

Chapter 2 - Motion in 2 Dimensions

KEY CONCEPTS

After completing this chapter you will be able to

- explain the difference between vectors and scalars
- solve vector problems involving distance, position, and displacement
- describe how to determine total displacement in two dimensions by scale diagram and by the component method
- solve problems related to the horizontal and vertical components of motion of a projectile using kinematics equations (determine the range, maximum height, and time of flight for a projectile's motion)
- assess the social and environmental impacts of a technology that applies kinematics concepts

Learning Goal: By the end of today, I will be able to calculate the displacement of an object in two dimensions using a vector scale diagram.

Feb 1-9:35 PM

VECTORS

PART 1: THE GEOMETRY AND ALGEBRA OF VECTORS

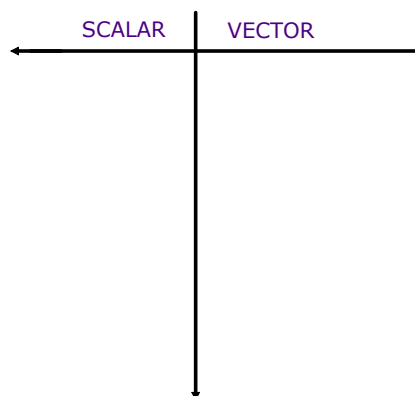
Define:

Scalar:

a quantity that can be described by a single number (magnitude).

Vector:

A quantity that has both direction and magnitude.



- DISTANCE
- VELOCITY
- MASS
- SPEED
- WEIGHT
- DISPLACEMENT

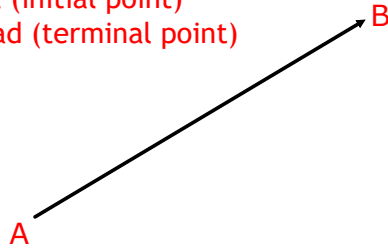
Aug 31 - 1:42 PM

TO REPRESENT A GEOMETRIC VECTOR

-directed line segment

Drag to A or B

Tail (initial point)
Head (terminal point)



\vec{AB}

Length= represents the magnitude

Arrow= shows direction

Magnitude (or size) of the vector is shown with absolute value signs

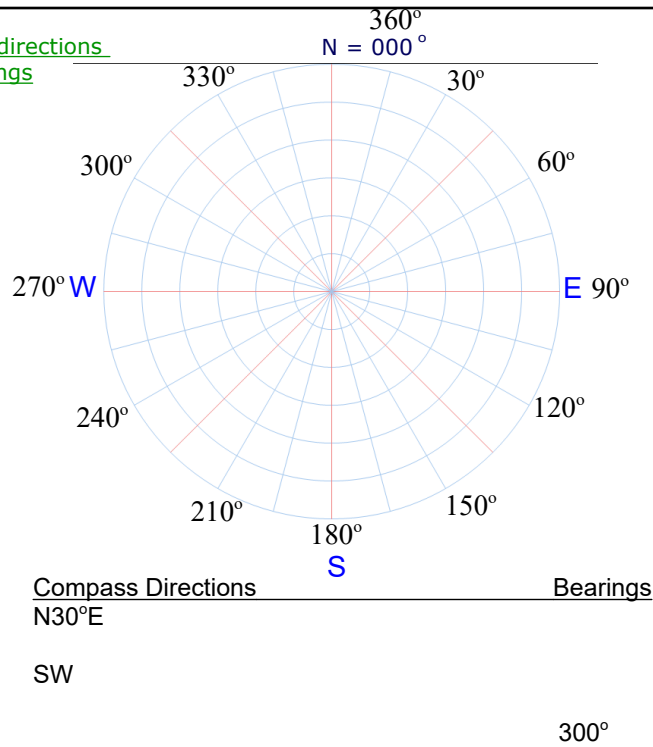
-magnitudes are always positive
-vectors are drawn to SCALE, so a larger arrow represents a larger magnitude

Direction of Vector can be described by:

- 1/ Compass direction
(assume north at top of page unless otherwise stated)
- 2/ Bearings
(north is 000°)
- 3/ Up, down, right, left

Aug 31 - 2:00 PM

Compass directions and Bearings

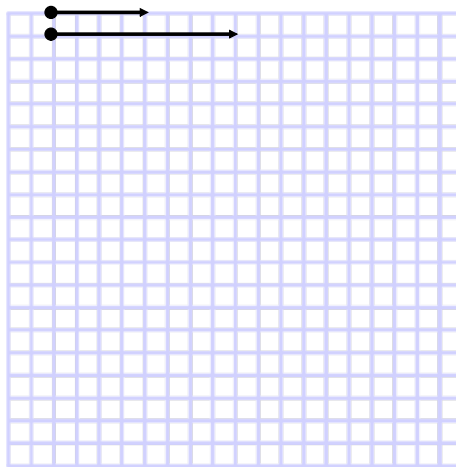


Aug 31 - 2:10 PM

Drawing Vectors:

Ex: displacement 3 km southeast.

(1cm blocks = 1 km)

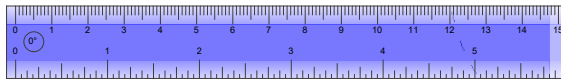
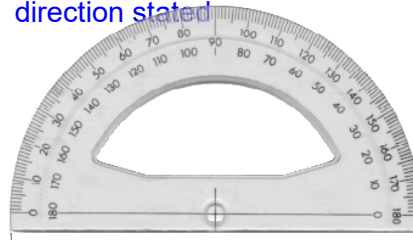
Steps to draw vector

1/ State scale

2/ Select a convenient initial point

3/ Use a protractor to mark the correct direction

4/ Construct an appropriate length line segment in the direction stated



Aug 31 - 2:18 PM

Challenge: Use your ruler and protractor to draw two vector displacements;

8km [S] followed by 6km [E]

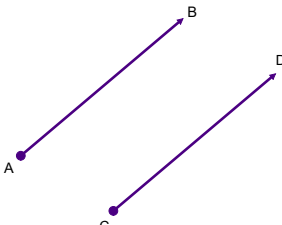
Include arrow directions and make sure the diagram is as accurate as you can make it.

Measure the resultant displacement (from start to finish directly). Measure the angle for the direction of the resultant.

Compare your measured answers to the calculated answers using Pythagorean theorem and primary trig. ratios.

Feb 27-2:23 PM

Equivalent or Equal Vectors:



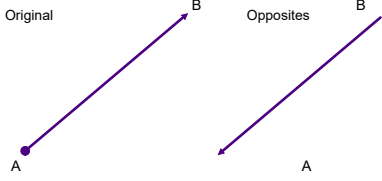
$\vec{AB} = \vec{CD}$

Two vectors are equal if:

1. the vectors have the SAME magnitude
2. are parallel (same direction)

Opposite Vectors:

Opposite Vectors have the same magnitude but opposite direction.



Original: \vec{AB} Opposites: \vec{BA}

$\vec{AB} = -\vec{AB}$ or \vec{BA}

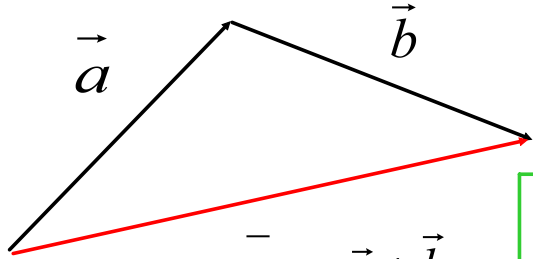
Note the direction change can be indicated by the "-" sign or by reversing the letters.

The magnitude is the same. $|\vec{AB}| = |\vec{BA}|$

Aug 31 - 2:18 PM

Adding Vectors

To add vectors, we arrange them TIP to TAIL



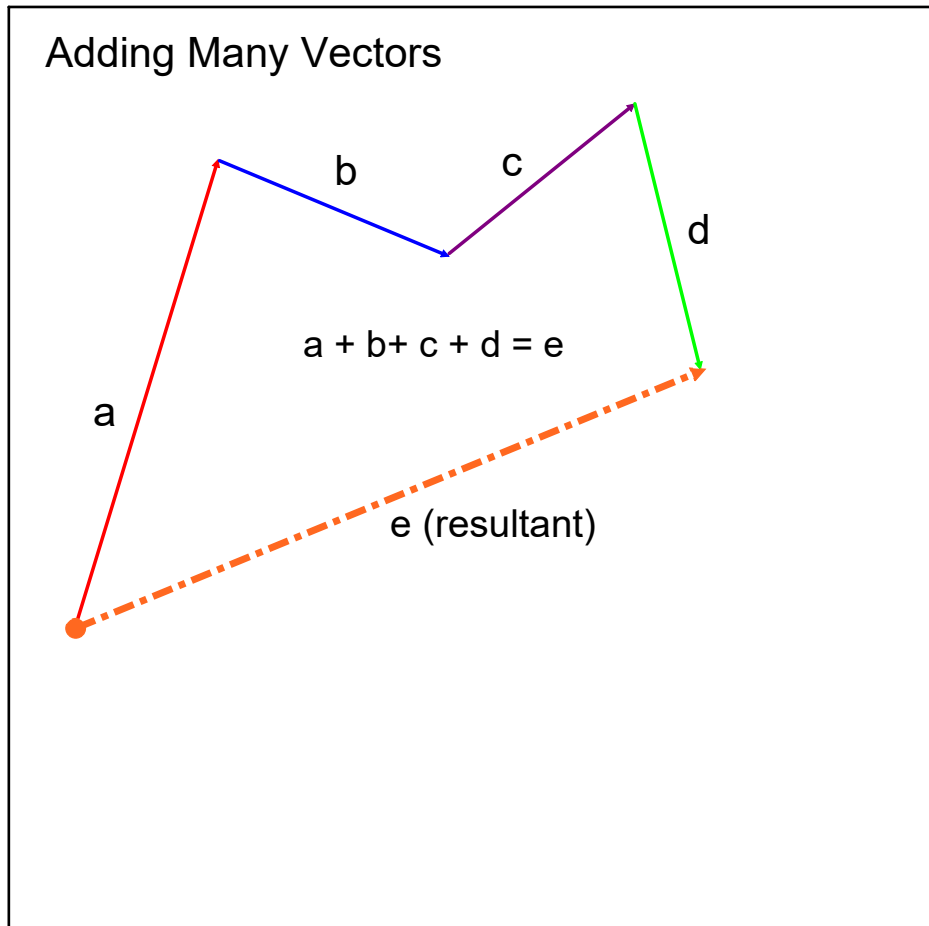
\vec{c} or $\vec{a} + \vec{b}$

$$\vec{a} + \vec{b} = \vec{c}$$

$$\vec{a} + \vec{b} - \vec{c} = 0$$

The RESULTANT is vector formed when an arrow is connected from the start to finish of the added vectors.

Oct 2-12:48 PM



Oct 2-12:51 PM

Practice

- Use a scale diagram to determine the sum of each pair of displacements. T/I C
 - $\Delta \vec{d}_1 = 72 \text{ cm [W]}$, $\Delta \vec{d}_2 = 46 \text{ cm [N]}$
 - $\Delta \vec{d}_1 = 65.3 \text{ m [E } 42^\circ \text{ N]}$, $\Delta \vec{d}_2 = 94.8 \text{ m [S]}$
- A cyclist travels $450 \text{ m [W } 35^\circ \text{ S]}$ and then rounds a corner and travels $630 \text{ m [W } 60^\circ \text{ N]}$. T/I
 - What is the cyclist's total displacement?
 - If the whole motion takes 77 s , what is the cyclist's average velocity?

Group Task - VSD**Task - Drawing**

Sep 25-10:03 AM

2.1 Questions

1. Draw a Cartesian coordinate system on a sheet of paper. On this Cartesian coordinate system, draw each vector to scale, starting at the origin.
 - (a) $\Delta \vec{d} = 8.0 \text{ cm [S } 15^\circ \text{ E]}$
 - (b) $\Delta \vec{d} = 5.7 \text{ cm [N } 35^\circ \text{ W]}$
 - (c) $\Delta \vec{d} = 4.2 \text{ cm [N } 18^\circ \text{ E]}$
2. How could you express the direction of each vector listed in Question 1 differently so that it still describes the same vector?
3. The scale diagram shown in Figure 11 represents two vectors.

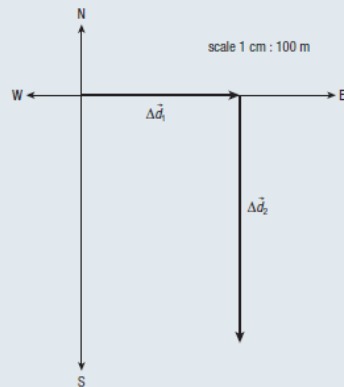


Figure 11

- (a) Use the given scale to determine the actual vectors.
- (b) Copy the scale diagram and complete it to determine the resultant vector when the two vectors are added.
4. A taxi drives 300.0 m south and then turns and drives 180.0 m east. What is the total displacement of the taxi?
5. What is the total displacement of two trips, one of 10.0 km [N] and the other of 24 km [E]?
6. If you added the two displacements in Question 5 in the opposite order, would you get the same answer? Explain.
7. A horse runs 15 m [N 23° E] and then 32 m [S 35° E]. What is the total displacement of the horse?
8. A car travels 28 m [E 35° S] and then turns and travels 45 m [S]. The whole motion takes 6.9 s.
 - (a) What is the car's average velocity?
 - (b) What is the car's average speed?
9. An aircraft experiences a displacement of 100.0 km [N 30° E] due to its engines. The aircraft also experiences a displacement of 50.0 km [W] due to the wind.
 - (a) What is the total displacement of the aircraft?
 - (b) If it takes 10.0 min for the motion to occur, what is the average velocity, in kilometres per hour, of the aircraft during this motion?

Aug 31 - 2:16 PM