

# UNIVERSITY OF SASKATCHEWAN

Department of Physics and Engineering Physics

## Physics 117.3 MIDTERM TEST

February 11, 2016

Time: 90 minutes

NAME: \_\_\_\_\_  
(Last)                      **Please Print**                      (Given)

STUDENT NO.: \_\_\_\_\_

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	<input checked="" type="checkbox"/>	15	
B1	<input type="checkbox"/>	10	
B2	<input type="checkbox"/>	10	
B3	<input type="checkbox"/>	10	
B4	<input type="checkbox"/>	10	
TOTAL		45	

continued on page 2...

**PART A**

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

- A1. A tensile force  $F$  stretches a wire of original length  $L$  by an amount  $\Delta L$ . Consider another wire of the same composition and cross-sectional area, but of length  $2L$ . If a force of  $2F$  is applied to this wire of length  $2L$ , then the amount that it stretches is:
- (A)  $\frac{1}{2} \Delta L$       (B)  $\Delta L$       (C)  $2 \Delta L$       (D)  $4 \Delta L$       (E)  $8 \Delta L$

- A2. Which one of the following is **not** a unit of pressure?
- (A) Pascal (Pa)      (B) atmosphere (atm)      (C) cm of mercury (cm Hg)  
(D)  $\text{kg}\cdot\text{m}/\text{s}^2$       (E) pounds per square inch (psi)

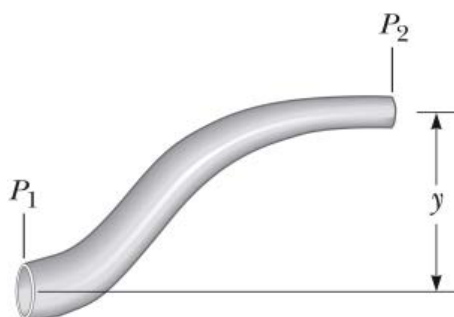
- A3. How deep under the surface of a lake would the pressure be double the pressure at the surface? ( $1 \text{ atm} = 1.01 \times 10^5 \text{ Pa}$ , density of water =  $1.00 \times 10^3 \text{ kg}/\text{m}^3$ )
- (A) 1.00 m      (B) 9.80 m      (C) 10.3 m      (D) 32.2 m      (E) 43.6 m

- A4. Assuming that water is an incompressible fluid, what happens as a rock, released when fully-submerged just below the surface of the water in a swimming pool, sinks toward the bottom?

As the rock sinks,

- (A) the buoyant force on the rock increases and the average pressure on the rock increases.  
(B) the buoyant force on the rock increases and the average pressure on the rock decreases.  
(C) the buoyant force on the rock decreases and the average pressure on the rock decreases.  
(D) the buoyant force on the rock decreases and the average pressure on the rock increases.  
(E) the buoyant force on the rock remains constant and the average pressure on the rock increases.

- A5. Water moves through the pipe shown below in steady, ideal flow.



Which one of the following statements is correct concerning the pressure and flow speed in region 2 compared to region 1?

- (A) Both the pressure and flow speed are higher in region 2 than in region 1.  
(B) Both the pressure and flow speed are lower in region 2 than in region 1.  
(C) The pressure is lower in region 2 but the flow speed is higher than in region 1.  
(D) The pressure is higher in region 2 but the flow speed is lower than in region 1.  
(E) The pressure is lower in region 2 than in region 1 but the flow speed is the same.
- A6. A 3.0-cm-diameter pipe is replaced by one of the same length but of 6.0-cm-diameter. If the pressure difference between the ends of the new pipe remains the same as for the original pipe, by what factor is the volume flow rate of a viscous liquid through the new pipe greater than the volume flow rate through the original pipe?
- (A) 16      (B) 8      (C) 4      (D) 2      (E) 1 (no change)
- A7. Three identical ideal springs each have the same spring constant  $k$ . If these three springs are connected end-to-end, forming a spring three times the length of one of the original springs, what is the effective spring constant of the combination?
- (A)  $9k$       (B)  $3k$       (C)  $k$       (D)  $k/3$       (E)  $k/9$

- A8. Which one of the following statements is **FALSE** regarding a horizontal mass-spring system that moves with simple harmonic motion in the absence of friction?
- (A) The total energy of the system remains constant.
  - (B) The potential energy stored in the system is greatest when the mass passes through the equilibrium position.
  - (C) The energy of the system is continually transformed between kinetic and potential energy.
  - (D) The total energy of the system is proportional to the square of the amplitude of the motion.
  - (E) The speed of the oscillating mass has its maximum value when the mass passes through the equilibrium position.
- A9. Simple pendulum 1, of length  $L_1$ , has a bob of mass  $m_1$ . Simple pendulum 2, of length  $L_2$ , has a bob of mass  $m_2$ .  $L_2 = 3L_1$  and  $m_2 = 3m_1$ . Which one of the following statements concerning the periods,  $T_1$  and  $T_2$ , of the pendula is correct?
- (A)  $T_2 = \frac{1}{\sqrt{3}} T_1$
  - (B)  $T_2 = \frac{1}{3} T_1$
  - (C)  $T_2 = T_1$
  - (D)  $T_2 = \sqrt{3} T_1$
  - (E)  $T_2 = 3 T_1$
- A10. What is the increase in the decibel level at a particular location when the power output from a sound source emitting a single frequency is doubled?
- (A) 3.0 dB
  - (B) 10.0 dB
  - (C) 20.0 dB
  - (D) 40.0 dB
  - (E) 200 dB
- A11. A wave is travelling with a speed of  $v$  along a string in which the tension is  $T$ . If the tension is suddenly doubled, what is the new wave speed?
- (A)  $\frac{1}{4} v$
  - (B)  $\frac{1}{2} v$
  - (C)  $\frac{v}{\sqrt{2}}$
  - (D)  $\sqrt{2} v$
  - (E)  $4v$
- A12. The distance between consecutive crests of a water wave is 2.0 m. As the wave passes a duck floating on the water, you notice that the interval between times when the duck is at maximum upward displacement is 2.0 s. The speed of the water wave is
- (A) 0.25 m/s
  - (B) 0.50 m/s
  - (C) 1.0 m/s
  - (D) 2.0 m/s
  - (E) 4.0 m/s
- A13. If you double the tension in a guitar string, the fundamental frequency of vibration of the string...
- (A) increases by a factor of  $\sqrt{2}$ .
  - (B) becomes half as large.
  - (C) doubles.
  - (D) increases by a factor of 4.
  - (E) does not change.
- A14. Given that the strings of a guitar are the same length, is it possible for the strings to have the same tension but have different fundamental frequencies of vibration?
- (A) Yes, and the lower the desired fundamental frequency, the smaller the required linear mass density of the string.
  - (B) Yes, and the lower the desired fundamental frequency, the larger the required linear mass density of the string.
  - (C) No, this is not possible because all strings at the same tension must have the same fundamental frequency.
  - (D) Yes, and the higher the desired fundamental frequency, the larger the required linear mass density of the string.
  - (E) No, this is not possible because all strings of the same length must have the same fundamental frequency.
- A15. A truck is being driven at a speed of 130 km/h due East. Two police cars, both moving with a speed of 150 km/h, and both with sirens emitting sound of the same frequency,  $f$ , are approaching the truck. Car 1 is approaching the truck from behind and car 2 is approaching the truck from ahead. Which one of the following statements is correct?
- (A) The driver of the truck hears the same frequency  $f$  from each of the police sirens.
  - (B) The driver of the truck hears the same frequency  $f_o > f$  from each of the police sirens.
  - (C) The driver of the truck hears the same frequency  $f_o < f$  from each of the police sirens.
  - (D) The driver of the truck hears a higher frequency from the siren of the police car behind than he does from the siren of the police car ahead.
  - (E) The driver of the truck hears a higher frequency from the siren of the police car ahead than he does from the siren of the police car behind.

**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.

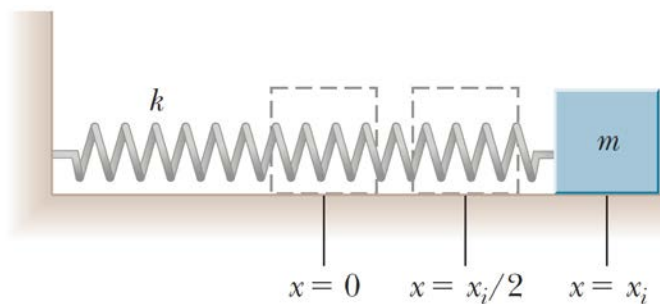
B1. A 62.0-kg survivor of a cruise ship disaster rests atop a block of Styrofoam insulation, using it as a raft. The Styrofoam has dimensions  $2.00\text{ m} \times 2.00\text{ m} \times 0.0900\text{ m}$ . The bottom  $0.0240\text{ m}$  of the Styrofoam block is submerged. Sea water has a density of  $1.03 \times 10^3\text{ kg/m}^3$ .

- (a) Calculate the magnitude of the buoyant force exerted by the water on the Styrofoam block. (3 marks)

- (b) Calculate the weight of the Styrofoam block. If you did not obtain an answer for (a), use a value of 955 N. (4 marks)

- (c) Calculate the density of Styrofoam. If you did not obtain an answer for (b), use a value of 355 N. (3 marks)

- B2. A horizontal spring attached to a wall has a spring constant of  $k = 851 \text{ N/m}$ . A block of mass  $m = 1.00 \text{ kg}$  is attached to the spring and rests on a frictionless, horizontal surface. The block is pulled to a position  $x_i = 6.00 \text{ cm}$  from equilibrium and released.



- (a) Calculate the potential energy stored in the spring when the block is  $6.00 \text{ cm}$  from equilibrium. (3 marks)

- (b) Calculate the speed of the block as it passes through the equilibrium position. If you did not obtain an answer for (a), use a value of  $1.50 \text{ J}$ . (3 marks)

- (c) Calculate the speed of the block when it is at a position  $x_i/2 = 3.00 \text{ cm}$ . (4 marks)

B3. A speaker that emits sound waves uniformly in all directions is placed between two observers who are 36.0 m apart, along the line connecting them. Observer 1 records an intensity level of 82.4 dB and observer 2 records an intensity level of 75.7 dB.

(a) Calculate the intensity of the sound detected by each observer. (4 marks)

Observer 1:	<input type="text"/>
Observer 2:	<input type="text"/>

(b) Calculate the distance of Observer 1 from the speaker. If you did not obtain answers for (a), use  $I_1 = 1.75 \times 10^{-4} \text{ W/m}^2$  and  $I_2 = 3.50 \times 10^{-5} \text{ W/m}^2$ . (6 marks)

B4. A steel wire in a piano has a length of 0.700 m and a mass of 4.30 g.

- (a) Calculate the tension force that must be applied to the string so that the fundamental resonant frequency is 261.6 Hz. (4 marks)

- (b) Given that the density of steel is  $7.85 \times 10^3 \text{ kg/m}^3$ , calculate the cross-sectional area of the wire. (3 marks)

- (c) Given that Young's modulus for steel is  $2.00 \times 10^{11} \text{ Pa}$ , calculate the amount that the string stretches when the force calculated in (a) is applied to it. If you did not obtain an answer for (a), use a value of 825 N and if you did not obtain an answer for (b), use a value of  $7.80 \times 10^{-7} \text{ m}^2$ . (3 marks)