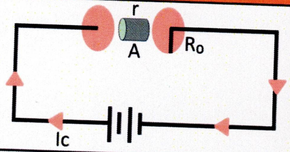
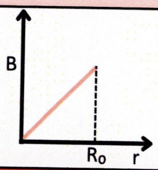
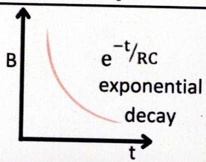
EM WAVES

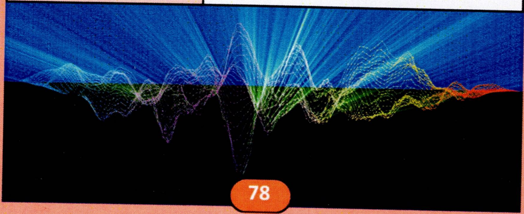
Displacement Current

Displacement current results due to change in Electric field	
Charge on capacitor at any time t	$q = CV\left[1 - e^{-t/RC}\right]$
Conduction Current	$I_e = \frac{dq}{dt} = \frac{V}{R} e^{-t/RC}$
Electric field varying with time b/w the plates of capacitor	$\overrightarrow{E_E} = \frac{CVe^{-t/RC}}{\pi R_0^{\,2} \varepsilon_0}$
Flux at A if cylinder is drawn at surface	$\phi_E = \frac{CVr^2}{\varepsilon_0 R_0^{\,2}}\left[1 - e^{-t/RC}\right]$
Charge between plates of capacitor	$q_E = \varepsilon_0 \left[\frac{CVr^2}{\varepsilon_0 R_0^{\,2}}\left[1 - e^{-t/RC}\right]\right]$
Displacement Current	$I_{dis} = \frac{V}{R}\left[1 - e^{-t/RC}\right]\left[\frac{r^2}{R_0^{\,2}}\right]$ $I_d = \varepsilon_0 \left(\frac{d\phi_E}{dt}\right)$

Magnetic field b/w plates of capacitor	$\vec{B} = \frac{\mu_0 V}{2\pi R} e^{-t/RC} \frac{r^2}{R_0^{\,2}}$
	

Maxwell's Equations

Gauss's law of Electricity	$\oint E.\,dA = \frac{Q}{\varepsilon_0}$
Gauss's law of Magnetism	$\oint B.\,dA = 0$
Faraday's law	$\oint E.\,dl = \frac{-d\phi_B}{dt}$
Ampere-Maxwells law	$\oint B.\,dl = \mu_0 I_C + \mu_0 \varepsilon_0 \frac{d\phi_C}{dt}$



EM Waves

$y = A\sin(Kx \pm \omega t)$	y	Displacement of particles
	A	Amplitude
$2\pi\omega = \frac{2\pi}{T}$	x	Direction of propagation of wave
	$\dot{\omega}$	Angular frequency
$V_{max} = \frac{W}{K}$	k	Wave No $= \frac{2\pi}{\lambda}$

Speed

In vaccum	In medium
$C_{vaccum} = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$	$C_{medium} = \frac{1}{\sqrt{\mu_m \varepsilon_m}}$

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

Refractive Index	Poynting Vector
$\frac{C}{V} = \sqrt{\varepsilon_r \mu_r}$	$\vec{S} = \frac{1}{\mu_0}(\vec{E} \times \vec{B})$

Intensity

$\vec{I} = \frac{\text{Power}}{\text{Area of Wave front}}$	$\vec{I} = \frac{1}{2}\varepsilon_0 E_0^2 C$	$\vec{I} = \frac{B_0^2}{2\mu_0} C$

Energy Densities of EM Waves	
$\mu_E = \frac{1}{2}\varepsilon_0 E^2$	$\mu_B = \frac{B^2}{2\mu_0}$
$< \mu_E > = \frac{1}{4}\varepsilon_0 {E_0}^2$ $= \frac{1}{2} E_0 E_{rms}^2$	$< \mu_B > = \frac{B^2}{4\mu_0}$ $= \frac{B_{rms}^2}{2\mu_0}$
$\mu_T = \frac{1}{2}\varepsilon_0 E_0^2$	$\mu_T = \frac{B_0^2}{2\mu_0}$

Energy of EM waves is equally distributed in electric field

$$\frac{\mu_E}{\mu_B} = 1$$