Problem 1 (50%). Calculate the following for \( a = [-1, 2, -3] \), and \( b = [3, -2, 1] \).

1. \( a + b \)
2. \( a - b \)
3. \( a \cdot b \)
4. \( a \times b \)
5. \(|a|\)

Answer:

1. \( a + b = [2, 0, -2] \)
2. \( a - b = [-4, 4, -4] \)
3. \( a \cdot b = -3 - 4 - 3 = -10 \)
4. \( a \times b = [-4, -8, -4] \)
5. \(|a| = \sqrt{14} \)

Problem 2 (20%). In the figure below, the directed segment \( \overrightarrow{PA} \) is an instantiation of vector \([1, 1]\), and \( \overrightarrow{PB} \) is an instantiation of vector \([3, 2]\). Let \( \overrightarrow{AB} \) be an instantiation of vector \( \mathbf{v} \). What is \( \mathbf{v} \)?

![Diagram](image)

Answer: \([3, 2] - [1, 1] = [2, 1] \).

Problem 3 (20%). As in Problem 2, \( \overrightarrow{PA} \) is an instantiation of vector \([1, 1]\), and \( \overrightarrow{PB} \) is an instantiation of vector \([3, 2]\). Let \( D \) be the projection of point \( A \) onto \( \overrightarrow{PB} \). What is the distance from \( P \) to \( D \)?
**Answer:** Let $\gamma$ be the angle of $\overrightarrow{P,A}$ and $\overrightarrow{P,B}$. Hence, $\|1,1\|\|3,2\| \cos \gamma = [1,1] \cdot [3,2] = 5$. The distance from $P$ to $D$ is exactly $|\overrightarrow{P,A}| \cos \gamma = |1,1| \cos \gamma = \frac{5}{\sqrt{13}} = \frac{5}{\sqrt{13}}$.

**Problem 4 (10%).** Define function $r(t) = [t, t^2, t^3]$. What is the value of $r'(1)$?

**Answer:** $r'(t) = [1, 2t, 3t^2]$. Hence, $r'(1) = [1, 2, 3]$. 

\[ \text{Answer: } r'(1) = [1, 2, 3]. \]