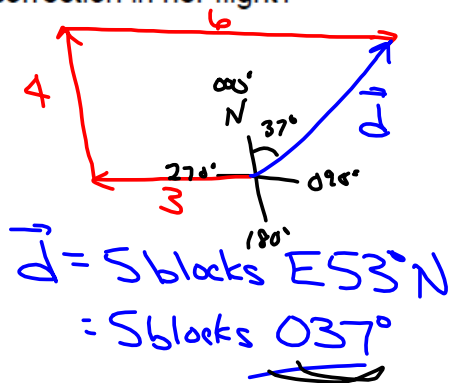


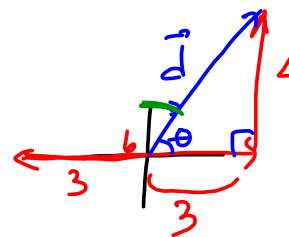
3. A boy delivering papers covers his route by travelling 3.0 blocks west, 4.0 blocks north, then 6.0 blocks east. A) What is his final displacement? B) What is the total distance travelled?  
 (5.0 blocks  $037^\circ$ , 13 blocks)

4. Find the sum of two vectors, one of which is 2.00 m east and the other is 3.00 m south.  
 (3.61 m  $146^\circ$ )

6. A plane is flying due north with a speed of 250 km/h when a wind comes up blowing at 40.0 km/h from the east. What is the resultant velocity of the plane if the pilot makes no correction in her flight?  
 (253 km/h  $351^\circ$ )



bearing = angle clockwise (CW)  
 from North



$$c^2 = a^2 + b^2$$

$$= 3^2 + 4^2$$

$$= 9 + 16 = 25$$

$$c = 5$$

3-4-5  $\Delta$   
 $d = 5 \text{ blocks}$   
 $\theta = 53^\circ$   
 $\tan \theta = \frac{4}{3}$   
 $\theta = 53^\circ$

7. A man walks 600 m bearing  $270^\circ$ , then turns and walks 250 m bearing  $180^\circ$ . Find his resultant displacement. (650 m  $247^\circ$ )
8. An airplane flies 400 km/h  $000^\circ$  when there is no wind. If a 50.0 km/h East wind comes up and the pilot makes no correction in his flight, what will his resultant velocity be? (403 km/h  $353^\circ$ )
9. A man heads straight across a river in his canoe paddling at the rate of 2.0 m/s. The river current is flowing at the rate of 4.0 m/s. What is the resultant velocity of the canoe? (4.5 m/s  $27^\circ$  to shore)

from East  
(towards West)



$$V^2 = V_B^2 + V_C^2$$

$$= 2^2 + 4^2$$

$$V^2 = 20$$

$$V = 4.5 \frac{m}{s}$$

$$\tan \theta = \frac{2 \frac{m}{s}}{4 \frac{m}{s}}$$

$$\theta = 27^\circ$$

$$\vec{V} = 4.5 \frac{m}{s} @ 27^\circ \text{ to shore}$$

$$= 4.5 \frac{m}{s} \text{ } 63^\circ \text{ downstream}$$

## When Can We Add Vectors?

So far, we've been assuming that we can add vectors unconditionally, which unfortunately is NOT the case.

In order to add vectors, three conditions MUST ALL be met:

1. The vectors must be of the same type.

We can add 2 displacements. We can't add a displacement with a force or a velocity.

2. The vectors must affect the same object or <sup>group</sup> system of objects.

It makes sense to add 2 displacements of an object  
But not the displacements of 2 different objects UNLESS  
they are part of a group (e.g. relay team)

3. **Either**

The vectors are time independent <sup>time doesn't matter (No units of time in the unit)</sup>

**OR**

The vectors are simultaneous. at the same time

$$\text{Force: } N \left( 1N = 1 \frac{\text{kg} \cdot \text{m}}{\text{s}^2} \right)$$

↑ hidden in the unit.

**Example:**

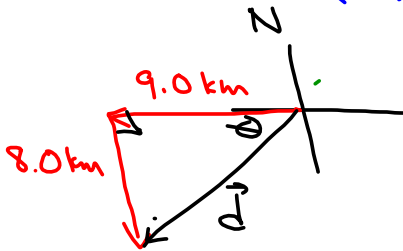
A hiker travels West at a rate of 3.0 km/h for 3 hours and then turns South and travels at a rate of 4.0 km/h for 2 hours.

- a. What is the total distance traveled by the hiker?  $d = 17 \text{ km}$
- b. What is the total displacement of the hiker?
- c. What is the average speed?
- d. What is the average velocity?

Same type ✓ ✓  
 Same obj ✓ ✓  
 Simultaneous X X  
 OR  
 time ind X ✓  
 Can't add the velocities ∴  
 Can add  $\vec{d}$

$$\vec{d}_1 = \vec{v}_1 t_1 = (3 \frac{\text{km}}{\text{h}} \text{ W})(3.0 \text{ h}) = 9.0 \text{ km W}$$

$$\vec{d}_2 = \vec{v}_2 t_2 = (4 \frac{\text{km}}{\text{h}} \text{ S})(2.0 \text{ h}) = 8.0 \text{ km S}$$



$$c^2 = a^2 + b^2$$

$$= 9^2 + 8^2 = 81 + 64$$

$$= 145$$

$$c = 12.0 \text{ km}$$

$$b) \vec{d} = 12.0 \text{ km W } 42^\circ \text{ S}$$

$$228^\circ$$

$$\tan \theta = \frac{8.0}{9.0}$$

$$\theta = 42^\circ$$

$$270^\circ - 42^\circ$$

$$c) V_{ave} = \frac{d}{t} = \frac{17 \text{ km}}{(3+2) \text{ h}} = 3.4 \frac{\text{km}}{\text{h}}$$

$$d) \vec{V}_{ave} = \frac{\vec{d}}{t} = \frac{12.0 \text{ km W } 42^\circ \text{ S}}{5 \text{ h}} = 2.4 \frac{\text{km}}{\text{h}} \text{ W } 42^\circ \text{ S (or } 228^\circ)$$

Homework: Question 10\*  
Questions 1-2 from More Vector Addition Questions

