Potentially useful formulae/info:

$\nabla \times \vec{\mathcal{H}} = \frac{\partial \vec{\mathcal{D}}}{\partial t} + \vec{\mathcal{J}};$ $\nabla \times \vec{\mathcal{E}} = -\frac{\partial \vec{\mathcal{B}}}{\partial t};$ $\nabla \cdot \vec{\mathcal{D}} = \rho;$ $\nabla \cdot \vec{\mathcal{B}} = 0;$

$\vec{\mathcal{B}} = \mu_o \vec{\mathcal{H}} + \mu_o \vec{\mathcal{M}}.$ $\vec{\mathcal{D}} = \epsilon_0 \vec{\mathcal{E}} + \vec{\mathcal{P}};$ $\vec{\mathcal{P}} = \epsilon_0 \chi \vec{\mathcal{E}};$ $\vec{\mathcal{D}} = \epsilon \vec{\mathcal{E}};$ $n = \sqrt{\frac{\epsilon}{\epsilon_0}};$ $c_0 = \frac{1}{\sqrt{\epsilon_0 \mu_0}} \approx 3 \times 10^{10}\ \mathrm{cm/s}$

$$\vec{S} = \vec{E} \times \vec{\mathcal{H}} \quad I = \left\langle \vec{S} \right\rangle = \mathrm{Re}\left[\vec{S}\right] = \mathrm{Re}\left[\frac{1}{2}\vec{E} \times \vec{H}^*\right] \quad (\nabla^2 + k^2)E = 0 \quad \left[\nabla_T^2 + i2k\frac{\partial}{\partial z}\right]A = 0$$

$$U(\vec{r}) = A_o \frac{W_o}{W(z)} \exp\left[-\left(\frac{\rho^2}{W^2(z)}\right)\right] \exp\left[ikz + ik\frac{\rho^2}{2R(z)} - i\zeta(z)\right] \quad \frac{1}{q(z)} = \frac{1}{R(z)} + i\frac{\lambda}{\pi W^2(z)} \quad \theta = \frac{w_o}{z_o}$$

$I = |U|^2;$ $W(z) = W_0\sqrt{1 + \left(\frac{z}{z_0}\right)^2};$ $R(z) = z\left[1 + \left(\frac{z_0}{z}\right)^2\right];$ $\zeta(z) = \tan^{-1}\left(\frac{z}{z_0}\right);$ $W_0 = \sqrt{\frac{\lambda z_0}{\pi}}$

$$U_{l,m}(x, y, z) = A_{l,m}\left[\frac{W_0}{W(z)}\right] G_l\left[\frac{\sqrt{2}x}{W(z)}\right] G_m\left[\frac{\sqrt{2}y}{W(z)}\right] \quad z = \frac{R}{1 + (\frac{\lambda R}{\pi W^2})^2} \quad q(z) = z - iz_o$$

$$\times \exp\left[-jkz - jk\frac{x^2 + y^2}{2R(z)} + j(l + m + 1)\zeta(z)\right], \quad W_o = \frac{W}{\sqrt{1 + \left(\frac{\pi W^2}{\lambda R}\right)^2}} \quad q_2 = \frac{Aq_1 + B}{Cq_1 + D}$$

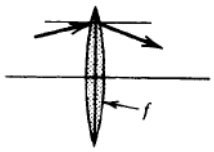
$G_0 = 1 \quad G_1(u) = 2ue^{-u^2/2} \quad G_2(u) = (4u^2 - 2)e^{-u^2/2}$

$$I = \frac{1}{2\eta}|E_1 + E_2|^2 = |U_1 + U_2|^2 = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos(\phi_1 - \phi_2)\ U_{1,2} = \sqrt{I_{1,2}}e^{i\phi_{1,2}}$$

$$\sqrt{1 + \Delta} = 1 + \frac{\Delta}{2} - \frac{\Delta^2}{8} + \ldots$$

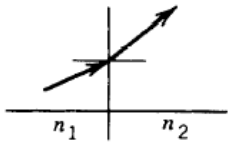
•For f(x) about x=a, the Taylor expansion is:

$$f(x) = f(a) + f'(a)(x - a) + \frac{f''(a)}{2!}(x - a)^2 + \ldots$$

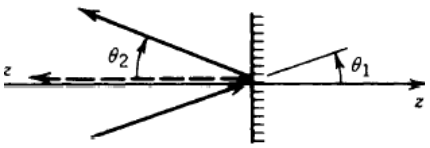


$\mathbf{M} = \begin{bmatrix} 1 & 0 \\ -\frac{1}{f} & 1 \end{bmatrix}$

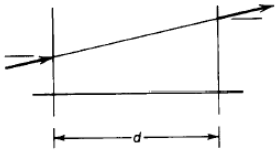
Convex, $f > 0$; concave, $f < 0$



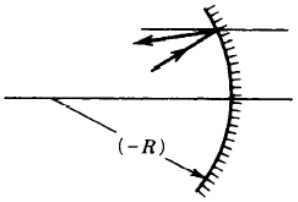
$\mathbf{M} = \begin{bmatrix} 1 & 0 \\ 0 & \frac{n_1}{n_2} \end{bmatrix}.$



$\mathbf{M} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

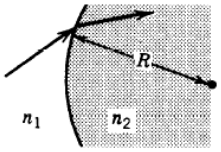


$\mathbf{M} = \begin{bmatrix} 1 & d \\ 0 & 1 \end{bmatrix}$



$\mathbf{M} = \begin{bmatrix} 1 & 0 \\ \frac{2}{R} & 1 \end{bmatrix}$

Concave, $R < 0$; convex, $R > 0$



$\mathbf{M} = \begin{bmatrix} 1 & 0 \\ -\frac{(n_2 - n_1)}{n_2 R} & \frac{n_1}{n_2} \end{bmatrix}.$

Convex, $R > 0$; concave, $R < 0$

Potentially useful formulae/info:

$$f(x) = \frac{1}{2\pi}\int_{-\infty}^{\infty}\tilde{f}(k)e^{ikx}dk = \mathcal{F}^{-1}[\tilde{f}(k)]$$

$$\tilde{f}(k) = \int_{-\infty}^{\infty} f(x)e^{-ikx}dx = \mathcal{F}[f(x)]$$

$f(x) \longleftrightarrow$	$\tilde{f}(k)$
$\delta(x)$	1
$e^{ik_o x}$	$2\pi\delta(k-k_o)$
$\cos(k_o x)$	$\pi\left[\delta(k-k_o)+\delta(k+k_o)\right]$
1	$2\pi\delta(k)$
$\exp[-\alpha x^2]$	$\sqrt{\frac{\pi}{\alpha}}\exp\left[-\frac{k^2}{4\alpha}\right]$
$rect\left[\frac{x}{w}\right]$	$w\frac{\sin[kw/2]}{kw/2}$
$f(x-x_o)$	$\tilde{f}(k)e^{-ikx_o}$
$f(x)e^{ik_o x}$	$\tilde{f}(k-k_o)$
$\sum_{n=-\infty}^{\infty}\delta(x-nx_o)$	$\frac{1}{x_o}\sum_{m=-\infty}^{\infty}\delta\left(k-m\frac{2\pi}{x_o}\right)$

$$t(x,y) = e^{ik_o d_o}e^{i(n-1)k_o d(x,y)}$$

$$t(x,y) = e^{ik_o n d_o}\exp\left[-ik\frac{x^2+y^2}{2f}\right]$$

$$g(x,y) = h_o\tilde{f}(k_x,k_y)\Big|_{k_x=\frac{kx}{d},k_y=\frac{ky}{d}}$$

$$h_o = -i\frac{k}{2\pi d}e^{ikd}$$

$$\frac{ka^2}{2d} << \pi \qquad \frac{kb^2}{2d} << \pi$$

$$\nabla\times\vec{\mathbf{H}} = -i\omega\epsilon\vec{E}$$
$$\nabla\times\vec{\mathbf{E}} = = i\omega\mu\vec{H}$$
$$\nabla\cdot\vec{\mathbf{E}} = 0$$
$$\nabla\cdot\vec{\mathbf{H}} = 0.$$

$$a(x)\otimes b(x) = \int_{-\infty}^{\infty}a(x')b(x-x')dx'$$

- If $c(x) = a(x)\otimes b(x)$ then $\mathcal{F}[c(x)] = \mathcal{F}[a(x)]\cdot\mathcal{F}[b(x)]$
- If $c(x) = a(x)\cdot b(x)$ then $\mathcal{F}[c(x)] = \mathcal{F}[a(x)]\otimes\mathcal{F}[b(x)]$