Example 1

The upward velocity of a rocket is given as a function of time in Table 1.

Table 1 Velocity as a function of time.

t (s)	$v(t)$ (m/s)
0	0
10	227.04
15	362.78
20	517.35
22.5	602.97
30	901.67

Using forward divided difference, find the acceleration of the rocket at $t = 16$ s.

Solution

To find the acceleration at $t = 16$ s, we need to choose the two values of velocity closest to $t = 16$ s, that also bracket $t = 16$ s to evaluate it. The two points are $t = 15$ s and $t = 20$ s

$$a(t_i) \approx \frac{v(t_{i+1}) - v(t_i)}{\Delta t}$$

$$t_i = 15$$

$$t_{i+1} = 20$$

$$\Delta t = t_{i+1} - t_i$$

$$= 20 - 15$$

$$= 5$$

$$a(16) \approx \frac{v(20) - v(15)}{5}$$

$$= \frac{517.35 - 362.78}{5}$$

$$= 30.914 \text{ m/s}^2$$