Newton's first law → see slides

DEMO of block on sandpaper

DEMO of cart on airtrack

⇒ force changes velocity of an ~~object~~ object.

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

If there are more than one force acting on a body:

$\boxed{\Sigma \vec{F} = m\vec{a}}$ → Newton's second law. (see slides)

Gravitational force

$F_g = \frac{G m_1 m_2}{r^2}$, r is the distance between the ~~end~~ center of masses of m_1 & m_2.

$G = 6.67 \times 10^{-11}\ N m^2/kg^2$

On ~~the~~ and near earth's surface

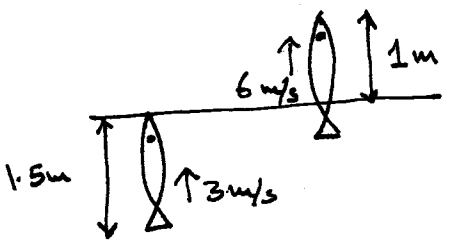
$m_1 = M_E$ (mass of earth, 5.98×10^{24} kg)

$r \approx R_E$ (Earth's radius since we are near earth's surface, $R_E = 6.38 \times 10^6$ m).

⇒ $F_g = \left(\frac{GM_E}{R_E^2}\right) m$, where m is the mass of test object.

⇒ $F_g = mg \left(g = \frac{GM_E}{R_E^2} = 9.8\ m/s^2\right)$ ⇒ $F_g = \underbrace{mg}_{\text{weight of the object}} = ma$ ⇒ $a = g$.

hence g is acceleration due to gravity



$\Delta y = 1$ m, $v = 6$ m/s, $v_0 = 3$ m/s

$v^2 = v_0^2 + 2a\Delta y$

$6^2 = 3^2 + 2a \cdot 1$

$\Rightarrow a = 13.5 \text{ m/s}^2$

$\Sigma F_y = F - mg = ma$

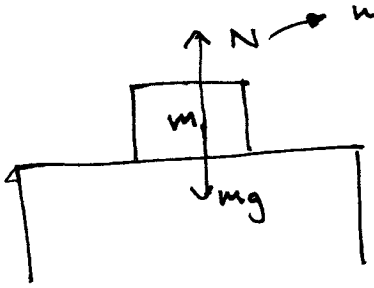
$\Rightarrow F = m(g+a) = 61(9.8 + 13.5) = 1421.3$ N

Newton's third law

DEMO → Spring balances

DEMO → Two mail scales

Statement of Newton's third law → see lecture slides.



$\Sigma F_y = N - mg = ma = 0$

$\Rightarrow N = mg$

normal reaction is perpendicular to the surface