

Printed Name: _____

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

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PHYSICS 221 EXAM 1

September 16, 2009

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 4.

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. Unless otherwise indicated, 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 back 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, 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: [17pt] A tortoise and a hare are running a 500 m race. The hare has a comfortable lead, and stops to rest after 200 m. At this time, the tortoise has crawled only 50 m, but is continuing toward the finish line at a steady pace. The hare waits 10 minutes to let the tortoise get ahead, and then starts running at its original pace, just in time to finish in a tie.

(a) [5pt] Draw a position-time diagram for the race, showing both animals.

(b) [6pt] How long did the entire race take?

(c) [6pt] What were the speeds of the tortoise and the hare in m/s?

Problem 2: [16pt] A place kicker must kick a football from a point 36 m from the goal. He kicks the ball upward at an angle of 45° , sending the ball high enough to pass comfortably through the goal posts at a height of 4.8 m above the ground.

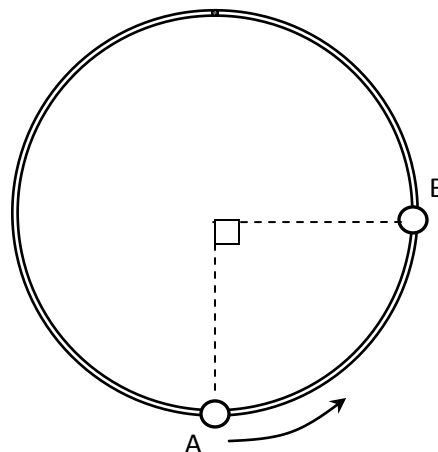
(a) [5pt] What was the initial speed of the football just after it was kicked?

(b) [5pt] How long was the football in the air before it hit the ground again?

(c) [6pt] What was the football's velocity as it passed over the goal post? Give the speed and direction angle relative to the horizontal, with positive angle upward, negative downward. [If you don't have an answer to part (a), you may use $v_0 = 22 \frac{\text{m}}{\text{s}}$.]

Problem 3: [17pt] A car drives around a circular track 1200 m in circumference, with constant tangential acceleration, starting from rest at point A, travelling counter-clockwise, and completing one revolution in 52 seconds.

(a) [5pt] What is the car's tangential acceleration?



(b) [6pt] What is the car's velocity vector at point B, which is $\frac{1}{4}$ of the way around the track? Give the magnitude and angle relative to the forward direction.

(c) [6pt] What is the car's total acceleration vector at point B? Give the magnitude and angle relative to the forward direction. [If you don't have answers to the previous parts, you may use $a_t = 1.0 \frac{m}{s^2}$, $v = 20 \frac{m}{s}$.]