EELE 417 Practice Exam #1
Fall 2014
Unless otherwise stated, assume propagation in air, 1 atm, 20°C, c = 343 m/sec $\rho_0 c$ = 415 Pa · sec/m

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(1) A harmonic plane wave with frequency 200 Hz is propagating through air at 1 atm, 20° C. A standard sound level meter (unweighted) reports 85 dB SPL re 20μPa.

(a) Determine the *RMS pressure* (P_e) and the *pressure amplitude* (P) for this wave.

(b) What would the sound level meter report if the "A-weighting" filter were now turned on?

(c) Determine the wavelength.

(2) A small source (ka<<1) of spherical waves radiates into air at 150 Hz.

(a) At **what distance** from the source will the pressure and particle speed be 45° out of phase?

(b) At the distance where the pressure and particle speed are 45° out of phase, what is the numerical value of the complex **specific acoustic impedance**?

(c) If the pressure amplitude (P) is found to be 0.05 Pa at a distance of 30 cm from this source, what is the **particle speed amplitude (U)** and the **particle displacement amplitude (A)** at that distance?

(3) A loudspeaker driver is to be modeled as a simple damped mechanical oscillator with the following parameters:

R_m = mechanical resistance = 1.75 N·s/m
m = mass = 12 grams (0.012 kg)
$f(t)$ = applied force = 38 cos(2π·100t) N

(a) What is the **maximum stiffness** for which the steady-state displacement amplitude will still be at least 1 centimeter at this frequency? Show your work and explain your reasoning.

(b) What is the **damped natural frequency** for this driver, using the stiffness you calculated in part (a)?