Phys 3610, Fall 2008
Problem Set #4, Hint-o-licious Hints

1. *Taylor*, **5.9** You are given A and $v_{\max}$. Conservation of energy will let you solve for $\omega = \sqrt{\frac{k}{m}}$. Get τ (period) from that

2. *Taylor*, **5.31** Make a rather non-trivial plot using software of some sort. I will give some pointers on using Maple and Matlab in class.

3. *Taylor*, **5.33** Just find $x(0) = x_0$ and $\dot{x}(0) = v_0$ for the functions given in (5.69) and solve for B_1 and B_2 to get (5.70). You'll use these in problem 5.36.

These constants come from the initial conditions. The rest come from the *physical parameters* of the driven damped oscillator.

4. *Taylor*, **5.36** Make a rather non-trivial plot using software of some sort. I will give some pointers on using Maple and Matlab in class.

5. *Taylor*, **5.42** Find the period of the (undamped) pendulum and use the fact that the Q value is π times the number of cycles the system makes in the decay time.

6. *Taylor*, **6.9** Applying the E–L equation for $y(x)$ leads to the (easy) differential equation

$$y'' + y = 0$$

(With the +, the answer isn't sines and cosines!). There will be constants to be determined which you find by using the given endpoints of the curve.

7. *Taylor*, **6.12** The E–L equation led me to the DE

$$(x^2 + C_1^2)y'^2 = C_1^2$$

Isolate y' and integrate to yet $y(x)$.

8. *Taylor*, **6.21** The result of Problem 6.20 is that if we are treating y as $y(x)$ and the integrand does not depend on x (the independent variable) then

$$f - y'\frac{\partial f}{\partial y'} = \text{ constant}$$

9. *Taylor*, **6.27** Here you use the E–L equations for several parametrized variables and it is not hard to show that they imply (similar to the 2D case done in the book)

$$x' = C_1 y' \qquad y' = C_2 z' \qquad z' = C_3 x'$$

the only question is how do these relations dictate that the resulting curve is a straight line. Note that you can't just pull out $\frac{dy}{dx}$ as in the 2D case.

The answer is that $(x(u), y(u), z(u))$ gives a curve in space which could possibly be very convoluted. But note that the vector tangent to the curve at any u must be parallel to the vector $d\mathbf{r}/du$, namely

$$(x'(u), y'(u), z'(u))$$

and you can easily show that this vector hsa the same *direction* at all points. A curve with a tangent vector which always points in the same direction is pretty clearly a straight line. And *that* is how you know it's a line.

Note that $x'(u)$ and the rest are not necessarily constants! (If they were, then the curve is clearly a straight line.)