APPENDIX 1: DERIVATION OF THE SPEED OF LIGHT FROM MAXWELL'S EQUATIONS

Given Maxwell's basic equation

$$\nabla \times E = \frac{\partial B}{\partial t} \qquad \nabla \times B = \mu_o \epsilon_o \frac{\partial E}{\partial t}$$

$$\nabla \cdot E = 0 \qquad \nabla \cdot B = 0$$

We then compute

$$\nabla \times (\nabla \times E) = -\frac{\partial(\nabla \times B)}{\partial t} = -\mu_o \epsilon_o \frac{\partial^2}{\partial t^2} E$$

Therefore

$$\nabla^2 E = \mu_o \epsilon_o \frac{\partial^2}{\partial t^2} E$$

Using the basic definition for the energy of a wave

$$E = E_0 \sin\left(2\pi \frac{x-vt}{\lambda}\right)$$

After differentiating the above equation we get

$$\frac{\partial^2 E}{\partial x^2} = -E_0 \left(\frac{2\pi}{\lambda}\right)^2 \sin\left(2\pi \frac{x-vt}{\lambda}\right) \quad \text{and} \quad \frac{\partial^2 E}{\partial t^2} = -E_0 \left(\frac{2\pi v}{\lambda}\right)^2 \sin\left(2\pi \frac{x-vt}{\lambda}\right)$$

Then after substituting back into our wave equation

$$v^2 = \frac{1}{\mu_o \epsilon_o}$$

Therefore

$$v = \sqrt{\frac{1}{\mu_o \epsilon_o}} = \sqrt{\frac{1}{(8.85418782 \times 10^{-12} m^{-3}\, kg^{-1} s^4\, A^2) * (1.25663706 \times 10^{-6}\, m\, kg\, s^2 A^{-2})}} = 2.99792458 \times 10^8 \text{ m/s}$$

This is the exact value for the speed of light as it is know today.