MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01 Fall 2004

EXAM 1
Friday, October 1, 2004

FAMILY (Last) NAME

GIVEN (First) NAME

STUDENT ID NUMBER

Your Recitation (check one) →

R15	TR 10:00		Roman Barankov
R16	TR 11:00		Roman Barankov
R01	MW 1:00		Wit Busza
R02	MW 2:00		Wit Busza
R03	MW 3:00		Wit Busza
R23	TR 11:00		Serkan Cabi
R24	TR 12:00		Serkan Cabi
R04	MW 1:00		Bruno Coppi
R05	MW 2:00		Bruno Coppi
R11	MW 3:00		Bruno Coppi
R14	TR 3:00		Qudsia Ejaz
R25	TR 1:00		Qudsia Ejaz
R20	TR 11:00		Michael Feld
R21	TR 2:00		Michael Feld
R22	TR 3:00		Michael Feld
R06	MW 2:00		Paul Joss
R07	MW 3:00		Paul Joss
R08	MW 4:00		Paul Joss
R13	TR 2:00		Chris Kouvaris
R09	MW 1:00		Christoph Paus
R10	MW 2:00		Christoph Paus
R12	TR 1:00		Rishi Sharma
R17	TR 12:00		Rishi Sharma
R18	TR 9:00		Vladan Vuletic
R19	TR 10:00		Vladan Vuletic

Instructions:
1. SHOW ALL WORK. All work must be done in this booklet. Print your name on each sheet. Please put a box around your final answer.
2. One 8 ½ x 11 sheet of notes allowed.
3. This is a closed book exam.
4. CALCULATORS, BOOKS, COMPUTERS and CELL PHONE are NOT ALLOWED.
5. Do all FOUR (4) problems.
6. Extra pages provided.
7. Do not start working until told to do so. Exams will be collected 5 minutes before the hour.

Problem	Maximum	Score	Grader
1	15		
2	15		
3	15		
4	15		
TOTAL	60		

Name:_____

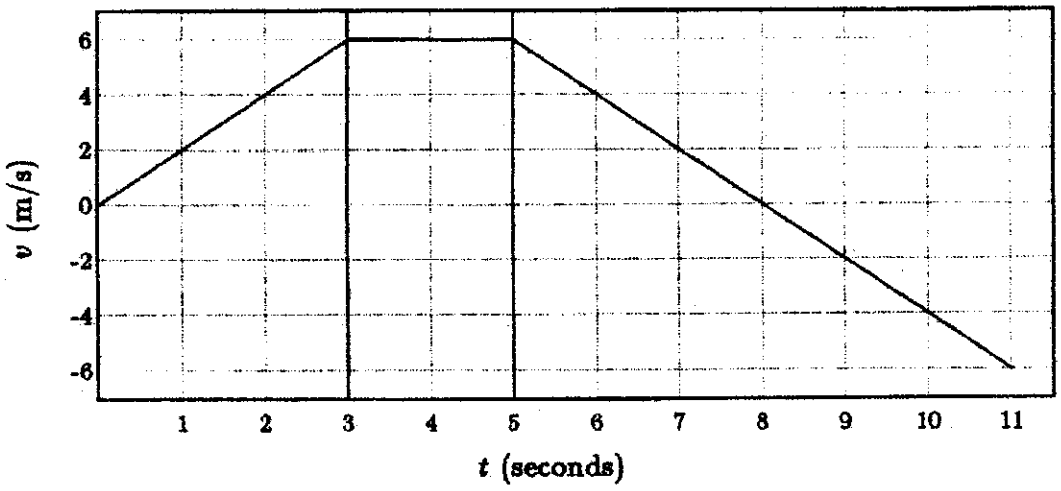
Problem 1: Kinematics (15 Points)

A particle moves along a straight line, x. At time t=0, its position is at x = 0. The velocity, *v*, of the object changes as a function of time as shown in the figure. *v* is in m/s, x is in meters and t is in seconds.

a) What is x at t = 5 sec?

b) What is the acceleration, a, at t = 1 sec

c) What is the average speed between t = 0 and t = 5 sec?



Name:_____

Problem 2: Runner catches Bus (15 Points)

An Olympic runner at Harvard Square wants to catch an MBTA bus to MIT. The bus is stopped at the curb. The man runs at a constant rate of 10 m/s towards the bus. When he is 9 m from the bus, the bus starts accelerating at a rate of 2 m/s^2. Assume that x = 0 and t = 0 when the man sees the bus leave the curb.

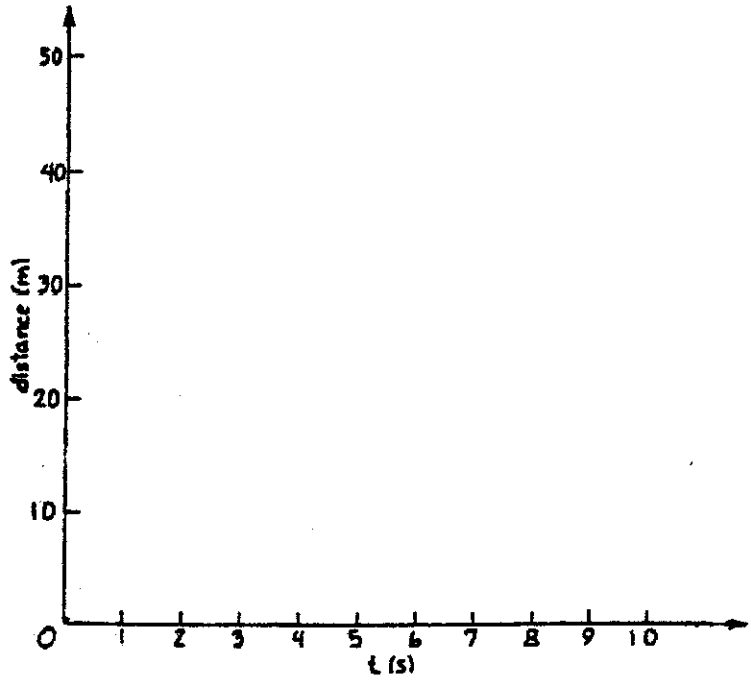
a. Will he catch the bus?

b. How many seconds will it take to catch the bus?

c. How far will the bus travel till the man reaches it?

d. Sketch below the trajectories (x_M and x_B vs. t) of the man and the bus for times t = 0 to t = 10 sec.

e. Is there more than one opportunity to intercept the bus? If so, where and when?



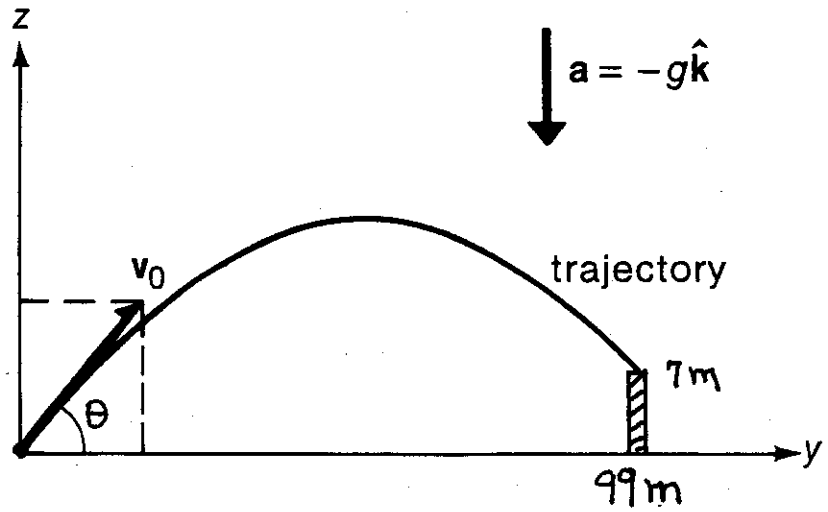
Name:_____

Problem 3: Ballistic Motion (15 Points)

A projectile is launched at an angle, Θ, to the horizontal and just clears a fence. The fence is 7 m higher than the launch point and it is 99 m away. Assume that $g = 10\ m/s^2$. Assume that $\sin\Theta = 4/5$ and that $\cos\Theta = 3/5$.

a. What is the launch <u>speed</u>, v_0?

b. What is the <u>time of flight</u> of the projectile from the launch point to the fence?



Name:_____

Problem 4: Vectors and $\mathbf{F} = m\vec{\mathbf{a}}$ (15 Points)

A particle of mass m = 5kg, initially at rest at x = 0 and y = 0 is acted upon by two forces $\vec{\mathbf{F}}_1$ and $\vec{\mathbf{F}}_2$. The force $\vec{\mathbf{F}}_1$ is shown in the diagram. Note that $\sin\Theta = 4/5$ and $\cos\Theta = 3/5$ and $\tan\Theta = 4/3$. The net acceleration of the particle is $\vec{\mathbf{a}} = 12\,\hat{\mathbf{i}}$ m/s^2. $\vec{\mathbf{a}}$ is shown in the diagram. Neglect gravity. Note that $\vec{\mathbf{F}}_1$, $\vec{\mathbf{F}}_2$, $\vec{\mathbf{F}}_3$, $\vec{\mathbf{a}}$ and $\hat{\mathbf{i}}$ are all vectors.

a. What is the force $\vec{\mathbf{F}}_2$? Either give the magnitude and direction of $\vec{\mathbf{F}}_2$ or its components. Plot $\vec{\mathbf{F}}_2$ on the diagram.

b. What is the position vector of the particle at t = 10 s?

c. What is the velocity of the particle at t = 10 s?

d. What additional force $\vec{\mathbf{F}}_3$ would be required to make the acceleration $\vec{\mathbf{a}} = 0$? Give the magnitude and the direction of $\vec{\mathbf{F}}_3$ or its components.