

**Phys 375 HW 1**  
**Fall 2009**  
**Problems Due 14 / 15 September, 2009**

0. **Summarize the results of your lab-0 experiment** and data fitting. Briefly describe the procedure and show an example data plot and fit. Also present the results of your determination of the divergence angle of your laser,  $\theta$ .
1. **Error analysis.** For the following list of data, calculate (“by hand” – i.e. use a calculator and show your work) the mean, mode, median, standard deviation, variance, and standard deviation of the mean. Please do the analysis “by hand” – just this once.  
{7.127, 7.125, 7.041, 6.963, 7.125, 6.820, 7.027, 6.843, 7.067, 7.084}
2. **Error propagation.** You are trying to determine the acceleration due to gravity  $g$  by measuring the period of a pendulum,  $T$ , of length  $L$  using the relation  $T = 2\pi \sqrt{\frac{L}{g}}$ .  
The summary of measured data is  $T = 3.818 \pm 0.009 \text{ sec}$ , and  $L = 361.58 \pm 0.40 \text{ cm}$ . By propagating errors, determine the best value and uncertainty in  $g$ . If you could go back and revise the experiment, which quantity would you want to measure more precisely?
3. Pedrotti<sup>3</sup>, 3<sup>rd</sup> edition, problem 1-3.
4. Pedrotti<sup>3</sup>, 3<sup>rd</sup> edition, problem 1-15.
5. An electromagnetic wave is specified (in SI units) by the following function:  
$$\vec{E} = (-6\hat{i} + 3\sqrt{5}\hat{j})(10^4 \text{ V/m}) \exp\left[i\left\{\frac{1}{3}(\sqrt{5}x + 2y)\pi \times 10^7 - 9.42 \times 10^{15} t\right\}\right]$$
Find:  
(a) the direction along which the electric field oscillates,  
(b) the scalar value of amplitude of electric field,  
(c) the direction of propagation of the wave,  
(d) the propagation number and wavelength,  
(e) the frequency and angular frequency, and  
(f) the speed.
6. An underwater swimmer shines a beam of light up toward the surface. It strikes the air-water interface at  $35^\circ$ . At what angle will it emerge into the air?