

Printed Name: \_\_\_\_\_

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

|              |             |
|--------------|-------------|
| Problem 1    | / 20        |
| Problem 2    | / 20        |
| Problem 3    | / 20        |
| Bonus        |             |
| <b>Total</b> | <b>/ 60</b> |

## PHYSICS 221 EXAM 1

September 15, 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 6. The Bonus Question is extra credit, and is optional.

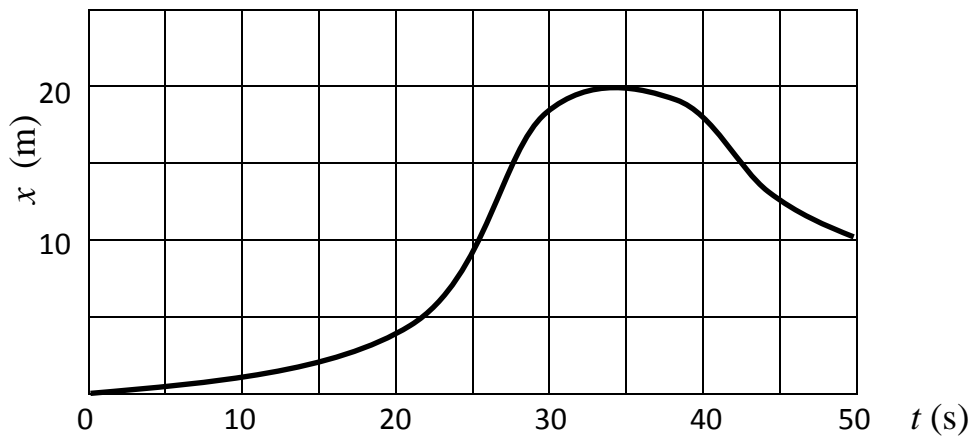
Read each problem carefully so that you are certain what it is asking. Do not panic or be discouraged if you cannot do every part of every problem. If a part of a problem depends on a previous answer you have not obtained, define a symbol for it and proceed to maximize your credit. Keep moving to finish 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. 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: [20pt]** A rabbit runs through a straight pipe. The position  $x$  measured from the end of the pipe is shown in the following figure as a function of time.



Questions (a) – (d) **do not** require an explanation.

(a) [3pt] What is the rabbit's displacement for the 50 second trip?

(b) [3pt] How far does the rabbit travel during this time (total distance of trip)?

(c) [3pt] What is the rabbit's average velocity?

(d) [3pt] What is the rabbit's average speed?

Questions (e) – (f) require a **reason** as part of the answer.

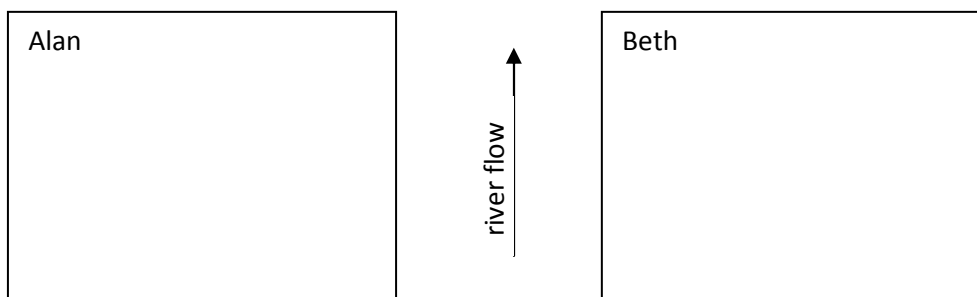
(e) [4pt] Estimate the rabbit's maximum velocity using a line **you draw** on the above graph.

(f) [4pt] Estimate the time when the rabbit had its greatest acceleration. **Explain** your choice.

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**Problem 2: [20pt]** Alan and Beth start together at the same point on the bank of a 50-m wide stream that flows with speed 1.0 m/s. Both swimmers can swim at an equal speed of 2.5 m/s in still water. Alan swims downstream 50 m and then swims back, while Beth swims to a point directly across the river and returns to the starting point.

(a) **Draw and label** vector diagram showing the following vectors **for each swimmer** in the labeled boxes as they travel away from the starting point: The velocity of the swimmer relative to the river, the velocity of the river relative to the ground, and the velocity of the swimmer relative to the ground. The direction of the river flow is shown. Assume both swimmers start on the left bank.



(b) [4pt] How long does Alan take to return to the starting point (round trip)?

(c) [4pt] What are the magnitude and direction of Beth's velocity vector  $\vec{v}_{BR}$  **relative to the river** on the way to the other side? Take the direction across the river to be zero degrees, and down the river to be  $90^\circ$ .

(d) [4pt] What are the magnitude and direction of Beth's velocity vector  $\vec{v}_{BG}$  **relative to the ground** on the way to the other side?

(e) [4pt] How long does Beth take to return to the starting point (round trip)?

**Problem 3: [20pt]** A ball is tossed from window at a height of 136 m in a tall building. The ball is thrown at a speed of 9.0 m/s at an angle of  $25^\circ$  upward from the horizontal.

(a) [4pt] What are the ball's initial velocity components  $v_i^x$  and  $v_i^y$ ? Take  $y$  to be positive upward.

(b) [6pt] What are the ball's velocity components  $v_f^x$  and  $v_f^y$  just before it lands?

(c) [4pt] What are the ball's speed and angle with respect to horizontal just before it lands?

(d) [3pt] How long does it take the ball to reach the ground?

(e) [3pt] How far from the base of the building does the ball land?

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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]** A battleship fires rounds simultaneously at ships A and B. The trajectory of each projectile is shown in the figure. Which ship is hit first? Justify your answer.

- (a) Ship A.
- (b) Ship B.
- (c) They are hit simultaneously.
- (d) More information is needed.

