

Topic: Magnitude and Vector Quantities

Reading Passage:

In physics, quantities can be classified as either scalars or vectors. A scalar quantity has only magnitude, which is a numerical value describing size or amount. Examples include mass, temperature, speed, and energy. These quantities can be fully described using a single number and unit. A vector quantity, however, has both magnitude and direction. This means that to describe a vector completely, you must state how large it is and the direction in which it acts. Common vector quantities include velocity, acceleration, displacement, and force. Because vectors involve direction, they follow different mathematical rules from scalars. For example, two forces acting in opposite directions cannot simply be added numerically; their directions must be considered. Understanding the difference between scalars and vectors is essential in physics because it affects how quantities combine and how physical situations are analysed. When solving problems involving motion or forces, identifying whether a quantity is scalar or vector helps determine the correct method to use.

Questions:

Section A:

1. Define the term magnitude.
2. State what makes a quantity a vector.
3. Give two examples of scalar quantities.
4. Explain why velocity is considered a vector quantity.
5. A student says, "Force is 10 N." Explain why this description is incomplete.

Section B:

6. A hiker walks 3 km east and then 4 km north.
 - (a) State the hiker's total distance travelled.
 - (b) Explain why distance is a scalar quantity.
 - (c) Calculate the hiker's displacement.
7. Two forces act on a box: 12 N to the right and 7 N to the left.
 - (a) Explain why forces cannot be added like scalars.
 - (b) Calculate the resultant force, including direction.

Section C:

8. Discuss why distinguishing between scalar and vector quantities is important when analysing motion. Include examples in your explanation.

Answer Key:

Section A:

1. Magnitude is the numerical size or amount of a quantity.
2. A vector has both magnitude and direction.
3. Examples include mass, temperature, speed, time, energy.
4. Velocity includes both speed (magnitude) and the direction of motion.
5. Force is a vector, so its direction must be stated for the description to be complete.

Section B:

6(a) Total distance = 7 km.

6(b) Distance is scalar because it has magnitude only and no direction.

6(c) Displacement = 5 km northeast.

7(a) Forces are vectors, so their directions must be considered when adding them.

7(b) Resultant force = 5 N to the right.

Section C:

8. Distinguishing between scalars and vectors ensures correct analysis of physical situations. Scalars such as speed or time can be added directly, but vectors such as velocity or force require direction to be considered. For example, two forces acting in opposite directions may cancel out, even if their magnitudes are large. Similarly, displacement depends on direction, while distance does not. Understanding these differences prevents errors in calculations involving motion and forces.