MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01X Fall Term 2001

PROBLEM SET 2

Handed out: September 14
Due: September 21 at 5 pm in 4-339B.

Please write your name, subject, recitation number, and the name of the recitation instructor on the top right corner of the first page of your homework solutions. The solutions should be placed in the appropriate box in room 4-339B.

Problem 1:

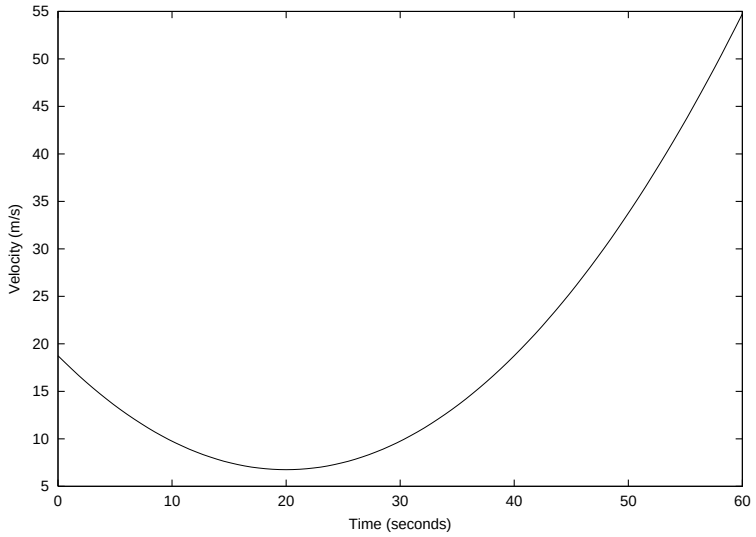
Consider a car traveling along a highway that runs east-west, and choose a coordinate system in which east is the positive direction. Describe briefly in words (e.g. "traveling east and speeding up") each of the following situations, and sketch v vs t and a vs t for each, assuming a constant acceleration.

Velocity at $t = 0$	Acceleration
positive	positive
positive	zero
positive	negative
zero	positive
zero	zero
zero	negative
negative	positive
negative	zero
negative	negative

Problem 2:

You are stuck in traffic, and to pass the time, you decide to plot your velocity over a one minute interval.

The graph approximately fits the function



$$v(t) = 0.03(t^2 - 40t + 625). \tag{1}$$

a. Without doing any calculations, make a rough sketch of your position vs. time.

b. Find a formula for $x(t)$, your position at any given time. Does this agree with your sketch?

c. Without doing any calculations, make a rough sketch of your acceleration vs. time.

d. Now find a formula for $a(t)$, your position at any given time. Does this agree with your sketch?

Problem 3:

You have been engaged to deliver by helicopter some carefully-packed crates of reward food to participants in a "Survivor" episode. The terrain is rough enough for it to be unsafe to land, so that you must hover and drop the crates. The crates are designed so that the eggs and tomatoes inside them will not get cracked and squashed, respectively, if the speed at impact is less than 8 m/s and 16 m/s, respectively.

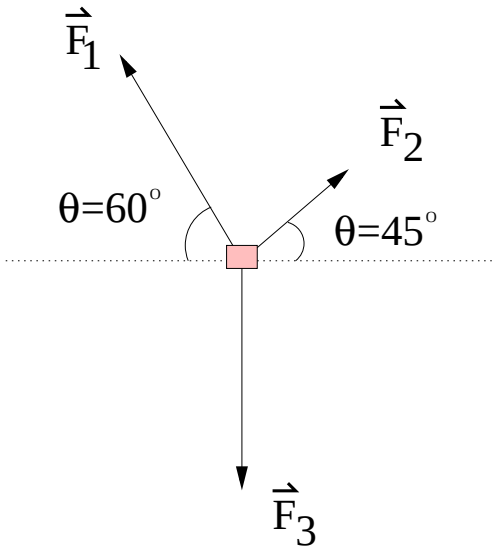
a. Assuming the crates are dropped from rest, what is the highest from the ground you can hover such that nothing breaks when the crates land?

b. Suppose you accidentally start ascending before the last crate is dropped. As a result, the last crate is dropped at a height of 9 meters when the helicopter is rising vertically upward at 3 m/s. How long does it take the last crate to hit the ground?

c. Will the survivors enjoy any intact items from the last crate?

Problem 4:

Three forces of magnitudes $F_1 = 7.0\ N$, $F_2 = 3.0\ N$ and $F_3 = 6.0\ N$ are applied to a mass $m = 3$ kg, initially at rest. $\vec{F_1}$ is directed to the left at 60 degrees from the horizontal, $\vec{F_2}$ is directed to the right at 45 degrees, and $\vec{F_3}$ is directed vertically downwards. See the accompanying diagram. At $t = 0$ the mass is released.



a. What is the resultant force's magnitude and direction?

b. What is the magnitude and direction of the acceleration of the mass?

c. What is the magnitude and direction of the velocity of the mass at $t = 2$ seconds?

Problem 5:

You stand on a bathroom scale holding a 20 kg mass. Your mass is 70 kg.

a. Suppose you are not moving. What is the reading on the scale?

b. From rest, you lift the weight into the air. What happens to the reading on the scale as you do this? Explain.

c. What happens if you throw the weight into the air? Explain.

(Hint: draw a force diagram, paying attention to action-reaction pairs. Isolate the bodies of interest, and look at forces acting **on** each body of interest, not **by** it.)