

# Electromagnetism – Crib Sheet

Maxwell Equations

$$\begin{aligned}\nabla \cdot E &= 4\pi\rho \\ \nabla \times E &= -\frac{\partial B}{\partial t} \\ \nabla \cdot B &= 0 \\ \nabla \times B &= \frac{\partial E}{\partial t} + 4\pi J\end{aligned}$$

For a charge particle

$$F = q(E + v \times B)$$

Vector potential

$$\begin{aligned}E &= -\nabla\Phi \\ B &= \nabla \times A\end{aligned}$$

4 – vector notation

$$F_{\alpha\beta} = \begin{bmatrix} 0 & \frac{E_x}{c} & \frac{E_y}{c} & \frac{E_z}{c} \\ \frac{-E_x}{c} & 0 & B_z & -B_y \\ \frac{-E_y}{c} & -B_z & 0 & B_x \\ \frac{-E_z}{c} & B_y & -B_x & 0 \end{bmatrix}$$

$$J = (c\rho, J)$$

$$\mu_0 J^\beta = \partial_\alpha F^{\beta\alpha}$$