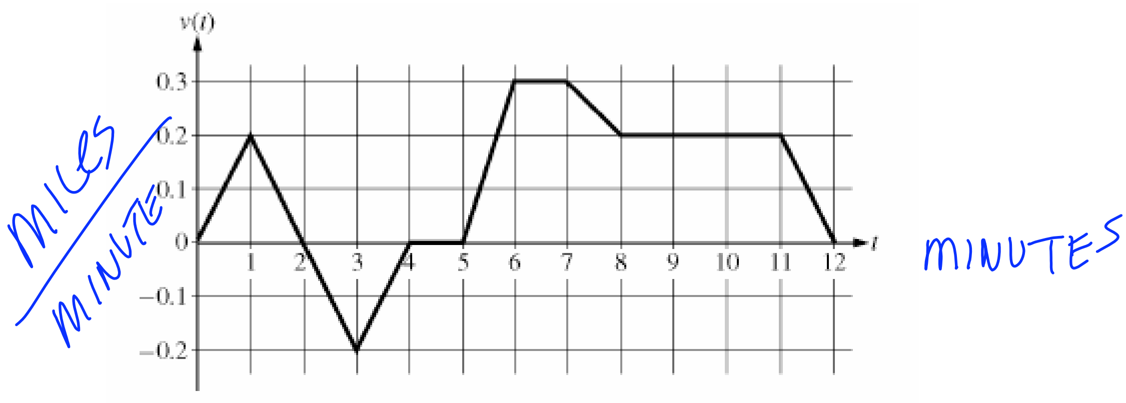
FR1



Skippy rides his bike along a straight road from home to school starting at home at $t = 0$ minutes and arriving at school at $t = 12$ minutes. His velocity, $v(t)$, in miles per minute is modeled by the piecewise function graphed above.

(a) Not long after leaving home, Skippy, to his horror, realizes that he has pulled a "Chucklehead Maneuver" by leaving his Calculus project at home. He turns around and returns home to retrieve it. At what time does he does he turn around to go back home? Justify your answer using Calculus and the graph above.

At t = 2 minutes, v(t) changes from positive to negative values. Hence, Skippy turns around to go back home at t = 2 minutes.

[If all you said was that the velocity became negative at t = 2, then you are ignoring the fact that the velocity could have been equal to zero for some time interval before having negative values.]

(b) Find the acceleration of the bike at time $t = 7.5$ minutes. Indicate units of measure.

$$a(t) = v'(t) \text{ so } a(7.5) = v'(7.5) = \frac{v(8) - v(7)}{8 - 7}$$

← need This DIFF.Q.

$$= \frac{0.2 - 0.3}{8 - 7} = -0.1 \frac{miles}{\min^2}$$

(c) During what time interval is the bike not in motion? Justify your answer.

Bike is not in motion during the interval $[4, 5]$ or $4 \le t \le 5$ minutes because $v(t) = 0$ during this interval.

Beware of "blah, blah, blah, …" syndrome. Some of you are including too much information, most of which is false, and lost points for this. Also, be award that a correct solution must have correct work.

FR2

The position, $s(t)$, of a particle is measured every 5 seconds and is provided in the table below.

Time [sec]	0	5	10	15	20
$s(t)$ [ft]	0	7	17	25	30

(A) Estimate the instantaneous velocity of the particle at $t = 15$ seconds. Include units.

$$v(15) \approx \frac{s(20) - s(15)}{20 - 15} = \frac{30 - 25}{20 - 15} = 1 \frac{ft}{\sec}$$

$$v(15) \approx \frac{s(15) - s(10)}{15 - 10} = \frac{25 - 17}{15 - 10} = \frac{8 \ ft}{5 \sec}$$

Once again, you must include your difference quotient!

(B) Find the average velocity on the time interval [0, 20] seconds.

$$av\ vel = \frac{s\ (20) - s\ (0)}{20 - 0}$$

$$= \frac{30 - 0}{20 - 0}$$

$$= \frac{3\ ft}{2\ \sec}$$

FREE RESPONSE BONUS QUESTION [This is optional]

The position of a different particle is given by the function $s(t) = t^3 + 3t^2 - 5t + 7$. At time $t = 0$ is the speed of the particle increasing or decreasing? Explain fully.

$$v(t) = s'(t) = 3t^2 + 6t - 5$$

$$v(0) = -5$$

$$a(t) = v'(t) = s''(t) = 6t - 6$$

$$a(0) = 6$$

At time t = 0, v(0) < 0 and a (0) > 0. Hence, the speed is decreasing at t = 0.

FR3

Consider the closed curve in the xy-plane given by

$$x^2 + 2x + y^4 + 4y = 5.$$

(a) Show that $\frac{dy}{dx} = \frac{-(x+1)}{2(y^3+1)}$.

See our chapter review solutions

(b) Find the coordinates of the two points on the curve where the line tangent to the curve is vertical.

See our chapter review solutions

(C) Write the equation of the line tangent to the curve at the point $(2, -1)$

$$\left.\frac{dy}{dx}\right|_{(2,\,-1)} = \text{undefined}$$

There is a vertical tangent at the point (2, - 1). Hence, the equation of the tangent line at the point (2, -1) is $x = 2$