Review: Forces + Newton

November 4, 2016 8:55 AM

3.1 Force of Gravity

$F_g = mg$ $\qquad g = 9.8\,m/s^2$

$F_g = \frac{GMm}{r^2}$ $\qquad G = 6.67 \times 10^{-11}\ \frac{N \cdot m^2}{kg^2}$

r ← distance btwn centers of M and m

can derive:

$F_g = F_g$

$\cancel{m}g = \frac{GM\cancel{m}}{r^2}$

r ← distance from centre of M

g ↑ grav. field strength

3.2 Friction

$F_{fr} = \mu F_N$

F_N ← normal force, on a horizontal plane, is equal (and opposite) to F_g

μ "mu" = coefficient of friction $\mu = \frac{F_{fr}}{F_N}$

- in a "constant velocity" situation, the applied force is equal to the friction force.

3.3 Hooke's Law

$F = k\Delta x$

Δx ← stretch

k ← spring constant N/cm or N/m

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

4.1 Newton's 1st Law: an object in motion tends to stay in motion ....

4.2 Newton's 2nd Law: $F_{net} = ma$

$F_{net} = F_{app} - F_{against}$

ma

F_{app} ↑ causing the motion

$F_{against}$ ↑ resisting the motion

Fall at same rate:

$F_{net} = F_{app} - F_{against}$

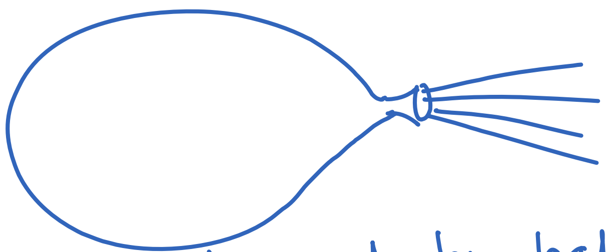
$ma = F_g - 0$ (crossed out)

$\frac{ma}{m} = \frac{mg}{m}$

$a = g$

mass irrelevant if ignore air resistance

4.3 Newton's 3rd Law: For every action there is an equal and opposite reaction



action: air pushed out by balloon

reaction: balloon is pushed by the air.

4.4 Momentum

$\vec{F} = m\vec{a}$

$\vec{p} = m\vec{v}$

$\vec{p}_1 + \vec{p}_2 = \vec{p}_f$

$m_1\vec{v}_1 + m_2\vec{v}_2 = (m_1 + m_2)v_f$ ← two objects collide and stick together

before — collision — after

← 2 objects ...

$$(m_1+m_2)V_i = m_1V_{1f} + m_2V_{2f}$$ ← 2 objects splitting

before = after

momentum before = momentum after

$mv + mv + mv = mv + mv + \ldots$

units for p: $kg\frac{m}{s}$

$$\text{Impulse} = \Delta\vec{p} \quad \leftarrow \left[kg\cdot\frac{m}{s}\right]$$

$$= F\cdot t \quad \leftarrow [N\cdot s]$$

units for momentum and impulse are $kg\frac{m}{s}$ or $N\cdot s$

$$\Delta\vec{p} = \vec{F}\Delta t$$

$$mv_f - mv_i = F\Delta t$$

$$\Delta p = p_f - p_i$$
$$= mv_f - mv_i$$