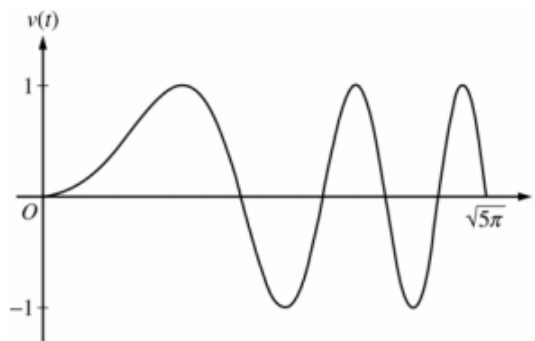


**FRQ Packet #5 - Velocity and Acceleration****2007 AP Calculus AB FRQ (Form B) Question 2**

Calculator - In Class

A particle moves along the  $x$ -axis so that its velocity  $v$  at time  $t \geq 0$  is given by  $v(t) = \sin(t^2)$ . The graph of  $v$  is shown above for  $0 \leq t \leq \sqrt{5\pi}$ . The position of the particle at time  $t$  is  $x(t)$  and its position at time  $t = 0$  is  $x(0) = 5$ .

- (a) Find the acceleration of the particle at time  $t = 3$ .
- (b) Find the total distance traveled by the particle from time  $t = 0$  to  $t = 3$ .
- (c) Find the position of the particle at time  $t = 3$ .
- (d) For  $0 \leq t \leq \sqrt{5\pi}$ , find the time  $t$  at which the particle is farthest to the right. Explain your answer.



### 2004 AP Calculus AB FRQ (Form A) Question 3

Calculator - In Class

A particle moves along the  $y$ -axis so that its velocity  $v$  at time  $t \geq 0$  is given by  $v(t) = 1 - \tan^{-1}(e^t)$ .

At time  $t = 0$ , the particle is at  $y = -1$ . (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 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.

# 2006 AP Calculus AB FRQ (Form B) Question 6

No Calculator - HW Not Timed

$t$ (sec)	0	15	25	30	35	50	60
$v(t)$ (ft/sec)	-20	-30	-20	-14	-10	0	10
$a(t)$ (ft/sec <sup>2</sup> )	1	5	2	1	2	4	2

A car travels on a straight track. During the time interval  $0 \leq t \leq 60$  seconds, the car's velocity  $v$ , measured in feet per second, and acceleration  $a$ , measured in feet per second per second, are continuous functions. The table above shows selected values of these functions.

- (a) Using appropriate units, explain the meaning of  $\int_{30}^{60} |v(t)| dt$  in terms of the car's motion. Approximate

$\int_{30}^{60} |v(t)| dt$  using a trapezoidal approximation with the three subintervals determined by the table.

- (b) Using appropriate units, explain the meaning of  $\int_0^{30} a(t) dt$  in terms of the car's motion. Find the exact value of  $\int_0^{30} a(t) dt$ .

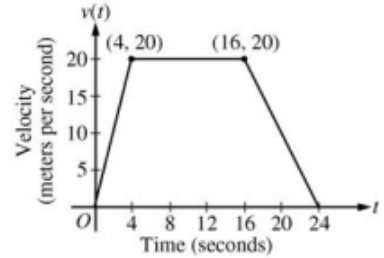
- (c) For  $0 < t < 60$ , must there be a time  $t$  when  $v(t) = -5$ ? Justify your answer.

- (d) For  $0 < t < 60$ , must there be a time  $t$  when  $a(t) = 0$ ? Justify your answer.

# 2005 AP Calculus AB FRQ (Form A) Question 5

No Calculator - HW Timed 15 minutes

A car is traveling on a straight road. For  $0 \leq t \leq 24$  seconds, the car's velocity  $v(t)$ , in meters per second, is modeled by the piecewise-linear function defined by the graph above.



- Find  $\int_0^{24} v(t) \, dt$ . Using correct units, explain the meaning of  $\int_0^{24} v(t) \, dt$ .
- For each of  $v'(4)$  and  $v'(20)$ , find the value or explain why it does not exist. Indicate units of measure.
- Let  $a(t)$  be the car's acceleration at time  $t$ , in meters per second per second. For  $0 < t < 24$ , write a piecewise-defined function for  $a(t)$ .
- Find the average rate of change of  $v$  over the interval  $8 \leq t \leq 20$ . 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?

## 2003 AP Calculus AB FRQ (Form A) Question 2

Calculator - HW Timed 15 minutes

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.