

1. (NC) A particle moves in the  $xy$ -plane so that at any time  $t$ , the position of the particle is given by  $\mathbf{r}(t) = \langle t^3 + 4t^2, t^4 - t^3 \rangle$ .

(a) Find the velocity vector when  $t = 1$ .

(b) Find the acceleration vector when  $t = 2$ .

2. (NC) A particle moves in the  $xy$ -plane so that at any time  $t \geq 0$ , the position of the particle is given by  $\mathbf{r}(t) = \langle t^2 + 3t, t^3 - 3t^2 \rangle$ .
- (a) Find the velocity vector when  $t = 1$ .

(b) Find magnitude of the velocity vector when  $t = 1$

(c) What is the meaning of the magnitude of the velocity vector when  $t = 1$

3. (NC) A particle moves in the  $xy$ -plane at time  $t$ ,  $0 \leq t \leq 2\pi$ , the position of the particle is given by  $\mathbf{r}(t) = \langle \sqrt{3} - 4 \cos(t), 1 - 2 \sin(t) \rangle$ . The path intersects the  $x$ -axis twice. Write an equation that represents the distance traveled by the particle between the two  $x$ -intercepts. Do not evaluate.

## Answers

1. (a)  $\langle 11, 1 \rangle$ , (b)  $\langle 20, 36 \rangle$
2. (a)  $\langle 5, -3 \rangle$  (b)  $\sqrt{34}$  (c) speed
3. intersects when  $t = \frac{\pi}{6}$  and  $\frac{5}{6}$  so  $\int_{\pi/6}^{5\pi/6} \sqrt{(4 \sin t)^2 + (-2 \cos t)^2} dt \approx 7.347$