HW 1

Due: Tuesday, Sept. 4

Krane, Chapter 2, Problem 3

Chappell Problems:

1. Summarize reasons why a physicist in 1799 might think that light is a wave? A particle?
2. Do you think that Thomas Young's double slit experiment gave convincing evidence that light was a wave? Why or why not?
3. Describe the significance of the Michelson-Morley experiment. Why was it so revolutionary and what impact did it have on physics?

Homework Hints:

Krane Problem 3 gets messy fast unless you assume that the ether drift speed is much less than the speed of light, i.e. $u \ll c$. (This is a reasonable assumption since a shift of one fringe corresponds to a relatively slow speed compared to the speed of light). When you make this assumption, you can use the binomial expansion to simplify things. You may find the following helpful:

$$(1 \pm x)^n \approx 1 \pm n\,x \quad \text{for } x \ll 1$$

For example, you can use the binomial expansion to approximate $\dfrac{1}{(1+x)^2} \approx 1 - 2x$ for $x \ll 1$

Or you could approximate $\dfrac{1}{(1-y^2)} \approx 1 + y^2$ for $y^2 \ll 1$

Let's look at an example that uses variables from relativity. Suppose you want to evaluate $\dfrac{A}{(1-u^2/c^2)^3}$ in the $u \ll c$ limit. Since $u \ll c$, then $(u^2/c^2) \ll 1$. We identify $x = u^2/c^2$ and $n = -3$ to write:

$$\frac{A}{(1-u^2/c^2)^3} \approx A(1-(-3)u^2/c^2)$$

So we find

$$\frac{A}{(1-u^2/c^2)^3} \approx A(1+3u^2/c^2)$$