

Printed Name: _____

Section: 1 (8AM) 2 (9AM)

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Bonus	
Total	/ 60

PHYSICS 221 EXAM 4

December 8, 2008

Do not open this booklet until instructed. The exam will end promptly at 50 minutes after the hour.

Instructions: When you are told to begin, check that this examination booklet contains all the numbered pages from 2 through 5. The Bonus Question is extra credit, and is optional.

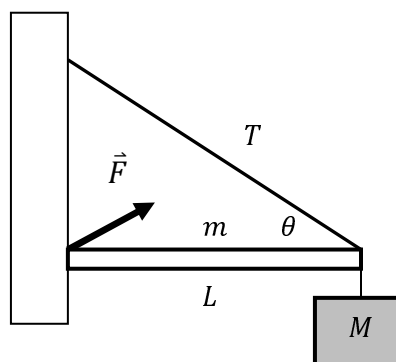
Read each problem carefully so that you are certain what it is asking. Do not panic or be discouraged if you cannot do every part of every problem. If a part of a problem depends on a previous answer you have not obtained, define a symbol for it and proceed to maximize your credit. Keep moving to finish as much as you can!

You must show your work. The purpose of this exam is to show how well you understood the material we have covered. You must include an adequate explanation, including correct equations where applicable, for full credit. A number with no explanation will not get credit. **Show your answer's units**, and give an adequate number of significant digits. Completely numerical solutions showing no equations are not eligible for partial credit. Do not use scratch paper. Indicate any work on the backs of the pages that you wish to be considered.

Box your answers.

This examination is administered under the Cadet Honor Code. All suspected violations must be reported appropriately. The seat next to you must be unoccupied. No talking is permitted during the examination, apart from questions to the instructor. You may use a scientific calculator, but may not use "advanced features", including graphing, solving, derivatives, integrals, symbolic manipulation, or equation storage capabilities. Any other electronic devices, including headphones, cell phones, PDAs, and MP3 players, may not be used during the exam in any way. You may use the equation sheet distributed with the exam. No other notes or textbooks may be open during the exam.

Problem 1: [15pt] A crate of mass $M = 184$ kg suspended at the end of beam of mass $m = 72$ kg and length $L = 1.20$ m. A wire is attached to the wall as shown, with $\theta = 30^\circ$.



(a) [5pt] Find the tension T in the wire.

(b) [10pt] Find the components F_x, F_y of the force \vec{F} supporting the left end of the beam.

Problem 2: [15pt] A satellite weighing 1200 N on Earth is placed in a circular orbit around the Earth. The radius of the orbit is 4.0 Earth radii, so that the satellite is at a constant altitude of 3.0 earth radii above Earth's surface. The Earth's radius is $R_E = 6370$ km.

(a) [5pt] What is the magnitude of the gravitational force on the satellite in orbit?

(b) [10pt] How much work was needed to put the satellite into orbit? Neglect the Earth's rotation, and assume it started at rest on the Earth's surface.

Problem 3: [15pt] Water is kept in a large open tank with a hose attached to the bottom. The hose has a diameter of 2.4 cm. The top of the water in the tank is 7.5 m above the hose.

(a) [6pt] When the hose is plugged with a rubber stopper, what is the friction force needed to hold the stopper in?

(b) [9pt] When the stopper is removed, what is the flow rate in kg/s of water from the hose?

Problem 4: [15pt] A 0.50 kg object is attached to a light-weight spring with force constant 8.00 N/m. It vibrates in simple harmonic motion with an amplitude of 12.0 cm.

(a) [5pt] What is the maximum acceleration of the mass?

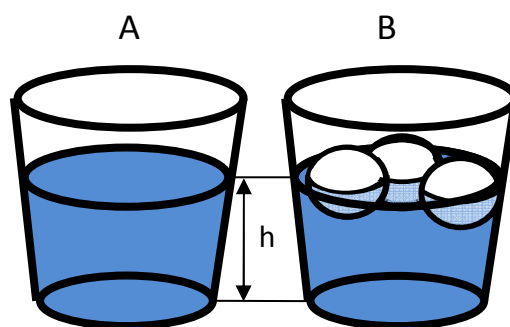
(b) [5pt] What is the maximum speed of the mass?

(c) [5pt] How long does the object take to complete one oscillation (back and forth)?

The following problem is extra credit, and can increase your score by a maximum of 3 points. You cannot get more than 60 points on this exam via extra credit, however.

Bonus Question: [3pt] Two identical glasses are filled to the same level. Glass A contains only water, and glass B contains water with some plastic balls floating in it. Which glass weighs more?

- (a) Glass A.
- (b) Glass B.
- (c) Their weights are equal.
- (d) More information is needed to decide.



Circle your answer [1pt] and explain it briefly [2pt] using physical concepts.