7. [6 points] The function \( r(t) \), defined for all real numbers \( t \), gives the position of a particle moving along the unit circle,

\[
r(t) = (\cos(t - t^3), \sin(t - t^3)).
\]

a. [3 points] Find all values of \( t \) where the particle stops moving.

Solution: The particle stops moving when its speed is zero. The speed is given by

\[
\sqrt{(-\sin(t - t^3)(1 - 3t^2))^2 + (\cos(t - t^3)(1 - 3t^2))^2} = |1 - 3t^2|.
\]

Therefore the speed is zero at \( t = \pm \frac{1}{\sqrt{3}} \).

Answer: \( t = \pm \frac{1}{\sqrt{3}} \)

b. [3 points] For which values of \( t \) is the particle moving counterclockwise?

Solution: The parametric function \( r(t) \) moves counterclockwise precisely when \( f(t) = t - t^3 \) is increasing, which is the same as \( f'(t) > 0 \). Since \( f'(t) = 1 - 3t^2 \), this happens for \( t \) in \((-\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}})\).

Answer: \(-\frac{1}{\sqrt{3}} < t < \frac{1}{\sqrt{3}}\)