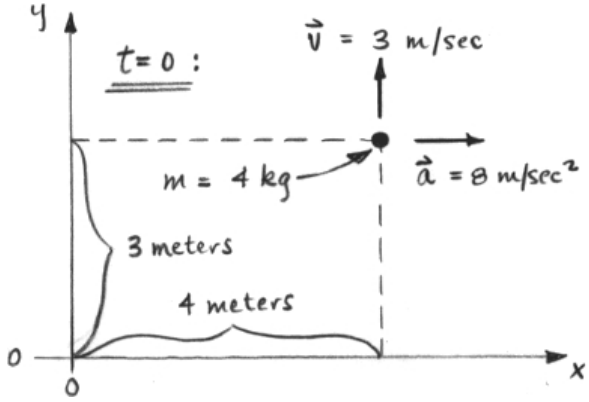
University of California, Berkeley
Physics H7A Fall 1998 (*Strovink*)

PRACTICE EXAMINATION 1

Directions. Do all three problems (weights are indicated). This is a closed-book closed-note exam except for one $8\frac{1}{2} \times 11$ inch sheet containing any information you wish on both sides. You are free to approach the proctor to ask questions – but he or she will not give hints and will be obliged to write your question and its answer on the board. You may use a calculator but you do not need one – roots, circular functions, *etc.*, may be left unevaluated if you do not know them. Use a bluebook. Do not use scratch paper – otherwise you risk losing part credit. Cross out rather than erase any work that you wish the grader to ignore. Justify what you do. Box or circle your answer.

1. (25 points). A 4 kg mass moves in the x-y plane under the influence of a *constant* force. At t=0, the particle's *position*, *velocity*, and *acceleration* are shown in the diagram.



This problem will be graded on *answers only* – no part credit will be given. The answer to each question has three parts – *value* (3 points), *unit* (1 point), and *direction* (1 point). If for a particular question you believe the *direction* to be undefined or irrelevant, please leave it blank.

Organize your answers in columns as shown:

part	value	unit	direction
(a)			
(b)			
(c)			
(d)			
(e)			

a. What is the particle's *momentum* at t=0?

b. What is the *force* acting on the particle?

c. What is the particle's *momentum* at t=0.375 sec?

d. What is the particle's *position* at t=1 sec?

e. What is the particle's *velocity* when its absolute value (its *speed*) is at a minimum?

2. (40 points) A Millikan oil drop of mass m and charge q moves between two horizontal capacitor plates separated by a distance d. A battery of voltage V is applied to the plates, so that the electrical force on the drop is upward, of magnitude qV/d. When it is moving, the drop experiences an opposing drag force $\mathbf{F} = -k\mathbf{v}$, where $\mathbf{v}$ is its velocity and k is a constant.

a. For $t < 0$ the drop is observed to be exactly stationary, despite the gravitational force that is exerted upon it. What is the voltage V in terms of the other constants?

b. At $t = 0$ the plates are shorted out (V=0), and remain shorted thereafter. Calculate a, the *downward* acceleration of the drop immediately after the plates are shorted.

c. As $t \to \infty$ the acceleration of the drop becomes essentially zero. What is its *downward* velocity v then?

d. For any time $t > 0$, write a differential equation containing v, its first time derivative dv/dt, and constants.

e. Find a solution for the *downward* acceleration $a(t)$, valid for all $t > 0$. [*Hint*: Differentiate the answer to part (d.) with respect to time to get a simple differential equation for $a(t)$. Solve it by integration.

Use the result of part (b.) to determine the constant of integration.]

3. (35 points) A wooden block of mass M, initially at rest on a horizontal table with coefficient of sliding friction μ, is struck by a bullet of mass m and velocity v. The bullet lodges in the center of the block. How far does the block slide?