

Scaled Vector Diagrams

Lesson Notes

What is a Vector?

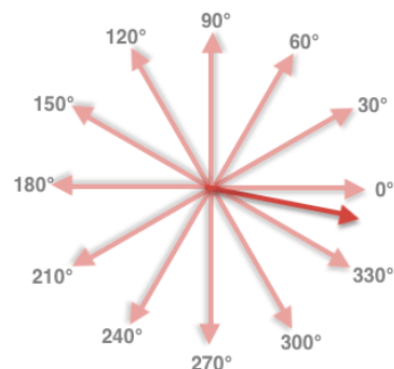
A vector is a type of quantity that is fully described by a **magnitude** (i.e., a numerical value) and a **direction**.

Counter-Clockwise from East Convention

When a vector is not directed along one of the four cardinal directions, an angle measure must be used to indicate its precise direction. In the **counter-clockwise (CCW) from East** convention, the direction east is defined as 0° , and the direction of all vectors is described by the counter-clockwise angle of rotation that the vector makes with due East.

Examples are shown at the right.

CCW from East Convention



Vector Magnitude

The magnitude of a vector describes its size in a quantitative manner. It is associated with a numerical value. In vector diagrams, the length of the vector arrow represents the magnitude of the vector quantity.

Scale

Vector diagrams utilize a scale to help represent the magnitude. A scale indicates the ratio of the distance on a map to the actual distance along the ground. It takes the form of ...

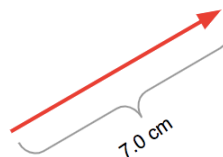
$$1 \text{ inch} = 100 \text{ miles}$$

The "1 inch" is the distance on the map and the "100 miles" is the distance along the ground (the *real world distance*).

Scale Conversion

The indicated scale must be used to convert the measured length of a vector on a diagram to actual *real-world* values for the vector's magnitude.

$$\text{Scale: } 1 \text{ cm} = 5.0 \text{ m/s}$$



This velocity vector is 7.0 cm in length. Its magnitude is

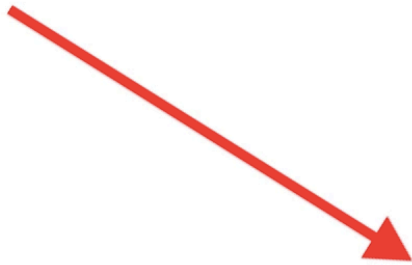
$$7.0 \text{ cm} \cdot (5.0 \text{ m/s} / 1 \text{ cm}) = \mathbf{35.0 \text{ m/s}}$$

Determining Magnitude and Direction of a Vector from a Scaled Diagram

1. Gather a protractor and a ruler.
2. Move 0-point on ruler to one of the ends of the arrow, aligning the ruler parallel to the arrow.
3. Measure the length of the arrow. Then use the scale to convert the arrow length to real world units for the magnitude of the vector.
4. Move the transparent protractor on top of the diagram, positioning the origin at the tail of the vector.
5. Starting at due East, measure around the perimeter of the protractor to determine the counter-clockwise angle of rotation that the arrow makes with East. This is the direction.

Examples:

Scale: 1 cm = 20.0 mi



Magnitude:

Direction:

Scale: 1 cm = 50.0 km



Magnitude:

Direction:

Method for Drawing a Scaled Vector Diagram:

- Select a scale.
- Indicate scale on diagram.
- Mark a starting location for the tail of the vector.
- Using a protractor, mark a reference point for the alignment of the vector in the indicated direction.
- Using a ruler, draw out the vector the appropriate length in the indicated direction.

