1. What is the formula relating the dot product of two vectors \( \mathbf{u} \) and \( \mathbf{v} \) to their lengths and the angle \( \phi \) between them?

Consider the figure to the right. The vectors \( \mathbf{a} = (3, 1, 0) \) and \( \mathbf{b} = (2, 5, 0) \) are shown. Refer to this figure for all the remaining questions.

2. What is the value of \( \theta \) in degrees?

3. Find \( \mathbf{a} \times \mathbf{b} \).

4. Which way does \( -(\mathbf{a} \times \mathbf{b}) \) point (up or down)?

5. Keeping \( \mathbf{a} \) fixed and rotating \( \mathbf{b} \) away from \( \mathbf{a} \) (counterclockwise) while keeping \( \mathbf{b} \) in the \( xy \) plane and its length constant, what happens . . .

5a. . . . to \( \mathbf{a} \cdot \mathbf{b} \) as \( \theta \) increases towards \( \pi/2 \)? (Circle one of these choices or write in a better one:)
   - (1) \( \mathbf{a} \cdot \mathbf{b} \) increases towards \( \| \mathbf{a} \| \cdot \| \mathbf{b} \| \)
   - (2) \( \mathbf{a} \cdot \mathbf{b} \) decreases to 0
   - (3) \( \mathbf{a} \cdot \mathbf{b} \) remains constant

5b. . . . to \( \| \mathbf{a} \times \mathbf{b} \| \) as \( \theta \) increases towards \( \pi/2 \)? (Circle one of these choices or write in a better one:)
   - (1) \( \| \mathbf{a} \times \mathbf{b} \| \) increases towards \( \| \mathbf{a} \| \cdot \| \mathbf{b} \| \)
   - (2) \( \| \mathbf{a} \times \mathbf{b} \| \) decreases to 0
   - (3) \( \| \mathbf{a} \times \mathbf{b} \| \) remains constant

6. If \( \theta = \pi \), what are both \( \mathbf{a} \cdot \mathbf{b} \) and \( \mathbf{a} \times \mathbf{b} \)? (two separate questions).

\[ \mathbf{a} \cdot \mathbf{b} = \]
\[ \mathbf{a} \times \mathbf{b} = \]