

## Physics Formula Sheet

### Kinematics

$$\begin{aligned} \vec{v}_{ave} &= \frac{\Delta \vec{d}}{\Delta t} & \vec{a} &= \frac{\vec{v}_f - \vec{v}_i}{\Delta t} & \vec{d} &= \vec{v}_i \Delta t + \frac{1}{2} \vec{a} \Delta t^2 & \vec{d} &= \vec{v}_f \Delta t - \frac{1}{2} \vec{a} \Delta t^2 \\ \vec{v}_f^2 &= \vec{v}_i^2 + 2\vec{a}\vec{d} & \vec{d} &= \frac{(\vec{v}_f + \vec{v}_i)}{2} \Delta t & & & & \\ \vec{a}_c &= \frac{v^2}{r} & v &= \frac{2\pi r}{T} & d &= r\theta & v &= r\omega & a &= r\alpha \end{aligned}$$

### Dynamics

$$\begin{aligned} \vec{F} &= m\vec{a} & \vec{F}_g &= m\vec{g} & \vec{F}_f &= \mu\vec{F}_N & \vec{F}_s &= -k\vec{x} \\ \frac{R^3}{T^2} &= K & \vec{F}_g &= \frac{Gm_1m_2}{r^2} & \vec{g} &= \frac{Gm_1}{r^2} & \vec{F}_c &= \frac{mv^2}{r} \\ \vec{F}_c &= \frac{4\pi^2 mr}{T^2} & & & & & & \end{aligned}$$

### Momentum and Energy

$$\begin{aligned} \vec{F}\Delta t &= m\Delta\vec{v} & \vec{p} &= m\vec{v} & W &= \vec{F}\vec{d} & W &= \Delta E = \vec{F}\vec{d} \cos\theta \\ P &= \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t} & E_k &= \frac{1}{2} m\vec{v}^2 & E_g &= m\vec{g}\vec{h} & E_s &= \frac{1}{2} k\vec{x}^2 & e &= \frac{E_{out}}{E_{in}} \\ E_g &= \frac{-Gm_1m_2}{r} & E_T &= \frac{1}{2} E_g \text{ (orbital E)} & & & E_k &= -\frac{1}{2} E_g \text{ (orbital E)} \end{aligned}$$

### Waves, Sound and Light

$$\begin{aligned} v &= \lambda f & v &= 332m/s + (0.6m/s/^\circ C)T & T &= \frac{1}{f} \\ T &= 2\pi\sqrt{\frac{m}{k}} & T &= 2\pi\sqrt{\frac{L}{g}} & f &= f_o \left( \frac{v+v_o}{v-v_s} \right) & \frac{n\lambda}{2} &= L_{open}, \frac{(2n-1)\lambda}{4} = L_{closed} \\ \frac{\sin\theta_1}{\sin\theta_2} &= \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1} & \lambda &= \frac{xd}{nL} & \lambda &= \frac{d \sin\theta}{n} & \lambda &= \frac{d\Delta x}{L} \\ M &= \frac{h_i}{h_o} = \frac{-d_i}{d_o} & \frac{1}{f} &= \frac{1}{d_o} + \frac{1}{d_i} & n &= \frac{c}{v} & I_2 &= I_1 \cos^2\theta \\ \tan\theta_B &= \frac{n_2}{n_1} & |P_n S_1 - P_n S_2| &= n\lambda & v &= d_T n f & \Delta x &= \frac{L\lambda}{2t} \end{aligned}$$

## Electricity and Magnetism

$$\vec{F}_e = \frac{kq_1q_2}{r^2} \quad |\vec{E}| = \frac{kq_1}{r^2} \quad |\vec{E}| = \frac{F_e}{q_2} \quad |\vec{E}| = \frac{V}{d}$$

$$V = \frac{\Delta E}{q} \quad E_e = \frac{kq_1q_2}{r} \quad V = \frac{kq_1}{r} \quad I = \frac{q}{t}$$

$$V = IR \quad P = IV \quad \vec{F}_m = qvB \quad F_m = BIL$$

$$V = LvB \quad \frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{I_s}{I_p} \quad Q=Ne$$

## Nature of Matter

$$hf = E_{k_{\max}} + W \quad W = hf_o \quad E_{k_{\max}} = qV_{stop} \quad E = hf = \frac{hc}{\lambda}$$

$$N = N_o \left( \frac{1}{2} \right)^{\frac{t}{h}} \quad E = pc \quad p = \frac{h}{\lambda} = \frac{hf}{c} \quad \lambda = \frac{h}{mv}$$

$$E = mc^2 \quad m = \frac{m_o}{\sqrt{1 - \frac{v^2}{c^2}}} \quad L = L_o \sqrt{1 - \frac{v^2}{c^2}} \quad t = \frac{t_o}{\sqrt{1 - \frac{v^2}{c^2}}}$$

## Constants

$$g = 9.81 \text{ m/s}^2 \quad G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \quad M_E = 5.98 \times 10^{24} \text{ kg}$$

$$R_E = 6.37 \times 10^6 \text{ m} \quad k = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2 \quad 1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$$

$$e = 1.60 \times 10^{-19} \text{ C} \quad c = 3.00 \times 10^8 \text{ m/s} \quad h = 6.63 \times 10^{-34} \text{ Js}$$

$$m_e = 9.11 \times 10^{-31} \text{ kg} \quad m_p = 1.673 \times 10^{-27} \text{ kg} \quad m_n = 1.675 \times 10^{-27} \text{ kg}$$

$$m_\alpha = 6.65 \times 10^{-27} \text{ kg} \quad 1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$$

## Math Formulae and Metric Prefixes

$$c^2 = a^2 + b^2 - 2ab\cos C \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \quad \sin \theta = \frac{O}{H} \quad \cos \theta = \frac{A}{H} \quad \tan \theta = \frac{O}{A}$$

$$ax^2 + bx + c = 0; \quad \text{Quadratic Equation: } x = \frac{-b \pm (b^2 - 4ac)^{1/2}}{2a}$$

$$\text{pico(p)} = 10^{-12} \quad \text{nano(n)} = 10^{-9} \quad \text{micro}(\mu) = 10^{-6} \quad \text{milli(m)} = 10^{-3}$$

$$\text{centi(c)} = 10^{-2} \quad \text{giga(G)} = 10^9 \quad \text{mega(M)} = 10^6 \quad \text{kilo(k)} = 10^3$$