

Formula Sheet for LSU Physics 2113, First Exam, Fall '14

- Constants, definitions:**

$$g = 9.8 \frac{\text{m}}{\text{s}^2}$$

$$R_{\text{Earth}} = 6.37 \times 10^6 \text{ m}$$

$$M_{\text{Earth}} = 5.98 \times 10^{24} \text{ kg}$$

$$G = 6.67 \times 10^{-11} \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}$$

$$R_{\text{Moon}} = 1.74 \times 10^6 \text{ m}$$

$$\text{Earth-Sun distance} = 1.50 \times 10^{11} \text{ m}$$

$$M_{\text{Sun}} = 1.99 \times 10^{30} \text{ kg}$$

$$M_{\text{Moon}} = 7.36 \times 10^{22} \text{ kg}$$

$$\text{Earth-Moon distance} = 3.82 \times 10^8 \text{ m}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \frac{\text{C}^2}{\text{Nm}^2}$$

$$k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}$$

$$e = 1.60 \times 10^{-19} \text{ C}$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$m_p = 1.67 \times 10^{-27} \text{ kg}$$

$$1 \text{ eV} = e(1\text{V}) = 1.60 \times 10^{-19} \text{ J}$$

$$\text{dipole moment: } \vec{p} = q\vec{d}$$

$$m_e = 9.11 \times 10^{-31} \text{ kg}$$

$$\text{charge densities: } \lambda = \frac{Q}{L}, \quad \sigma = \frac{Q}{A}, \quad \rho = \frac{Q}{V}$$

$$\text{Area of a circle: } A = \pi r^2$$

$$\text{Area of a sphere: } A = 4\pi r^2$$

$$\text{Volume of a sphere: } V = \frac{4}{3}\pi r^3$$

$$\text{Area of a cylinder: } A = 2\pi r\ell \quad \text{Volume of a cylinder: } V = \pi r^2\ell$$

- Units:**

$$\text{Joule} = \text{J} = \text{N}\cdot\text{m}$$

- Kinematics (constant acceleration):**

$$v = v_o + at \quad x - x_o = \frac{1}{2}(v_o + v)t \quad x - x_o = v_o t + \frac{1}{2}at^2 \quad v^2 = v_o^2 + 2a(x - x_o)$$

- Circular motion:**

$$F_c = ma_c = \frac{mv^2}{r}, \quad T = \frac{2\pi r}{v}, \quad v = \omega r$$

- General (work, def. of potential energy, kinetic energy):**

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

$$\vec{F}_{\text{net}} = m\vec{a}$$

$$E_{\text{mech}} = K + U$$

$$W = -\Delta U \text{ (by field)}$$

$$W_{\text{ext}} = \Delta U = -W \text{ (if objects are initially and finally at rest)}$$

- Gravity:**

$$\text{Newton's law: } |\vec{F}| = G \frac{m_1 m_2}{r^2}$$

$$\text{Gravitational acceleration (planet of mass } M): a_g = \frac{GM}{r^2}$$

$$\text{Gravitational Field: } \vec{g} = -G \frac{M}{r^2} \hat{r} = -\frac{dV_g}{dr}$$

$$\text{Gravitational potential: } V_g = -\frac{GM}{r}$$

$$\text{Law of periods: } T^2 = \left(\frac{4\pi^2}{GM} \right) r^3$$

$$\text{Potential Energy: } U = -G \frac{m_1 m_2}{r_{12}}$$

$$\text{Potential Energy of a System (more than 2 masses): } U = - \left(G \frac{m_1 m_2}{r_{12}} + G \frac{m_1 m_3}{r_{13}} + G \frac{m_2 m_3}{r_{23}} + \dots \right)$$

$$\text{Gauss' law for gravity: } \oint_S \vec{g} \cdot d\vec{S} = -4\pi G M_{\text{ins}}$$

- Electrostatics:**

$$\text{Coulomb's law: } |\vec{F}| = k \frac{|q_1| |q_2|}{r^2}$$

$$\text{Force on a charge in an electric field: } \vec{F} = q\vec{E}$$

$$\text{Electric field of a point charge: } |\vec{E}| = k \frac{|q|}{r^2}$$

$$\text{Electric field of a dipole on axis, far away from dipole: } \vec{E} = \frac{2k\vec{p}}{z^3}$$

$$\text{Electric field of an infinite line charge: } |\vec{E}| = \frac{2k\lambda}{r}$$

$$\text{Torque on a dipole in an electric field: } \vec{\tau} = \vec{p} \times \vec{E}$$

$$\text{Potential energy of a dipole in } \vec{E} \text{ field: } U = -\vec{p} \cdot \vec{E}$$