Student Name: _____ First Letter of Last Name:

Student Number: _____

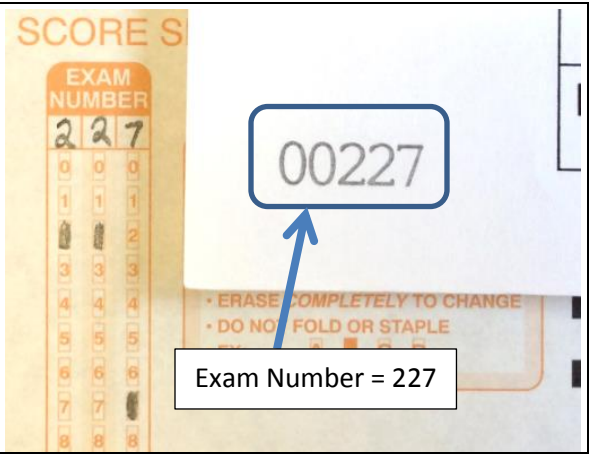
Section (circle one): 201 (Ives) 202 (Bates/Charbonneau) 203 (Kotlicki)

Physics 101 – Midterm Test 2, Mar. 19, 2014

Individual Part - Time: 6:00 pm – 6:55 pm

Mega-important instructions:

1. On the *bubble sheet* please bubble in *and* write your information for the three following things:
   a. *I.D. Number* (your student number),
   b. *Name*, and
   c. *Exam Number* (the last three digits of the exam number on the bottom left-hand corner of your midterm, see picture to the right)
2. Fill in your identification information at the top of this page
3. Remove the formula sheet from the midterm and *keep it*. Do not hand it in with your midterm. You will need to know your individual exam number for the group exam.



The fine print:

1. This examination consists of 11 pages including the title page and a formula sheet at the back. Make sure that this paper is complete.
2. Please put your Name on each page of this midterm.
3. Each candidate must place in front of her/him a student card for identification.
4. You are permitted to use any type of dedicated calculator (graphing, programmable, cheap scientific), but cannot use your smartphone, tablet, laptop or similar electronic device.
5. You are permitted to bring 4 sheets of paper (double-sided) containing notes with you for the exam, but are not allowed any additional materials beyond this (e.g., no textbook, additional course notes, etc.)
6. Candidates are not permitted to ask questions of the invigilators, except in cases of supposed errors or ambiguities in examination questions.
7. No candidate shall be permitted to enter the examination room after the expiration of one-half hour from the scheduled starting time, or to leave during the first half hour of the examination.
8. Candidates suspected of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action: speaking or communicating with other candidates; purposely exposing written papers to the view of other candidates, where the plea of accident or forgetfulness shall not be received; and using or keeping on any communication devices (laptops, cell phones, etc.). These devices have to be switched off and stored out of reach.
9. Candidates must not destroy or mutilate any examination material beyond removing the formula sheet; must hand in all examination papers; and must not take any examination material from the examination room.
10. Use the back of pages for additional space if necessary but indicate this clearly
11. Attempt all questions. Show all your work to receive part marks. Good luck.

Q	A2-A14 (26)	B1 (8)	B2 (8)	B3 (8)
Marks	On Connect			

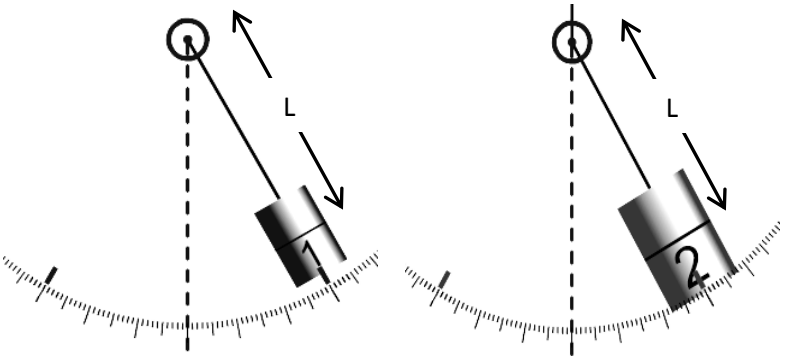
Name: _____

A1. Which section are you in?

D) 201 (Ives) E) 202 (Bates/Charbonneau) F) 203 (Kotlicki)

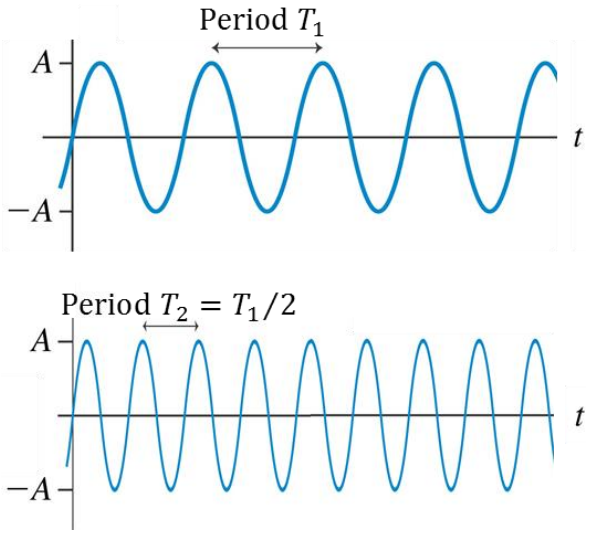
A2. Two simple pendulums are shown. They each have the same length L (from the pivot point to the center of the mass), but pendulum 2 has twice the mass of pendulum 1. They are released at the same time from equal initial angular displacements. Compare how long it takes these two pendulums to swing through a full cycle (all the way back and forth once). Ignore any effects due to friction or air resistance.

A) It takes pendulum 2 longer than pendulum 1 to swing through a full cycle
B) It takes pendulum 1 longer than pendulum 2 to swing through a full cycle
C) Both pendulums take equal times to swing through a full cycle



A3. The history graphs for two different traveling waves are shown. The wave speed for wave 1 is 50 m/s and the wave speed for wave 2 is 100 m/s. The period for wave 2 is half the period of wave 1. How do the wavelengths of these two travelling waves compare?

A) $\lambda_2 = 4\lambda_1$
B) $\lambda_2 = 2\lambda_1$
C) $\lambda_2 = \lambda_1$
D) $\lambda_2 = \frac{1}{2}\lambda_1$
E) $\lambda_2 = \frac{1}{4}\lambda_1$



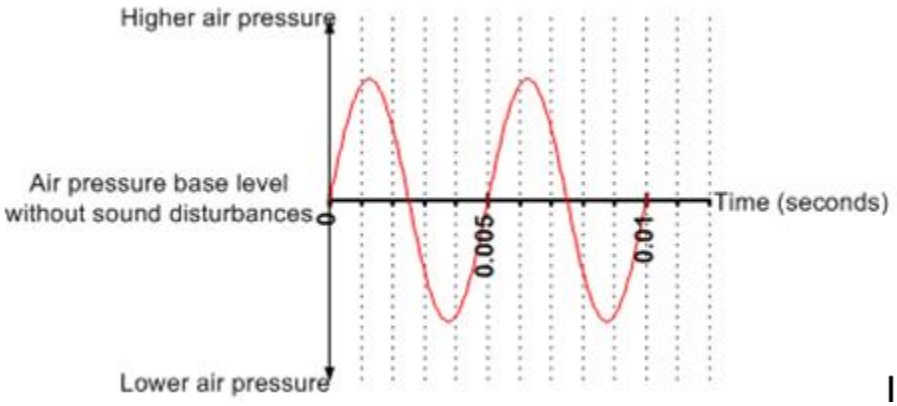
A4. The alarm sound you chose on your phone is set so that it starts quiet but quickly gets louder. If the alarm starts at a *loudness* of 40dB and the acoustic *power* emitted by your phone increases by a factor of 40, what is the final loudness of the alarm?

A) 80.0 dB
B) 56.0 dB
C) 41.6 dB
D) 42.6 dB
E) 66.0 dB

Name: _____

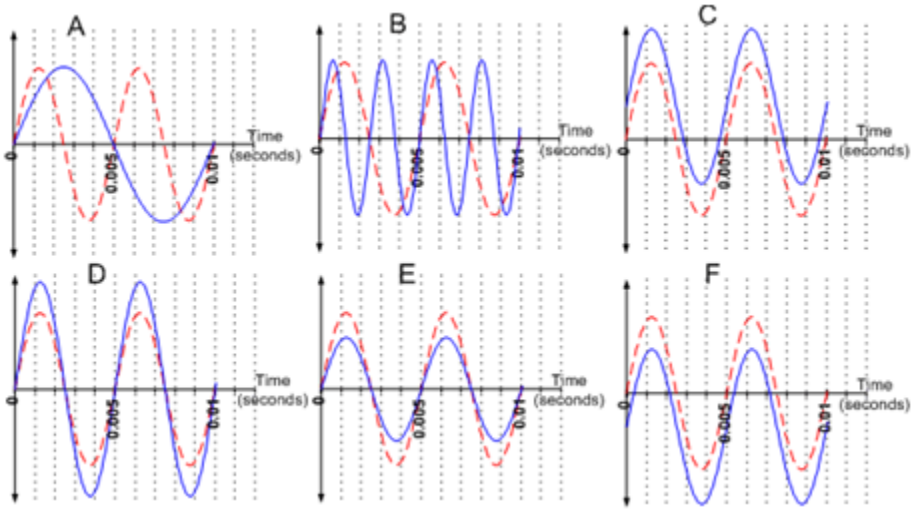
***The following situation is for the following two questions*.**

In the following graph you will find the pressure measured at the listener's ear as a function of time for a tone of frequency 200 Hz generated by a speaker.



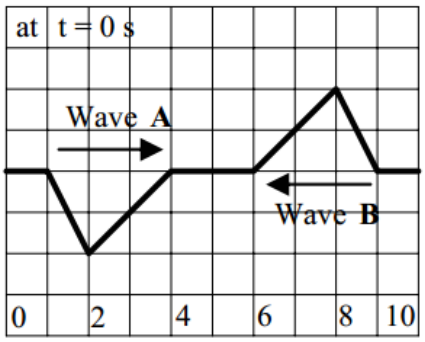
A5. Which one of the *solid* curves (A-F) could represent the curve for a *higher* pitch (frequency)? ***The pressure measurement for the original tone is shown as a dashed line and the new one as a solid line.***

A6. Which one of the *solid* curves (A-F) could represent the curve if the speaker settings are unchanged, but the listener moves to a new position closer to the source? Assume the listener is at rest in the new closer position. ***The pressure measurement for the original position is shown as a dashed line and the new one as a solid line.***



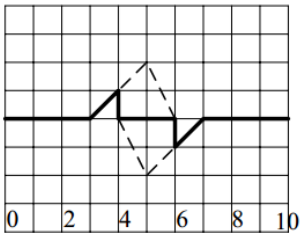
Name: _____

A7. Two pulses are moving toward each other. Each pulse has a speed of 1 cm/s. The large figure shows the pulses at time t = 0 s. Each square on the grid corresponds to 1 cm x 1cm.

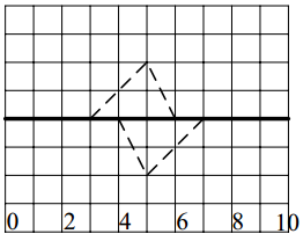


Select the drawing that corresponds to the shape of the resultant pulse after 3 seconds. The dashed lines indicate the correct positions of the individual pulses after 3 seconds. The solid lines indicate the resulting pulse.

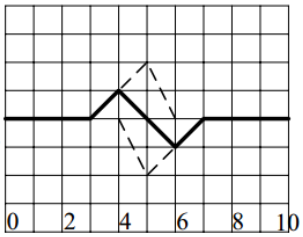
A.



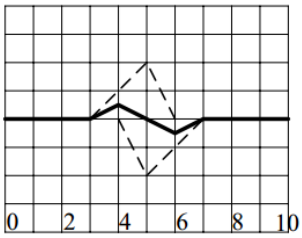
B.



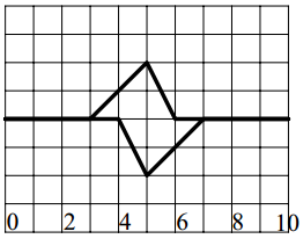
C.



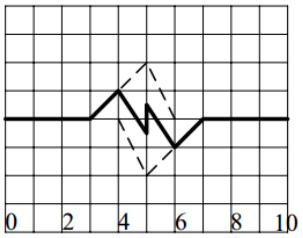
D.



E.



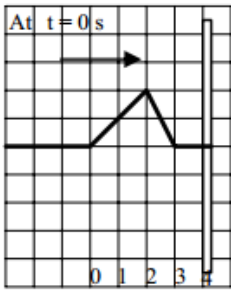
F.



Name: _____

***The following situation is for the following two questions*.**

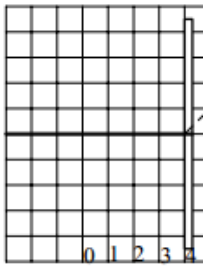
A girl is demonstrating wave motion on a string attached to a pole. She flicks the string creating an *asymmetric* pulse moving toward the pole. The pulse has a speed of 1cm/s. Each square in the figure corresponds to 1 cm x 1 cm. The figure to the right shows the pulse at t = 0s.



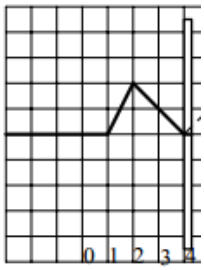
A8. Select the drawing below that corresponds to the shape of the resultant pulse after **4 s**, assuming the string is *firmly* attached to the pole.

A9. Select the drawing below that corresponds to the shape of the resultant pulse after **4 s**, assuming the string is tied to a ring that can move *loosely* up and down the pole.

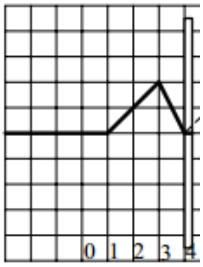
A



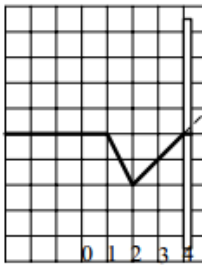
B



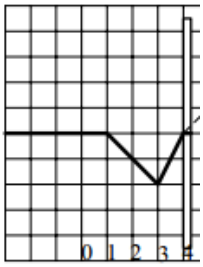
C



D

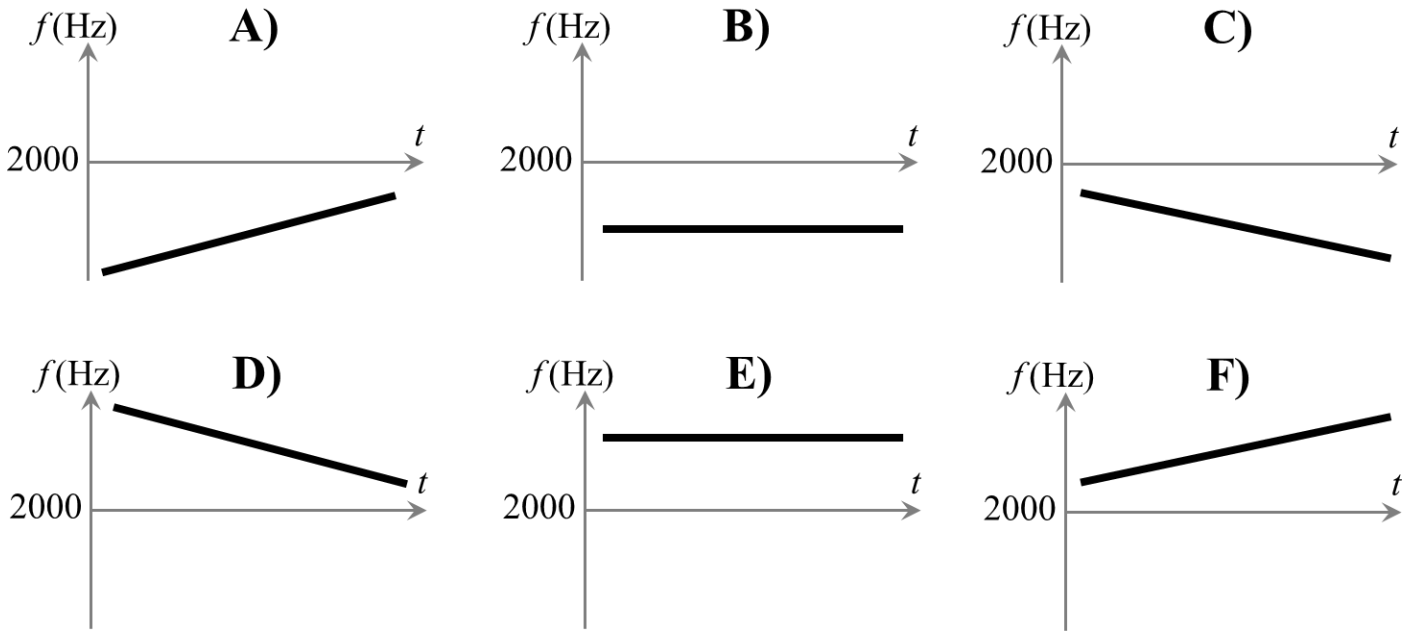


E



Name: _____

A10. You are standing on the sidewalk when all of a sudden you notice a police officer running as fast as he can *directly toward you* while blowing his whistle. The whistle produces a tone which corresponds to a frequency of 2000 Hz. Assuming that the police officer is running toward you at a constant speed, which graph best shows the frequency of the whistle that you hear as he approaches you? *Please note that this question is only asking about some period of time while the police officer is running directly toward you.*

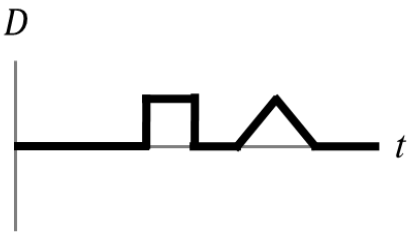


A11. A damped mass-spring oscillator loses 40% of its *energy* during each cycle. If the amplitude of the oscillation starts at 1.00 m, what is the amplitude of the oscillation after one cycle?

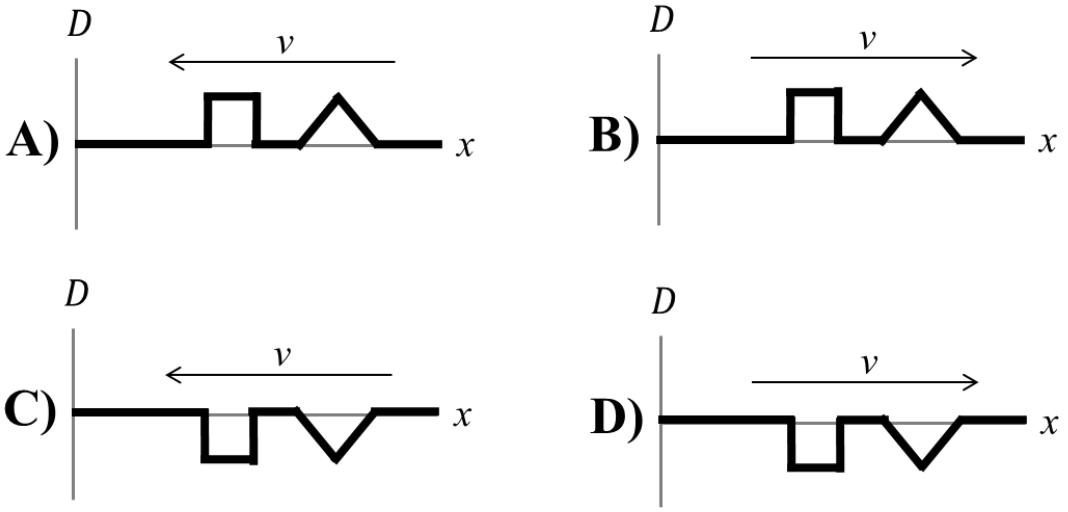
A) 0.160 m
B) 0.200 m
C) 0.360 m
D) 0.400 m
E) 0.600 m
F) 0.632 m
G) 0.640 m
H) 0.775 m
I) 0.800 m
J) 0.840 m

Name: _____

A12. A double pulse is moving along a string toward a point located at x_0. The history graph showing the vertical displacement of the point located at x_0 is shown to the right.



Which of the snapshot graphs below show the correct shape of the pulse and the direction it is travelling?



***The following situation is for the following two questions*.**

The equation for a transverse wave on a string is $D(x,t) = 0.75\sin(4.0x + 65t)$, where D and x are in meters, and t is in seconds.

A13. What is the wave speed for this wave?

A) 0.00220 m/s
B) 0.0615 m/s
C) 2.59 m/s
D) 5.25 m/s
E) 16.3 m/s
F) 41.4 m/s
G) 48.8 m/s
H) 102 m/s
I) 260 m/s
J) 1630 m/s

A14. What is the maximum transverse speed for a piece of this string?

A) 0.00220 m/s
B) 0.0615 m/s
C) 2.59 m/s
D) 5.25 m/s
E) 16.3 m/s
F) 41.4 m/s
G) 48.8 m/s
H) 102 m/s
I) 260 m/s
J) 1630 m/s

Name: _____

Part B - Problems

B1. A research boat is equipped with ultrasonic detectors and is travelling in the water. A dolphin swims toward the boat and sends a 45.15 kHz pulse of ultrasound. The speed of sound in salt water is approximately 1500 m/s. Assume that the water is calm so that the speed of the water can be treated as zero.

Part a) If the boat is travelling at 10 m/s *toward* the dolphin and the dolphin is swimming at 20 m/s *toward* the boat, what frequency of ultrasound is detected on the boat? Please use 5 significant figures for your final answer and remember to *clearly* show your work.

$f =$

Part b) If the boat is travelling at 10 m/s ***away*** from the dolphin and the dolphin is swimming at 20 m/s *toward* the boat, what frequency of ultrasound is detected on the boat? Please use 5 significant figures for your final answer and remember to *clearly* show your work.

$f =$

Name: _____

B2. John wants to watch the hockey game on TV but finds that his father has fallen asleep in the reclining chair 4.0 m away from the TV. His dad will wake up if he hears noises louder than 65 dB.

Part a) What is the loudest (in dB) possible volume as heard by John, at which John can watch the hockey game without waking his father if John is sitting on the couch, 2.5 m away from the TV?

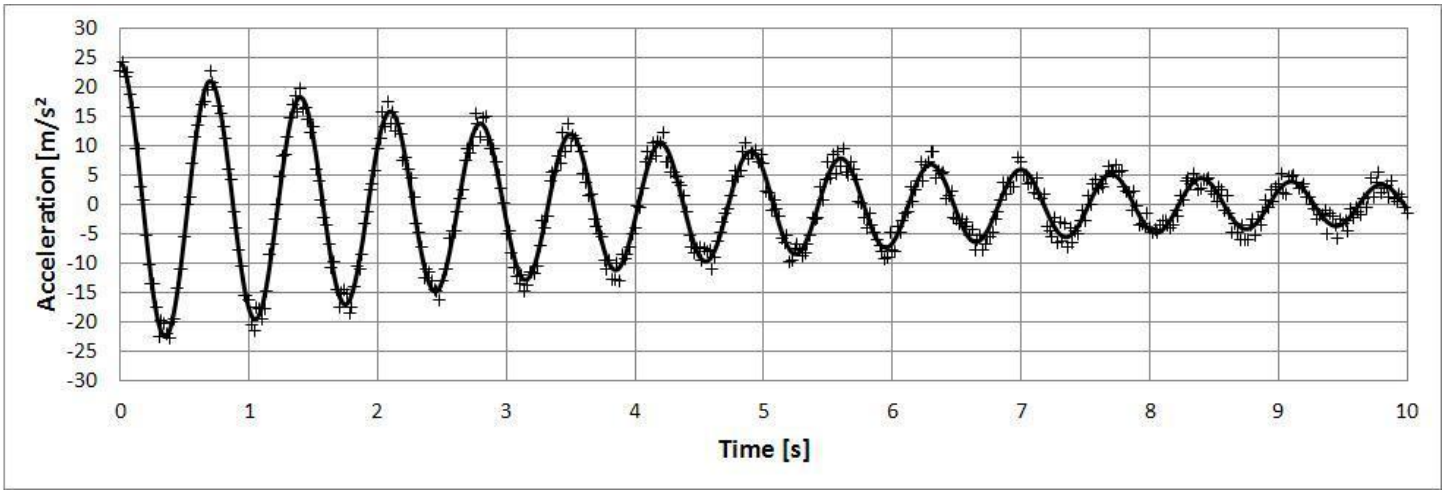
$\beta =$	dB

Part b) If you assume that the acoustic power emitted from the speakers is the same in all directions, what is the average acoustic power emitted from the TV when it is turned up so that his sleeping father hears it only at 65 dB?

$P =$	W

Name: _____

B3. Engineers working on a car prototype, before the shock absorbers were installed, had the entire car pushed down and then released, and recorded the acceleration as a function of time. The graph of the recording is shown below, with the best fit line shown as a smooth curve. The mass of the car was 1500 kg.



Part a) Assuming that the graph of *acceleration* (not amplitude) as a function of time can be described by

$$a = a_0 e^{-t/\tau} \cos(\omega t + \phi),$$

find the parameters a_0, τ, ω and ϕ of this function. ***Don't forget your units!***

$a_0 =$
$\tau =$
$\omega =$
$\phi =$

Part b) What is the total spring constant for this motion?

$k =$

Name: _____

Fluids:

$$P = P_0 + \rho g h \qquad A_1 v_1 = A_2 v_2 \qquad P_{\text{gauge}} = P - P_0$$

$$P + \frac{1}{2}\rho v^2 + \rho g h = \text{constant} \qquad F_B = m_f g = \rho_f g V \qquad \rho = \frac{m}{V}$$

Harmonic Motion:

$$F = -kx \qquad PE = \frac{1}{2}kx^2 \qquad KE = \frac{1}{2}mv^2$$

$$x(t) = A\cos(\omega t + \phi_0) \qquad v(t) = -A\omega \sin(\omega t + \phi_0) \qquad a(t) = -A\omega^2 \cos(\omega t + \phi_0) = -\omega^2 x(t)$$

$$\omega = 2\pi f = \frac{2\pi}{T} \quad \left(f = \frac{1}{T}\right) \qquad \omega = \sqrt{\frac{k}{m}} \quad \text{(spring)} \qquad \omega = \sqrt{\frac{g}{L}} \quad \text{(simple pendulum)}$$

$$E = \frac{1}{2}kA^2 = \frac{1}{2}mv_{\max}^2 \qquad A(t) = A_0 e^{-(t/2\tau)}, \ \ \tau = \frac{m}{b} \qquad E(t) = E_0 e^{-(t/\tau)}$$

$$\omega' = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$$

Travelling Waves:

$$k = \frac{2\pi}{\lambda} \qquad v = f\lambda = \frac{\omega}{k} \qquad v = \sqrt{\frac{T}{\mu}}$$

General equation for a travelling wave: $D(x,t) = D_M \sin(kx \mp \omega t + \phi_0)$

Sound:

$$I = \frac{P}{A} \qquad I = \frac{P}{4\pi r^2} \text{ (spherical wave)} \qquad \beta(\text{dB}) = 10\log_{10}\left(\frac{I}{I_0}\right)$$

$$f = f_0\left(\frac{1 \pm \frac{v_o}{v}}{1 \mp \frac{v_s}{v}}\right) = f_0\left(\frac{v \pm v_o}{v \mp v_s}\right)$$

Constants:

$P_0 = P_{\text{atmosphere}} = 1.013 \times 10^5 \text{Pa}$; $\rho_{\text{fresh water}} = 1.00 \times 10^3 \text{ kg/m}^3$;

$\rho_{\text{air}} = 1.29 \text{ kg/m}^3$; $\rho_{\text{mercury}} = 13.6 \times 10^3 \text{ kg/m}^3$; $g = 9.81 \text{ m/s}^2$

$I_0 = 10^{-12} \text{ W/m}^2$; $v_{\text{sound}}(\text{in air}) = 343 \text{ m/s}$