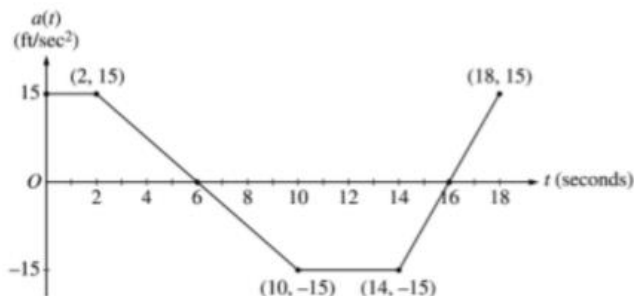


2001 AP Calculus AB-3

A car is traveling on a straight road with velocity 55 ft/sec at time $t = 0$. For $0 \leq t \leq 18$ seconds, the car's acceleration $a(t)$, in ft/sec², is the piecewise linear function defined by the graph above.



- (a) Is the velocity of the car increasing at $t = 2$ seconds? Why or why not?
- (b) At what time in the interval $0 \leq t \leq 18$, other than $t = 0$, is the velocity of the car 55 ft/sec? Why?
- (c) On the time interval $0 \leq t \leq 18$, what is the car's absolute maximum velocity, in ft/sec, and at what time does it occur? Justify your answer.
- (d) At what times in the interval $0 \leq t \leq 18$, if any, is the car's velocity equal to zero? Justify your answer.

(a) Since $v'(2) = a(2)$ and $a(2) = 15 > 0$, the velocity is increasing at $t = 2$.

1 : answer and reason

(b) At time $t = 12$ because

$$v(12) - v(0) = \int_0^{12} a(t) dt = 0.$$

2 : $\left\{ \begin{array}{l} 1 : t = 12 \\ 1 : \text{reason} \end{array} \right.$

(c) The absolute maximum velocity is 115 ft/sec at $t = 6$.

The absolute maximum must occur at $t = 6$ or at an endpoint.

$$\begin{aligned} v(6) &= 55 + \int_0^6 a(t) dt \\ &= 55 + 2(15) + \frac{1}{2}(4)(15) = 115 > v(0) \end{aligned}$$

$$\int_6^{18} a(t) dt < 0 \text{ so } v(18) < v(6)$$

4 : $\left\{ \begin{array}{l} 1 : t = 6 \\ 1 : \text{absolute maximum velocity} \\ 1 : \text{identifies } t = 6 \text{ and } \\ \quad t = 18 \text{ as candidates} \\ \text{or} \\ \text{indicates that } v \text{ increases,} \\ \quad \text{decreases, then increases} \\ 1 : \text{eliminates } t = 18 \end{array} \right.$

(d) The car's velocity is never equal to 0. The absolute minimum occurs at $t = 16$ where

$$v(16) = 115 + \int_6^{16} a(t) dt = 115 - 105 = 10 > 0.$$

2 : $\left\{ \begin{array}{l} 1 : \text{answer} \\ 1 : \text{reason} \end{array} \right.$