HW Rectilinear motion Name:_____

2002 (Calculator)

3) An object moves along the x-axis with initial position $x(0) = 2$. The velocity of the object at time $t \geq 0$ is given by $v(t) = \sin\left(\frac{\pi}{3}t\right)$.

a) What is the acceleration of the object at time $t = 4$?

b) Consider the following two statements.

Statement I: For $3 < t < 4.5$, the velocity of the object is decreasing.

Statement II: For $3 < t < 4.5$, the speed of the object is increasing.

Are either or both of these statements correct? For each statement provide a reason why it is correct or not correct.

c) What is the total distance traveled by the object over the time interval $0 \leq t \leq 4$?

d) What is the position of the object at time $t = 4$?

2003 (Calculator)

2) A particle moves along the x-axis so that its velocity at time t is given by $v(t) = -(t+1)\sin\left(\frac{t^2}{2}\right)$.

At time $t = 0$, the particle is at position $x = 1$.

a) Find the acceleration of the particle at time $t = 2$. Is the speed of the particle increasing at $t = 2$? Why or why not?

b) Find all times t in the open interval $0 < t < 3$ when the particle changes direction. Justify your answer.

c) Find the total distance traveled by the particle from time $t = 0$ until time $t = 3$.

d) During the time interval $0 \leq t \leq 3$, what is the greatest distance between the particle and the origin? Show the work that leads to your answer.

2004 (Calculator)

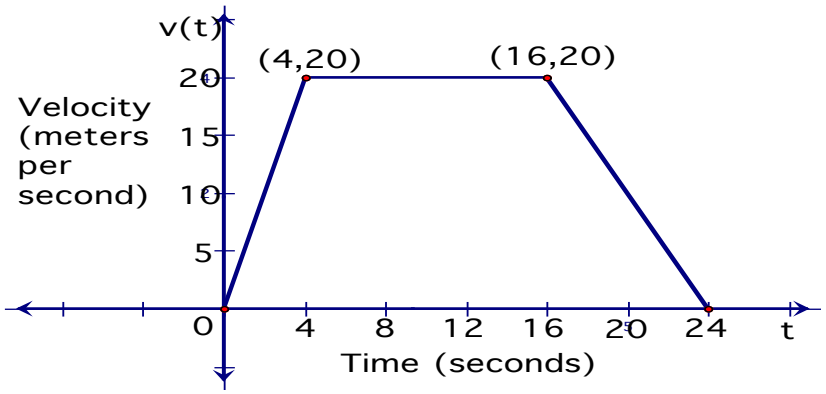
2) A particle moves along the y-axis so that its velocity v at time $t \geq 0$ is given by $v(t) = 1 - \tan^{-1}\left(e^t\right)$. At time $t = 0$, the particle is at position $y = -1$. (Note: $\tan^{-1} x = \arctan x$)

a) Find the acceleration of the particle at time $t = 2$.

b) Is the speed of the particle increasing or decreasing at time $t = 2$? Give a reason for your answer.

c) Find the time $t \geq 0$ at which the the particle reaches its highest point. Justify your answer.

d) Find the position of the particle at time $t = 2$. Is the particle moving toward the origin or away from the origin at time $t = 2$? Justify your answer.



2005 (No Calculator)

5) A car is traveling in a straight line. For $0 \le t \le 24$ seconds, the car's velocity $v(t)$, in meters per second, is modeled by the piece-wise linear function defined by the graph above.

a) Find $\int_0^{24} v(t)\,dt$. Using correct units, explain the meaning of $\int_0^{24} v(t)\,dt$.

b) For each of $v'(4)$ and $v'(20)$, find the value or explain why it does not exist. Indicate units of measure.

c) Let $a(t)$ be the car's acceleration at time t, in meters per second. For $0 < t < 24$, write a piecewise-defined function for $a(t)$.

d) Find the average rate of change of v over the interval $8 \le t \le 20$. Does the Mean Value Theorem guarantee a value of c, for $8 < c < 20$, such that $v'(c)$ is equal to this average rate of change? Why or why not?

t (seconds)	0	10	20	30	40	50	60	70	80
v(t) (feet per second)	5	14	22	29	35	40	44	47	49

2006 (No Calculator))

4) Rocket A has positive velocity $v(t)$ after being launched upward from an initial height of 0 feet at time $t = 0$ seconds. The velocity of the rocket is recorded for selected values of t over the interval $0 \le t \le 80$ seconds, as shown in the table above.

a) Find the average acceleration of Rocket A over the time interval $0 \le t \le 80$ seconds. Indicate units of measure.

b) Using correct units, explain the meaning of $\int_{10}^{70} v(t)\,dt$ in terms of the rocket's flight. Use a midpoint Riemann sum with 3 subintervals of equal length to approximate $\int_{10}^{70} v(t)\,dt$.

c) Rocket B is launched upward with an acceleration of $a(t) = \frac{3}{\sqrt{t+1}}$ feet per second. At time $t = 0$ seconds, the initial height of the rocket is 0 feet, and the initial velocity is 2 feet per second. Which of the two rockets is traveling faster at $t = 80$ seconds? Explain your answer.