Forces - advanced concepts (introduction)

All forces obey Newton's 3 laws

Three slightly more difficult forces to analyze are
- Centripetal
- Gravitational
- Spring

$F_C \rightarrow$ name

$\Sigma F_r \rightarrow$ analyze

Centripetal force $F_c = \Sigma F_r = mv^2/r$ $\frac{mv^2}{r}$ = mag.

Centripetal force is the nickname for all the forces causing an object to move in a circular fashion. The net (ΣF_r) of these forces point toward the center of the circle the particle is following. Centripetal force only changes the direction of the particle, not the speed.

If we draw a radial vector from the center of the circle the particle is following, then all force parallel to that radial vector affect the circular motion.
- forces that point toward the center of the circle are positive and those that point away are negative
- forces at right angles to the radial vector are ignored as they have no influence in that direction. (They only change the speed of the object along its circular path, as opposed to changing the direction)

Gravitational force $F_g = Gm_1m_2/r^2$ $F_g = G\frac{m_1m_2}{r^2}$

G = universal gravitational constant = 6.67×10^{-11} $N\text{-}m^2/kg^2$
(this just converts the units into Newtons for you)

On the surface of Earth $F_g = mg$ therefore $g = Gm_2/r^2$

The nickname for F_g is weight. $w = mg$

The force of gravity is always the same between the two objects involved in the gravitational attraction. You pull on the Earth as much as it pulls on you.

Notice that the r in the denominator is squared. That means that when you double your distance from an object the gravitational force is ¼ the original strength. This is known as the inverse square law (very important)

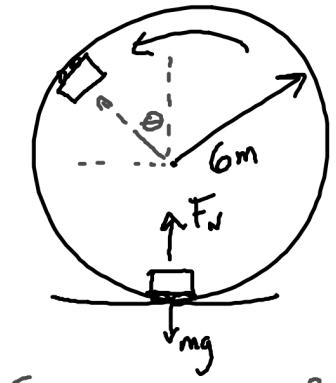
Also notice that if the mass of either object changes, then so does the gravitational force between them. The relationship is directly proportional.

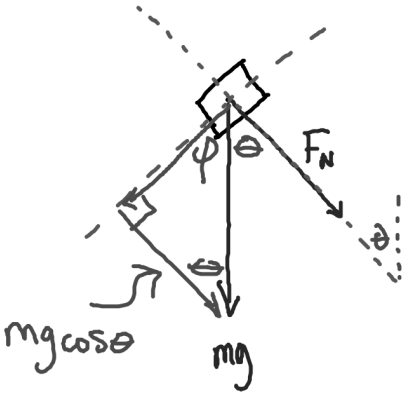
Spring force $F_S = -kx$ (this is only true for ideal springs)

Also called Hooke's Law, we can see that as we stretch (or compress) a spring, the force will increase linearly and act in the opposite direction to the movement of the free end of the spring.

k is known as the spring constant and is a measure of the strength of the spring. k is measured in N/m.

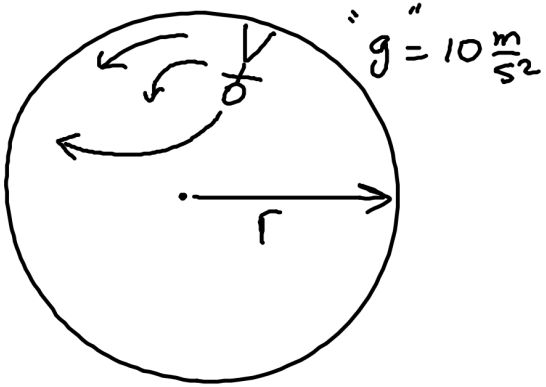
When we combine multiple springs, we have to follow separate rules based on the orientation of the combination to determine how the system will change. This is called k effective. More about this later.





$$F_c = \Sigma F_r = \frac{mv^2}{r}$$

$$F_N + mg\cos\theta = \frac{mv^2}{r}$$


"g" = 10 m/s²
f
r