected length

k = spring constant (N/m, N/cm, lb/in, etc...) This is unique for each spring

EXAMPLE 1 : (Static Equilibrium)





WHAT IS m?

$$F_s = kx$$

$$F_s = 8400\,\text{N/m}\,(0.05\,\text{m})$$
$$= 420\,\text{N}$$

$$\Sigma F = \cancel{ma} = 0$$

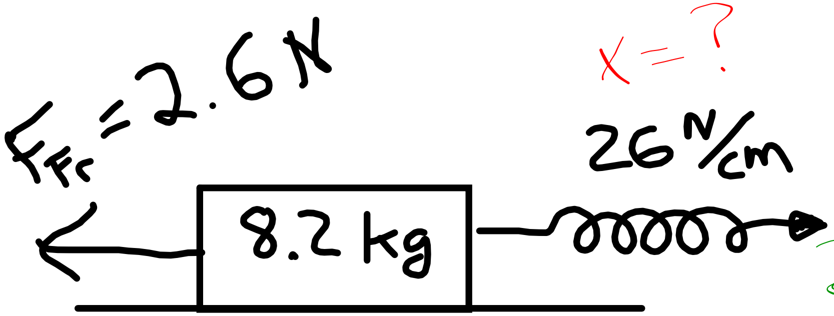
$$F_s - mg = 0$$

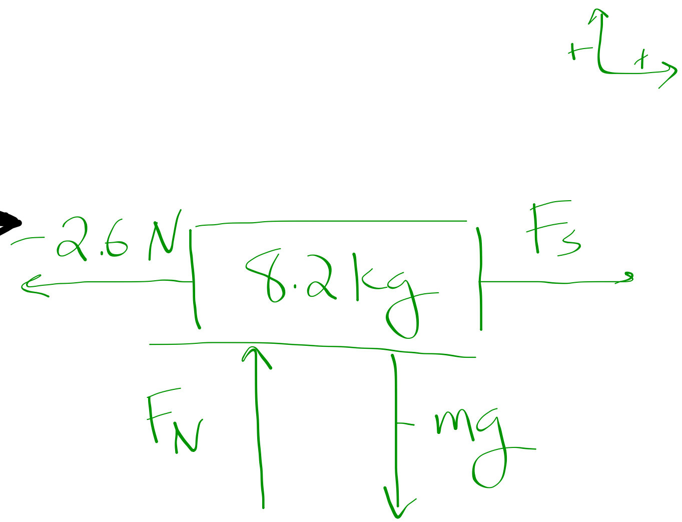
$$420 - mg = 0$$

$$m = \frac{420}{9.8} = \boxed{42.9\,\text{kg}}$$

EXAMPLE 2 (Static Equilibrium)

$x = ?$





$$\sum F_x = \cancel{ma_x} = 0$$

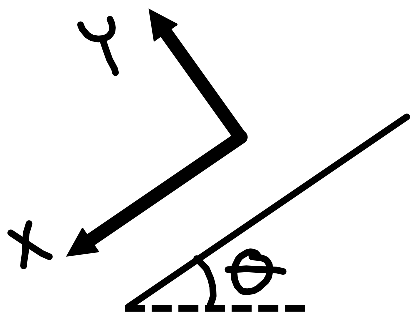
$$-2.6 + F_s = 0$$

$$F_s = 2.6\text{ N} = kx = 26\,\text{N/cm}\,(x)$$

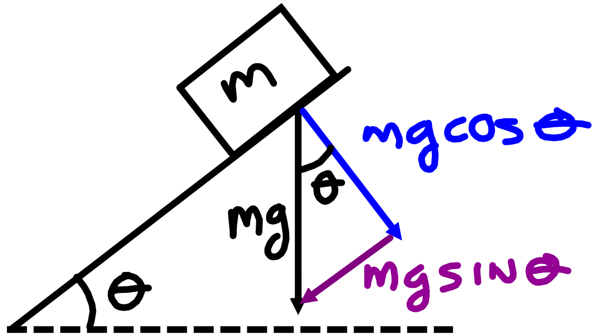
$$x = 0.1\text{ cm}$$

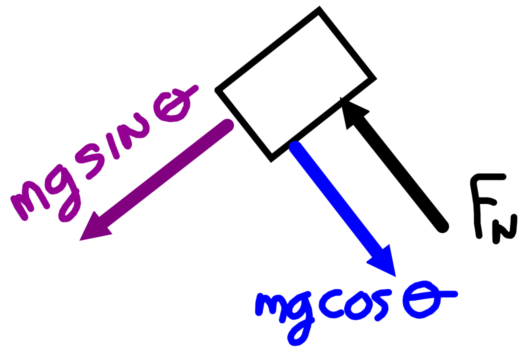
How should we handle inclines?

Use this reference frame . . . because motion will be along the incline

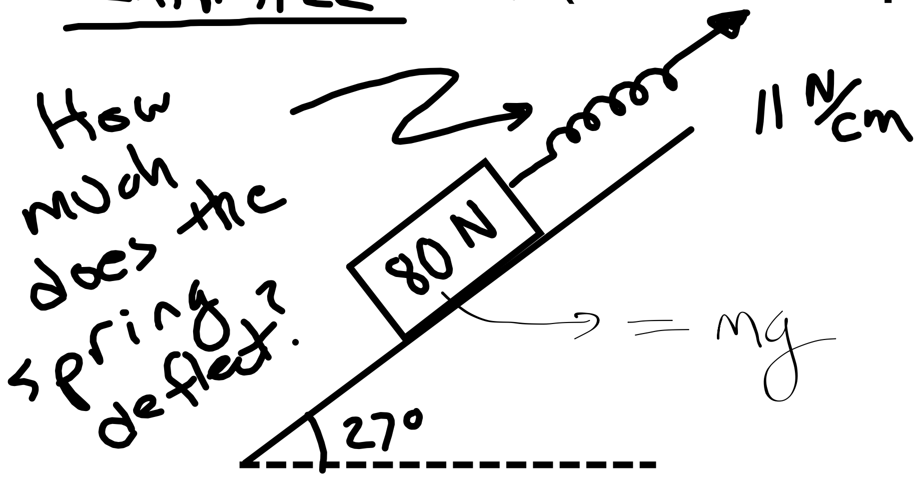


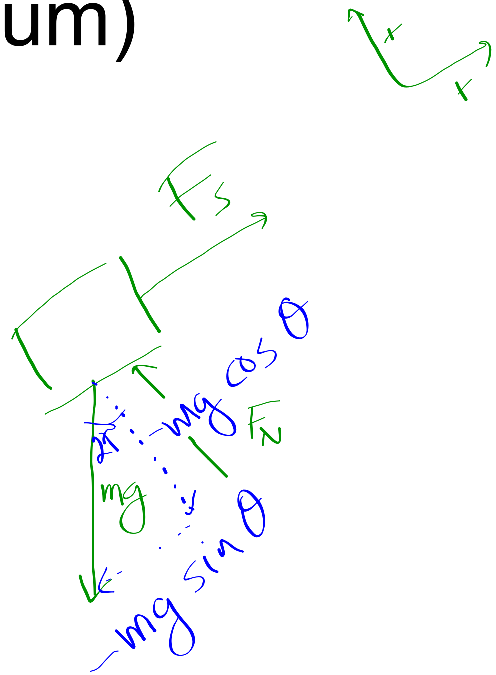
We need the force of gravity, which is vertically down, resolved into X and Y components for this new reference frame





EXAMPLE 4: (Static Equilibrium)





$$F_s = kx$$

$$\sum F_x = \cancel{m}a_x = 0$$

$$F_s + -mg\sin\theta = 0$$

$$F_s = mg\sin\theta = 80\sin 27 = 36.32\,N$$

$$x = \frac{F_s}{k} = \frac{36.32}{11\ N/cm}$$

$$\boxed{x = 3.3\,cm}$$