$$\cancel{\frac{\partial E}{\partial t} = -\frac{\partial B}{\partial x}}$$

$$\frac{\partial E}{\partial x} = -\frac{\partial B}{\partial t}$$ ← Faraday's Law.

$$-\frac{\partial B}{\partial x} = \varepsilon_0 \mu_0 \frac{\partial E}{\partial t}.$$ ← Maxwell's term in Ampere's Law.

$$\Rightarrow \frac{\partial^2 E}{\partial x^2} = -\frac{\partial^2 B}{\partial x \partial t}.$$

$$\Rightarrow -\frac{\partial^2 B}{\partial t \partial x} = \varepsilon_0 \mu_0 \frac{\partial^2 E}{\partial t^2}.$$

$$\therefore \frac{\partial^2 E}{\partial x^2} = \varepsilon_0 \mu_0 \frac{\partial^2 E}{\partial t^2}.$$

$$\text{or } \frac{\partial^2 B}{\partial x^2} = \varepsilon_0 \mu_0 \frac{\partial^2 B}{\partial t^2}.$$

Classical wave Eq.

$$\frac{\partial^2 \psi}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 \psi}{\partial t^2}.$$

$$\Rightarrow \frac{1}{v^2} = \varepsilon_0 \mu_0$$

$$\Rightarrow v = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$$

$$\frac{1}{v^2}\frac{\partial^2\psi}{\partial t^2} = \frac{\partial^2\psi}{\partial x^2}$$

Solution: $A\,\psi(x-vt) + B\,\psi(x+vt)$.

e.g. $(x-vt)^2$ is a solution.

e^{y^2} $\quad e^{(x-vt)^2}$ and $e^{(x+vt)^2}$

are also solution.

Dispersion relationship $\omega = ck \Leftrightarrow c = f\lambda$.

$\sin y$. $\quad \sin(x-vt)$ and $\sin(x+vt)$

are solution.

$\cos y$ $\quad \cos(x-vt)$ is a solution.

$\Rightarrow \cos(x-ct)$.

$\cos(kx-\omega t)$. $\cancel{\Leftrightarrow}\ \omega$ $\quad \Rightarrow \frac{\omega}{k} = c$.

$\Rightarrow \cos k(x-\frac{\omega}{k}t)$. $\quad$ or $\omega = ck$.

Time:

$$\boxed{\begin{aligned}\omega &= 2\pi f\\ f &= \frac{1}{T}\end{aligned}}$$

Length:

$$\boxed{k = \frac{2\pi}{\lambda}}$$

wave number.

$$k = \frac{2\pi}{\lambda}.$$

$$v = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$$

$$= \frac{1}{\sqrt{8.85\times10^{-12} \times 4\pi\times10^{-7}}}$$

$$= \underline{2.99\times10^{8}} \ \text{m/s}.$$

Light is a kind of EM radiation.

$$\cos(kx-\omega t).$$

$$e^{i(kx-\omega t)}$$

$$\cos\left(\frac{2\pi}{\lambda}x - 2\pi f t\right). \leftarrow$$ High school Textbook.

$$\frac{\partial E}{\partial x} = -\frac{\partial B}{\partial t}.$$

$$E = E_{max}\cos(kx-\omega t) \qquad B = B_{max}\cos(kx-\omega t)$$

$$\therefore kE_{max}\cos(kx-\omega t) = \omega B_{max}\cos(kx-\omega t)$$

$$kE_{max} = \omega B_{max}$$

$$E_{max} = c B_{max}.$$

Energy :

$$E^2 = p^2c^2 + m_0^2c^4$$

For light. $m_0 = 0$.

$$E = pc \Rightarrow p = \frac{E}{c}$$

True for light only.