10. [14 points] Fearing that she is losing authority over her robot ward, Dr. Durant has installed a tracking chip in Steph's mainframe. The chip gives Steph's location separately in x- and y-coordinates, where the units of the axes are miles, Dr. Durant's office corresponds to the origin (x, y) = (0, 0), the positive y-axis points north, and the positive x-axis points east. On night 1, Dr. Durant noticed unusual levels of activity; t hours after midnight, Steph began moving according to the parametric equations

$$x = f(t) \qquad \qquad y = g(t),$$

where f(t) and g(t) are plotted below for $0 \le t \le 5$.



a. [2 points] When was Steph farthest north and south on night 1? Write your answers in the blanks provided. You do **not** need to show your work.

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Solution: North: <u>4</u> a.m. South: <u>2</u> a.m.
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b. [3 points] What was Steph's speed at t = 4.9 on night 1? You may use the fact that f'(4.9) = -1. Include units.

Solution: Her speed is $\sqrt{(-1)^2 + (-2.4)^2} = \sqrt{6.76}$ mi/hr.

c. [2 points] What direction was Steph moving at t = 2 on night 1? Circle only one answer.

NORTH AND EAST	EAST ONLY	SOUTH AND EAST
NORTH AND WEST	WEST ONLY	SOUTH AND WEST

10 (continued). Recall that on night 1, Steph's position was given by the parametric equations

$$x = f(t) \qquad \qquad y = g(t),$$

where f(t) and g(t) are plotted below for $0 \le t \le 5$. As before, Dr. Durant's office is at the origin (x, y) = (0, 0), the positive y-axis points north, and the positive x-axis points east.



d. [3 points] How far away was Steph from Dr. Durant's office at t = 1 on night 1? Solution: Steph was $\sqrt{1^2 + 1.5^2} = \sqrt{3.25}$ mi away.

On night 2, Steph's movements were even stranger, following the parametric equations

$$x = \int_0^t f(s) \, ds \qquad \qquad y = \int_0^t g(s) \, ds.$$

e. [2 points] What direction was Steph moving at t = 2 on night 2? Circle only one answer.

NORTH AND EAST	EAST ONLY	SOUTH AND EAST
NORTH AND WEST	WEST ONLY	SOUTH AND WEST

f. [2 points] Did Steph come to a stop between midnight and 5 a.m. on night 2? If so, at what time(s) did she come to a stop?

Solution: Yes; she came to a stop at 3 a.m.