Phys 531 Assignment 3 Due September 19

1. For each of the following complex number expressions, find the real part, the imaginary part, the magnitude, and the phase. (I'm using $i = \sqrt{-1}$.) You should do the complex number manipulations by hand, but you can use a calculator for evaluating algebraic expressions or trig functions if you wish. For (a) and (f), express your results in terms of the real parameters a and b.

(a)

$$\frac{1}{a + ib}$$

(b)

$$\frac{1 + i}{2 + i}$$

(c)

$$(3 - 2i)\exp\left(\frac{3i\pi}{4}\right)$$

(d)

$$\exp\left(\frac{i\pi}{3}\right) \cdot \exp\left(\frac{i\pi}{4}\right)$$

(e)

$$(1 + i)^{3/2}$$

(f)

$$\cos(a + ib)$$

Hint: for (f), use $\cos\alpha = \frac{1}{2}(e^{i\alpha} + e^{-i\alpha})$.

2. Saleh and Teich, Problem 2.2-2, page 78.

3. Saleh and Teich, Exercise 2.2-1, page 50. To be concrete, assume that you require the phase error of the parabolic approximation to be less than 0.1 rad. Verify that in this case, $N_F\theta_m^2/4 \ll 1$.

4. Saleh and Teich, Problem 2.4-2, page 78.

5. Show that

$$\frac{1}{2a}\int_{y_0 - a}^{y_0 + a} \exp(-iky)\, dy = \exp(-iky_0)\,\mathrm{sinc}(ka)$$

where $\mathrm{sinc}(x) \equiv \sin(x)/x$. We'll use this relation several times.