UNIVERSITY OF SASKATCHEWAN

Department of Physics and Engineering Physics

Physics 117.3

MIDTERM EXAM – Regular Sitting

February 14, 2019 Time: 90 minutes

NAME: _____ STUDENT NO.: _____

(Last) **Please Print** (Given)

LECTURE SECTION (please check):

- ❑ 01 Dr. Y. Yao
- ❑ 02 Mr. B. Zulkoskey

INSTRUCTIONS:

1. This is a closed book exam.
2. The test package includes a test paper (this document), an exam booklet, a formula sheet, a scratch card and an OMR (OpScan / bubble) 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, or calculators in smart phones 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 name on the exam booklet and scratch card.
5. Enter your name and NSID on the OMR (OpScan / bubble) sheet.
6. The test paper, the exam booklet, the formula sheet, the scratch card, and the OMR (OpScan / bubble) sheet must all be submitted.
7. No test materials will be returned.

QUESTION NUMBER	MAXIMUM MARKS	MARKS OBTAINED
A1-12	12	
B1-4	8	
B5-8	8	
B9-12	8	
B13-16	8	
MARK	out of 36:	

PART A

For each of the following questions in Part A, enter the most appropriate response on the OMR (OpScan / bubble) sheet. Use the exam booklet for your rough work.

A1. Let h be the depth below the surface of the ocean at which the absolute pressure is twice atmospheric pressure (i.e. $2P_{atm}$). The pressure at a depth of $2h$ below the surface of the ocean is

(A) $2.5P_{atm}$ (B) $3P_{atm}$ (C) $4P_{atm}$ (D) $5P_{atm}$ (E) $9P_{atm}$

A2. Two objects of identical volume are placed in a container that is filled with an unknown liquid. One object floats and the other sinks to the bottom. Which one of the following is a true statement concerning the masses of the objects?

(A) Both objects have the same mass.
(B) The floating object's mass is greater than the mass of the object that sinks.
(C) The floating object's mass is less than the mass of the object that sinks.
(D) Nothing can be said about the masses without knowing the densities of the objects.
(E) Nothing can be said about the masses without knowing the density of the unknown liquid.

A3. An ideal incompressible fluid is flowing through a horizontal pipe with a constriction. One section of the pipe has a radius of R and the other section 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 flow speed at the narrower end is four times the flow speed at the larger end.
(E) The pressure is the same throughout the pipe.

A4. A spherical object of radius r falls with a terminal speed υ through a fluid with viscosity η. Which one of the following statements is **TRUE**?

(A) The net force on the object has magnitude mg.
(B) The object has an acceleration of magnitude g.
(C) The viscous drag force causes the net force on the object to be zero.
(D) The viscous drag force is in the same direction as the force of gravity on the object.
(E) The viscous drag force is the only force acting on the object.

A5. If one could transport a simple pendulum of constant length from the Earth's surface to the Moon's, where the acceleration due to gravity is one-sixth (1/6) of that on Earth, by what factor would the pendulum frequency be changed?

(A) $f_M \approx 6f_E$ (B) $f_M \approx 2.5f_E$ (C) $f_M \approx 0.41f_E$ (D) $f_M \approx 0.17f_E$ (E) $f_M = 3.5f_E$

A6. Consider two rigid bars. The shear modulus of bar 1 is larger than the shear modulus of bar 2. Which one of the following statements **must** be **TRUE**?

(A) Bar 1 is longer than bar 2.
(B) Bar 1 has a larger surface area than bar 2.
(C) Bar 1 is heavier than bar 2.
(D) The net force acting on bar 1 is larger than the net force acting on bar 2.
(E) Bar 1 and bar 2 are made of different materials.

A7. A horizontal pipe is replaced by one of the same length but half of the radius. If the pressure difference between the ends of the pipe is doubled, by what factor is the volume flow rate of a viscous liquid through the new pipe changed from the volume flow rate through the original pipe?

(A) $Q_2 = \frac{1}{16} Q_1$ (B) $Q_2 = \frac{1}{8} Q_1$ (C) $Q_2 = \frac{1}{2} Q_1$
(D) $Q_2 = Q_1$ (E) $Q_2 = 2Q_1$

A8. A source is producing sound energy at a constant rate. You detect a sound intensity level of 60.0 dB. If you reduce your distance from the sound source by a factor of 2, how does the sound intensity level at your new location compare to the sound intensity level at your original location?

(A) The sound intensity level doubles.
(B) The sound intensity level increases by a factor of 4.
(C) The sound intensity level increases by a factor of 10.
(D) The sound intensity level increases by a factor of 100.
(E) The sound intensity level increases by a factor less than 2.

A9. The speed of a wave in a stretched string is initially 50 m/s. What will be the new wave speed if the tension in the string is increased by 18%?

(A) 50 m/s (B) 54 m/s (C) 21 m/s (D) 59 m/s (E) 45 m/s

A10. 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.

A11. The standing wave pattern in a pipe is NANA, where N stands for node and A for antinode. Which one of the following statements is **TRUE**?

(A) The pipe is open at both ends.
(B) The pipe is closed at both ends.
(C) The pipe is open at one end and closed at the other end.
(D) The pipe is vibrating at the fundamental frequency.
(E) The pipe is vibrating at the second harmonic frequency.

A12. Which one of the following statements is true regarding electromagnetic waves traveling through a vacuum?

(A) All waves have the same wavelength.
(B) All waves have the same frequency.
(C) The electric and magnetic fields associated with the waves are parallel to each other and perpendicular to the direction of wave propagation.
(D) The electric and magnetic fields associated with the waves are perpendicular to each other and to the direction of wave propagation.
(E) The speed of the waves depends on their frequency.

PART B

Work out the answers to the following Part B questions.

Before scratching any options, be sure to double-check your logic and calculations.

You may find it advantageous to do as many of the parts of a question as you can before scratching any options.

When you have an answer that is one of the options and are confident that your method is correct, scratch that option on the scratch card. if you reveal a star on the scratch card then your answer is correct (full marks, 2/2).

If you do not reveal a star with your first scratch, try to find the error in your solution. If you reveal a star with your second scratch, you receive 1.2 marks out of 2.

Revealing the star with your third, fourth, or fifth scratches does not earn you any marks, but it does give you the correct answer.

You may answer all four Part B question groupings (B1-4, B5-8, B9-12, and B13-16) and you will receive the marks for your best 3 groupings.

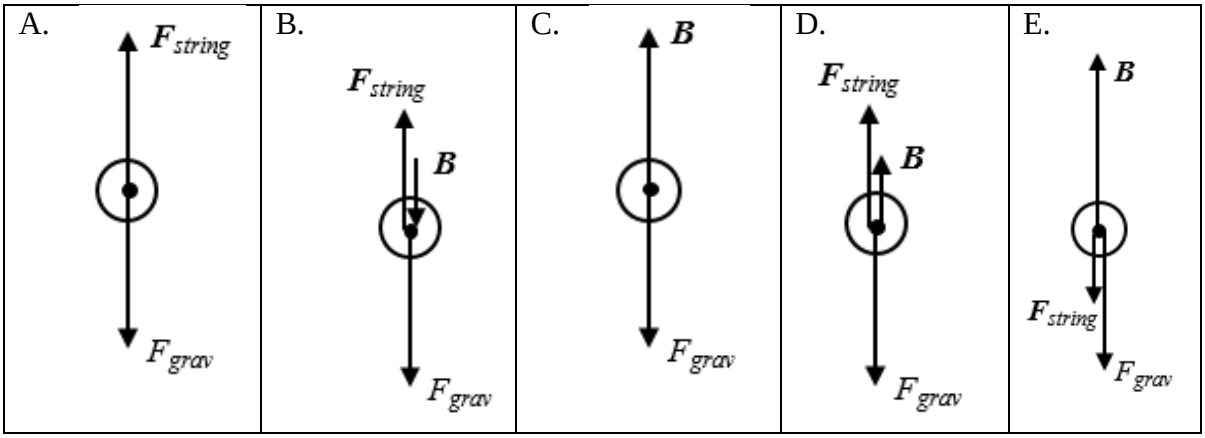
Use the provided exam booklet for your rough work.

A wooden block of mass 3.00 kg floats in water, and a steel object of mass 0.255 kg is attached to the bottom of the block by a massless string. The steel object is not in contact with the bottom of the container. The density of steel is 8.05×10^3 kg/m^3. The density of wood is 0.750×10^3 kg/m^3. The density of water is 1.00×10^3 kg/m^3.

B1. Which one of the following statements is **TRUE**?

(A) The buoyant force on the wooden block is equal to its weight.
(B) The tension in the string is zero.
(C) The buoyant force on the steel object is equal to its weight.
(D) The tension in the string is equal to the weight of the steel object.
(E) The buoyant force on the wooden block is equal to the weight of the volume of water it displaces.

B2. Which one of the following is the correct free-body diagram for the steel object?



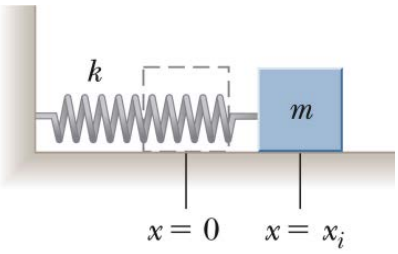
B3. Calculate the magnitude of the buoyant force on the steel object.

B4. Calculate the magnitude of the buoyant force on the wooden block.

B5. Which one of the following quantities is at a maximum when an object in simple harmonic motion is at its maximum displacement?

(A) acceleration (B) momentum (C) speed (D) kinetic energy (E) frequency

A block of mass m = 2.00 kg on a horizontal frictionless surface is attached to a horizontal spring of force constant k = 511 N/m, as shown in the diagram. The block is pulled to the right of equilibrium a distance of x_i = 5.00 cm and released from rest.



B6. Calculate the speed of the mass when it passes through the equilibrium position.

B7. Calculate the frequency of the oscillatory motion of the mass.

B8. Calculate the position of the mass at a time of 0.250 s after release.

At time $t = 0$, two trains are separated by a distance of 255 m. Train A is stationary and train B is moving toward the right (away from train A) at a speed of 40.0 m/s. The horns on both trains are identical and are both producing sounds with a frequency of 375 Hz. A listener is between the two trains, 85.0 m away from train A at time $t = 0$, and moving toward the right with a speed of 8.00 m/s. Assume that the speed of sound in air is 343 m/s.

B9. The power produced by one horn is 80.0 W. Calculate the intensity, due just to the horn on train A, received by the listener at time $t = 0$.

B10. Calculate the intensity level of the total sound (due to both horns) received by the listener at time $t = 0$.

B11. Calculate the frequency of the sound of train A's horn, as heard by the listener.

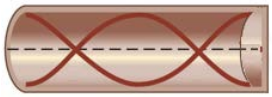
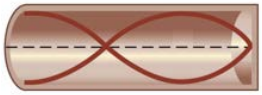
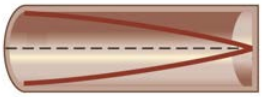
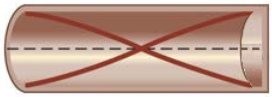
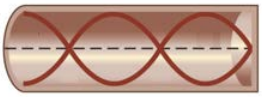
B12. Calculate the frequency of the sound of train B's horn, as heard by the listener.

A pipe of length L is open at one end and closed at the other. The pipe is made to go into resonance at a frequency of 4.50×10^2 Hz. Assume that the speed of sound in air is 343 m/s.

B13. One of the following frequencies is the fundamental frequency for this pipe. Which one is it?

(A) 1.50×10^2 Hz (B) 2.50×10^2 Hz (C) 9.00×10^2 Hz
(D) 1.25×10^2 Hz (E) 2.25×10^2 Hz

B14. Which one of the following is the correct diagram for the standing wave pattern in the pipe when it is in resonance at 4.50×10^2 Hz?

A. 	B. 	C. 
D. 	E. 	

B15. Calculate the length of the pipe.

B16. The closed end of the pipe is now opened and the pipe is made to go into resonance at 6.00×10^2 Hz. To which harmonic does this frequency correspond?

END OF EXAMINATION