SPH3U
UNIVERSITY PHYSICS

KINEMATICS

- Vectors
  (P.11-13)

Vector Scale Diagrams

Motion along a straight line (i.e., one dimension) is easy to analyze but in real life most motion does not occur in a straight line. However, there is another method you can use to solve displacement problems: vector scale diagrams. A ***vector scale diagram*** *is a representation of motion using vectors drawn to a particular scale. Vector scale diagrams are very useful in measuring the total displacement of an object from its original position.*

VECTOR SCALE DIAGRAM

- representation of motion using vectors drawn to scale

Vectors

*A **vector** can be represented by a directed line segment, which is a straight line segment between two points with an arrowhead pointing in a specific direction. The end with the arrowhead is called the **tip** while the other end is called the **tail**.*

VECTOR

- directed line segment

NOTE!

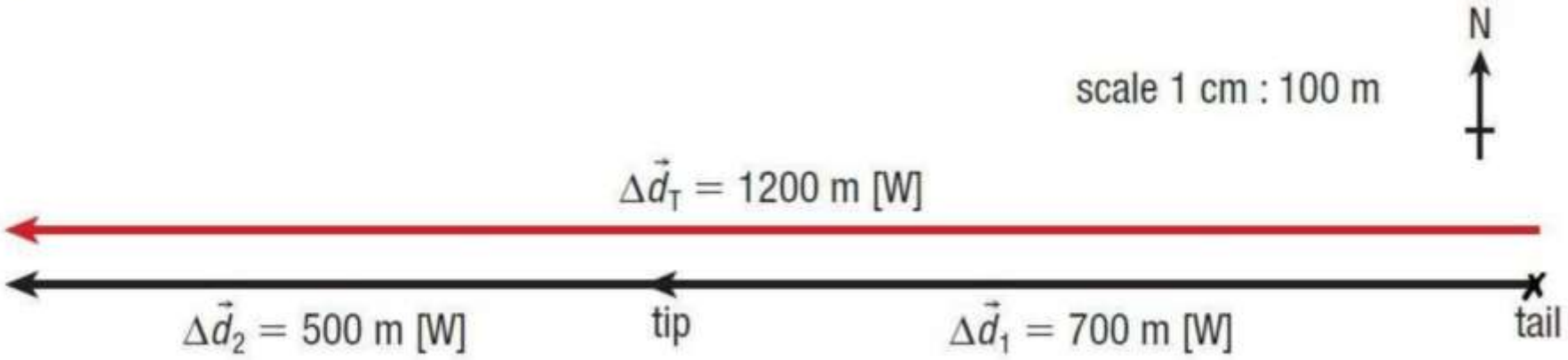
Vectors are added tip to tail.

Vector Scale Diagrams

For straight-line motion, vector scale diagrams are not very complex. Consider the two displacements:

$$\Delta\vec{d}_1 = 700\ m[W] \quad \& \quad \Delta\vec{d}_2 = 500\ m[W]$$

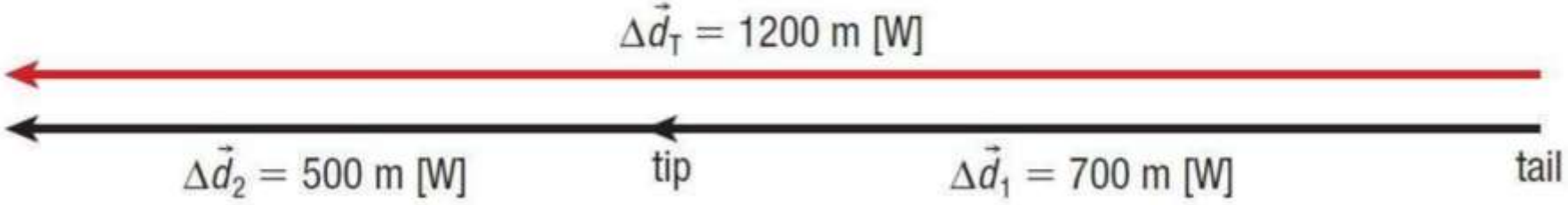
We can determine the total displacement that results from adding these two vectors together by ① drawing a vector scale diagram of the motion and then ② measuring the length of the line that represents the total displacement.



Vector Diagrams

NOTE!

In most cases we will not use a scale diagram. Instead, we will sketch the vector diagram that represents the motion and then use that to help determine the displacement. When we are dealing with motion in two dimensions, we will need to use Pythagoras and trigonometry to determine the vector length and direction (see Q.4 at the end of this powerpoint).



Vector Diagrams

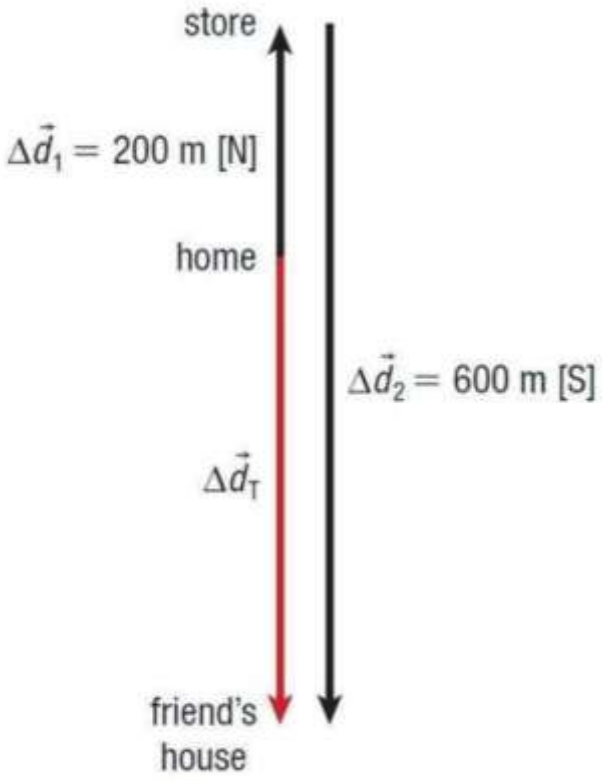
PRACTICE

1. Fred is going to visit a friend but he needs to stop at the variety store first. He walks 200 m[N] from his home to the store and then 600 m[S] to his friend's house.

   (a) Sketch a vector diagram of the situation showing:

   (i) the displacement vectors and

   (ii) the total displacement vector.



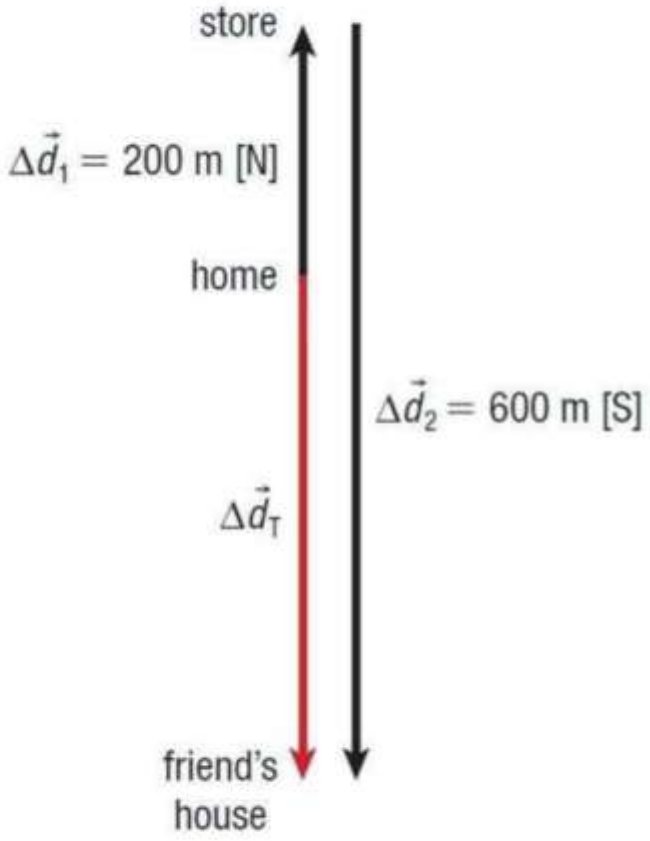
Vector Diagrams

PRACTICE

1. Fred is going to visit a friend but he needs to stop at the variety store first. He walks 200 m[N] from his home to the store and then 600 m[S] to his friend's house.

   (b) What is Fred's total displacement?

(b) $\Delta d_T = 400$ m[S]



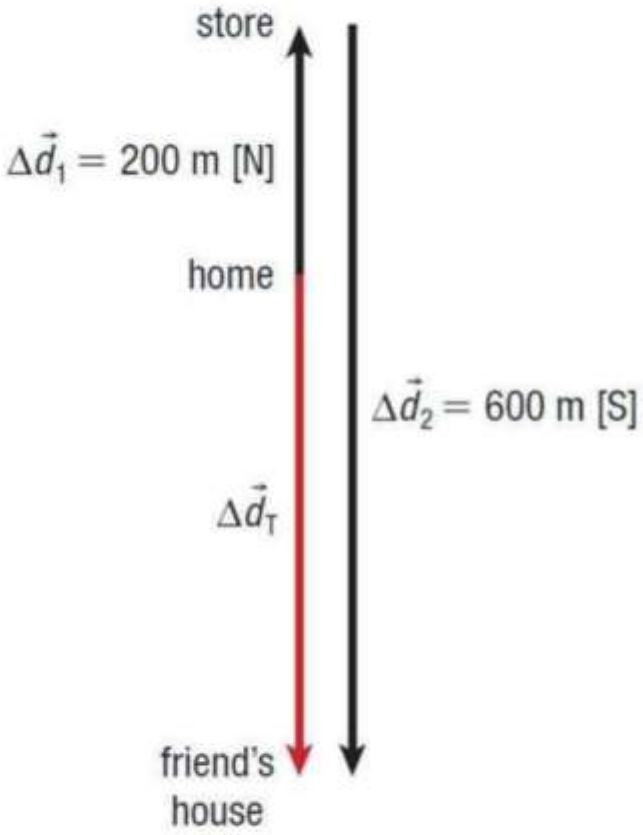
Vector Diagrams

PRACTICE

1. Fred is going to visit a friend but he needs to stop at the variety store first. He walks 200 m[N] from his home to the store and then 600 m[S] to his friend's house.

   (c) What is Fred's total distance?

(c) $\Delta d_T = 800$ m



Vector Diagrams

PRACTICE

2. A rabbit runs 3.8 m[N] and stops to nibble on some grass. The rabbit then hops 6.3 m[N] to scratch against a small tree.

   (a) Sketch a diagram of the motion showing the displacement vectors and the total displacement vector.

Vector Diagrams

PRACTICE

2. A rabbit runs 3.8 m[N] and stops to nibble on some grass. The rabbit then hops 6.3 m[N] to scratch against a small tree.

   (b) What is the rabbit's total displacement?

(b) $\Delta d_T = 10.1$ m[N]

Vector Diagrams

PRACTICE

3. A skateboarder slides 4.2 m up a ramp, stops, and then slides 2.7 m down the ramp before jumping off.
   (a) Sketch a diagram of the motion showing the displacement vectors and the total displacement vector.

Vector Diagrams

PRACTICE

3. A skateboarder slides 4.2 m up a ramp, stops, and then slides 2.7 m down the ramp before jumping off.

   (b) What is his (i) total distance and (ii) total displacement up the ramp?

(b) $d_T = 6.9$ m; $\Delta d_T = 1.5$ m[up]

Vector Diagrams

PRACTICE

4. Determine the x- and y-components of the following vectors.

   (a) 5.0 m [N 37° E]

   (b) 13 m/s [W 67° S]

   (a) v_x = 3.0 m [E]
   v_y = 4.0 m [N]

   (b) v_x = 5.0 m/s [W]
   v_y = 12 m/s [S]

NOTE! These vectors (or multiples thereof) are often used in physics vector problems because their components are whole numbers.