

Physic formulary

School

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1 Constants

Bohr radius	$a_0 = \frac{4\pi\epsilon_0\hbar^2}{m_e e^2} = \frac{\epsilon_0\hbar^2}{\pi m_e e^2} = \frac{\hbar}{m_e c \alpha} = 5.291\,772\,109\,03 \times 10^{-11} \text{ m}$
Velocity of light:	$c_0 = 299\,792\,458 \frac{\text{m}}{\text{s}}$
Elementary charge:	$e = 1.602\,176\,634 \times 10^{-19} \text{ C}$
Vacuum permittivity:	$\epsilon_0 = 8.854\,187\,812\,8 \times 10^{-12} \frac{\text{F}}{\text{m}}$
Permittivity of air:	$\epsilon_r = 1.000\,59$
Faraday constant	$F = 96\,485.332\,123\,3 \frac{\text{C}}{\text{mol}}$
Acceleration due to gravity:	$g = 9.806\,65 \frac{\text{m}}{\text{s}^2}$
Gravitational constant:	$G = 6.674\,30 \times 10^{-11} \frac{\text{m}^3}{\text{kg s}^2}$
Planck constant:	$h = 6.626\,070\,15 \times 10^{-34} \frac{\text{J}}{\text{Hz}}$
Electron mass:	$m_e = 9.109\,383\,701\,5 \times 10^{-31} \text{ kg}$ $m_e = 0.510\,998\,950\,00 \frac{\text{MeV}}{c_0^2}$
	$m_\mu = 1.883\,531\,627 \times 10^{-28} \text{ kg}$
Muon mass:	$m_\mu = 105.658\,375\,5 \frac{\text{MeV}}{c_0^2}$ $m_\mu = 0.113\,428\,925\,9 \text{ Da}$
Neutron mass:	$m_n = 1.674\,927\,498\,04 \times 10^{-27} \text{ kg}$ $m_n = 939.565\,420\,52 \frac{\text{MeV}}{c_0^2}$
Proton mass:	$m_p = 1.672\,621\,923\,69 \times 10^{-27} \text{ kg}$ $m_p = 938.272\,088\,16 \frac{\text{MeV}}{c_0^2}$
Vacuum permeability:	$\mu_0 = 1.256\,637\,062\,12 \times 10^{-6} \frac{\text{H}}{\text{m}}$
Permeability of air:	$\mu_r = 1.000\,000\,37$

2 Other physical interrelationships

Visible spectrum:	380 nm to 750 nm
Speed of sound under standart conditions:	$343 \frac{\text{m}}{\text{s}}$
Dalton Da / unified atomic mass unit u:	$\text{Da/u} = 1.660\,539\,066\,60 \times 10^{-27} \text{ kg}$
Hydrogen mass:	$m_{\text{H}} = 1.007\,84 \text{ Da to } 1.008\,11 \text{ Da}$
Atomic mass of helium ^4He	$m_{\text{He}} = 4.002\,603\,254 \text{ Da}$
Alternate energy units:	$\text{kW h} = 3.6 \times 10^6 \text{ J}$
	$\text{eV} = 1.602\,176\,634 \times 10^{-19} \text{ J}$
Pressure:	$1 \text{ Pa} = 1 \frac{\text{N}}{\text{m}^2}$
	$1 \text{ bar} = 10^5 \text{ Pa}$
Absolute zero:	$-273.15^\circ\text{C} = 0 \text{ K}$

3 Energy

Kinetic Energy

$$E_k = \frac{1}{2}mv^2$$

Potential Energy

$$U = \begin{cases} mgh & \text{(gravitational)} \\ \frac{1}{2} \cdot k \cdot x^2 & \text{(elastic)} \\ \frac{1}{2} \cdot C \cdot V^2 & \text{(electric)} \\ -mB & \text{(magnetic)} \\ \int F(r) dr & \text{(general)} \end{cases}$$

4 Motion

uniform linear motion

$$s(t) = vt \ (+s_0)$$

$$v(t) = \text{const.}$$

$$a(t) = 0$$

non-uniform linear motion

$$s(t) = \frac{1}{2}at^2 \ (+v_0 t + s_0)$$

$$v(t) = at \ (+v_0)$$

$$a(t) = \text{const.}$$

Circular motion

$$F_z = \frac{mv^2}{r} = m\omega^2 r$$

$$\omega = \frac{v}{r} = \frac{2\pi}{T} = \frac{\Delta\varphi}{\Delta t} \quad \varphi \text{ in rad}$$

$$f = \frac{1}{T}$$

5 Momentum

momentum itself

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

$$= \frac{h}{\lambda}$$

photons

$$= \sqrt{m_0^2 c_0^2 + \frac{E^2}{c_0^2}}$$

general

relations to momentum

$$\sum_i m_i u_i = \sum_i m_i v_i$$

conservation of
momentum

$$\Delta p = F \Delta t$$

$$E_k = \int p \, dv$$

6 Electricity

General

$$I = \frac{\Delta Q}{\Delta t} = \frac{\partial Q}{\partial t} = \dot{Q}$$

in A

$$R = \frac{U}{I} = \rho \frac{l}{A}$$

in Ω

$$E = U \cdot Q$$

$$P = \frac{\Delta E}{\Delta t} = UI$$

in W Energy flow
/ "Power"

7 Fields

7.1 Newtonian gravitation

Homogeneous field

$$E = mgh$$

$$\vec{F}_g = m\vec{g}$$

$$\vec{g} = \frac{\vec{F}_g}{m}$$

$$\Delta\varphi = \frac{E}{m} = gh$$

Radial symmetric field

$$U = GMm \left(\frac{1}{r_1} - \frac{1}{r_2} \right)$$

$$U = -GMm \frac{1}{r} \quad \text{for } r_1 \rightarrow \infty$$

$$\vec{F}_g = -G \frac{Mm}{r^2} \hat{r}$$

$$\vec{g} = \frac{\vec{F}_g}{m} = -G \frac{M}{r^2} \hat{r}$$

$$\Delta\varphi = \frac{E}{m} = \gamma M \left(\frac{1}{r_1} - \frac{1}{r_2} \right)$$

7.2 Electromagnetism

homogenous field

$$E = q \left| \vec{E} \right| d$$

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