

## [gex124] Vector functions I

Consider a particle of unit mass moving at in the  $xy$ -plane with position vector,

$$\mathbf{x}(t) = \sin(2t)\hat{\mathbf{i}} + \cos(4t)\hat{\mathbf{j}}, \quad t \geq 0.$$

- (a) What are its shortest distance  $r_1$  and its longest distance  $r_2$  from the origin of the coordinate system? At what earliest times  $t_1$  and  $t_2$ , respectively, are these distances realized?
- (b) At what earliest time  $t_3$  is the particle instantaneously at rest? At what earliest time  $t_4$  does the particle reach its highest speed and what is that speed  $v_4$ ?
- (c) At what earliest time  $t_5$  does the particle experience a force directed Northeast if the  $y$ -axis points North and the  $x$ -axis East?

Hint: The Mathematica commands `FindMinimum`, `FindMaximum`, and `FindRoot` are useful tools.

**Solution:**