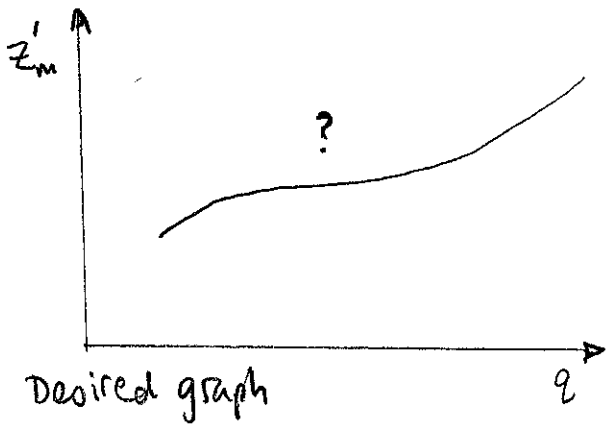
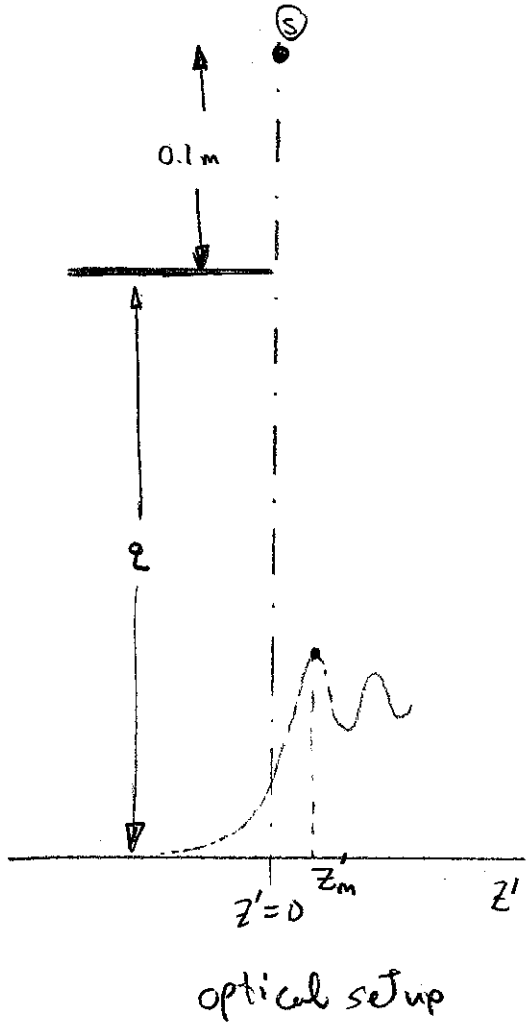
Advanced Optics Homework Due 2/15/07

1. Consider a knife edge located 0.1 m from a source of wavelength 1 micron. Make a graph showing the *position* of the maximum diffracted intensity on a screen, as a function of q, the distance of the screen from the knife, for $0 < q < 1$ m.

Also, make a graph showing the intensity of that peak. Do two graphs: one of the intensity compared to the unobstructed intensity, and one of the absolute intensity. (Note that the unobstructed intensity falls off as you move farther from the source!)

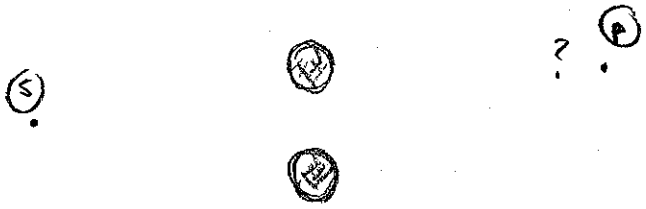
Are your solutions accurate for the full range of q? Why or why not?





2. What is the maximum intensity obtainable behind two equal wires?

Also Chapter 9: 2,8,11,14.



1. the first max is at $v = -1.2$.

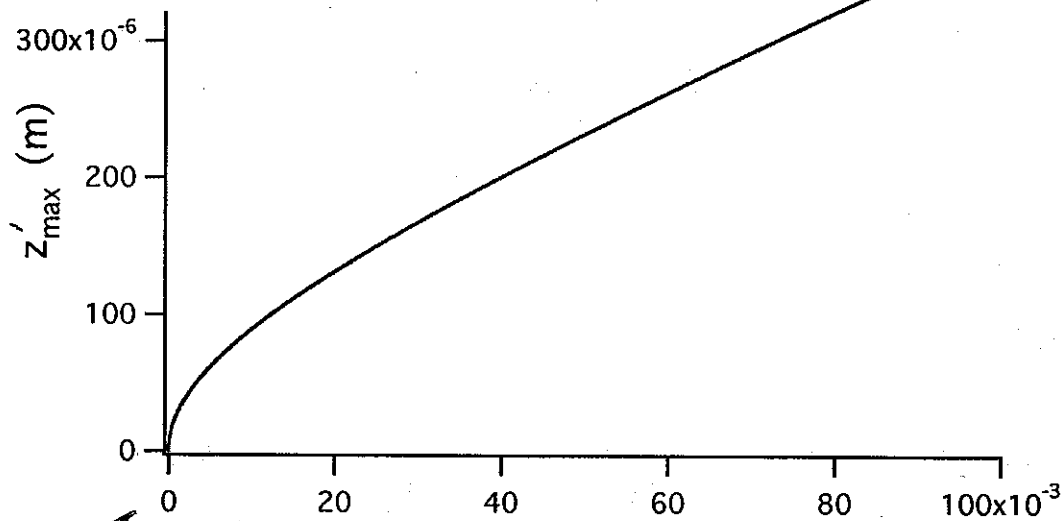
From geometry $z' = \frac{p+q}{p} \cdot z$ and $z = v\sqrt{\frac{\lambda L}{2}} = v\sqrt{\frac{\lambda pq}{2(p+q)}}$

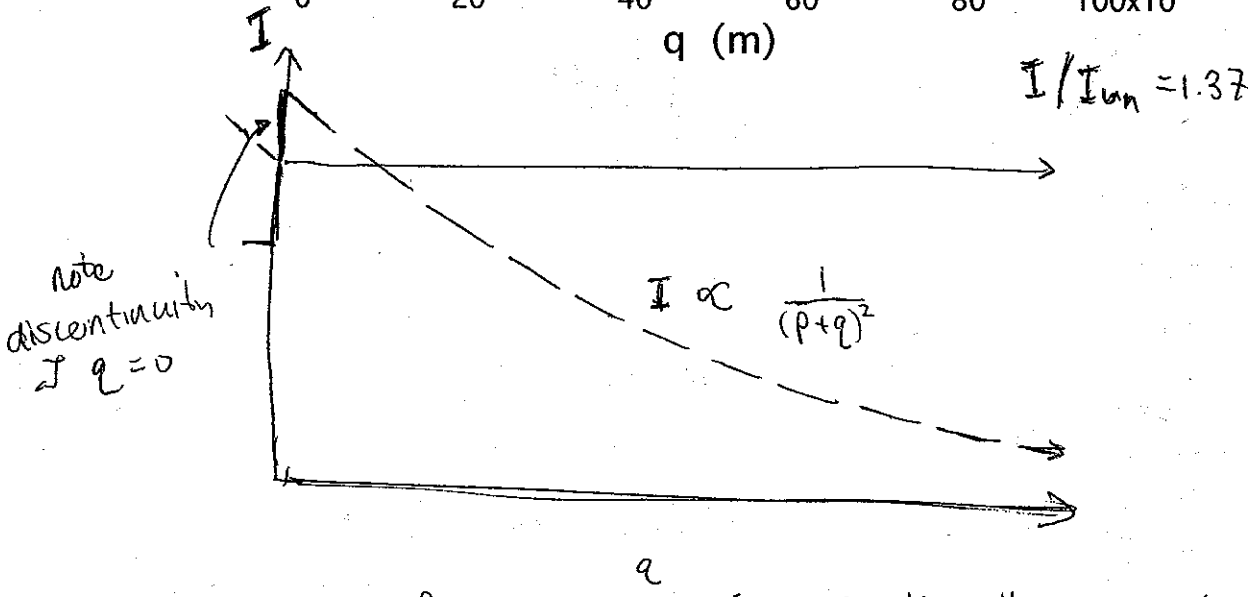
so $z'_{max} = 1.2\,\frac{p+q}{p}\sqrt{\frac{\lambda pq}{2(p+q)}}$

$= 1.2\sqrt{\frac{\lambda}{2}}\sqrt{\frac{q}{p}(p+q)} = 1.2\sqrt{\frac{\lambda}{2}}\sqrt{q + \frac{q^2}{p}}$

For large q, $z'_{max} \propto q$.

For small q, $z'_{max} \propto \sqrt{q}$



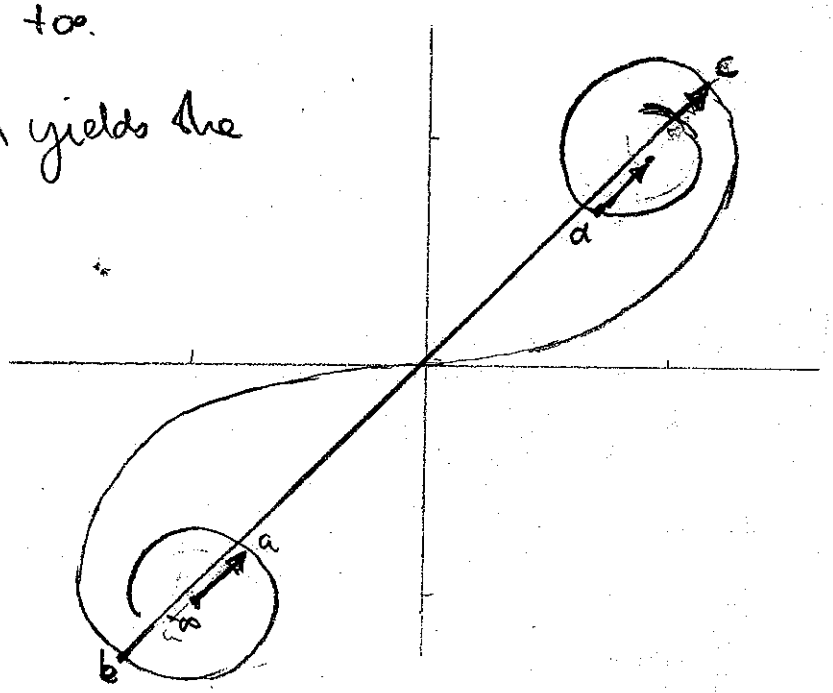


Solution not valid for small q: ignored obliquity and rr!

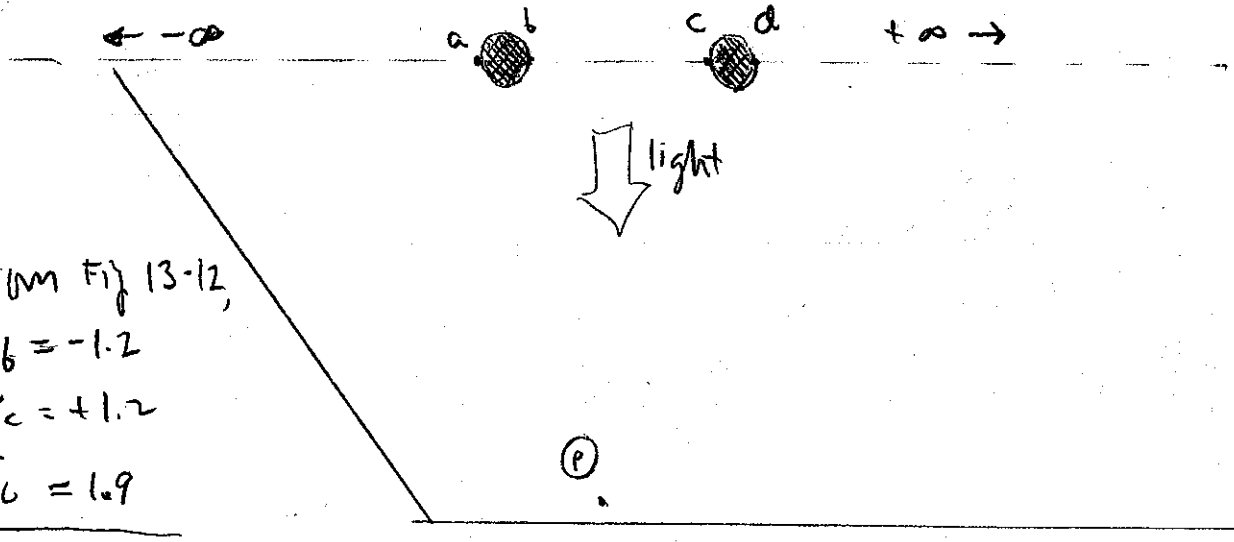
2. Maximum intensity behind 2 wires?

We desire 3 phasors off the Cornu spiral that add to give the largest field. The first phasor must start at $v = -\infty$, and the third must end at $+\infty$.

Some contemplation yields the phasors shown.



Geometry:



From Fig 13-12,

$v_b = -1.2$

$v_c = +1.2$

$\overline{bc} = 1.9$

$v_a = -1.88$

$v_d = +1.88$

$\overline{da} = ((0.38-0.5)^2 + (0.38-0.5)^2)^{1/2}$

$= 0.17$

Total lags $= 1.9 + 0.17 + 0.17 = 2.24$

$\boxed{I = 2.5\, I_{un}}$