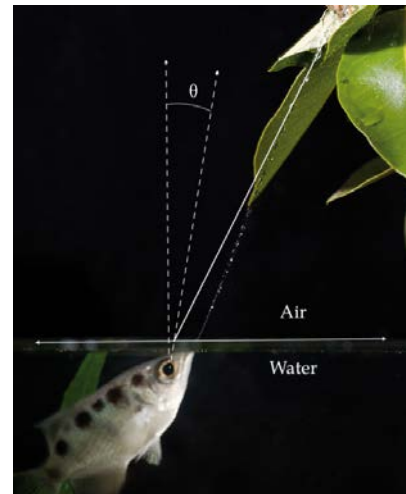# Polytechnic Tutoring Center
Midterm Review – PH 2033 Spring 2021

Disclaimer: This mock exam is only for practice. It was made by tutors in the Polytechnic Tutoring Center and is not representative of the actual exam given by the Academic Department.

1. A simple spring harmonic oscillator has an amplitude of 2.0 cm and a spring constant $k = 300$ N/m. At what distance from equilibrium is the potential energy equal to 18% of the total energy of the oscillator?

2. A 65 cm long guitar string that has mass of 1.5 g is vibrating at a fundamental frequency of 330 Hz. Calculate the tension in the string.

3. The intensity of an electromagnetic wave is 2.0×10^7 W/m2. What is the amplitude of the magnetic field of this wave?

4. A bat with coronavirus is flying toward a prey at 10 m/s while using echolocation to detect the prey. The bat sends out a 100 kHz ultrasonic sound, and the wave bounces back after having contact with the stationary prey. What is the frequency that the bat will be hearing?

5. A ray of unpolarized light shined through a stack of polarizers. What is the minimum number polarizers it takes to layer up in order to produce polarized light with an intensity below 10% of its original intensity if the angle between each polarizer is 20°.

6. A 20 kg block slides to the left along a horizontal frictionless surface and hits an uncompressed spring of spring constant 810 N/m, which sends the mass back to the right with the same speed. For how long is the block in contact with the spring?

7. Archerfish are known for preying on land-based insects by shooting them down with water droplets from their specialized mouths. However, due to the index of refraction of water n=1.33, it is only able to see a region within a limited angle measured from directly above the fish. What is the largest angle at which the fish can see something above the water?

8. The magnetic field of a plane electromagnetic wave in vacuum is given by
$$B_z = B_0 \sin(kx - \omega t)$$
What is the corresponding expression for the electric field?

9. A single speaker in a storefront display is playing Backstreet Boys at a sound level of 75 dB (as heard from the register). What sound level will the cashier perceive if three more speakers in the display are activated?

10. A bean of light is travelling with electric field
$$\vec{E} = E_0 \sin(kx + \omega t) \, \hat{\jmath}$$
and magnetic field
$$\vec{B} = B_0 \sin(kx + \omega t) \, \hat{k}$$
Compute the poynting vector $\hat{S}$.