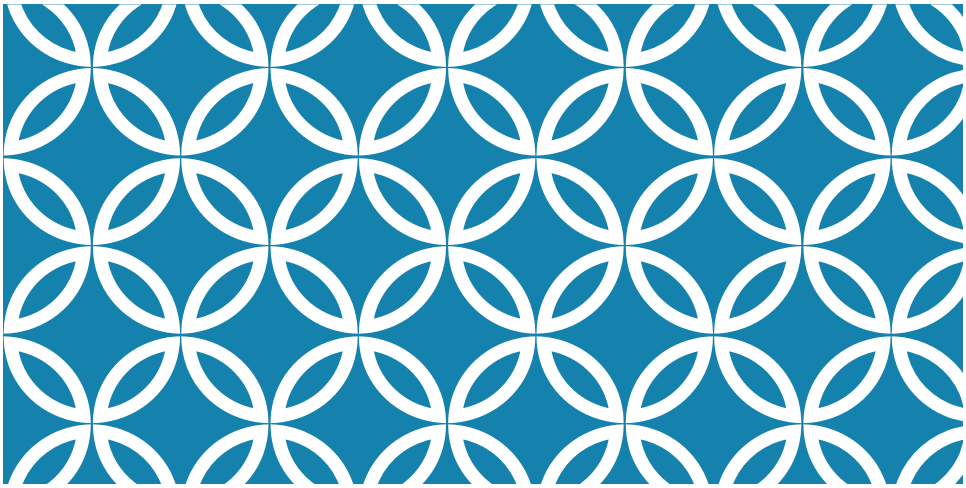


TWO-DIMENSIONAL MOTION, VECTORS, AND PROJECTILE MOTION

AP Physics Unit 1
Kinematics

OBJECTIVES

- Recognize the differences among, one-, two-, and three-dimensional motion
- Describe the properties of a vector and how to find the sum or difference of two vectors
- Be able to solve vector problems graphically and mathematically.
- Solve problems involving projectile motion

SCALAR & VECTOR QUANTITIES AND GRAPHICAL VECTOR ADDITION

A **scalar** is a physical quantity that has magnitude but no direction

- Examples – Mass of an object, # of leaves on a tree, speed

Vector – Physical quantity that has both direction and magnitude

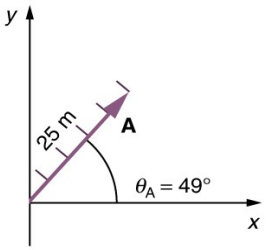
- Velocity includes speed and direction

$\vec{v}$ = 100 km/h to north

Tail → Head

- Vectors have a head and tail
- A **resultant vector** represents the sum of two or more vectors.
- Resultant vector goes from the tail of the first vector to the tip of the second vector
- Vectors can be added **graphically.**

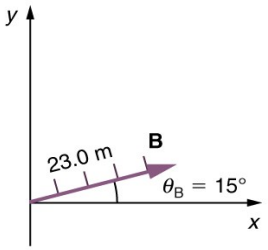
DESCRIBING VECTOR POSTION



25m, 49° North of East

Or

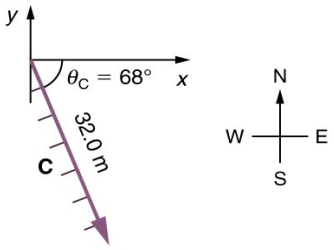
25m 41° East of North



23.0m, 15° North of East

Or

23.0m 75° East of North

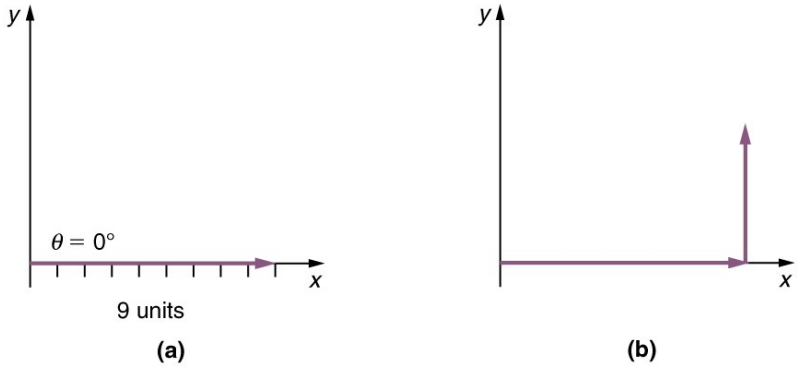


32.0m, 68° South of East

Or

32.0m, 22° East of South

TAIL TO HEAD METHOD OF ADDING VECTORS



Example: two displacements of the person walking in a city:

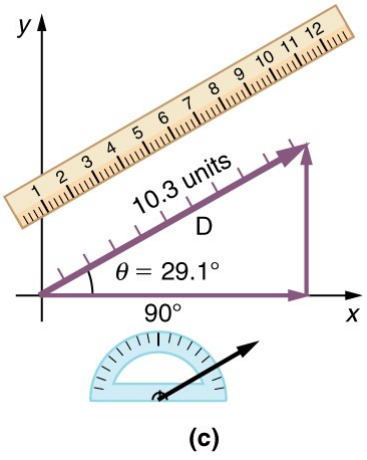
a) Person starts walking 9 units to East: Draw a vector representing the displacement

b) Draw a vector representing the displacement to the north. The tail of this vector should originate from the head of the first, east-pointing vector

TAIL TO HEAD METHOD OF ADDING VECTORS

Using a protractor:

- draw a line at an angle Ø relative to the east-west axis.
- The length *D* of the arrow is proportional to the vector's magnitude and is measured along the line with a ruler.
- In this example, the magnitude *D* of the vector is 10.3 units, and the direction ϑ is 29.1° north of east.



ADDING VECTORS

Adding vectors – Make sure using same units!

- Can be added in any order
- You can draw one vector with its **tail** starting at the **tip** of the other as long as the size and direction of each vector do not change.

The **resultant vector** can then be drawn from the tail of the first vector to the tip of the last vector.

Resultant – vector representing the sum of 2 or more vectors

- Vector A – 15 km/h north
- Vector B – 70 km/h 45° south of east
- Vector C – 9 km/h north
- Resultant R – 66 km/h 20° north of east