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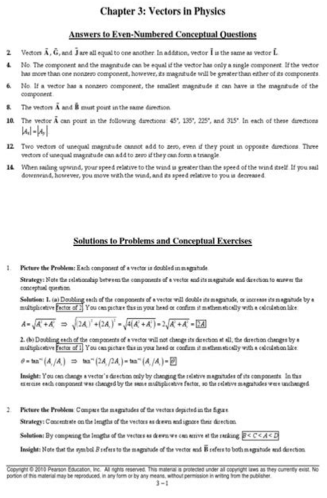

Chapter 3: Vectors in Physics

Answers to Even-Numbered Conceptual Questions

2. Vectors $\vec{A}$, $\vec{G}$, and $\vec{J}$ are all equal to one another. In addition, vector $\vec{I}$ is the same as vector $\vec{L}$.
4. No. The component and the magnitude can be equal if the vector has only a single component. If the vector has more than one nonzero component, however, its magnitude will be greater than either of its components.
6. No. If a vector has a nonzero component, the smallest magnitude it can have is the magnitude of the component.
8. The vectors $\vec{A}$ and $\vec{B}$ must point in the same direction.
10. The vector $\vec{A}$ can point in the following directions: 45°, 135°, 225°, and 315°. In each of these directions $|A_x| = |A_y|$.
12. Two vectors of unequal magnitude cannot add to zero, even if they point in opposite directions. Three vectors of unequal magnitude can add to zero if they can form a triangle.
14. When sailing upwind, your speed relative to the wind is greater than the speed of the wind itself. If you sail downwind, however, you move with the wind, and its speed relative to you is decreased.

Solutions to Problems and Conceptual Exercises

1. **Picture the Problem:** Each component of a vector is doubled in magnitude.

   Strategy: Note the relationship between the components of a vector and its magnitude and direction to answer the conceptual question.

   Solution: **1. (a)** Doubling each of the components of a vector will double its magnitude, or increase its magnitude by a multiplicative factor of 2. You can picture this in your head or confirm it mathematically with a calculation like:

   $A = \sqrt{A_x^2 + A_y^2} \Rightarrow \sqrt{(2A_x)^2 + (2A_y)^2} = \sqrt{4(A_x^2 + A_y^2)} = 2\sqrt{A_x^2 + A_y^2} = \boxed{2A}$

   2. (b) Doubling each of the components of a vector will not change its direction at all; the direction changes by a multiplicative factor of 1. You can picture this in your head or confirm it mathematically with a calculation like:

   $\theta = \tan^{-1}(A_y/A_x) \Rightarrow \tan^{-1}(2A_y/2A_x) = \tan^{-1}(A_y/A_x) = \boxed{\theta}$

   Insight: You can change a vector's direction only by changing the relative magnitudes of its components. In this exercise each component was changed by the same multiplicative factor, so the relative magnitudes were unchanged.

2. **Picture the Problem:** Compare the magnitudes of the vectors depicted in the figure.

   Strategy: Concentrate on the lengths of the vectors as drawn and ignore their direction.

   Solution: By comparing the lengths of the vectors as drawn we can arrive at the ranking $\boxed{B < C < A < D}$

   Insight: Note that the symbol B refers to the magnitude of the vector and $\vec{B}$ refers to both magnitude and direction.

3 – 1

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Physics Chapter 4 Answers