

**Class Problems and Homework**  
Physics 403: Mathematical Methods  
March 24, 2008

Problems: Instructor, group and homework.

1. Consider the following 2nd order differential equation:

$$\ddot{x} + \omega^2 x = 0.$$

- (a) Take the general solution as

$$x = A \sin(\omega t + \delta)$$

and determine  $A$  and  $\delta$  if  $x(0) = 0.14$  m and  $\dot{x}(0) = -0.02$  m/s.

- (b) Take the general solution as

$$x = A \sin \omega t + B \cos \omega t$$

and determine  $A$  and  $B$  for the same initial conditions as above.

- (c) Write the auxiliary equation, and then write the general solution in terms of complex exponentials:

$$x = C_1 e^{i\omega t} + C_2 e^{-i\omega t}$$

Determine  $C_1$  and  $C_2$  for the conditions above.

2. A damped harmonic oscillator has a mass of 1.0 kg, spring constant  $k = 12$  N/m and a resistive damping force of  $(-8\text{Ns/m})\dot{x}$ . Determine the motion if  $x(0) = 0.15$  m and  $\dot{x}(0) = 0$  m/s.
3. A damped harmonic oscillator has a mass of 1.0 kg, spring constant  $k = 4$  N/m and a resistive damping force of  $(-8\text{Ns/m})\dot{x}$ . Determine the motion if  $x(0) = 0.15$  m and  $\dot{x}(0) = 0$  m/s.