Solution 23.9

The first forward difference formula of $O(h^2)$ from Fig. 23.1 can be used to estimate the velocity for the first point at t = 0,

$$f'(0) = \frac{-58 + 4(32) - 3(0)}{2(25)} = 1.4 \frac{\text{km}}{\text{s}}$$

The acceleration can be estimated with the second forward difference formula of $O(h^2)$ from Fig. 23.1

$$f''(0) = \frac{-78 + 4(58) - 5(32) + 2(0)}{(25)^2} = -0.0096 \frac{\text{km}}{\text{s}^2}$$

For the interior points, centered difference formulas of $O(h^2)$ from Fig. 23.3 can be used to estimate the velocities and accelerations. For example, at the second point at t = 25,

$$f'(25) = \frac{58 - 0}{2(25)} = 1.16 \frac{\text{km}}{\text{s}}$$

$$f''(25) = \frac{58 - 2(32) + 0}{(25)^2} = -0.0096 \frac{\text{km}}{\text{s}^2}$$

For the final point, backward difference formulas of $O(h^2)$ from Fig. 23.2 can be used to estimate the velocities and accelerations. The results for all values are summarized in the following table.

t	У	V	а
0	0	1.40	-0.0096
25	32	1.16	-0.0096
50	58	0.92	-0.0096
75	78	0.68	-0.0096
100	92	0.44	-0.0096
125	100	0.20	-0.0096

Copyright © McGraw-Hill Education. This is proprietary material solely for authorized instructor use. Not authorized for sale or distribution in any manner. This document may not be copied, scanned, duplicated, forwarded, distributed, or posted on a website, in whole or part.