Chapter 3 Problem 48 [†]

Given

$\vec{r}_1 = \left\{2.2\hat{i} + 3.7\hat{j} - 1.2\hat{k}\right\}\ \mu m$

$\vec{r}_2 = \left\{4.6\hat{i} + 1.9\hat{k}\right\}\ \mu m$

$\Delta t = 6.2\ s$

Solution

Find the average velocity of the bacterium.

$$\vec{\bar{v}} = \frac{\Delta\vec{r}}{\Delta t} = \frac{\vec{r}_2 - \vec{r}_1}{\Delta t}$$

$$\vec{\bar{v}} = \frac{\left\{4.6\hat{i} + 1.9\hat{k}\right\}\mu m - \left\{2.2\hat{i} + 3.7\hat{j} - 1.2\hat{k}\right\}\ \mu m}{(6.2\ s)}$$

$$\vec{\bar{v}} = \left\{0.387\hat{i} - 0.597\hat{j} + 0.500\hat{k}\right\}\ \mu m/s$$

The magnitude is then

$$\bar{v} = \sqrt{(\bar{v}_x)^2 + (\bar{v}_y)^2 + (\bar{v}_z)^2}$$

$$\bar{v} = \sqrt{(0.387)^2 + (-0.597)^2 + (0.500)^2}\ \mu m/s$$

$$\bar{v} = 0.87\ \mu m/s$$

[†]Problem from Essential University Physics, Wolfson