UNIVERSITY OF SASKATCHEWAN
Department of Physics and Engineering Physics

Physics 117.3
MIDTERM TEST

February 12, 2015 Time: 90 minutes

NAME: _____ STUDENT NO.: _____
(Last) **Please Print** (Given)

LECTURE SECTION (please check):

- ❑ 01 Dr. Y. Yao
- ❑ 02 B. Zulkoskey
- ❑ C16 Dr. A. Farahani

INSTRUCTIONS:

1. This is a closed book exam.
2. The test package includes a test paper (this document), a formula sheet, and an OMR sheet. The test paper consists of 8 pages, including this cover page. **It is the responsibility of the student to check that the test paper is complete**.
3. Only a basic scientific calculator (e.g. Texas Instruments TI-30X series, Hewlett-Packard HP 10s or 30S) may be used. Graphing or programmable calculators, or calculators with communication capability, are **not** allowed.
4. Enter your name and student number on the cover of the test paper and check the appropriate box for your lecture section. Also enter your student number in the top right-hand corner of each page of the test paper.
5. Enter your name and NSID on the OMR sheet.
6. The test paper, the formula sheet and the OMR sheet must all be submitted.
7. The marked test paper will be returned. The formula sheet and the OMR sheet will NOT be returned.

ONLY THE THREE PART B QUESTIONS THAT YOU INDICATE WILL BE MARKED

PLEASE INDICATE WHICH THREE PART B QUESTIONS ARE TO BE MARKED

QUESTION NUMBER	TO BE MARKED	MAXIMUM MARKS	MARKS OBTAINED
A1-15	☑	15	
B1	❑	10	
B2	❑	10	
B3	❑	10	
B4	❑	10	
TOTAL		45	

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PART A

FOR EACH OF THE FOLLOWING QUESTIONS IN PART A, ENTER THE MOST APPROPRIATE RESPONSE ON THE OMR SHEET.

A1. An ideal incompressible fluid is flowing through a horizontal pipe with a constriction. One end of the pipe has a radius of R and the other end of the pipe has a radius of ½ R. Which one of the following statements is true?

(A) Both the flow speed and pressure are higher at the larger end.
(B) The flow speed is the same throughout the pipe but the pressure is lower at the larger end.
(C) The flow speed at the larger end is half the flow speed at the narrower end.
(D) The pressure is the same throughout the pipe, but the flow speed at the larger end is four times the flow speed at the narrower end.
(E) The pressure is lower at the narrower end.

A2. Which one of the following statements best explains why an object released from rest in a viscous fluid reaches a terminal speed? (The density of the object is greater than the density of the fluid.)

(A) The magnitude of the buoyant force on the object is greater than the magnitude of the weight of the object.
(B) The magnitude of the buoyant force on the object equals the magnitude of the weight of the object.
(C) The resistive drag force of the fluid on the object is constant.
(D) The resistive drag force of the fluid on the object decreases as the speed of the object increases.
(E) The resistive drag force of the fluid on the object increases as the speed of the object increases.

A3. Blood with viscosity η is flowing through a vein of radius R_1 and length L, with a volume flow rate of Q_1. The vein contracts, so that the new radius R_2 is 85% of the original radius. If the pressure difference between the two ends of the vein remains the same, what is the new volume flow rate Q_2 in terms of Q_1?

(A) $Q_2 = 0.85Q_1$ (B) $Q_2 = 0.72Q_1$ (C) $Q_2 = \dfrac{Q_2}{0.85}Q_1$ (D) $Q_2 = 0.52Q_1$ (E) $Q_2 = 0.61Q_1$

A4. Two hoses, one of 20-mm diameter, the other of 15-mm diameter, are connected to a faucet, one after the other. At the open end of the hose, the flow of water is 10 litres per minute. Through which hose does the water flow faster?

(A) the 20-mm hose
(B) the 15-mm hose
(C) The flow speed is the same in both hoses.
(D) The answer depends on which of the hoses comes first in the flow.
(E) The answer depends on the lengths of the hoses.

A5. A mass is hung on a spring (k = 100 N/m) and set in simple harmonic motion. The period of oscillation is T. If the spring is cut in half, so that now k = 200 N/m, and the same mass is set in simple harmonic motion again, what is the new period of oscillation?

(A) T (B) $\frac{1}{2}T$ (C) $\sqrt{2}\,T$ (D) $\frac{1}{\sqrt{2}}T$ (E) $2T$

A6. If one could transport a simple pendulum of fixed length from the Earth's surface to the Moon's, where the acceleration due to gravity is one-sixth (1/6) that on the Earth, how would the pendulum's frequency of oscillation on the Moon compare to its frequency of oscillation on the Earth?

(A) $f_{Moon} = 6\,f_{Earth}$ (B) $f_{Moon} = 2.5\,f_{Earth}$ (C) $f_{Moon} = 0.86\,f_{Earth}$
(D) $f_{Moon} = 0.17\,f_{Earth}$ (E) $f_{Moon} = 0.41\,f_{Earth}$

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A7. The distance between the crest of a wave and the next trough is 1 m. If wave crests are passing a particular point at the rate of 2 per second, what is the speed of the wave?

(A) 1 m/s (B) 2 m/s (C) 4 m/s (D) 8 m/s
(E) The wave speed is impossible to determine from the given information.

A8. An object attached to a spring is moving with simple harmonic motion of amplitude *A*. When the kinetic energy of the object equals the potential energy stored in the spring, what is the position of the object relative to the equilibrium position?

(A) A (B) 0 (C) $\frac{1}{2}A$ (D) $\frac{1}{\sqrt{2}}A$ (E) $2A$

A9. As you travel down the highway in your car, an ambulance moves away from you at a high speed, sounding its siren at a frequency of 400 Hz. Which one of the following statements is true?

(A) You and the ambulance driver both hear a frequency greater than 400 Hz.
(B) You and the ambulance driver both hear a frequency less than 400 Hz.
(C) You and the ambulance driver both hear a frequency of 400 Hz.
(D) You hear a frequency greater than 400 Hz, whereas the ambulance driver hears a frequency of 400 Hz.
(E) You hear a frequency less than 400 Hz, whereas the ambulance driver hears a frequency of 400 Hz.

A10. A point source broadcasts sound into a uniform medium. An observer moves away from the source at a certain speed. If the power is increased by a factor of 4 and the distance from the source is doubled, what is the resulting change in decibel level?

(A) The decibel level goes down by more than 10 dB.
(B) The decibel level goes up by less than 10 dB.
(C) There is no change in the decibel level.
(D) The answer cannot be determined because the speed of the observer is not known.
(E) The decibel level goes down by less than 10 dB.

A11. A sound wave travelling in air has a frequency f and wavelength λ. A second sound wave travelling in air has a wavelength of $\lambda/4$. What is the frequency of the second sound wave?

(A) $4f$ (B) $2f$ (C) f (D) $\frac{1}{2}f$ (E) $\frac{1}{4}f$

A12. Tripling the power output from a speaker emitting a single frequency of sound will result in what increase in intensity level?

(A) 0.33 dB (B) 4.8 dB (C) 3.0 dB (D) 9.0 dB (E) 6.2 dB

A13. Choose the option that correctly completes this sentence: "When two waves are out of phase by ____, destructive interference will occur".

(A) 90° (B) 270° (C) 540° (D) 720° (E) 450°

A14. Which one of the following sets of resonant frequencies **cannot** apply to a pipe that is open at one end and closed at the other?

(A) 100 Hz, 300 Hz, 500 Hz, and no other frequencies between 100 Hz and 500 Hz.
(B) 20 Hz, 60 Hz, 100 Hz, and no other frequencies between 20 Hz and 100 Hz.
(C) 100 Hz, 200 Hz, 300 Hz, and no other frequencies between 100 Hz and 300 Hz.
(D) 50 Hz, 150 Hz, 250 Hz, and no other frequencies between 100 Hz and 1600 Hz.
(E) 30 Hz, 90 Hz, 150 Hz, and no other frequencies between 30 Hz and 150 Hz.

A15. When two tuning forks are sounded at the same time, a beat frequency of 5 Hz occurs. If one of the tuning forks has a frequency of 245 Hz, what is the frequency of the other tuning fork?

(A) 235 Hz (B) 242.5 Hz (C) 247.5 Hz
(D) 240 Hz is the only possibility (E) either 240 Hz or 250 Hz

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PART B

ANSWER THREE OF THE PART B QUESTIONS ON THE FOLLOWING PAGES AND INDICATE YOUR CHOICES ON THE COVER PAGE.

FOR EACH OF YOUR CHOSEN PART B QUESTIONS ON THE FOLLOWING PAGES, GIVE THE COMPLETE SOLUTION AND ENTER THE FINAL ANSWER IN THE BOX PROVIDED.

THE ANSWERS MUST CONTAIN THREE SIGNIFICANT FIGURES AND THE UNITS MUST BE GIVEN.

SHOW AND EXPLAIN YOUR WORK – NO CREDIT WILL BE GIVEN FOR ANSWERS ONLY.

EQUATIONS NOT PROVIDED ON THE FORMULAE SHEET MUST BE DERIVED.

USE THE BACK OF THE PREVIOUS PAGE FOR YOUR ROUGH WORK.

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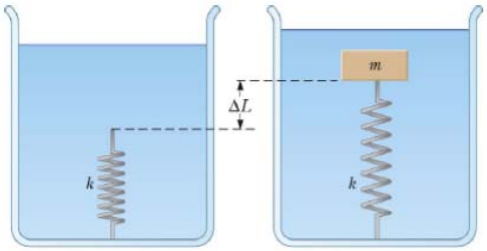
B1. A light spring of force constant $k = 1.00 \times 10^2$ N/m is attached to the bottom of a large beaker of water as shown. A 4.00-kg block of wood (density = 6.50×10^2 kg/m^3) is connected to the spring, and the block-spring system is allowed to come to static equilibrium.



(a) Calculate the buoyant force exerted by the water on the block. (3 marks)

(b) Calculate the elongation, ΔL, of the spring. If you did not obtain an answer for (a), use a value of 49.5 N. (4 marks)

(c) The block detaches from the spring and rises to the surface. Once the block has come to rest, calculate the percentage of its volume that is submerged. (3 marks)

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B2. A 326-g object on a horizontal, frictionless surface is attached to a horizontal spring and undergoes simple harmonic motion with a period of 0.250 s. The total energy of the system is 5.83 J.

(a) Calculate the maximum speed of the object. (3 marks)

(b) Calculate the force constant of the spring. (4 marks)

(c) Calculate the amplitude of the motion. If you did not obtain an answer for (b), use a value of 201 N/m. (3 marks)

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B3. A train sounds its horn as it approaches a crossing. The horn can be heard at an intensity level of 50.0 dB by an observer 10.0 km away. Treat the horn as a point source and neglect any absorption of sound by the air. You may assume that the sound energy propagates uniformly in all directions.

(a) Calculate the average rate at which sound energy is generated by the horn. (5 marks)

(b) Calculate the intensity level of the horn's sound heard by someone at a distance of 50.0 m from the train. (5 marks)

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B4. A steel wire with mass 25.0 g and length 1.35 m is strung on a bass guitar so that the length of the string that is free to vibrate is 1.10 m.

(a) Calculate the linear mass density of the string. (2 marks)

(b) Calculate the velocity of the wave on the string that will produce a fundamental frequency of 41.2 Hz. (3 marks)

(c) Calculate the tension required to produce a fundamental frequency of 41.2 Hz. (3 marks)

(d) Calculate the wavelength of the sound wave produced in air when the string is vibrating at a frequency of 41.2 Hz. The speed of sound in air is 343 m/s. (2 marks)

END OF EXAMINATION