

ENGG1410-E: Short Test 1

Name:

Student ID:

Write all your answers on this sheet, and use the back if necessary.

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

1. $\mathbf{a} + \mathbf{b}$

2. $\mathbf{a} - \mathbf{b}$

3. $\mathbf{a} \cdot \mathbf{b}$

4. $\mathbf{a} \times \mathbf{b}$

5. $|\mathbf{a}|$

Answer:

1. $\mathbf{a} + \mathbf{b} = [2, 0, -2]$

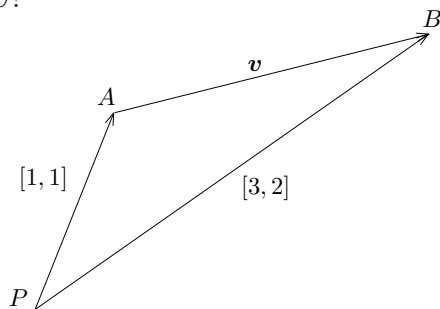
2. $\mathbf{a} - \mathbf{b} = [-4, 4, -4]$

3. $\mathbf{a} \cdot \mathbf{b} = -3 - 4 - 3 = -10$

4. $\mathbf{a} \times \mathbf{b} = [-4, -8, -4]$

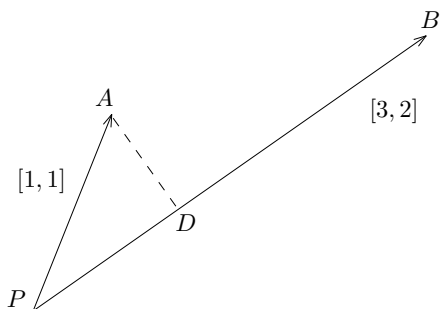
5. $|\mathbf{a}| = \sqrt{14}$

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



Answer: $[3, 2] - [1, 1] = [2, 1]$.

Problem 3 (20%). As in Problem 2, $\overrightarrow{P, A}$ is an instantiation of vector $[1, 1]$, and $\overrightarrow{P, B}$ is an instantiation of vector $[3, 2]$. Let D be the projection of point A onto $\overrightarrow{P, B}$. What is the distance from P to D ?



Answer: Let γ 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 $|\overrightarrow{P, A}| \cos \gamma = |[1, 1]| \cos \gamma = \frac{5}{||[3, 2]||} = \frac{5}{\sqrt{13}}$.

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

Answer: $\mathbf{r}'(t) = [1, 2t, 3t^2]$. Hence, $\mathbf{r}'(1) = [1, 2, 3]$.