

Last Name: _____ First Name _____ ID _____

Discussion Section: _____ Discussion TA Name: _____

Instructions—Turn off your cell phone and put it away.

Calculators cannot be shared. Please keep yours on your own desk.

This is a closed book exam. You have 90 minutes to complete it.

This is a multiple choice exam. Use the bubble sheet to record your answers.

1. Use a #2 pencil; do **not** use a mechanical pencil or a pen. Fill in completely (until there is no white space visible) the circle for each intended input – both on the identification side of your answer sheet and on the side on which you mark your answers. If you decide to change an answer, erase vigorously; the scanner sometimes registers incompletely erased marks as intended answers; this can adversely affect your grade. Light marks or marks extending outside the circle may be read improperly by the scanner.
2. Print your last name in the **YOUR LAST NAME** boxes on your answer sheet and print the first letter of your first name in the **FIRST NAME INI** box. Mark (as described above) the corresponding circle below each of these letters.
3. Print your NetID in the **NETWORK ID** boxes, and then mark the corresponding circle below each of the letters or numerals. Note that there are different circles for the letter “I” and the numeral “1” and for the letter “O” and the numeral “0”. **Do not** mark the hyphen circle at the bottom of any of these columns.
4. You may find the version of **this Exam Booklet at the top of page 2**. Mark the version circle in the **TEST FORM** box in the bottom right on the front side of your answer sheet. **DO THIS NOW!**
5. Stop **now** and double-check that you have bubbled-in all the information requested in 2 through 4 above and that your marks meet the criteria in 1 above. Check that you do not have more than one circle marked in any of the columns.
6. Print your UIN# in the **STUDENT NUMBER** designated spaces and mark the corresponding circles. You need not write in or mark the circles in the **SECTION** box.
7. Write in your course on the **COURSE LINE** and on the **SECTION line**, print your **DISCUSSION SECTION**. (You need not fill in the **INSTRUCTOR** line.)
8. Sign (**DO NOT PRINT**) your name on the **STUDENT SIGNATURE line**.

*Before starting work, check to make sure that your test booklet is complete. After these instructions, you should have **7** **numbered pages** plus 2 *Formula Sheets*.*

On the test booklet:

Write your **NAME**, your **Discussion TA’s NAME**, your **DISCUSSION SECTION** and your **NETWORK-ID**. Also, write your **EXAM ROOM** and **SEAT NUMBER**.

When you are finished, you must hand in BOTH the exam booklet AND the answer sheet. Your exam will not be graded unless both are present.

Academic Integrity—Giving assistance to or receiving assistance from another student or using unauthorized materials during a University Examination can be grounds for disciplinary action, up to and including expulsion.

This Exam Booklet is Version A. Mark the **A** circle in the **TEST FORM** box in the bottom right on the front side of your answer sheet. **DO THIS NOW!**

Exam Format & Instructions:

This exam is a combination of

- * Three-Answer Multiple Choice (3 points each)
- * Five-Answer Multiple Choice (6 points each)

There are 23 problems for a maximum possible raw score of 108 points.

Instructions for Three-Answer Multiple Choice Problems:

Indicate on the answer sheet the correct answer to the question (*a, b* or *c*).

Each question is worth 3 points. If you mark the wrong answer, or mark more than one answer, you receive 0 points.

Instructions for Five-Answer Multiple Choice Problems:

Indicate on the answer sheet the correct answer to each question (*a, b, c, d* or *e*).

Credit is awarded in the following way:

- If you mark one answer and it is correct, you will receive 6 points;
- If you mark two answers, and one of them is correct, you will receive 3 points;
- If you mark three answers and one of them is correct, you will receive 2 points.
- If you mark no answer or more than three answers, you will receive 0 points.

1) Consider water falling from a faucet. At the faucet opening, water flows with a velocity of 0.6 m/s and a diameter of 1.43 cm . What is the diameter of the water flow after the water has fallen 57 cm ? Assume the water is incompressible.

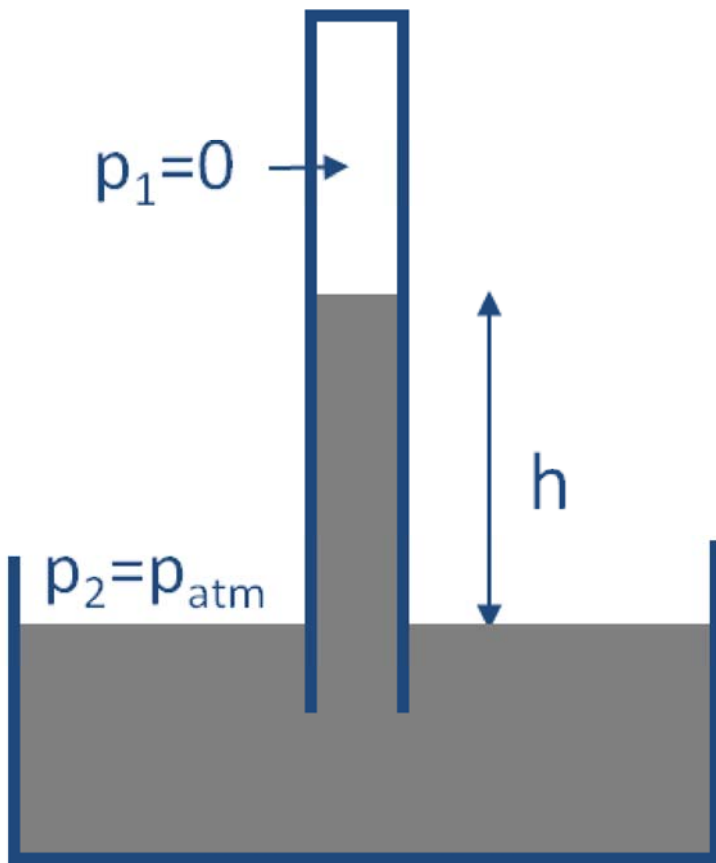
- a. 70.9 cm
- b. 0.858 cm
- c. 61.1 cm
- d. 25.3 cm
- e. 60.1 cm

2) A 1.4 kg block is attached to a massless spring of unknown spring constant. The spring is stretched by 5.5 cm and released, when the block starts oscillating. The oscillation period is found to be 0.3 s . What is the total energy of the block-spring system?

- a. 0.00186 mJ
- b. $9.29 \times 10^{-4} \text{ mJ}$
- c. 0.0169 mJ
- d. $4.43 \times 10^{-5} \text{ mJ}$
- e. $2.35 \times 10^{-5} \text{ mJ}$

The next two questions pertain to the situation described below.

Shown below is a barometer, a device to measure atmospheric pressure. An evacuated tube is inserted into a pool of liquid with density of 950 kg/m^3 .

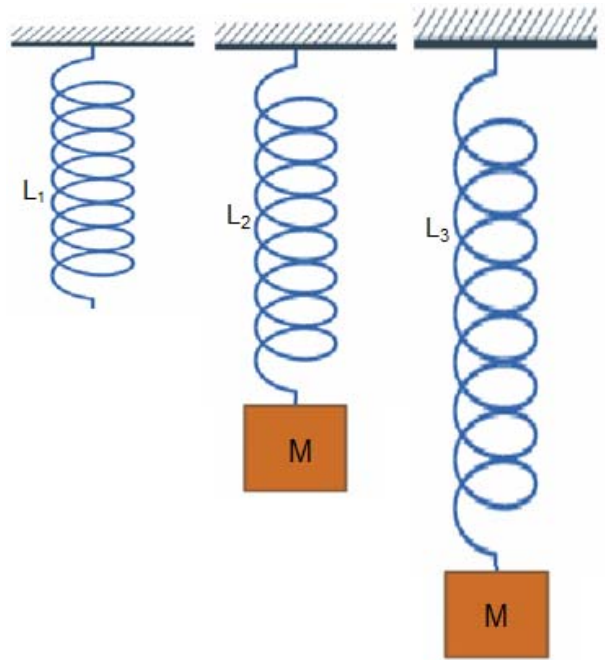


- 3) If the liquid rises up inside the tube such that the height difference between inside and outside levels $h = 10.3 \text{ m}$, what is the atmospheric pressure?
- a. $P_{atm} = 6900 \text{ Pa}$
 - b. $P_{atm} = 28600 \text{ Pa}$
 - c. $P_{atm} = 33800 \text{ Pa}$
 - d. $P_{atm} = 982 \text{ Pa}$
 - e. $P_{atm} = 67600 \text{ Pa}$
- 4) For the same atmospheric pressure, how would the height difference, h , change if a tube of smaller diameter is used?
- a. h will decrease.
 - b. h will increase.
 - c. h will remain the same.

- 5) A 2 kg mass bounces on the end of a spring completing one period every 2π seconds. What is the spring constant of the spring?
- 2 N/m
 - 1 N/m
 - 4 N/m
 - 1.41 N/m
 - 2.83 N/m

The next four questions pertain to the situation described below.

Consider a vertically hanging spring of force constant $k = 17\text{ N/m}$ and of length $L_1 = 17\text{ cm}$ as shown on the left of the figure. A mass $M = 0.7\text{ kg}$ is attached to the spring, which extends the spring to a new equilibrium length L_2 as shown in the middle of the figure.



- 6) Determine the length of the spring L_2
- $L_2 = 98\text{ cm}$
 - $L_2 = 57\text{ cm}$
 - $L_2 = 40\text{ cm}$
- 7) The mass is gently pulled vertically down such that the spring extends from length L_2 to a length L_3 and then released as shown on the right of the figure. The mass begins to execute simple oscillations. Determine the period of the oscillations T .
- $T = 1.3\text{ s}$
 - $T = 22\text{ s}$
 - $T = 15\text{ s}$
 - $T = 31\text{ s}$
 - $T = 0.64\text{ s}$

8) If the total energy of the oscillating mass is 0.1 J , determine the maximum extension of the spring ($L_3 - L_2$). Take the potential energy of the mass to be zero when the spring has a length L_2 .

- a. 0.077 cm
- b. 0.22 cm
- c. 0.054 cm
- d. 0.11 cm
- e. 0.15 cm

9) What is the maximum speed the mass v_{max} ?

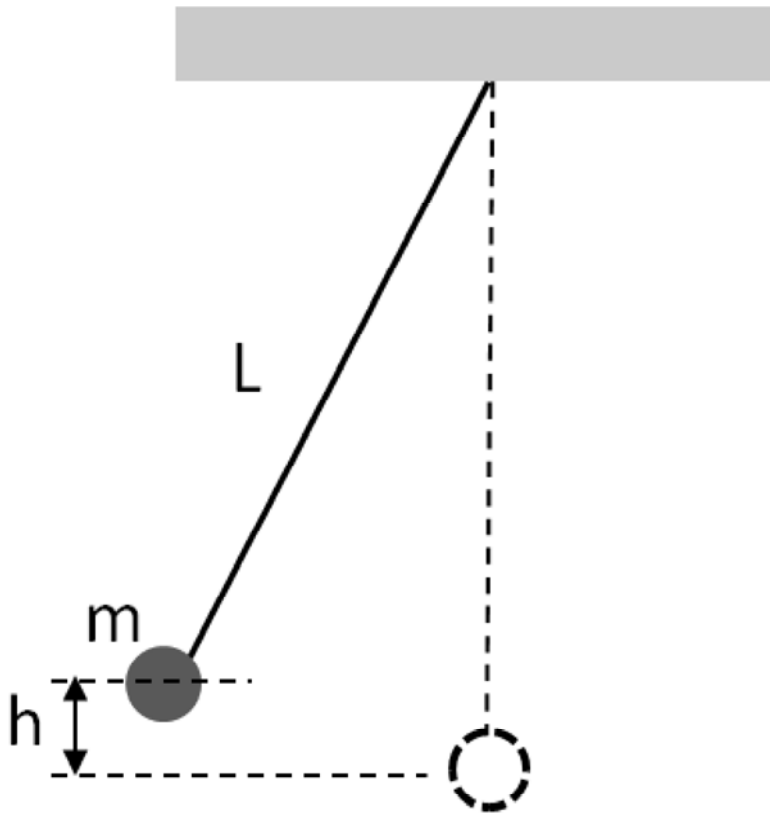
- a. $v_{max} = 0.535 \text{ m/s}$
- b. $v_{max} = 1.07 \text{ m/s}$
- c. $v_{max} = 0.378 \text{ m/s}$
- d. $v_{max} = 0.267 \text{ m/s}$
- e. $v_{max} = 0.756 \text{ m/s}$

10) Which of the following will decrease the period of a pendulum?

- a. Increasing the mass of the pendulum bob
- b. Decreasing the length of the pendulum
- c. Placing the pendulum on the moon

The next two questions pertain to the situation described below.

A pendulum bob of mass $m = 1.2 \text{ kg}$ hangs from a ceiling as shown below. The length of the pendulum $L = 3.5 \text{ m}$. Initially, it is held at a position $h = 0.01 \text{ m}$ high from the lowest position.



11) Once released, the pendulum will start oscillating. What is the oscillation period?

- a. 0.598 s
- b. 3.75 s
- c. 2.24 s

12) Now imagine you bring the pendulum to another planet where the gravitational acceleration is smaller than that on Earth (the pendulum is no longer in an elevator). If you want to have it oscillate with the same period as on Earth, what modification should you make?

- a. Reduce the length of the pendulum.
- b. Make the bob heavier.
- c. Make the initial height h larger.

- 13) A sound wave is
- A longitudinal wave
 - A transverse wave
 - An electromagnetic wave
- 14) If the frequency of a wave is 110 Hz , and the wavelength is 2 m , what is the velocity of the wave?
- 22 m/s
 - 880 m/s
 - 55 m/s
 - 220 m/s
 - 4 m/s
- 15) If a sound source moves in the direction of a stationary observer, the observer hears the sound wave at a greater
- Wavelength
 - Frequency
 - Velocity
 - Amplitude
 - Period
- 16) A cylinder is capped by a piston such that it contains a volume of 20 ml of an ideal gas at a pressure of 30 psi . If the volume is decreased to 10 ml , what is the new pressure?
- 10 psi
 - 20 psi
 - 40 psi
- 17) The temperature of an ideal gas quadruples. How does the root-mean-square speed of the gas molecules of the hotter gas, v'_{rms} , compare to the root-mean-square molecular speed of the cooler gas, v_{rms} ?
- $v'_{rms} = 16v_{rms}$
 - $v'_{rms} = 0.5v_{rms}$
 - $v'_{rms} = 4v_{rms}$
 - $v'_{rms} = 2v_{rms}$
 - $v'_{rms} = v_{rms}$

- 18) A piece of metal ($\alpha = 16 \cdot 10^{-6} K^{-1}$) at $273 K$ has length $1 m$. By how much does the length change if it is heated to $900 K$?
- $100 mm$
 - $10 cm$
 - $10 mm$
- 19) A ring of metal with a circular hole in the middle is heated. As a result of heating, the diameter of the hole
- Increases
 - Stays the same
 - Decreases
- 20) An observer measures the loudness of a speaker to be $50 dB$. What would be the loudness of 100 identical speakers together?
- $250 dB$
 - $500 dB$
 - $70 dB$
 - $150 dB$
 - $55 dB$
- 21) The speed of a $490 Hz$ sound wave is v . What will be the speed, v' , of an $980 Hz$ sound wave?
- $v' = 4v$
 - $v' = v/2$
 - $v' = 2v$
 - $v' = 16v$
 - $v' = v$
- 22) You are standing $6m$ from a speaker and measure sound intensity I . If you walk until you are $12 m$ from the speaker, what will be the new intensity you measure, I' ?
- $I' = I$
 - $I' = I/2$
 - $I' = 4I$
 - $I' = 2I$
 - $I' = I/4$

23) One of the strings on a guitar is 22 *cm* long. What is the wavelength of the fundamental frequency for this string?

- a. 22 *cm*
- b. 11 *cm*
- c. 44 *cm*