

AP FRQ Review WS: Particle Motion

1) Calculator-Active

A particle moves along the x -axis with velocity given by $v(t) = \frac{10 \sin(0.4t^2)}{t^2 - t + 3}$ for time $0 \leq t \leq 3.5$.

The particle is at position $x = -5$ at time $t = 0$.

(a) Find the acceleration of the particle at time $t = 3$.

(b) Find the position of the particle at time $t = 3$.

(c) Evaluate $\int_0^{3.5} v(t) dt$, and evaluate $\int_0^{3.5} |v(t)| dt$. Interpret the meaning of each integral in the context of the problem.

(d) A second particle moves along the x -axis with position given by $x_2(t) = t^2 - t$ for $0 \leq t \leq 3.5$. At what time t are the two particles moving with the same velocity?

2) Non-Calculator

2017

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.

3) Non - Calculator

For $0 \leq t \leq 12$, a particle moves along the x -axis. The velocity of the particle at time t is given by

$v(t) = \cos\left(\frac{\pi}{6}t\right)$. The particle is at position $x = -2$ at time $t = 0$.

- (a) For $0 \leq t \leq 12$, when is the particle moving to the left?
- (b) Write, but do not evaluate, an integral expression that gives the total distance traveled by the particle from time $t = 0$ to time $t = 6$.
- (c) Find the acceleration of the particle at time t . Is the speed of the particle increasing, decreasing, or neither at time $t = 4$? Explain your reasoning.
- (d) Find the position of the particle at time $t = 4$.

4) Calculator

A particle moves along a straight line. For $0 \leq t \leq 5$, the velocity of the particle is given by

$v(t) = -2 + (t^2 + 3t)^{6/5} - t^3$, and the position of the particle is given by $s(t)$. It is known that $s(0) = 10$.

- (a) Find all values of t in the interval $2 \leq t \leq 4$ for which the speed of the particle is 2.
- (b) Write an expression involving an integral that gives the position $s(t)$. Use this expression to find the position of the particle at time $t = 5$.
- (c) Find all times t in the interval $0 \leq t \leq 5$ at which the particle changes direction. Justify your answer.
- (d) Is the speed of the particle increasing or decreasing at time $t = 4$? Give a reason for your answer.