

**PHYS 121: First Hour Exam****June 12, 2008**

Do not begin this exam until instructed to do so. Please complete this form and read the rules on this cover sheet now.

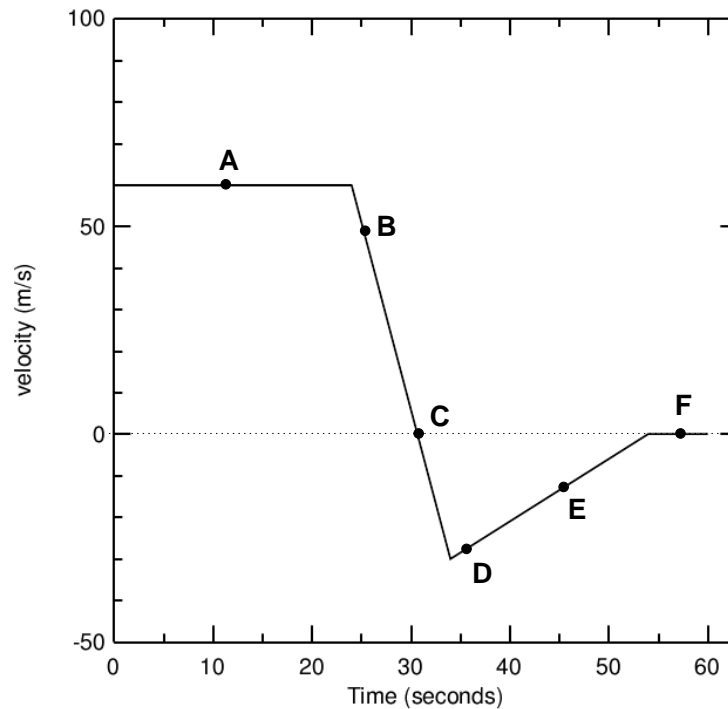
Your Name: \_\_\_\_\_

**Rules for Exam:**

This exam is worth either 5 or 10 percent of your grade. You have 80 minutes to complete the exam. You are allowed one textbook. You are also allowed one  $8\frac{1}{2} \times 11$  sheet of hand-written notes (both sides). Answer all questions. Show your work. Partial credit will be awarded for cases where you have progressed toward the correct answer. If you have a question on the wording of a problem or the interpretation of a problem, raise your hand and a proctor will come to you. Write your answers on the pages provided. Calculators are okay, but no PDA's or laptops.

1. Relax. Don't panic.
2. Put a box around your final answer. Use English words.
3. Be as clear as possible when you are working the problems. It helps to draw a picture or say in a few words what you are doing. You will be awarded partial credit for knowing how to solve the problem even if you cannot successfully implement that solution. State clearly the central physics concept associated with each problem. Explain your work. The correct answer alone is worth nothing.
4. You will receive most of the points if you set up the problem clearly and correctly. If you make a math blunder or plug in the wrong numbers at the end, this will cost you a relatively small number of points.
5. Take your time. Do not rush your work. Presentation counts. Neatness counts. Illegible or very untidy answers will be graded as simply wrong. Irrelevant or hostile comments are grounds for lost points. Do not annoy the graders. Show that you care about your work. Go slow, take care, and pace yourself so that you can keep your work organized.

| Problem<br>1 | Problem<br>2 | Problem<br>3 | Problem<br>4 | <b>-Total-<br/>Score</b> |
|--------------|--------------|--------------|--------------|--------------------------|
|              |              |              |              |                          |

**Problem 1: One-Dimensional Motion: (25 points)**

A particle is constrained to move in one dimension. The *velocity* vs. time for this particle is shown **above**. For part (a) and (b), please select *all* points that apply from the list A, B, C, D, E, and F as shown above.

**Part (a)** Which of these points if any, correspond to the particle being *at rest* at that particular point? Explain how you know this.

**Part (b)** Which of these points, if any, correspond to the particle moving with *constant acceleration*? Explain how you know this?

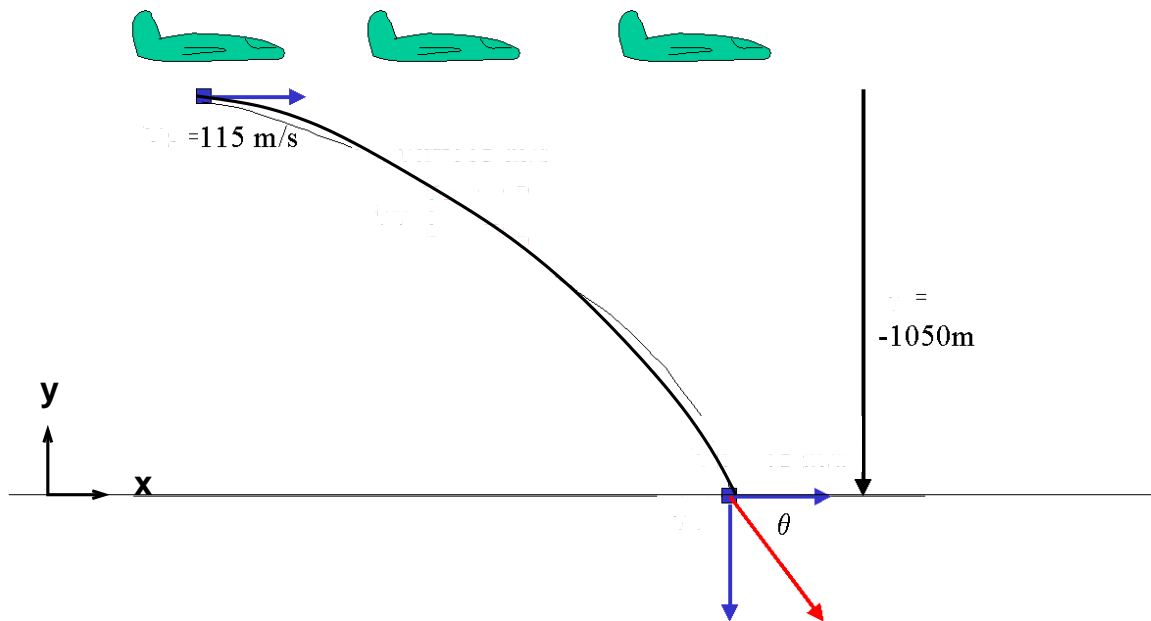
**Part (c)** Which *one* of these points, (A, B, C, D, E, or F) corresponds to the particle being at the *maximum distance* from the starting point? Explain how you know this?

**Part (d)** On the next page make a *plot* of acceleration vs. time for the motion shown here. Chose reasonable scales for your plot.

**Part (e)** (Harder:) Assuming that the particle starts at position  $x = 0$  at time  $t = 0$  determine the *approximate* position of the particle (in meters) at the time corresponding to Point F. Explain your work.

**(Extra space for Problem 1 if needed):**

**(More Extra space for Problem 1 if needed):**

**Problem 2: Projectile Motion (25 points)**

An airplane releases a cargo box from a height of 1050 meters above the ground. The plane is traveling at a horizontal speed of 115 meters per second. Figure is *not* to scale! Ignore air resistance.

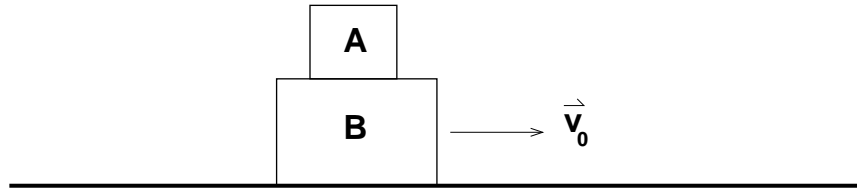
**Part (a):** How much time will elapse from when the box is released to when it hits the ground?

**Part (b):** Write down a *vector expression* in terms of *cartesian unit vectors* for the velocity of the cargo box at the instant just before it hits the ground. Use the indicated coordinate system.

**Part (c):** Determine the magnitude and direction of the velocity vector of the cargo box at the instant just before it hits the ground. Indicate the direction by determining the angle  $\theta$  as shown.

**(Extra space for Problem 2:)**

**(More Extra space for Problem 2 if needed:)**

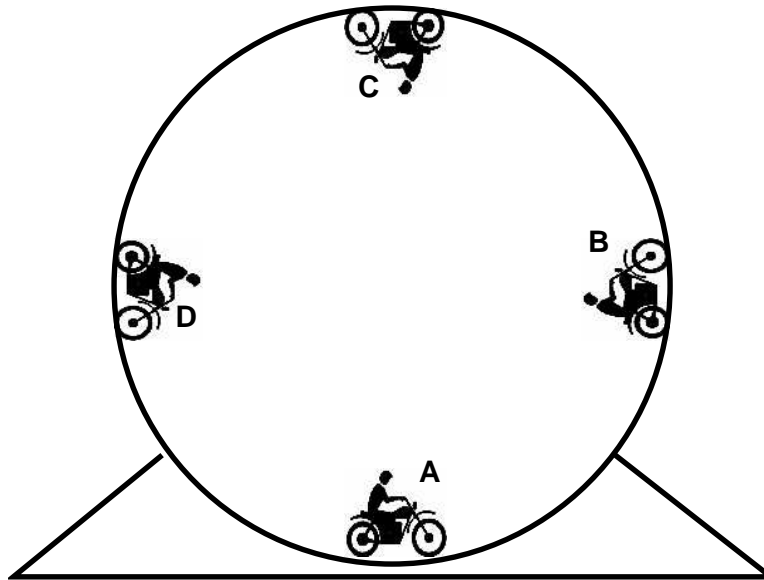
**Problem 3: Sliding Blocks (25 points)**

Two wooden blocks are stacked upon each other and placed on the floor as shown. Block A has a mass  $m_A$  and sits on Block B which has a mass of  $m_B$ . The blocks are pushed across the surface of the floor by the instructor and then release at time  $t = 0$  with an initial velocity  $v_0$ . From this point, the blocks slide *together* across the floor with Block A remaining on top of Block B so that Block A does not move *relative* to Block B. The coefficient of sliding friction between Block B and the floor is  $\mu_k$ . The coefficient of static friction between Block A and Block B is  $\mu_s$ .

Use Newton's Second and Third Laws to determine the magnitude and direction of all forces applied to each block during the interval of time after the blocks have been released and while they are sliding on the floor.

**(Extra space for Problem 3:)**

**(More Extra space for Problem 3 if needed:)**

**Problem 4: (25 points)**

A motorcyclist performs a somewhat nauseating trick by driving on a vertical circular track (so-called “loop-the-loop”). The position of the motorcyclist is shown at four positions (A, B, C, D) corresponding to bottom, right, top and left points on the track respectively. The mass of the motorcyclist and his motorcycle together is given as  $m$ . The radius of the circular path is  $R$ .

**a)** Assume that the motorcyclist maintains *constant speed*  $V$ . Draw a careful Free Body Diagram of all of the forces on system that is the motorcyclist and his motorcycle together when he is in Position C. Calculate the magnitude and direction of each force.

**b)** Assume that the motorcyclist maintains *constant speed*  $V$ . Draw a careful Free Body Diagram of all of the forces on system that is the motorcyclist and his motorcycle together when he is in Position D. Calculate the magnitude and direction of each force.

**c)** Harder: Assume the motorcyclist is at point  $B$  with speed  $V$  but is also *speeding up* so that the rate of change of the speed  $\frac{dV}{dt} = A$ . Draw a careful Free Body Diagram of all of the forces on system that is the motorcyclist and his motorcycle together when he is in Position B. Calculate the magnitude and direction of each force.

**Possibly useful hint:** For this problem, the requirement that the motorcyclist maintains a constant speed does *not* mean that he is “coasting”.

**(Extra space for Problem 4):**

**(More extra space for Problem 4 if needed):**