# Maxwell equations to electric field wave equation none 

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#### Abstract

Generated by the Physics Derivation Graph.


Eq. 1 is an initial equation.

$$
\begin{equation*}
\vec{\nabla} \times \vec{E}=-\mu_{0} \frac{\partial \vec{H}}{\partial t} \tag{1}
\end{equation*}
$$

Eq. 2 is an initial equation.

$$
\begin{equation*}
\vec{\nabla} \times \vec{H}=\epsilon_{0} \frac{\partial}{\partial t} \vec{E} \tag{2}
\end{equation*}
$$

Eq. 3 is an initial equation.

$$
\begin{equation*}
\vec{\nabla} \cdot \vec{E}=\rho / \epsilon_{0} \tag{3}
\end{equation*}
$$

Partially differentiate Eq. 2 with respect to $t$; yields Eq. 4.

$$
\begin{equation*}
\vec{\nabla} \times \frac{\partial \vec{H}}{\partial t}=\epsilon_{0} \frac{\partial^{2} \vec{E}}{\partial t^{2}} \tag{4}
\end{equation*}
$$

Apply curl to both sides of Eq. 1; yields Eq. 5.

$$
\begin{equation*}
\vec{\nabla} \times \vec{\nabla} \times \vec{E}=-\mu_{0} \vec{\nabla} \times \frac{\partial \vec{H}}{\partial t} \tag{5}
\end{equation*}
$$

Substitute LHS of Eq. 5 into Eq. 4; yields Eq. 6.

$$
\begin{equation*}
\vec{\nabla} \times \vec{\nabla} \times \vec{E}=-\mu_{0} \epsilon_{0} \frac{\partial^{2} \vec{E}}{\partial t^{2}} \tag{6}
\end{equation*}
$$

Eq. 7 is an assumption.

$$
\begin{equation*}
\rho=0 \tag{7}
\end{equation*}
$$

Substitute LHS of Eq. 3 into Eq. 7; yields Eq. 8.

$$
\begin{equation*}
\vec{\nabla} \cdot \vec{E}=0 \tag{8}
\end{equation*}
$$

Eq. 9 is an identity.

$$
\begin{equation*}
\vec{\nabla} \times \vec{\nabla} \times \vec{E}=\vec{\nabla}\left(\vec{\nabla} \cdot \vec{E}-\nabla^{2} \vec{E}\right) \tag{9}
\end{equation*}
$$

Substitute LHS of Eq. 9 into Eq. 8; yields Eq. 10.

$$
\begin{equation*}
\vec{\nabla} \times \vec{\nabla} \times \vec{E}=-\nabla^{2} \vec{E} \tag{10}
\end{equation*}
$$

Substitute LHS of Eq. 10 into Eq. 6; yields Eq. 11.

$$
\begin{equation*}
\nabla^{2} \vec{E}=\mu_{0} \epsilon_{0} \frac{\partial^{2} \vec{E}}{\partial t^{2}} \tag{11}
\end{equation*}
$$

Eq. 11 is one of the final equations.

## References

