Chapter 2 Problem 22 [†]

Given
Figure 2.15 in the text.

Solution
a) Find the greatest velocity in the +x direction.

The greatest positive velocity is where the line is increasing with the greatest slope, which is around $t = 2\ s$. To find this slope estimate the times when the line is at $2\ m$ and $4\ m$. These times are $1.6\ s$ and $2.3\ s$ respectively. The velocity (slope) is then

$$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{4\ m - 2\ m}{2.3\ s - 1.6\ s} = 2.9\ m/s$$

b) Find the greatest velocity in the -x direction.

The greatest negative velocity is where the line is decreasing with the greatest slope, which is around $t = 4\ s$. To find this slope estimate the times when the line is at $4\ m$ and $3\ m$. These times are $3.6\ s$ and $4.25\ s$ respectively. The velocity (slope) is then

$$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{3\ m - 4\ m}{4.25\ s - 3.6\ s} = -1.5\ m/s$$

c) Find the times when the object is at rest.

The object is at rest when the tangent to the curve is horizontal. This occurs around $t = 3\ s$ and $t = 5\ s$.

d) Find the average velocity over the interval shown.

The average velocity is calculated by taking the initial point $(0\ m, 0\ s)$ and the final point $(3\ m, 6\ s)$.

$$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{3\ m - 0\ m}{6\ s - 0\ s} = 0.5\ m/s$$

[†]Problem from Essential University Physics, Wolfson