

Particle Motion -- With your Graphing Calculator!

1. (2005-B) A particle moves along the x-axis so that its velocity v at time t , for $0 \leq t \leq 5$, is given by $v(t) = \ln(t^2 - 3t + 3)$.

- Find the acceleration of the particle at time $t = 4$.
- Is the particle speeding up or slowing down at $t = 4$? Explain.
- Find all times t in the open interval $0 < t < 5$ at which the particle changes direction. During which time intervals, for $0 \leq t \leq 5$, does the particle travel to the left?
- Find the average acceleration of the particle over the interval $0 \leq t \leq 2$.

2.

(2004) 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 $y = -1$.

- Find the acceleration of the particle at time $t = 2$.
- Is the speed of the particle increasing or decreasing at time $t = 2$? Give a reason for your answer.
- Find the time $t \geq 0$ at which the particle reaches its highest point. Justify your answer.

3. (2003) A particle moves along the x -axis so that its velocity at any time t is given by $v(t) = -(t+1)\sin\left(\frac{t^2}{2}\right)$.
- A. Find the acceleration of the particle at $t = 2$. Is the speed of the particle increasing at $t = 2$? Why or why not?
 - B. Find all times in the interval $0 \leq t \leq 3$ when the particle changes direction. Justify your answer.
 - C. If the particle starts at the origin at $t = 0$, on which side of the origin will the particle be at $t = 2$? Justify your answer.

4. (2002-B) A particle moves along the x -axis so that its velocity at any time t , for $0 \leq t \leq 16$, is given by $v(t) = e^{2\sin t} - 1$. At time $t = 0$, the particle is at the origin.

- A. At what time is the particle at rest? Justify your answer.
- B. During what intervals of time is the particle moving to the left? Give a reason for your answer.
- C. What is the acceleration of the particle at time $t = 2$? Is the particle's speed increasing or decreasing at time $t = 2$? Justify your answer.

5. (2002) 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.