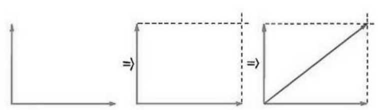
Vectors - 2

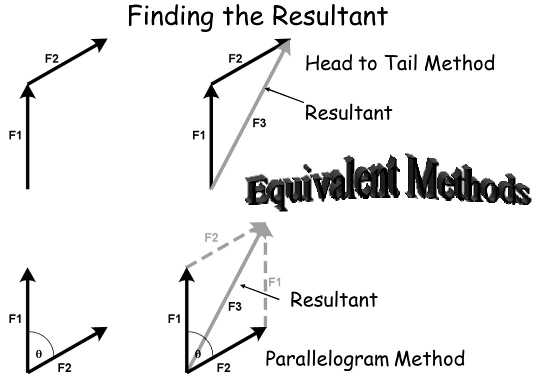
Adding Vectors

- The sum of two or more vectors is called their resultant.
- To find the resultant of two vectors that don't act in exactly the same or opposite direction, we use the parallelogram method.
- Construct a parallelogram wherein the two vectors are adjacent sides—the diagonal of the parallelogram shows the resultant.



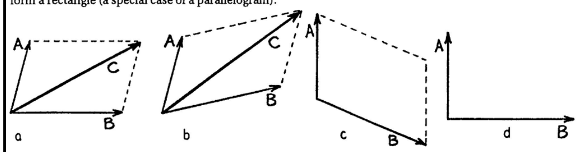
Vector Addition

Finding the Resultant



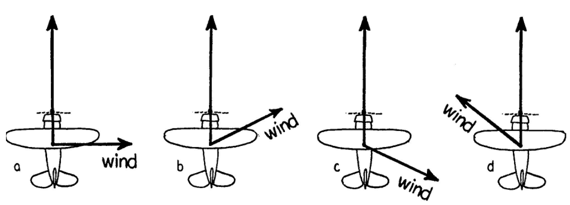
Parallelogram Method

When vectors **A** and **B** are at an angle to each other, they add to produce the resultant **C** by the ***parallelogram rule***. Note that **C** is the diagonal of a parallelogram where **A** and **B** are adjacent sides. Resultant **C** is shown in the first two diagrams, *a* and *b*. Construct the resultant **C** in diagrams *c* and *d*. Note that in diagram *d* you form a rectangle (a special case of a parallelogram).



Velocity Vectors

Below we see a top view of an airplane being blown offcourse by wind in various directions. Use the parallelogram rule to show the resulting speed and direction of travel for each case. In which case does the airplane travel fastest across the ground? _____ Slowest? ______



Boat Velocity Vectors

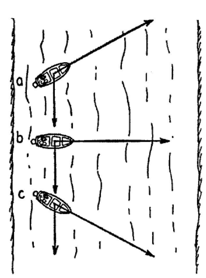
To the right we see top views of 3 motorboats crossing a river. All have the same speed relative to the water, and all experience the same water flow.

Construct resultant vectors showing the speed and direction of the boats.

a. Which boat takes the shortest path to the opposite shore?______

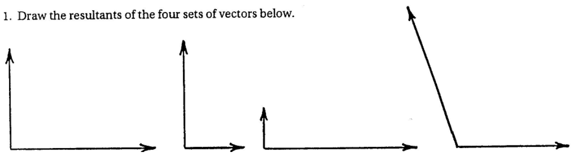
b. Which boat reaches the opposite shore first? ________

c. Which boat provides the fastest ride? _________



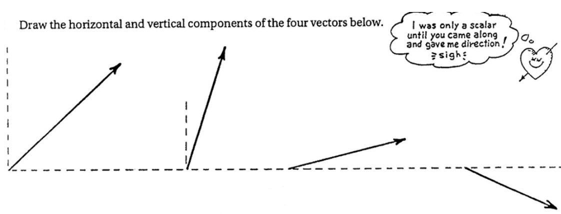
More Practice

1. Draw the resultants of the four sets of vectors below.



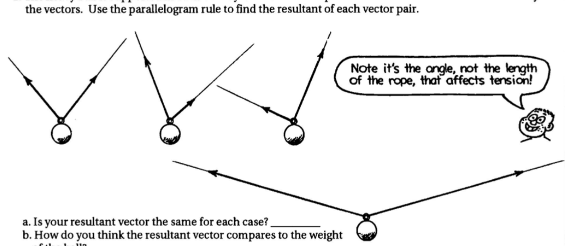
Components Practice

Draw the horizontal and vertical components of the four vectors below.



Tension Vectors

1. The heavy ball is supported in each case by two strands of rope. The tension in each strand is shown by the vectors. Use the parallelogram rule to find the resultant of each vector pair.



a. Is your resultant vector the same for each case? ________
b. How do you think the resultant vector compares to the weight of the ball?
____

Tension & Weight

2. Now let's do the opposite of what we've done above. More often, we know the weight of the suspended object, but we don't know the rope tensions. In each case below, the weight of the ball is shown by the vector **W**. Each dashed vector represents the resultant of the pair of rope tensions. Note that each is equal and opposite to vectors **W** (they must be; otherwise the ball wouldn't be at rest).
   a. Construct parallelograms where the ropes define adjacent sides and the dashed vectors are the diagonals.
   b. How do the relative lengths of the sides of each parallelogram compare to rope tensions? ____________
   c. Draw rope-tension vectors, clearly showing their relative magnitudes.