Note Card Substitute

GR 3

Write in the space below only.

Put your name on the back of the sheet.

✓

Power: $1W = 1\frac{J}{s}$

Current (I): $1A = 1\frac{C}{s}$

Resistance (R): $1\Omega = 1\frac{V}{A} = \frac{Js}{C^2}$

Elec. Pot. (V): $1V = 1\frac{J}{C} = \frac{\text{work}}{\text{charge}}$

Capacitance: $1\,\text{Farad} = 1\frac{C}{V} = \frac{C^2}{J}$

($\vec{B}$) 1 tesla $= 1T = 1\frac{N}{Am} = \frac{Ns}{cm} = \frac{kg\,m/s}{s\,c\,m} = \frac{kg}{sc} = \frac{Vs}{m^2}$

frequency: $1\,Hz = \frac{1\,\text{cycle}}{\text{sec}}$

(Φ_B) Mag. Flux: weber $= 1\,Wb = 1\,Tm^2 = \frac{Nm}{A}$

for charging capacitor: $I(t) = I_0 e^{-t/\tau} = I_0 e^{(-t/RC)}$

$I_{through} = I_1 + I_2 - I_3$

$\vec{v}\times\vec{w} = \begin{vmatrix} i & j & k \\ v_1 & v_2 & v_3 \\ w_1 & w_2 & w_3 \end{vmatrix} = \vec{i} - \vec{j} + \vec{k}$

$\boxed{\Phi_B = AB\cos\theta}$

Lorentz-Force Law

$\vec{F}_{on\,q} = q\vec{v}\times\vec{B} = qvB\sin\theta$, direction by RHR

Cyclotron Motion: $r_{cyc} = \frac{mv}{qB}$ (mass of charge) $\quad f_{req\,cycl.} = \frac{qB}{2\pi m}$

$V = r\frac{q}{m}B$ (charge-to-mass ratio)

$v = \frac{E}{qB\sin\theta}$

$\Phi_B = AB\cos(\omega t)$ through generator coil

Faraday's Law

$\mathcal{E} = \frac{d\Phi_B}{dt} = VLB$ (A, velocity)

$I = \frac{V}{R} = \frac{\mathcal{E}}{R} = \frac{vLB}{R}$

$\mathcal{E}_{coil} = N\frac{d\Phi_B}{dt}$ $\quad \Phi_B = NBA\cos\theta$

Transformer $V_2 = \frac{N_2}{N_1}V_1$

For a Transformer of 2 diff-diam. coils: s = secondary, p = primary

$\Delta V_s = \frac{N_s A_s \mu_0 N_p}{R\,2 r_p}\frac{\Delta V_p}{\Delta t}$

$I_{disp} = \varepsilon_0\frac{d\Phi_E}{dt}$

$\vec{E} = \frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{r^2}\hat{r}$

$\vec{B} = \frac{\mu_0\sin\theta}{4\pi}\cdot\frac{qv}{r^2}\hat{r}$

Ampere's Law

$\oint\vec{B}\cdot d\vec{s} = \mu_0 I_{encl.}$

Mag Forces on current-carrying wires

$F_{wire} = IL B_\perp = ILB\sin\theta = L(\vec{I}\times\vec{B})$ (of wire)

$\vec{F}$ betw. 2 Parallel wires

$\vec{F}_{\parallel} = I_1 L B_2 = I_1 L\frac{\mu_0 I_2}{2\pi d}$

Biot-Savart Law - mag. field of a moving charge

$\vec{B} = \frac{\mu_0}{4\pi}\frac{qv\sin\theta}{r^2} = \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\hat{r}}{r^2} = \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\vec{r}}{r^3}$

$\vec{B}_{wire} = \frac{\mu_0 I_{encl.}}{2\pi d}$ $\quad \vec{B}_{coil\,ctr.} = \frac{\mu_0}{2}\frac{NI}{R}$ $\quad \vec{B}_{solenoid} = \frac{\mu_0 NI}{L}$ (length of solenoid)

$\vec{E} = \frac{dV}{ds}$

Maxwell's Eqns!

① $\Phi_E = \oint\vec{E}\cdot d\vec{A} = \frac{Q_{encl.}}{\varepsilon_0}$

② $\Phi_B = \oint\vec{B}\cdot d\vec{A} = 0$

③ $\Delta V = \oint\vec{E}\cdot d\vec{s} = -\frac{d\Phi_B}{dt} = -\mathcal{E}$

④ $\oint\vec{B}\cdot d\vec{s} = \mu_0 I_{through} + \varepsilon_0\mu_0\frac{d\Phi_E}{dt}$

⑤ $\vec{F} = q(\vec{E} + \vec{v}\times\vec{B})$

$\frac{d\Phi_E}{dt} = A\frac{dE}{dt}$

$\Phi_E = EA\cos\theta$

E-M waves

$T = \frac{2\pi}{\omega}$ $\quad v = \frac{\lambda}{T}$

$E(x,t) = E_0\sin(kx - \omega t)\ \hat{y}$

$B(x,t) = B_0\sin(kx - \omega t)\ \hat{z}$ (amplitude, wave #, angular freq.)

$V_{em} = \frac{1}{\sqrt{\mu_0\varepsilon_0}} = c$

$E_0 = cB_0$