

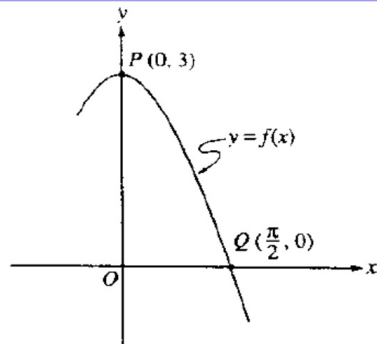
1)

A particle moves along the  $x$ -axis so that its velocity at any time  $t \geq 0$  is given by  $v(t) = 3t^2 - 2t - 1$ . The position  $x(t)$  is 5 for  $t = 2$ .

- Write a polynomial expression for the position of the particle at any time  $t \geq 0$ .
- For what values of  $t$ ,  $0 \leq t \leq 3$ , is the particle's instantaneous velocity the same as its average velocity on the closed interval  $[0, 3]$ ?
- Find the total distance traveled by the particle from time  $t = 0$  until time  $t = 3$ .

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2)



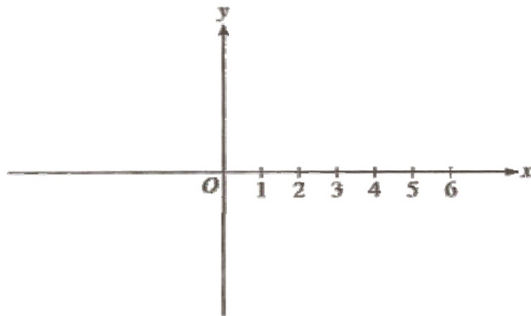
Let  $f$  be the function given by  $f(x) = 3 \cos x$ . As shown above, the graph of  $f$  crosses the  $y$ -axis at point  $P$  and the  $x$ -axis at point  $Q$ .

- Write an equation for the line passing through the points  $P$  and  $Q$ .
- Write an equation for the line tangent to the graph of  $f$  at point  $Q$ . Show the analysis that leads to your conclusion.
- Find the  $x$ -coordinate of the point on the graph of  $f$ , between points  $P$  and  $Q$ , at which the line tangent to the graph of  $f$  is parallel to line  $PQ$ .
- Let  $R$  be the region in the first quadrant bounded by the graph of  $f$  and line segment  $PQ$ . Write an integral expression for the volume of the solid generated by revolving the region  $R$  about the  $x$ -axis. Do not evaluate.

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3) Let  $f$  be the function given by  $f(x) = \sqrt{x-3}$ .

- (a) On the axes provided below, sketch the graph of  $f$  and shade the region  $R$  enclosed by the graph of  $f$ , the  $x$ -axis, and the vertical line  $x = 6$ .



- (b) Find the area of the region  $R$  described in part (a).
- (c) Rather than using the line  $x = 6$  as in part (a), consider the line  $x = w$ , where  $w$  can be any number greater than 3. Let  $A(w)$  be the area of the region enclosed by the graph of  $f$ , the  $x$ -axis, and the vertical line  $x = w$ . Write an integral expression for  $A(w)$ .
- (d) Let  $A(w)$  be as described in part (c). Find the rate of change of  $A$  with respect to  $w$  when  $w = 6$ .