Kinematics

Mathematical Description of Motion

Kinematics Unit Outline

I. Vectors

II. Six Definitions:
Distance, Position, Displacement,
Speed, Velocity, Acceleration

III. Two Equations:
Velocity, Displacement

IV. Freefall

	The student will be able to:	HW:
1	Define and distinguish the concepts scalar and vector. Make the connection between the visual representation of a vector and its numerical representation of magnitude and direction angle.	
2	Define, distinguish, and apply the concepts: distance, displacement, position.	1, 2
3	Define, distinguish, and apply the concepts: average speed, instantaneous speed, constant speed, average velocity, instantaneous velocity, constant velocity.	3 – 7
4	Define, distinguish, and apply the concepts: average acceleration and instantaneous acceleration, and constant acceleration.	8 – 16
5	State the displacement and velocity relations for cases of constant acceleration and use these to solve problems given appropriate initial conditions and values.	17 – 28
6	State and use the conditions of freefall, including the value of g, to solve associated problems.	29 – 41

Scalars and Vectors

Types of Quantities

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Scalars vs. Vectors

A **scalar** is a quantity that has only magnitude

- A scalar may be completely described by a single numerical value (may include units) that indicates the amount.

A **vector** is a quantity that has both magnitude and direction.

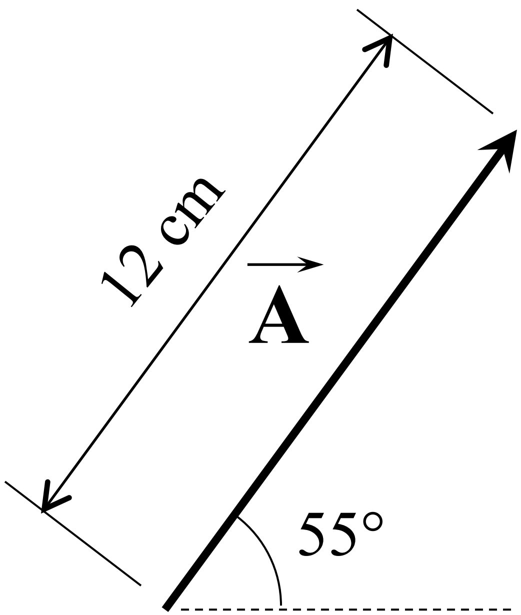
- The value of a vector is comprised of two or more pieces of information: a positive value indicating magnitude and some indication of direction.

Vector Notation

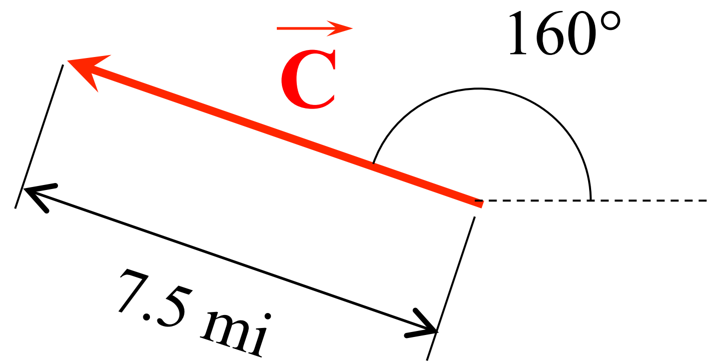
A vector is often described by two numerical values: magnitude and direction angle.

- The **magnitude** quantifies the amount or size of the vector.
- The **direction angle** is measured counterclockwise from an imaginary line passing through the tail of the vector and extending horizontally to the right or east.

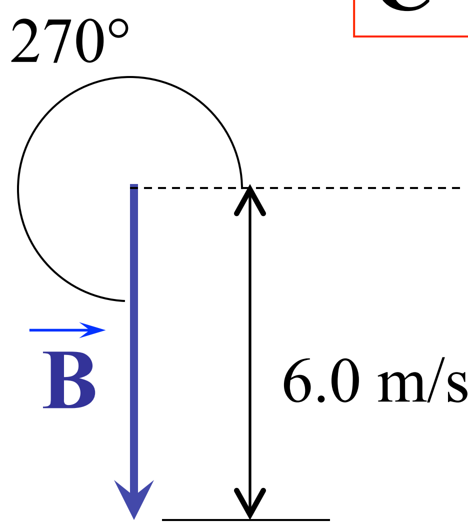
Some example vectors depicted:



$\vec{\mathbf{A}}$ = 12 cm, 55°

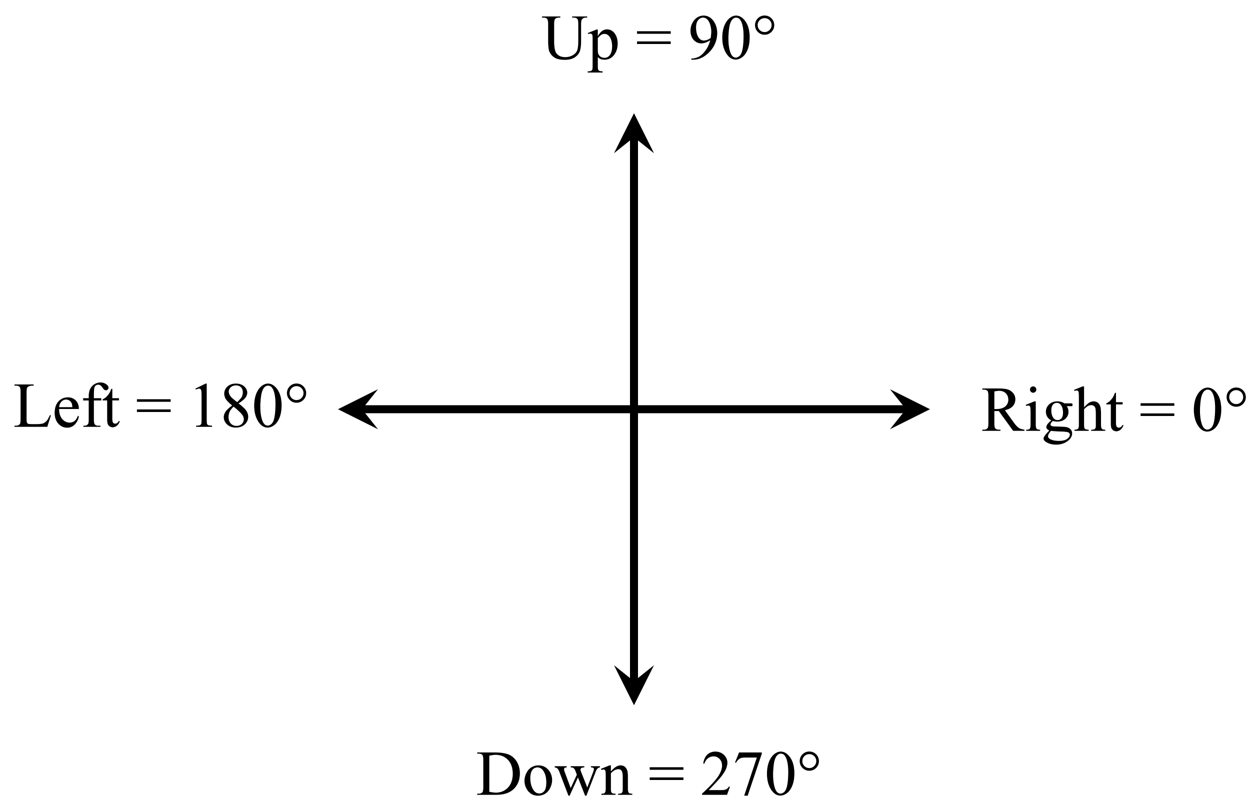


$\vec{\mathbf{C}}$ = 7.5 miles, 160°



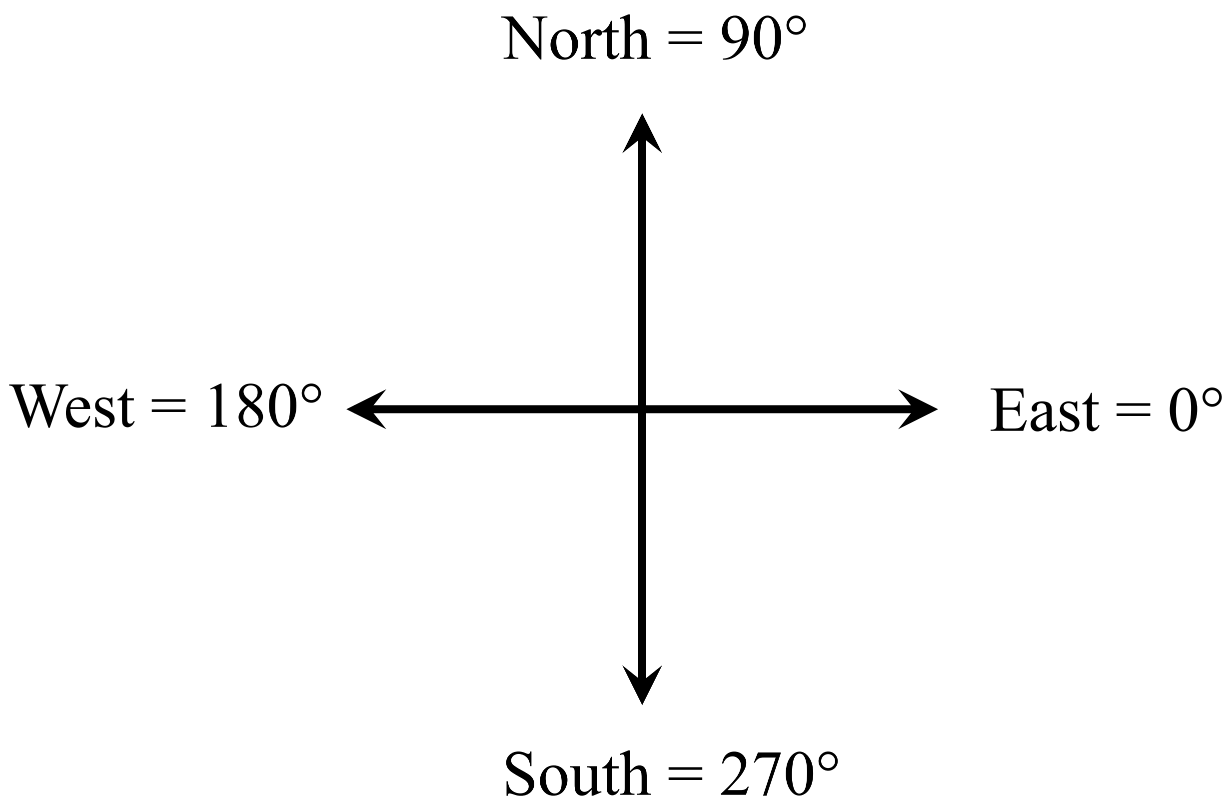
$\vec{\mathbf{B}}$ = 6.0 m/s, 270.0°

Cardinal Directions
(object moving in a vertical plane)



Angles such as these might be used to describe a baseball moving through the air, for example

Cardinal Directions
(object moving in a horizontal plane)



Angles such as these might be used to describe the flight of an aircraft across the country, for example.