Chapter 3 Problem 35 [†]

Given
$x(t) = 10t - 2t^2\ m$

Solution
a) Find the instantaneous velocity at $t = 2\ s$ and $t = 3\ s$.

Instantaneious velocity is found by taking the derivative of the position function.

$$v(t) = \frac{dx}{dt} = \frac{d}{dt}\left(10t - 2t^2\right) = 10 - 4t\ m/s$$

Evaluating the velocity function at $t = 2s$ gives

$$v(2\ s) = 10 - 4(2) = 2m/s$$

Evaluating the velocity function at $t = 3s$ gives

$$v(3\ s) = 10 - 4(3) = -2m/s$$

b) Find the instanteous speed at the same times.

The speed is just the magnitude of the velocity. Therefore,

$$s(2\ s) = |v(2\ s)| = |2\ s| = 2\ m/s$$

$$s(3\ s) = |v(3\ s)| = |-2\ s| = 2\ m/s$$

c) What is the average velocity between $t = 2\ s$ and $t = 3\ s$.

Average velocity is change in position divided by change in time.
First find the positions at $t = 2\ s$ at $t = 3\ s$.

$$x(2\ s) = 10(2) - 2(2)^2 = 12\ m$$

$$x(3\ s) = 10(3) - 2(3)^2 = 12\ m$$

Average velocity is

$$\vec{v}_{avg} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{12m/s - 12m/s}{3\ s - 2\ s} = 0\ m/s$$

[†]Problem from University Physics by Ling, Sanny and Moebs (OpenStax)