

## Equations for Exam 3

### Currents and Resistance

$$I = \frac{dQ}{dt}, \quad J = \frac{I}{A}, \quad J = nqv_d, \quad J = \sigma E, \quad \rho = \frac{1}{\sigma}, \quad R = \frac{\rho L}{A},$$

$$\Delta V = IR, \quad 1\Omega = 1V/A, \quad \mathcal{P} = I\Delta V = I^2R = (\Delta V)^2/R.$$

### DC Circuits

Series:  $R_T = R_1 + R_2 + \dots$ , Parallel:  $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$

$$\sum_{\text{junction}} I = 0, \quad \sum_{\text{loop}} \Delta V = 0$$

### RC Circuits

$$Q = C\Delta V, \quad 1F = 1\frac{C}{V}, \quad 1s = 1\Omega \times 1F$$

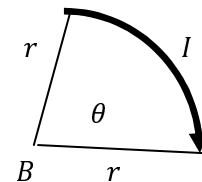
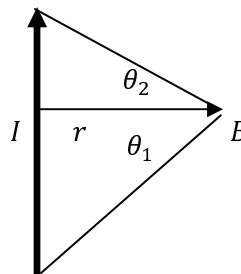
$$\frac{dI}{dt} = -RC I, \quad I = I_0 e^{-t/RC}, \quad t = RC \ln\left(\frac{I_0}{I}\right)$$

### Magnetic Fields

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}, \quad 1T = 1\frac{N}{A \cdot m}, \quad \vec{\tau} = \vec{r} \times \vec{F} = \vec{\mu} \times \vec{B}, \quad \vec{\mu} = NI\vec{A}, \quad U = -\vec{\mu} \cdot \vec{B}$$

$$\mu_0 = 4\pi \times 10^{-7} \frac{T \cdot m}{A} = 4\pi \times 10^{-7} \frac{N}{A^2} \quad \text{Cross product: } |\vec{A} \times \vec{B}| = AB \sin\theta$$

$$\vec{B} = \frac{\mu_0 I}{4\pi} \int \frac{d\vec{l} \times \hat{r}}{r^2}, \quad \text{straight line: } B = \frac{\mu_0 I}{4\pi r} (\sin\theta_1 + \sin\theta_2), \quad \text{center of arc: } B = \frac{\mu_0 I \theta}{4\pi r}$$



$$\frac{F}{L} = -\frac{\mu_0 I_1 I_2}{2\pi r}$$

$\vec{B}$  into page in both cases.