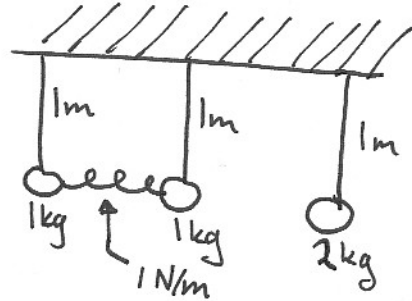


Physics 213a-2011 Exam 2 Practice Questions

You should be able to do each of these problems (including all sub-parts) in about 20 minutes or less. If it takes you longer, you have not mastered the associated material thoroughly enough. **Note:** Of course, these problems don't cover exactly the same topics as the questions on the real exam. Therefore, doing well on these practice problems does not insure that you are adequately prepared for the exam. However, doing poorly on these problems does mean that you need to study more.

For problem 1, assume $g = 1 \text{ m/s}^2$.

1a) Write the eigenvalue equation for the system shown here, filling in the matrix with numerical values.

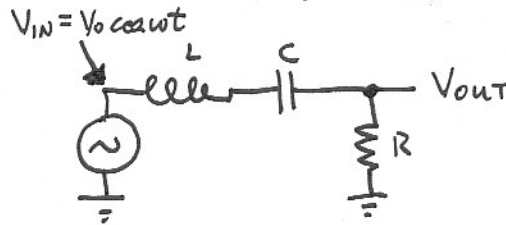


b) Using the results from part a, find the angular frequencies of the normal modes. You should find that two of the three frequencies are equal to each other, or are "degenerate".

c) Using your results from part a, find the eigenvector for the highest frequency normal mode; it need not be normalized.

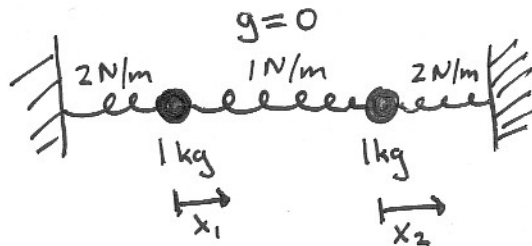
d) Verify that $|e_1\rangle = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$ and $|e_2\rangle = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$ are the eigenvectors for the two equal (degenerate) normal mode frequencies.

2) For the circuit shown here, V_{out} leads V_{in} by 45° . What is ω in terms of R , L , and C ?



Hint: Work by thinking of this as a damped driven oscillator, rather than by using complex impedances.

3) For the system shown here, $x_{10} = x_{20} = 0$, $\dot{x}_{10} = 1 \text{ cm/s}$, and $\dot{x}_{20} = 2 \text{ cm/s}$. What is $x_2(t)$?



4) Define the terms eigenvector, eigenvalue, eigenvalue equation, and normal mode. Make your definitions as general as possible, then illustrate them with an example.