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This is a 3-D problem involving average acceleration.

A particle has initial velocity $\vec{v} = 3.0\hat{i} - 4.0\hat{j} + 8.0\hat{k}$, and 5.0 s later it has final velocity $\vec{v} = 2.0\hat{i} - 1.0\hat{j} + 3.0\hat{k}$. Units are in m/s.

(a) What is the average acceleration over the 5.0 s interval?

(b) What is the magnitude, and show the orientation of the average acceleration?

Solution:

(a) $\bar{a} = \dfrac{\Delta\vec{v}}{\Delta t}$, $\Delta\vec{v} = \vec{v}_2 - \vec{v}_1$

$\Delta t = 5.0\ s$

$\Delta\vec{v} = 2.0\hat{i} - 1.0\hat{j} + 3.0\hat{k} - (3.0\hat{i} - 4.0\hat{j} + 8.0\hat{k})$

$\Delta\vec{v} = -1.0\hat{i} + 3.0\hat{j} - 5.0\hat{k}$

$\bar{a} = \dfrac{-1.0\hat{i} + 3.0\hat{j} - 5.0\hat{k}}{5.0}$

$\bar{a} = -0.2\hat{i} + 0.6\hat{j} - 1.0\hat{k}$ (answer)

(b) $|\bar{a}| = \sqrt{(-0.2)^2 + (0.6)^2 + (-1.0)^2}$

$|\bar{a}| = 1.18\ m/s^2$ (answer)