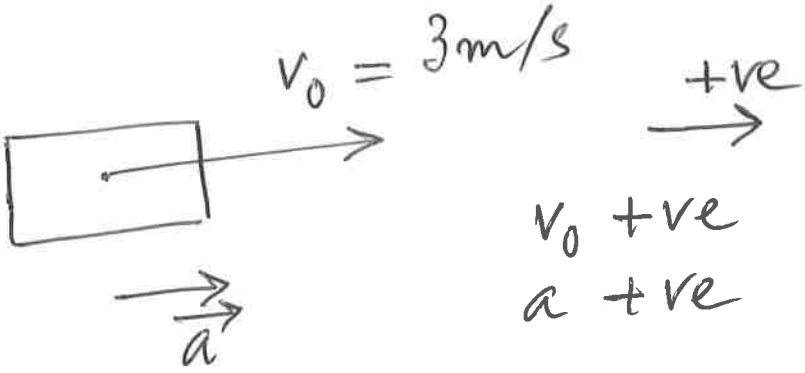
Physics 1

Displacement ≠ distance travelled.

Velocity ≠ speed.

Example 1



$\vec{v}$ and $\vec{a}$ have same direction ⇒ speed up

opposite " ⇒ slow down

Be careful of signs!

a) $s = v_0 t + \frac{1}{2} a t^2$ — 10s

initial velocity 3m/s; 10s; acceleration $2m/s^2$

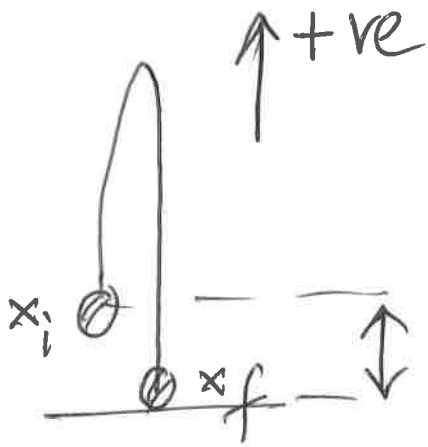
$\therefore s = 130m$

b) $v = v_0 + at$ — 10s

3m/s; $2m/s^2$

$\therefore v = 23m/s$

Example 2



v_0 is +ve
a is −ve

$s = x_f - x_i = -1.8\,m$

$$s = v_0 t + \frac{1}{2} a t^2$$

$s = -1.8$, $v_0 = 10$, $a = -9.81\,m/s^2$ (Acceleration due to gravity $9.81\,m/s^2$)

Simplify $4.9t^2 - 10t - 1.8 = 0$

Solve this quadratic equation

$t_1 = -0.17\,s$ (time cannot be negative)

$t_2 = 2.2\,s$ ⇐ only solution

$F = m.a$

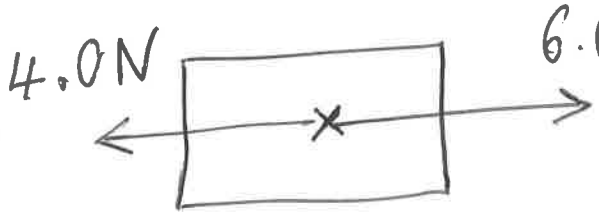
- F: force, N
- m: mass, kg
- a: acceleration, m/s^2

Easiest to use SI units

Mass (kg)
Length (m)
Amount (mole)
Temperature (K)

Example 3

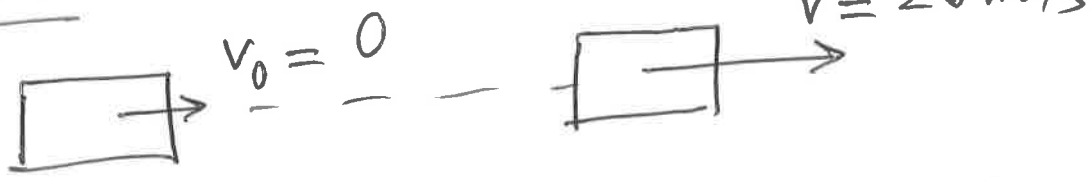
Force is a vector
Net force = vector sum of all forces



Net force $F = 2\,N$ directed to right

$$a = \frac{F}{m} = \frac{2(N)}{3(kg)} = 0.67\,m/s^2$$

Example 4

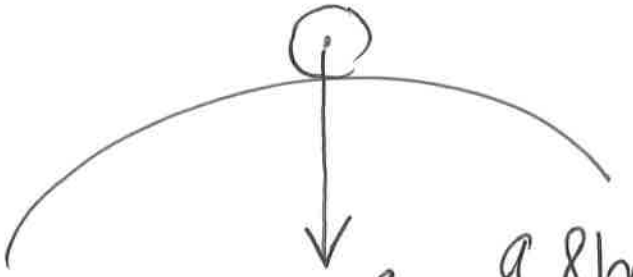


$$a = \frac{\Delta v}{\Delta t} \left(\text{or } \frac{dv}{dt}\right) = \frac{25}{10} = 2.5\,m/s^2$$

$F = ma = 3000\,N$ ← Net force = force produced by engine

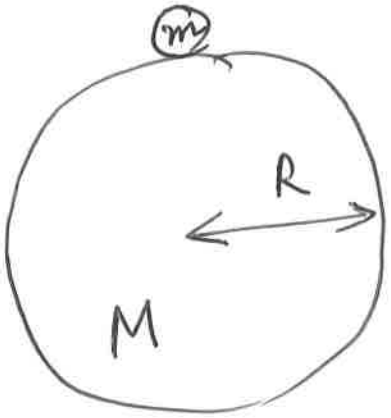
- 1200 kg
- 2.5 m/s^2

Gravity – physical force of attraction



$g = 9.8 m/s^2$ towards the centre of the Earth

Example 5



$$F_g = G\frac{M.m}{R^2} = m.g$$

(mass, acce.)

$$\therefore \boxed{g = \frac{G.M}{R^2}}$$

Want to calculate M

$$M = \frac{gR^2}{G}$$

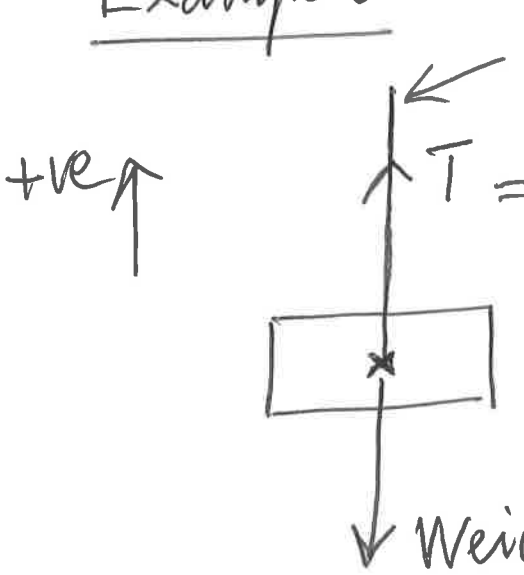
$$M = \frac{2.8 \times (6.2 \times 10^6)^2}{6.67 \times 10^{-11}}$$

$$\therefore M = 1.6 \times 10^{24} kg$$

$s = \frac{1}{2}gt^2$ (s: 12.5m, t: 3s)

$\therefore g = 2.8 m/s^2$

Example 6



Free body diagram

↳ 2 forces

Net force $F = T - W$ ← Negative indicates downward force

Newton's law $F = ma$

$\therefore \quad T - W = ma$

$T = ma + W$

$\vec{F} = \vec{T} + \vec{W}$ (Vector sum)

$= ma + mg$

mg: $9.81 m/s^2$

ma: 20kg, $1.5 m/s^2$

$T = 230\ N$