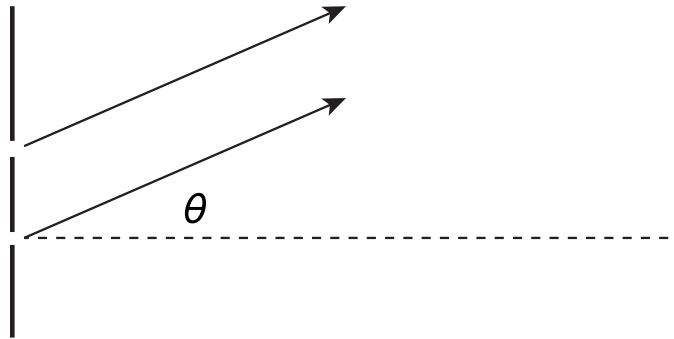# Biology 3820
Physical Principles in Biology
Fall Semester 2015

Quiz 5
4 December 2015

Please write your name on each page.
Be sure to show your work and include correct units in all of your answers!
25 points total.

1. To convince herself that lightwaves are real, a student has set up a double-slit experiment, as diagrammed below:

   The two slits are separated by a distance of $0.8\,\mu$m. For a light source, the student has used a red laser pointer, which produces light with a wavelength of $671\,$nm. As expected, she sees a pattern of light and dark bands of light projected from the two slits.

   (a) What is the smallest angle, θ, as defined in the drawing, at which a bright band of light would be found (excluding the case of $\theta = 0$)? As appropriate, add to the drawing above to illustrate your calculations.

(b) What is the smallest angle, θ, at which a dark band would centered?

(c) Suppose that, instead of a red laser pointer, the student tries a green one. Will the angle for the first dark band be smaller or greater than calculated in part b? You should not have to do any calculations to answer this question, but explain your reasoning.

(d) Suppose that the entire double-slit apparatus were to be immersed in water (with suitable insulation to prevent the laser from shorting out). How would the spacing of light and dark bands change? Explain your reasoning.

2. In class, we discussed two examples of proteins with special spectroscopic properties, the visual pigment (rhodopsin) and green fluorescent protein (GFP).

   (a) Briefly describe an important feature that these two proteins share and why this feature is important for their biological functions.

   (b) Briefly describe an important way in which rhodopsin and GFP differ with respect to their structures and biological properties.