PY106 EQUATION SHEET I

Constant Acceleration Equations

$x = x_o + v_o\, t + \frac{1}{2}\, a\, t^2$ $\qquad v = v_o + at$ $\qquad v^2 = v_o^2 + 2a(x - x_0)$

Newton's Laws

Newton's second law: $\Sigma \boldsymbol{F} = m\, \boldsymbol{a}$ $\qquad$ Newton's third law: $\boldsymbol{F}_{12} = -\boldsymbol{F}_{21}$

Energy and Work:

Work: $W = F\, d \cos\theta$ $\qquad$ Kinetic Energy: $K = \frac{1}{2}mv^2$ $\qquad W_{net} = \Delta K$

Gravitational Potential Energy: $U = mgh$

Energy Conservation: $U_i + K_i + W_{nc} = U_f + K_f$ $\qquad$ where W_{nc} is work done by non-conservative forces

Momentum: $\boldsymbol{p} = m\boldsymbol{v}$ $\qquad$ Centripetal acceleration: $a_c = \frac{v^2}{r}$

Constants: $k = \dfrac{1}{4\pi\varepsilon_o} = 9.0 \times 10^9\ \mathrm{N\,m^2/C^2}$ $\qquad \varepsilon_0 = 8.85 \times 10^{-12}\ \mathrm{C^2/(N\,m^2)}$ $\qquad e = 1.60 \times 10^{-19}\ \mathrm{C}$

Magnitude of the Electric Field of a charge: $E = \dfrac{k\,|q|}{r^2}$ $\qquad$ Magnitude of the Force : $|F| = \dfrac{k\,|q_1 q_2|}{r^2}$

Force-Field connection $\vec{F} = q\vec{E}$

Potential of a charge: $V = \dfrac{k\,q}{r}$ $\qquad$ Potential Difference For a uniform field: $|\Delta V| = Ed$

Potential Energy for two charges: $U = \dfrac{k\,q_1\,q_2}{r}$ $\qquad$ Potential Energy of a charge: $U = qV$

Electric field in a dielectric: $E = \dfrac{E_{vac}}{\kappa}$ $\qquad$ Electric field in a parallel plate capacitor: $E = \dfrac{Q}{\kappa\varepsilon_0 A}$

Capacitance: $C = \dfrac{Q}{|\Delta V|}$ $\qquad C = \dfrac{\kappa\varepsilon_o A}{d}$ $\qquad U = \dfrac{Q|\Delta V|}{2} = \dfrac{Q^2}{2C} = \dfrac{C(\Delta V)^2}{2}$