t (seconds)	0	2	8	14
$v(t)$ (meters per second)	15	12	6	0

The velocity of a particle, P, moving along the x-axis is modeled by a differentiable function v, where time t is measured in seconds and $v(t)$ is measured in meters per second. Selected values of $v(t)$ are shown in the table above.

(a) Use the data in the table to approximate $v'(6)$ using the average rate of change of $v(t)$ over the interval $2 \leq t \leq 8$. Show the computations that lead to your answer. Indicate units of measure.

(b) Interpret the meaning of $v'(6)$ in the context of the problem.

(c) Justify why there must be a time $t = k$, for $8 \leq k \leq 14$, when the velocity of the particle is 3 meters per second.

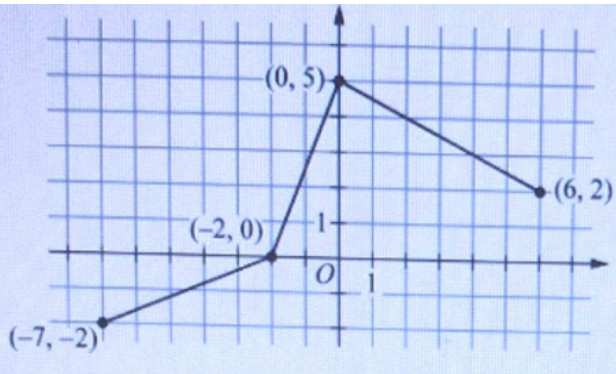
(d) Use a left Riemann sum with the three subintervals indicated by the data in the table to approximate the value of $\int_0^{14} v(t)\, dt$. Show the computations that lead to your answer.

(e) Find $\int_3^{21} v'\left(\frac{t}{3} + 7\right)\, dt$. Show the computations that lead to your answer.

(f) Let $p(x) = \int_0^{4x} v(2t)\, dt$. Find $p'(1)$. Show the computations that lead to your answer.

(g) The position of a second particle, Q, can be modeled by a twice-differentiable function g. It is known that $g(4) = 5$, $g'(4) = 2$, and $g''(4) = -6$. Is the speed of particle Q increasing or decreasing at time $t = 4$? Give a reason for your answer.

(h) Let $y = f(x)$ be the particular solution to the differential equation $\frac{dy}{dx} = -2x + 3y^2$ with initial condition $f(3) = 2$. Write an equation for the line tangent to the graph of f at the point $(3,\ 2)$.



Graph of h

The graph of the function h on the interval $-7 \leq x \leq 6$ consists of three line segments, as shown in the figure above. Let r be the function defined by $r(x) = \int_0^x h(t)dt$ for $-7 \leq x \leq 6$.

(a) For the function r, is $x = -2$ the location of a relative minimum, a relative maximum, or neither? Give a reason for your answer.

(b) Find the absolute minimum value of r on the interval $-7 \leq x \leq 6$. Justify your answer.

(c) On what open intervals contained in $-7 < x < 6$ is the graph of r both increasing and concave down? Give a reason for your answer.

(d) Find the value of $r''(-2)$, or explain why it does not exist.

(e) Find $\lim\limits_{x \to 0} \frac{r(x)}{x-4}$. Show the computations that lead to your answer.

(f) Let v be the function defined by $v(x) = r(x^2)$. Find the value of $v'\left(\sqrt{3}\right)$, or explain why it does not exist. Show the computations that lead to your answer. (Note: $\sqrt{3}$ can be keyboarded as $\text{sqrt}(3)$.)