

AVERAGE VELOCITY AND INSTANTANEOUS VELOCITY

Millano, Rei Benedict L.

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1. A car travels in a straight line along a road. Its distance x from a stop sign is given as a function of time t by the equation $x(t) = at^2 - bt^3$, where $a = 1.50 \text{ m/s}^2$ and $b = 0.500 \text{ m/s}^3$. Calculate the average velocity of the car for each time interval:

a. $t = 0$ to $t = 2.00\text{s}$ b. $t = 0$ to $t = 4.00\text{s}$ c. $t = 2.00\text{s}$ to $t = 4.00\text{s}$

$$F(t_2, t_1) = \frac{\left(\frac{1.5m}{s^2}(t_2^2) - \frac{0.5m}{s^3}(t_2^3)\right) - \left(\frac{1.5m}{s^2}(t_1^2) - \frac{0.5m}{s^3}(t_1^3)\right)}{t_2 - t_1}$$

$$\text{a. } F(2,0) = \frac{\left(\frac{1.5m}{s^2}(2^2 - 0.5 \cdot 2^3)\right) - \left(\frac{1.5m}{s^2}(0^2) - \frac{0.5m}{s^3}(0^3)\right)}{2 - 0}$$

$$\frac{\left(\frac{1.5m}{s^2}(4s^2) - \frac{0.5m}{s^3}(8s^3)\right) - 0}{2s}$$

$$\frac{(6m - 4m)}{2s} \rightarrow \frac{2m}{2s}$$

$$a = \frac{1m}{s}$$

$$\text{b. } F(4,0) = \frac{\left(\frac{1.5m}{s^2}(4^2) - \frac{0.5m}{s^3}(4^3)\right) - \left(\frac{1.5m}{s^2}(0^2) - \frac{0.5m}{s^3}(0^3)\right)}{4 - 0}$$

$$\frac{\left(\frac{1.5m}{s^2}(16s^2) - \frac{0.5m}{s^3}(64s^3)\right) - 0}{4s} \rightarrow \frac{(24m - 32m)}{4s} \rightarrow -\frac{8m}{4s} \rightarrow -\frac{2m}{s}$$

$$\text{c. } F(4,2) = \frac{\left(\frac{1.5m}{s^2}(4^2) - \frac{0.5m}{s^3}(4^3)\right) - \left(\frac{1.5m}{s^2}(2^2) - \frac{0.5m}{s^3}(2^3)\right)}{4 - 2}$$

$$\frac{\left(\frac{1.5m}{s^2}(16s^2) - \frac{0.5m}{s^3}(64s^3)\right) - \left(\frac{1.5m}{s^2}(4s^2) - \frac{0.5m}{s^3}(8s^3)\right)}{2s} \rightarrow \frac{(24m - 32m) - (6m - 4m)}{2s} \rightarrow -\frac{8m - 2m}{2s} \rightarrow -\frac{10m}{s}$$

2. A motorcycle rider is stopped at a traffic light. It then travels along a straight road so that its distance from the light is given by the equation $x(t) = bt^2 - ct^3$,

where $b = 2.40 \text{ m/s}^2$ and $c = 0.120 \text{ m/s}^3$.

Calculate the

a. average velocity of the rider for the time interval $t = 0$ to $t = 10.0 \text{ s}$

b. instantaneous velocity at $t = 0$, $t = 5.0 \text{ s}$ and $t = 10.0 \text{ s}$

$$F(t_2,t_1)=\frac{\left(\frac{2.4m}{s^2}(t_2^2)-\frac{0.12m}{s^3}(t_2^3)\right)-\left(\frac{2.4m}{s^2}(t_1^2)-\frac{0.12m}{s^3}(t_1^3)\right)}{t_2-t_1}$$

a. $F(10,2)=\frac{\left(\frac{1.5m}{s^2}(10^2)-\frac{0.5m}{s^3}(10^3)\right)-\left(\frac{1.5m}{s^2}(0^2)-\frac{0.5m}{s^3}(0^3)\right)}{4-0}$

$$\frac{\left(\frac{1.5m}{s^2}(100s^2)-\frac{0.5m}{s^3}(1000s^3)\right)-0}{4s}\rightarrow\frac{(150m-500m)}{2s}\rightarrow\frac{-350m}{2s}\rightarrow\frac{175m}{s}$$