Physics 4C Exam 1 Information

Spring 2017

Topics that could be included on Exam 1:

- Oscillating systems, including spring & mass, pendulums, oscillating systems in general
- Mathematical description of a wave (i.e. a sine function)
- Waves on a string, including speed, power, standing waves
- Sound waves, including pressure amplitude, speed, standing waves, intensity and intensity level
- Doppler effect for sound waves
- Pressure at depth, including u-tube
- Buoyancy
- Flow rate and Bernoulli’s
- Basic concepts from Physics 4A: forces, energy, momentum, center of mass, moment of inertia

The exam will be three pages. The first page will have five short multiple-choice problems. You can solve them any way you like, and then select the correct answer from the given choices. Only the selection of your answer will be graded (i.e. it’s either right or wrong... and you’re welcome to guess if you like.)

The second and third pages will include one problem each. You are expected to write a complete solution for each of these two problems, and you will be graded on the completeness of your solution. Your solution should include:

- Pictures: draw a clear picture (or pictures) of what is happening in the problem.
- Labeled Information: label, on your picture, all relevant information (known or unknown.)
- Equations: clearly show the connection between the relevant information by writing equations representing the appropriate physical concepts.
- Algebraic solution: combine your equations to create an algebraic solution.
- Calculated answer: use your algebraic solution and the given information to calculate a numerical answer.

I will provide scratch paper; all you will need is a calculator, a straightedge and something to write with. You’re welcome to use color for highlighting, if you wish. I will also provide the sheet of equations that follows this page (You are not expected to print that sheet and bring it with you. It will be included with your exam.)

You will have the entire class period available to work on the exam, which gives you about 30 minutes for each page. I expect some of you will finish in about an hour or so. I cannot extend the time, so please plan accordingly (Suggestion: if you get stuck on #1, do NOT spend 90 minutes trying to figure it out.)

If you feel like you know how to do the homework problems, you should be just fine for the exam.

The “reference number”: I will include on the exam a line for you to provide me with a five-digit number of your choosing. This is optional, but if you want to give me a number I will use it in place of your name on a score sheet that I will post to the class website and update after each exam. If you do not wish to be included on the sheet, you can leave the REF# line on your exam blank. If you give me a number with greater or fewer than five digits, it will be treated as if you left the line blank.

Please email questions if you have them.
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Equations for Exam 1

Oscillators: \[ x = A \cos(\omega t + \phi_o) \]

spring & mass: \[ K = \frac{1}{2} mv^2 \quad U = \frac{1}{2} kx^2 \quad E = \frac{1}{2} kA^2 \quad v_{\text{max}} = A \frac{k}{m} \quad a_{\text{max}} = A \frac{k}{m} \]

in general: \[ K = \frac{1}{2} mv^2 \quad U = \frac{1}{2} m\omega^2 x^2 \quad E = \frac{1}{2} m\omega^2 A^2 \quad v_{\text{max}} = A \omega \quad a_{\text{max}} = A \omega^2 \]

\[ \omega T = 2\pi \quad T = \frac{1}{f} \]

pendulum: \[ \omega^2 = \frac{mgd}{I_{\text{pivot}}} \quad I_{\text{pivot}} = I_{\text{cm}} + md^2 \]

Waves: \[ y = A \sin(kx - \omega t + \phi_o) \quad k\lambda = 2\pi \quad v = \lambda f \]

waves on a string: \[ v = \sqrt{\frac{\tau}{\mu}} \quad P = \frac{1}{2} \mu v^2 A^2 \quad \text{standing waves: } L = n \frac{1}{2} \lambda \]

sound waves: \[ p = BkA \quad v = \sqrt{\frac{B}{\rho}} \quad \text{in air: } v = 331 + 0.6T \]

\[ I = \frac{P}{A} \quad I = \frac{1}{2} \rho v \omega^2 A^2 \quad \beta = (10dB) \log \left( \frac{I}{I_o} \right) \quad \text{point source: } I = \frac{P}{4\pi r^2} \]

standing waves:
- open tube \[ L = n \frac{1}{2} \lambda \]
- closed tube \[ \lambda = \frac{4L}{n} \quad (n = 1, 3, 5, \ldots) \]

Doppler effect: \[ f_L = f_s \left( \frac{v \pm v_L}{v \mp v_s} \right) \]

Fluid Mechanics:

Pressure at depth: \[ p = p_o + \rho gd \]

Gauge pressure: \[ p_{\text{gauge}} = p_{\text{abs}} - p_o \]

Buoyant force: \[ B = \rho_{\text{fluid}} V_{\text{displ}} g \]

Flow rate: \[ \phi = \frac{\text{volume}}{\text{time}} = Av \]

Bernoulli’s Equation: \[ p_1 + \frac{1}{2} \rho v_1^2 + \rho gh_1 = p_2 + \frac{1}{2} \rho v_2^2 + \rho gh_2 \]

Useful Constants
\[ p_o = 1 \text{ atm} = 101,300 \text{ Pa} \]
\[ g = 9.80 \text{ m/s}^2 \]

density of water = 1.00 g/cc = 1000 kg/m$^3$