Name: ID:

General Physics I (151)

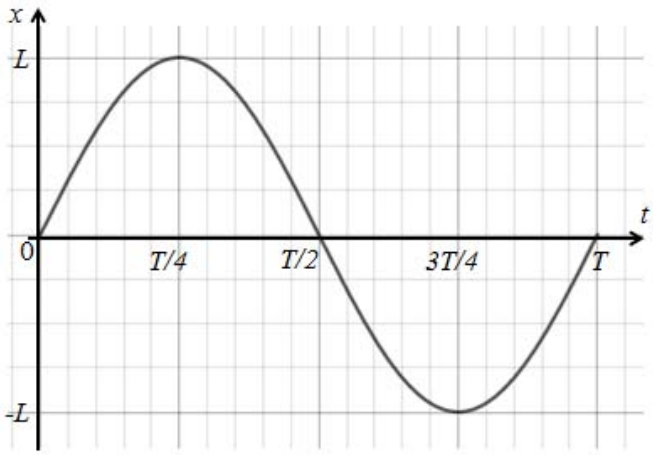
Discussion Questions #2

Concepts of Motion

1. Displacement, Velocity, and Acceleration of a Spring

A mass is attached to a spring. The mass oscillates back and forth between the positions $x = L$ and $x = -L$ in a time T, called the period of the oscillation. The position of the mass as a function of time is given by the graphed relationship

$$x(t) = L \sin\left(2\pi \frac{t}{T}\right).$$



a) What is the displacement Δx of the mass between times $t = 0$ and $t = T/4$?

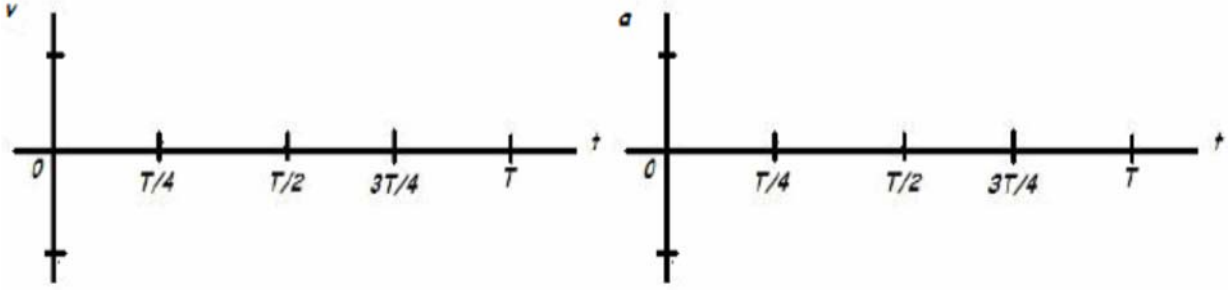
b) What is the average velocity $\bar{v}$ of the mass between times $t = 0$ and $t = T$?

c) In the time interval 0 to T, when is the velocity equal to zero?

d) Sketch the velocity $v(t)$ in the time interval 0 to T in the graph below left.

e) What is the average acceleration $\bar{a}$ of the mass between times $t = 0$ and $t = T/4$?

f) Sketch the acceleration of the mass $a(t)$, for the interval 0 to T in the graph below right.



2. Constant Acceleration

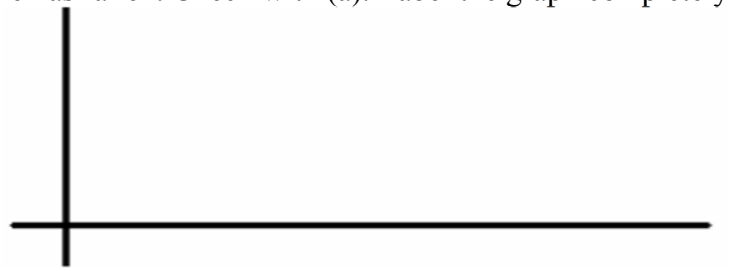
A stone falls off a cliff with zero initial velocity. Use the approximation $g = 10$ m/s^2.

a) Fill in the following table.

Time (s)	Distance (m)	Speed (m/s)
0		
1		
2		
3		

b) What is the average speed of the stone over the interval $t = 0$ to $t = 3$ sec?

c) Sketch a graph of $v(t)$ vs. t for 0 to 3 sec below. From the graph, find the distance that the stone has fallen. Check with (a). Label the graph completely.



3. A UMass student is running along a road at a speed of v_0 to catch a bus that has just stopped at the bus stop. The bus driver spots the student in the rear view mirror when she is Δx behind the bus, instantly closes the door on the remaining students standing in line, and takes off with a steady acceleration of a. The student continues to run at the same speed to catch the bus. You are asked to determine if she will catch it and how long that would take. (Start by drawing a diagram below. Include the bus and student.)

a) What equation describes the position of the student as a function of time, $x_S(t)$?

b) What equation describes the position of the bus as a function of time, $x_B(t)$?

c) At what time(s) t does the position of the student coincide with the position of the bus?

d) Under what conditions will the student never catch the bus?