In[2]:=

Homework IV

Problem 1. From lecture notes, the amplitude response of a driven, damped harmonic oscillator is given by:

```
In[22]:=  A[w_] := f0 / Sqrt[(w0^2 - w^2)^2 + g^2 w^2]
          phi[w_] := ArcTan[w0^2 - w^2, -g w]
```

Where g=gamma, w=omega, f0 = Force constant/mass, etc. Put in some constants, i.e. m = 0.1 kg, s = 1.6N/m, b=0.1 kg/s:

```
In[24]:=  w0 = Sqrt[1.6 / 0.1]; g = 1.0; f0 = 2 / 0.1;
          Print["Omega0= ", w0, ", gamma = ", g]

          Omega0= 4., gamma = 1.

In[26]:=  Print ["omega, amplitude, phi = ", 0.4, ",  ", A[0.4], ", ", phi[0.4]]

          omega, amplitude, phi = 0.4,  1.26222, -0.0252472

In[27]:=  Print ["omega, amplitude, phi = ", 4, ",  ", A[4], ", ", phi[4]]

          omega, amplitude, phi = 4,  5., -1.5708

In[28]:=  Print ["omega, amplitude, phi = ", 40, ",  ", A[40], ", ", phi[40]]

          omega, amplitude, phi = 40,  0.0126222, -3.11635
```

So, we see that the amplitude is small if w0 and w are different, phases of about 0 or -Pi. Amplitude is large when omega = omega0, phi is -Pi/2

Problem 2.

The amplitude will be maximum when dA/dw = 0.
We already entered A[w], so take its derivative, set it to zero and solve for w.

```
In[32]:=  Clear [w0, g, f0]
          Solve[D[A[w], w] == 0, w]
```

Out[33]= $\left\{\{w \to 0\}, \left\{w \to -\frac{\sqrt{-g^2 + 2\, w0^2}}{\sqrt{2}}\right\}, \left\{w \to \frac{\sqrt{-g^2 + 2\, w0^2}}{\sqrt{2}}\right\}\right\}$

We see from above that if gamma is very small, A is indeed maximum when omega=omega0, however gamma does shift the frequency at which A is maximum and this is called the "resonant frequency"