Physics 214 Fall 2002
Assignment #11 (due 12/5)

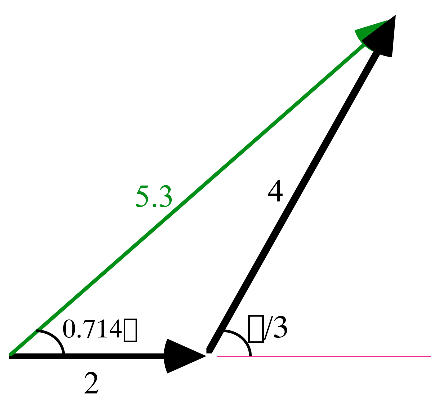
Reading

Phasors: *Young & Freedman* Sections 37–4, 38–4, and 38–5

Quantum Physics: *Young & Freedman* Sections 37–7, 40–2 through 40–4, 40–10, 41–2, 41–4, 41–6, and 42–1 through 42–5

Problems

1. *Young & Freedman* uses **phasors** to find the intensity in interference and diffraction experiments. A phasor is a vector that is analogous to a complex number. Adding complex numbers in the complex plane is just like adding vectors in the xy-plane. To add vectors, you sum the x-components to find the x-component of the sum and you sum the y-components to find the y-component of the sum. To add complex numbers, you sum the real parts to find the real part of the sum and you sum the imaginary parts to find the imaginary part of the sum. Thus the x-component of a phasor represents the real part of a complex number and the y-component represents the imaginary part. The angle of the phasor represents the phase of the complex number; the length represents the magnitude. Thus the sum $2 + 4e^{i\pi/3} \approx 5.3e^{0.714i}$ can be represented by the phasor diagram below.

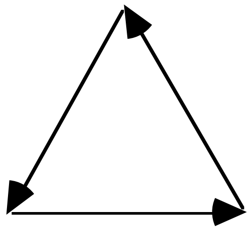


In an interference or diffraction problem, each phasor represents the complex amplitude of the light coming from one source. When we sum these phasors, the resultant phasor represents the complex amplitude of the superposition of light coming from all of the sources.

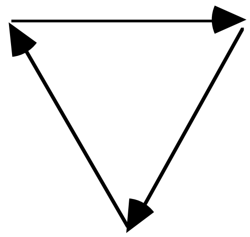
(continued)

Draw phasor diagrams to illustrate the following cases of interference and diffraction. If there is more than one possibility, illustrate all the possibilities.

Example: Minimum for 3 thin slits. Answer:



or



Now you try it!

(a) Principal maximum for 5 very narrow slits

(b) Minimum for 5 very narrow slits

(c) Secondary maximum for 5 very narrow slits (don't worry about making the angles *exact*)

(d) Maximum for two very narrow slits where one is twice as wide as the other ($I_2 = 2I_1$)

(e) First minimum for a single wide slit

(f) First maximum (not counting the central maximum) for a single wide slit (again, don't worry about making the angles *exact*)

2. *Young & Freedman* Exercise 40–12.

3. *Young & Freedman* Problem 40–45.

4. *Young & Freedman* Exercise 41–56.

5. *Young & Freedman* Exercise 42–10.

6. *Young & Freedman* Exercise 42–39.