

## 18. AB Calculus – Step-by-Step

Name \_\_\_\_\_

$x$	0	1	2	3	4	5	6	7
$f(x)$	3	5	13	33	71	133	225	353
$f'(x)$	1	4	13	28	48	76	109	148

In the chart above, selected values of  $x$  are given along with the values of the differentiable function  $f(x)$  as well as  $f'(x)$ .

a. Find the value of  $x$  closest to the result of the Mean-Value Theorem for  $f$  on  $[0, 7]$ . Show your reasoning.

b. If  $f^{-1}$  is the inverse function of  $f$ , find the derivative of  $f^{-1}$  at  $x = 5$ . That is, find  $[f^{-1}(5)]'$ .

c. If the table above is modeled using  $f(x) = x^3 + x + 3$ , show that the derivative of  $f^{-1}$  at  $x = 5$  gives the same result as your answer b) above.

d. Write an equation for the line tangent to  $f^{-1}(x)$  at  $x = 5$ .

**22. AB Calculus – Step-by-Step**

Name \_\_\_\_\_

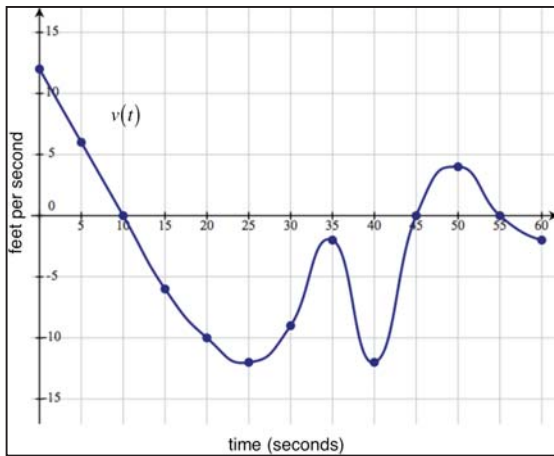
A particle moves along the  $x$ -axis so that at any time  $t$  its position is given by  $x(t) = \pi t - \sin 2\pi t$ .

- a. Find the velocity at time  $t$ .
  
  
  
  
  
  
  
  
  
  
- b. Find the acceleration at time  $t$ .
  
  
  
  
  
  
  
  
  
  
- c. Determine if the particle is speeding up or slowing down at time  $t = \frac{2}{3}$ . Justify your answer.
  
  
  
  
  
  
  
  
  
  
- d. What are all values of  $t$ ,  $0 \leq t \leq 1$ , for which the particle is at rest?
  
  
  
  
  
  
  
  
  
  
- e. How far does the particle travel between the times it is at rest for  $0 \leq t \leq 1$ ? Justify your answer.

23. AB Calculus – Step-by-Step

Name \_\_\_\_\_

A railroad engine is being positioned in a train yard over straight track. Its velocity is shown in the graph below in 5-second intervals as well as in a table of values. The graph is linear between  $t = 0$  and  $t = 15$  and has horizontal tangent lines at  $t = 25$ ,  $t = 35$ ,  $t = 40$ , and  $t = 50$ . At  $t = 0$ , the engine is in front of a control tower.



$t$ (seconds)	$v(t)$ ft per second
0	12
5	6
10	0
15	-6
20	-10
25	-12
30	-9
35	-2
40	-12
45	0
50	4
55	0
60	-2

- At what values of  $t$  does the engine have no acceleration?
- Write an expression for the speed of the engine from  $0 \leq t \leq 15$ .
- Give an approximation for the acceleration for the engine at  $t = 30$ . Specify units.
- For what values of  $t$  is the engine speeding up? Explain your reasoning.
- At what value of  $t$  is the engine the farthest from the control tower? Explain your answer.