

12.2 number 35: Let P_1 and P_2 be the points $P_1 = (-1, 1, 5)$ and $P_2 = (2, 5, 0)$.

- (a) Find a unit vector that points in the same direction as $\overrightarrow{P_1P_2}$.
- (b) Find the midpoint of the line segment from P_1 to P_2 .

Answer: (b) The midpoint of the line segment from P_1 to P_2 is obtained by averaging the coordinates of P_1 and P_2 . So the midpoint is $Q = (\frac{1}{2}, 3, \frac{5}{2})$. Notice that

$$\begin{aligned}\overrightarrow{P_1Q} &= \frac{3}{2}\vec{i} + 2\vec{j} - \frac{5}{2}\vec{k}, \\ \overrightarrow{QP_2} &= \frac{3}{2}\vec{i} + 2\vec{j} - \frac{5}{2}\vec{k}, \text{ and} \\ \overrightarrow{P_1P_2} &= 3\vec{i} + 4\vec{j} - \frac{5}{2}\vec{k} = 2\overrightarrow{P_1Q}.\end{aligned}$$

- (a) $\frac{1}{\sqrt{50}}(3\vec{i} + 4\vec{j} - \frac{5}{2}\vec{k})$ is the unit vector that points in the direction of $\overrightarrow{P_1P_2}$.