Physics 25 Problem Set 5

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due Monday, May 8

Please make your work neat, clear, and easy to follow. It is hard to grade sloppy work accurately. Generally, make a clear diagram, and label quantities. Derive symbolic answers, and then plug in numbers after a symbolic answer is available.

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1. For this problem, you can use the Mathematica notebook linked to the web sylabus near the link to this problem. You have a diffraction grating where the distance between the slits is $d = 20\,\mu$m, and the width of the slits is $a = 2\,\mu$m. You shine light of $\lambda = 632.8\,$nm on the grating.

   (a) Make a plot of the intensity of the light exiting the grating for exit angle θ between $-3/4$ and $3/4\,$Radians, when there are $N = 2$ and $N = 3$ slits in the grating.

   (b) Compute the angle of the first maximum outside of the central maximum at $\theta = 0$.

   (c) Compare on the same plot the intensity of light exiting the grating for exit angle θ between $-1/10$ and $1/10\,$Radians, for $N = 2$, $N = 3$, and $N = 4$.

   (d) Now light of two different wavelengths, $\lambda_1 = 632\,$nm and $\lambda_2 = 633.6\,$nm, illuminates the grating. You'd like to see two distinct peaks at the first maximum, corresponding to the two different wavelengths. Estimate the minimum number of slits in the grating you would need.
