Warm Up: Unit analysis and vectors

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1 Memory Bank

1. $\vec{v} = v_x\hat{i} + v_y\hat{j}$ ... Definition of a vector in terms of $\hat{i}$ and $\hat{j}$ components (representing the x-direction and y-direction).
2. $\vec{v} + \vec{w} = (v_x + w_x)\hat{i} + (v_y + w_y)\hat{j}$ ... Vector addition: the $\hat{i}$-components add with each other, and the $\hat{j}$-components add with each other.
3. $|\vec{v}| = \sqrt{v_x^2 + v_y^2}$ ... The magnitude of the vector
4. $v_x = |\vec{v}|\cos\phi$, $v_y = |\vec{v}|\sin\phi$ ... The x and y-components of the vector

2 Chapter 2 - Algebra of Vectors

1. Imagine a molecule in an ideal gas is ionized and trapped in an area using a magnetic field. It moves randomly in two dimensions, beginning at the origin. Determine the final location, if it follows the displacements below:
   - $\Delta\vec{x}_1 = 3\hat{i} + 3\hat{j}$ μm
   - $\Delta\vec{x}_1 = -1\hat{i} - 1\hat{j}$ μm
   - $\Delta\vec{x}_1 = 2\hat{i} - 2\hat{j}$ μm
   - $\Delta\vec{x}_1 = -4\hat{i} + 4\hat{j}$ μm
2. Draw the complete trajectory of the molecule in a two-dimensional coordinate system. What is the magnitude of the displacement from the origin?

3. Let $A = |\vec{A}| = 1$, and let $\theta_A = 60$ degrees. What are A_x and A_y? *Hint: use Fig. 1 to recall the comparison between a vector and a triangle.*

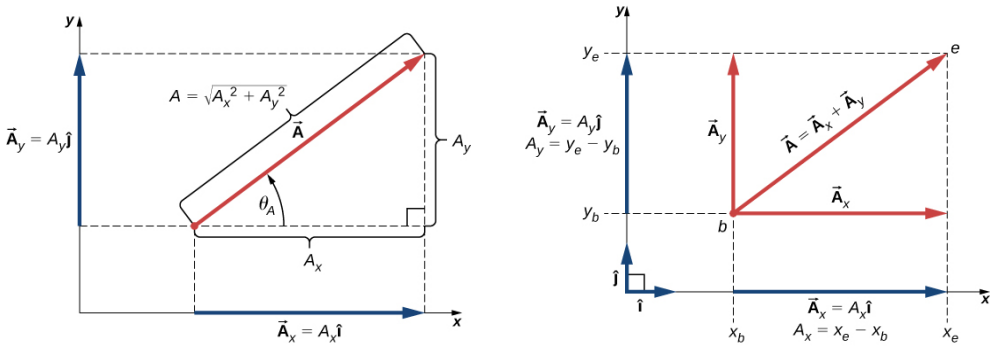

Figure 1: A vector $\vec{A}$ can be expressed with components A_x and A_y, or the magnitude $A = |\vec{A}|$ and the angle θ_A.