

Name: _____

Date: _____

Particle Motion Problems

A particle moves along the x-axis in such a way that its position at time t for $t \geq 0$ is given

by $x(t) = \frac{1}{3}t^3 - 3t^2 + 8t$.

- a) Show that at $t = 0$ the particle is moving to the right.
- b) Find all values of t for which the particle is moving to the left.
- c) What is the position, velocity and acceleration of the particle at $t = 3$?
- d) Find all intervals in $0 \leq t \leq 5$ for which the particle is speeding up and slowing down.
- e) When $t = 3$, what is the total distance the particle has traveled?

A particle moves along the x-axis so that at any time, $t \geq 0$, its acceleration is given by $a(t) = 6t + 6$. At time $t = 0$, the velocity of the particle is -9 and its position is -27 .

- a) Find $v(t)$, the velocity of the particle, for any time $t \geq 0$.
- b) For what values of $t \geq 0$ is the particle moving to the right?
- c) Find $x(t)$, the position of the particle, for $t \geq 0$.
- d) Find the total distance traveled by the particle from $[0, 3]$.
- e) For what values of t in $[0, 3]$ is the particle's instantaneous velocity the same as its average velocity?

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2. For $t \geq 0$, a particle moves along the x -axis. The velocity of the particle at time t is given by

$$v(t) = 1 + 2 \sin\left(\frac{t^2}{2}\right). \text{ The particle is at position } x = 2 \text{ at time } t = 4.$$

- (a) At time $t = 4$, is the particle speeding up or slowing down?
 - (b) Find all times t in the interval $0 < t < 3$ when the particle changes direction. Justify your answer.
 - (c) Find the position of the particle at time $t = 0$.
 - (d) Find the total distance the particle travels from time $t = 0$ to time $t = 3$.
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5. Two particles move along the x -axis. For $0 \leq t \leq 8$, the position of particle P at time t is given by $x_P(t) = \ln(t^2 - 2t + 10)$, while the velocity of particle Q at time t is given by $v_Q(t) = t^2 - 8t + 15$. Particle Q is at position $x = 5$ at time $t = 0$.
- (a) For $0 \leq t \leq 8$, when is particle P moving to the left?
- (b) For $0 \leq t \leq 8$, find all times t during which the two particles travel in the same direction.
- (c) Find the acceleration of particle Q at time $t = 2$. Is the speed of particle Q increasing, decreasing, or neither at time $t = 2$? Explain your reasoning.
- (d) Find the position of particle Q the first time it changes direction.
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