Physics 105 Formula Sheet

$$\mu = \frac{Mm}{M+m}, \qquad U_{\text{eff}} = \frac{l^2}{2\mu r^2} + U(r), \qquad \mathbf{F} = -\frac{GMm}{r^2}\,\hat{\mathbf{r}}, \qquad U = -\frac{GMm}{r}, \qquad T^2 = \frac{\pi^2 \mu A^3}{2C}$$

$$a_c = \frac{v^2}{r}, \qquad r = \frac{r_0}{1-\epsilon\cos\theta}, \qquad r_0 \equiv l^2/\mu C, \qquad \epsilon \equiv \sqrt{1+\frac{2El^2}{\mu C^2}}, \qquad C \equiv GMm$$

$$A = -C/E$$

$$\ddot{x} + \gamma\dot{x} + \omega_0^2 x = 0 \quad \left(\text{or} = \frac{F}{m}\right)$$

$$\ddot{x} + \omega_0^2 x = 0, \qquad \omega_0^2 = k/m, \qquad x = A\cos(\omega_0 t + \phi), \qquad 2\pi f = \omega, \qquad T = 1/f$$

$$e^{i\phi} = \cos\phi + i\sin\phi, \qquad z = x + iy = re^{i\phi}, \qquad r^2 = zz^*, \qquad \tan\phi = \frac{\text{Im}z}{\text{Re}z}$$

$$y(x,t) = f(x \mp vt), \qquad y(x,t) = A\cos(kx \mp \omega t) \qquad v = \frac{\lambda}{T} = \frac{\omega}{k}, \qquad \lambda = \frac{2\pi}{k}$$

$$f'_{sound} = f_0(v_s \pm v_{rec})/(v_s \mp v_{src})$$

$$\sin\alpha + \sin\beta = 2\sin\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}, \qquad \cos\alpha + \cos\beta = 2\cos\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}$$

$$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta, \qquad \cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$$

Lorentz transform : $x' = \gamma(x - vt), \quad y' = y, \quad z' = z, \quad t' = \gamma(t - xv/c^2)$

$$x = \gamma(x' + vt'), \quad y = y', \quad z = z', \quad t = \gamma(t' + x'v/c^2)$$

$$\beta = v/c, \qquad \gamma = 1/\sqrt{1-\beta^2}, \qquad u_x = (u'_x + v)/(1 + vu'_x/c^2), \qquad u_y = u'_y/\gamma(1 + vu'_x/c^2)$$

$$E = \gamma m_0 c^2, \qquad p = \gamma m_0 v, \qquad E^2 = p^2c^2 + m_0^2c^4, \qquad E = pc$$