

#1. A sailboat starts sailing from a point on the shore of a large, calm lake. A person on the boat wishes to sail to an island in the middle of the lake which is 5 miles to the South and 3 miles to the West of the starting point of the sailboat on the shore. There is a steady 8 mile per hour wind blowing in a direction from Southeast directly towards the Northwest.

- (a) In what direction should the person steer the sailboat so that they end up at the island?
(Report the sailboat's velocity vector in the form $\langle x\text{-component}, y\text{-component} \rangle$ where x is in the East direction and y is in the North direction)
- (b) What is the required speed of the sailboat?

#2. An object is moving in the x - y plane with a velocity vector, for $-\pi \leq t \leq \pi$, is given by

$$\vec{v}(t) = \langle 3 \cos(2t) + 2, 4 \sin(2t) + 3 \rangle.$$

The position of the object at time $t = \frac{\pi}{4}$ seconds is $\left(\frac{5}{2} + \frac{\pi}{2}, 3 + \frac{3\pi}{4} \right)$.

- (a) Find the position of the object at time $t = \frac{\pi}{3}$ seconds.
- (b) Find the acceleration vector of the object at any time t .
- (c) For what time(s), $t > 0$, is the tangent line to the object's path horizontal?
- (d) For what time(s), $t > 0$, is the tangent line to the object's path vertical?
- (e) For what time(s), $t > 0$, does the tangent line to the object's path have a slope of -2 ?
- (f) Set up (but do not evaluate) an integral for the total distance traveled by the object for $-1 \leq t \leq 2$.

#3. (a) Sketch the plane curve for the position vector $\vec{r}(t) = \langle 8 \sin t, 3 \cos t \rangle$.

(b) Find the velocity vector, $\vec{v}(t)$.

(c) To your sketch in part a, add: $\vec{r}\left(\frac{2\pi}{3}\right)$, $\vec{v}\left(\frac{2\pi}{3}\right)$, $\vec{a}\left(\frac{2\pi}{3}\right)$.

#4. Given vectors $\vec{a} = \langle -3, 6 \rangle$, $\vec{b} = \langle 2, -3 \rangle$, $\vec{c} = \langle 1, 5 \rangle$

(a) Find $2\vec{a} - 3\vec{b} + 5\vec{c}$

(b) Find magnitude $\left\| \vec{a} \right\|$

#5. Given position vector $\vec{r}(t) = \langle 5t^2 - t, e^t + \sin(2t) \rangle$

(a) Find $\vec{r}(-2)$

(b) Find $\vec{r}(2m - 3n)$