Introduction to Vectors

Most quantities we measure are **scalars**. These are measured with a size or magnitude, without regard to direction. For example, temperature is a scalar. While it can be positive or negative, it does not have a direction, such as right or left.

A **scalar** is a physical quantity that has only a magnitude or size.

Sometimes it is necessary to include a direction when we give the value for a quantity. For example, saying "Lisa walked three kilometers east" is not the same as saying "Lisa walked three kilometers south."

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

Force is a vector. You can pull on a door handle with a force of $25\ N\ [East]$, or you can push on the door handle with a force of $25\ N\ [West]$. While these forces have the same magnitude, they act in different directions. One force will open the door; the other force will not.

To specify a vector, you must include three pieces of information: a size, a unit, and a direction.

In physics, speed and velocity are often confused. **Speed** describes how fast an object is moving, regardless of direction. **Velocity** describes both how fast and in what direction an object is moving. It is the direction that makes them different.

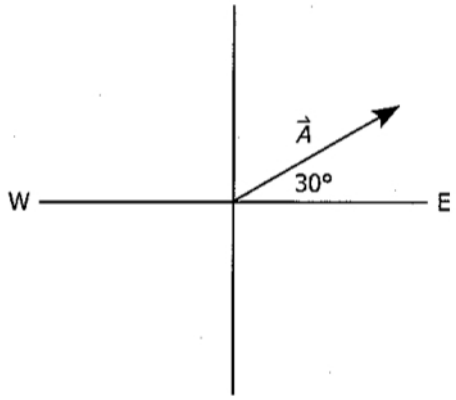
Scalar or Vector
In previous courses, you have been introduced to many quantities. Complete the following table.

Quantity	Symbol of the Quantity	Unit	Vector or Scalar
time instant	t	s	scalar
time interval	Δt	s	scalar
distance travelled	d	m	scalar
displacement	Δd	m	vector
mass	m	kg	scalar
length	l	m	scalar
speed	v	m/s	scalar
acceleration	a	m/s^2	vector
velocity	v	m/s	vector
force	F	N	vector
energy	E	J	scalar

How to Draw a Vector

Vectors are represented by arrow-tipped line segments. The ends of the vector are referred to as the **head** (the arrowhead) and the **tail** (the other end). The length of the arrow (drawn to scale) represents the magnitude of the quantity. The direction of the arrow represents the direction of the quantity.

The direction a vector points is typically described using compass directions: north, south, east, and west. If the vector does not point in one of these four directions, then its direction is indicated by the angle the vector makes with one of the axes of our coordinate system, as shown below.



The vector being represented is the vector $\vec{A}$.

Notice that the vector is drawn with its tail at the origin of the coordinate system, and that **the angle is measured at the tail**. Also, notice that the axes of the coordinate system have been labeled north, south, east, and west.

In order to draw a vector, we will follow the procedure below:

1. Choose a starting point.
   - leave room for your diagram (consider size and direction)

2. Choose a scale.
   - like a map scale (e.g. 1 cm = 100 km)
   - make it small enough that your vector will fit on your page
   - write your scale on your diagram

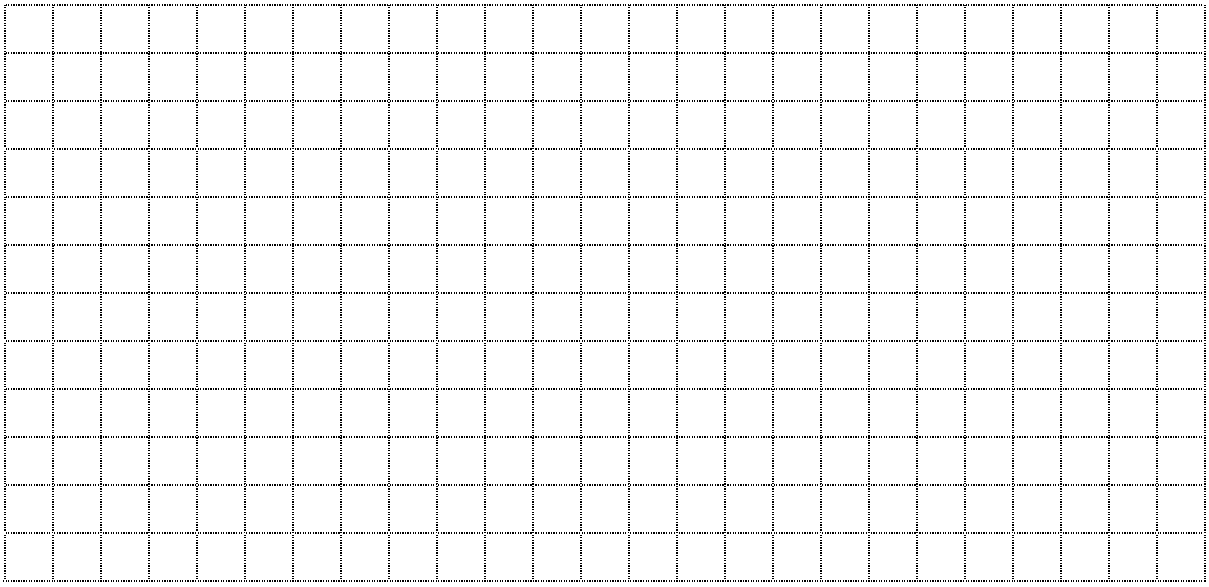
3. Define a system of direction.

4. Draw the vector.
   - direction as given in the question, according to your system
   - length according to scale

5. Label your diagram.
   - symbol
   - scale
   - magnitude
   - angle

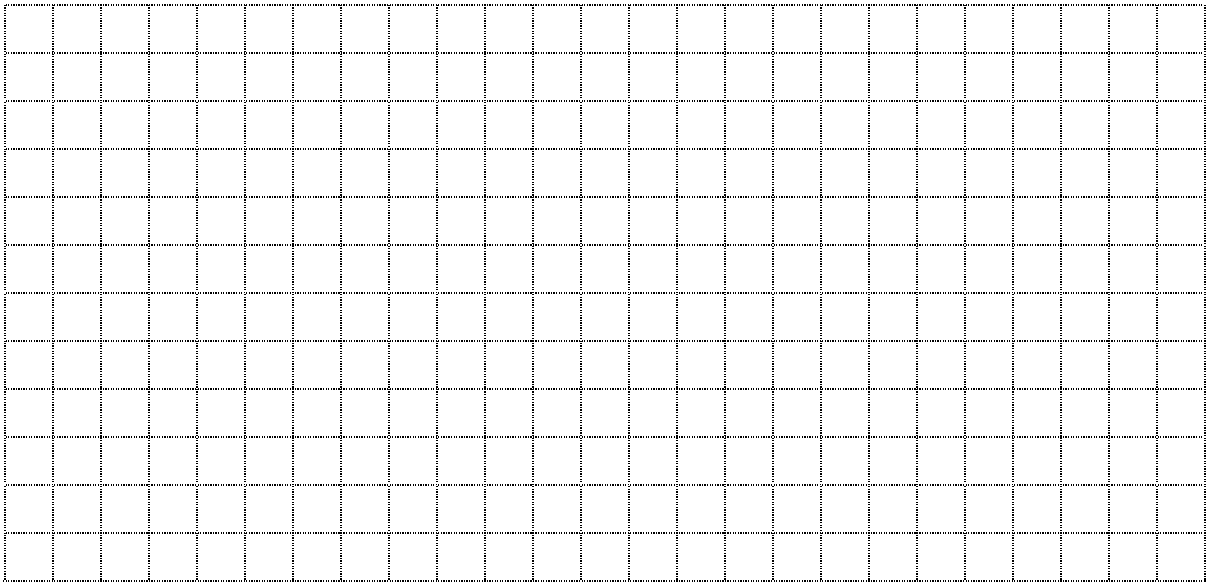
Example 1

Draw the vector $\vec{A} = 10\ m\ \left[30°\ North\ of\ East\right]$.



Example 2

Draw the vector $\vec{B} = 45\ m\ \left[45°\ W\ of\ S\right]$.



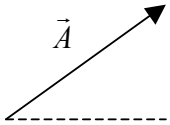
Physics 30S **Vectors Worksheet #1**

Identify the following quantities and state whether they are vectors or scalars.

	Quantity	Vector/Scalar
$22\ m$		
$1.35\ m/s\ [E]$		
$62\ N\ [N]$		
$35\ s$		
$18\ cm/s^2\ [S]$		

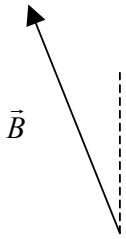
Determine the magnitude and direction of each of the following vectors. Write the vector notation for each.

1.



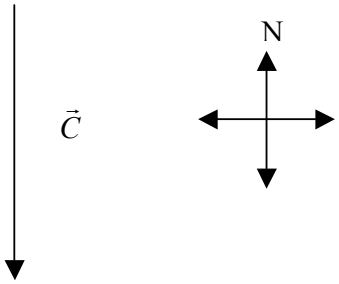
1 cm = 30 m/s

2.



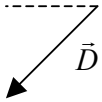
1 cm = 15 N

3.



1 cm = 90 m

4.



1 cm = 35 km/h

Draw and label a scale diagram representing each of the following vectors.

5. $\vec{E} = 40\ N$ [30° W of S]
6. $\vec{F} = 145\ cm$ [20° N of W]
7. $\vec{G} = 300\ Kg \cdot m/s^2$ [15° S of E]
8. $\vec{H} = 240\ m/s$ [85° N of E]
9. $\vec{I} = 19\ km/h$ [SW]
10. $\vec{J} = 106\ N$ [60° W of N]