Assignment 3

Question 1 (1 point)

The equation describing horizontal motion of the mass m attached to a spring is given by: $x=4\cos(8t+7\pi)$; where x is in meters and t in seconds. Find the magnitude of horizontal acceleration of this body at time t= 17 seconds.State your answer to the nearest tenth of the m/s^2

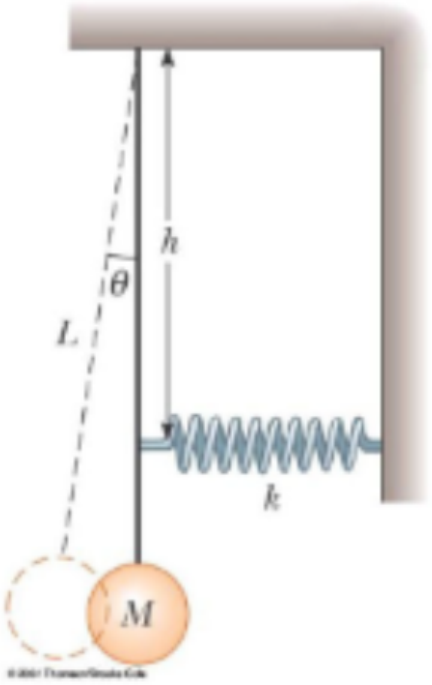
Question 2 (1 point)

A massless spring of constant 42N/m is attached vertically to a table. A 7-g balloon is filled with helium (density = 0.180 kg/m^3) to a volume of 1.70m^3 and is then connected to the spring, causing it to stretch to equilibrium distance d. Find d. State your answer to the nearest 0.001m. Take air density to be 1.225 kg/m^3 and g =9.8m/s^2

Question 3 (1 point)

A massless spring of constant 40N/m is attached vertically to a table. A 5-g balloon is filled with helium (density = 0.180 kg/m3) to a volume of $1.5m^3$ and is then connected to the spring, causing it to stretch. The spring (with a balloon) is then stretched further by 14cm and released. Find the period of spring oscillations about the equilibrium. Take air density to be 1.225 kg/m^3. Neglect the air resistance. State your answer to the nearest 0.001s.

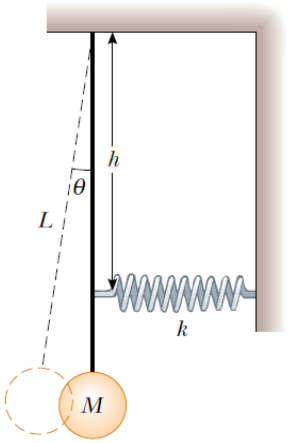
Question 4 (1 point)



A pendulum of length L = 0.98m and mass 4.3Kg has a spring of force constant k =600 N/m connected to it at a distance h = 0.41m below its point of suspension. Find the frequency 'f' of vibration of the system for small values of the amplitude (small θ). Assume the vertical suspension of length L is rigid, but ignore its mass.

Use g=9.8 for gravity. Round your answer to 3 decimal places.

Question 5 (1 point)
A pendulum of length L=6 m and mass M=1 kg has a spring of force constant k=30 N/m connected to it at a distance h=0.5m below its point of suspension. Find the frequency of vibration of the system for small values of the amplitude (for small angles, sinθ=θ , cosθ =1)). Assume the vertical suspension of length is rigid, but ignore its mass. State your answer in Hz to the nearest 0.01 (Use g=9.8m/s^2)



Question 6 (1 point)
A real spring with mass 0.21Kg and spring constant 72N/m is hanging vertically with a block of mass 1.02Kg attached to the end. Find the period in seconds of simple harmonic motion of this system. Round the answer to 2 decimal places.

Question 7 (1 point)
Straight wooden stick has mass M=0.70kg, Length L=1.9m, uniform cross-section A=20cm^2, and constant density has a small mass m=0.20kg attached to its one end. The stick is partially submerged in water (density =990kg/m^3). While in equilibrium, the stick will float in a vertical position with large part of it submerged. The stick is then pushed down by distance y_{max} =40cm from the equilibrium, and released. Find the period of the oscillations of this system. State your answer to the nearest 0.01s. Assume no drag forces are acting in this situation. Take g=9.8m/s^2

Question 8 (1 point)
A uniform rod of length 2.6 m, and 5.0 kg is suspended from a pivot a distance 0.1 m above its center of mass. The angular frequency in rad/s for small oscillations is approximately equal to: Take g=9.8m/s^2. State your answer to the nearest 0.01 of rad/s.

Question 9 (1 point)
A police car approaches the wall with speed of v= 28 m/s while emitting sound with frequency of 2,150Hz. What will be the beat frequency observed by the police officer? Use 340 m/s as the speed of sound in air. Round your answer to the nearest Hz.

Question 10 (1 point)
An earthquake on the ocean floor in the Gulf of Alaska produces a *tsunami*(sometimes incorrectly called a "tidal wave") that reaches Hilo, Hawaii, 4,440 km away, in a time interval of 6 h 30 min. Tsunamis have enormous wavelengths (100 to 200 km). From the information given, find the average ocean depth between Alaska and Hawaii. (This method was used in 1856 to estimate the average depth of the Pacific Ocean long before soundings were made to give a direct determination.) Propagation speed of the wave,
$v \approx \sqrt{gd}$;where d is the average ocean depth. Use g=9.8m/s .State your answer to the nearest meter.

Question 11 (1 point)
The ocean floor is underlain by a layer of basalt that constitutes the crust, or uppermost layer, of the Earth in that region. Below this crust is found denser periodotite rock, which forms the Earth's mantle. The boundary between these two layers is called the Mohorovicic discontinuity ("Moho" for short). If an explosive charge is set off at the surface of the basalt, it generates a seismic wave that is reflected back out at the Moho. If the speed of this wave in basalt is 5.0km/s and the two-way travel time is 1.6s, what is the thickness of this oceanic crust? State your answer in km to the nearest 0.01 km.

Question 12 (1 point)
A small ball of mass M=13.0kg is attached to a simple pendulum hanging from a uniform string of mass m=0.03kg. The period of oscillations for the simple pendulum is 8s. Determine the speed of a transverse wave (in m/s) in the string when the pendulum hangs at rest. Take $g=9.8m/s^2$. State your answer to the nearest 0.01m/s.
HINT: Since m<<M you may use the results for the ideal pendulum (with the massless string) in your solution.

Question 13 (1 point)
A loudspeaker is placed between two observers who are 110 m apart, along the line connecting them. If observer 1 records a sound level of 70 dB, what is the sound level observer 2 records? Observer 2 is 10 m from the speaker. State your answer to the nearest dB.

Question 14 (1 point)
If a single person in the stands of a stadium shouts, the sound intensity level at the centre of the field is 60dB. What is the intensity level when 7,500 spectators are shouting from the same distance? Assume that each person generates the same sound intensity at the centre of the field. State your answer in to the nearest 0.1 dB.

Question 15 (1 point)
What is the length in meters of a closed organ pipe with a fundamental frequency of 45 Hz? State your answer to the nearest m. The speed of sound in air is 343 m/s.

Question 16 (1 point)
A police car whose siren has a natural frequency of 1,250 Hz . A stationary observer detects this sound. What frequency does the observer measure, if the police car is approaching her at a speed of 21 m/s? The speed of sound in air is 343 m/s. State your answer to the nearest Hz.

Question 17 (1 point)
A bat, moving at 9 m/s, is chasing a flying insect. If the bat emits a 40-kHz chirp and receives back an echo at 40.0 kHz, at what speed is the insect moving? (Take the speed of sound in air to be v = 343 m/s.) State your answer to the nearest 0.01m/s.

NOTE: Sign of your answer matters!

Both of the speeds (insect's and bat's) are measured with respect to the stagnant air.