

PHYSICS 221

NAME:

Midterm Exam #1 (100 points)

February 7, 2007

This is a closed book, closed notes 60 minute exam.

Your Score	Your Grade
	/100

Multiple Choice/Short Answer Section (40 points)

Multiple Choice
/40
Section

Unless otherwise directed please circle the letter corresponding to the single *best* answer. For short answers only the answer will be graded (you do not need to show work). Each question counts 4 points.

1. A particle moving in one dimension has instantaneous velocity $v=0$ zero at $t=2$. Please circle **EACH** statement which **COULD POSSIBLY BE TRUE**. (You may circle multiple letters).

/4

- a. The particle has **positive** acceleration at $t=2$.
- b. The particle has **positive** speed at $t=2$.
- c. The particle has a **positive** average velocity between $t=1$ and $t=3$.
- d. The particle has a **positive** position at $t=2$.

2. A particle's velocity is $v(t) = (t+1)\mathbf{i} + t^2\mathbf{j}$. Write down the **instantaneous acceleration** at $t=2$

/4

$a(2) =$

3. A wall clock has a minute hand 8 cm long. Which of the following is the **displacement vector** of its tip between 3:15 and 4:00? (The y-axis runs upward from the clock's center through the 12).

/4

- a. $\Delta\mathbf{x} = (8\mathbf{i} + 8\mathbf{j})$ cm
- b. $\Delta\mathbf{x} = (8\mathbf{i} - 8\mathbf{j})$ cm
- c. $\Delta\mathbf{x} = (-8\mathbf{i} + 8\mathbf{j})$ cm
- d. $\Delta\mathbf{x} = (-8\mathbf{i} - 8\mathbf{j})$ cm

4. For vectors $\mathbf{A} = \mathbf{i} + \mathbf{j}$ and $\mathbf{B} = \mathbf{i} - \mathbf{j}$ write down the **magnitude** of the vector $\mathbf{C} = \mathbf{A} - 2\mathbf{B}$

/4

$|\mathbf{C}| =$

5. A particle moves at a constant speed of 2.0 m/s along a circular path of 4.0 m radius. What is the magnitude of its acceleration?

/4

a =

5. A particle has velocity $v_x(t) = 3t^2 - 2$. What is the displacement between $t=1$ and $t=2$?

/4

$\Delta x =$

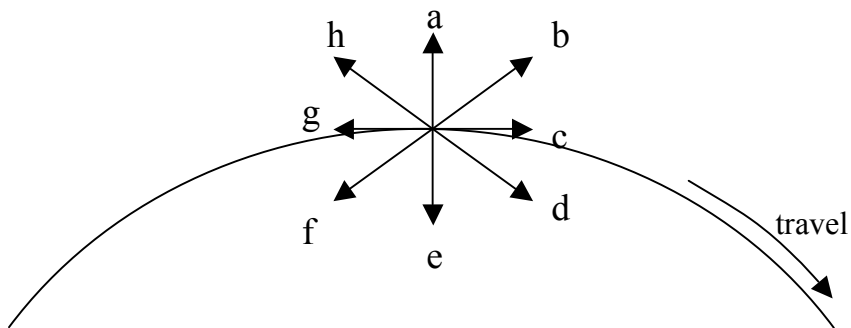
7. A particle has the following position and velocity at successive times:

at $t=0$ s:	$\mathbf{x} = (-2 \mathbf{i} + \mathbf{j}) \text{ m}$	$\mathbf{v} = (2 \mathbf{i} - \mathbf{j}) \text{ m/s}$
at $t=2$ s:	$\mathbf{x} = 3 \mathbf{j} \text{ m}$	$\mathbf{v} = (\mathbf{i} + \mathbf{j}) \text{ m/s}$

/4

The magnitude of the **average acceleration** is:

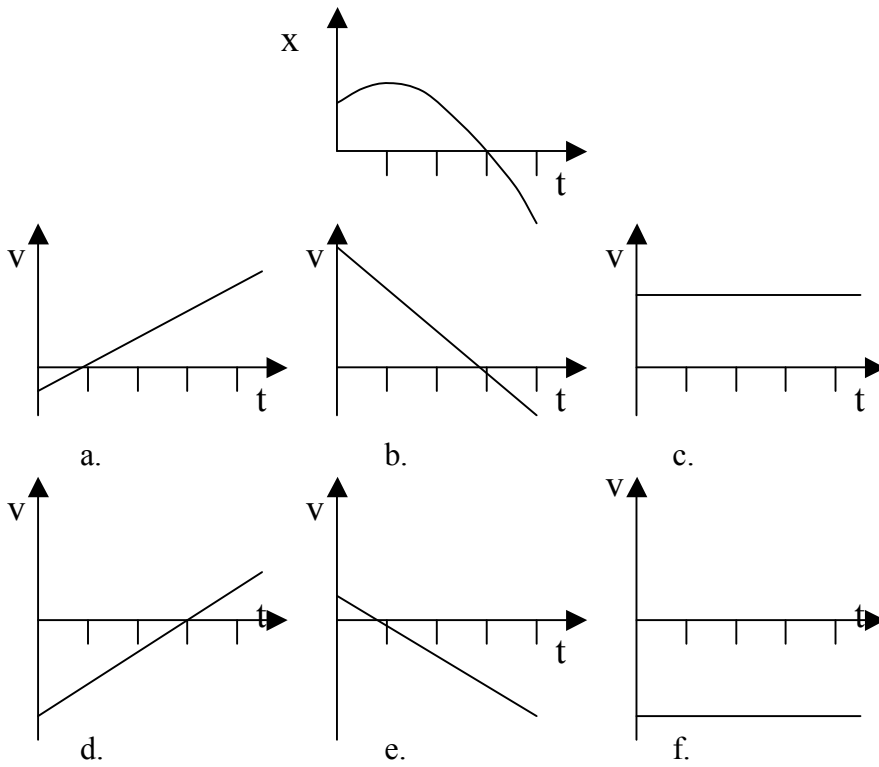
$\bar{a} =$



8. A car is traveling around a circular track in the **clockwise** direction and **slowing down**. Which of the arrows above could represent the car's **acceleration vector**?

/4

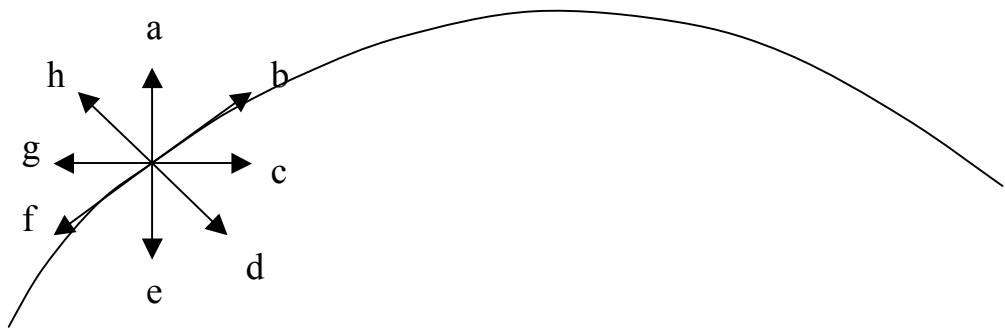
a. b. c. d. e. f. g. h.



9. The top panel is a position-vs-time graph (top). Which of the lower panels might represent its **velocity-vs-time** curve?

/4

- a. b. c. d. e. f.



10. A stone thrown from the left follows the path shown above. At the point on its upward leg, which arrow indicates its **instantaneous acceleration**?

/4

- a. b. c. d. e. f. g. h.

Open Response Questions (64 points total)

Notice: In this part of the exam, it is very important that you show how you obtained your answer. A complete answer will include a diagram, if appropriate. Circle your answer. Use the back if necessary.

Open Response

/60

Section

/15

1. (15 pts.) A truck on a straight road starts from rest, accelerating at 2.40 m/s^2 until it reaches a speed of 12.0 m/s . Then the truck travels for 20.0 s at constant speed until the brakes are applied, stopping the truck in a uniform manner in an additional 4.00 s .
 - a. How long is the truck in motion?
 - b. How far does the truck travel?
 - c. What is the average velocity of the truck for the motion described?

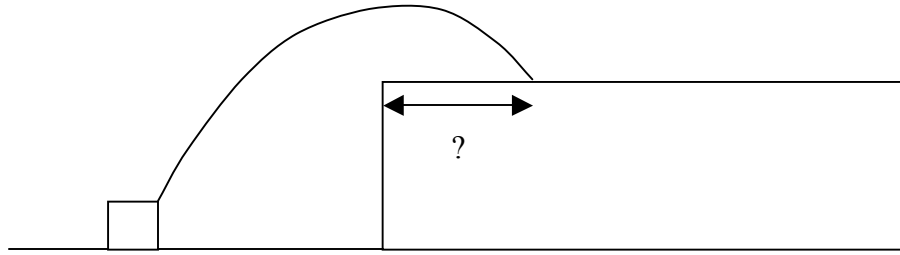
/10

2. (10 pts.) A robot-car is at position $\mathbf{r} = (5 \mathbf{i} - 10 \mathbf{j})$ m traveling at 4 m/s due North (in the \mathbf{j} direction). After 8 seconds it is at $\mathbf{r} = (3 \mathbf{i} - 2 \mathbf{j})$ m traveling at 4 m/s 45° East of North.
- What is the average velocity over that 8-second interval?
 - What is the **magnitude** of its average acceleration?

3. (15 pts) A ball is tossed from an upper-story window of a building. The ball is given an initial velocity of 15.00 m/s at an angle of 35.0° below the horizontal. It strikes the ground 3.00 s later.

/15

- a. How far horizontally from the base of the building does the ball strike the ground?
- b. Find the height from which the ball was thrown.



/20

4. (20 pts.) In preparation for a daring night-time raid, James Bond plans to catapult a heavy bag of equipment onto the flat roof of a 9.00 m tall building (a sketch of his plan is shown above). The bag will be launched at 15.0 m/s, 60.0° above the horizontal, from a launcher of 1 m off the ground. It will be launched from a road 10.0 m from the wall of the building. First determine where on the roof the bag will land, then answer the appropriate pair of questions below:

The plan will **succeed** if the bag lands on the roof. If so:

- How far from edge of the roof will the bag land?
- At what speed does the bag hit the roof?

The plan will **fail** if the bag hits the wall of the building. If so

- How high up that wall does the bag hit the wall?
- At what speed does the bag hit the wall?