FORMULARY SH1014

(Handpicked equations)

Special Relativity

Lorentz factor:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Time dilation:

$$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma t_0$$

Length contraction:

$$l = l_0 \sqrt{1 - \frac{v^2}{c^2}} = \frac{l_0}{\gamma}$$

Relativistic total energy:

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma mc^2$$

Relativistic kinetic energy:

$$K = \left(\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} - 1 \right) mc^2 = (\gamma - 1)mc^2$$

Relativistic momentum:

$$p = \frac{mv}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma mv$$

Relative velocity:

$$u' = \frac{u + v}{1 + \frac{uv}{c^2}}$$

Quantum Physics

Planck's law:

$$I = \frac{2hf^3}{c^2} \frac{1}{e^{hf/kT} - 1}$$

Energy levels for the infinite, one dimensional potential box:

$$E_n = \frac{n^2 h^2}{8ma^2}$$

Transmission- and emission coefficient:

If $E > U_0$:

$$R = \frac{sin^2\left[\sqrt{2m(E-U_0)}\left(\frac{a}{\hbar}\right)\right]}{sin^2\left[\sqrt{2m(E-U_0)}\left(\frac{a}{\hbar}\right)\right] + 4\frac{E}{U_0}\left(\frac{E}{U_0}-1\right)}$$

$$T = \frac{4\frac{E}{U_0}\left(\frac{E}{U_0}-1\right)}{sin^2\left[\sqrt{2m(E-U_0)}\left(\frac{a}{\hbar}\right)\right] + 4\frac{E}{U_0}\left(\frac{E}{U_0}-1\right)}$$

If $E < U_0$:

$$R = \frac{sinh^2\left[\sqrt{2m(U_0-E)}\left(\frac{a}{\hbar}\right)\right]}{sin^2\left[\sqrt{2m(U_0-E)}\left(\frac{a}{\hbar}\right)\right] + 4\frac{E}{U_0}\left(1-\frac{E}{U_0}\right)}$$

$$T = \frac{4\frac{E}{U_0}\left(1-\frac{E}{U_0}\right)}{sinh^2\left[\sqrt{2m(U_0-E)}\left(\frac{a}{\hbar}\right)\right] + 4\frac{E}{U_0}\left(1-\frac{E}{U_0}\right)}$$