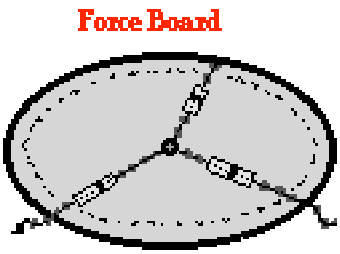
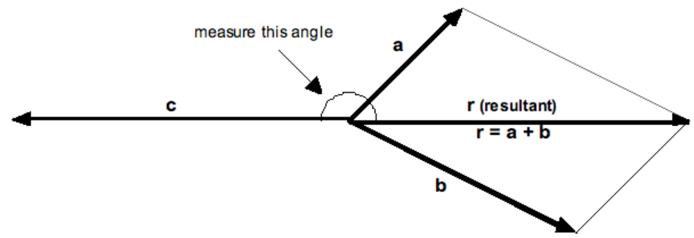
Unit 4 CP WS 3 – The Parallelogram Rule and Vector Components

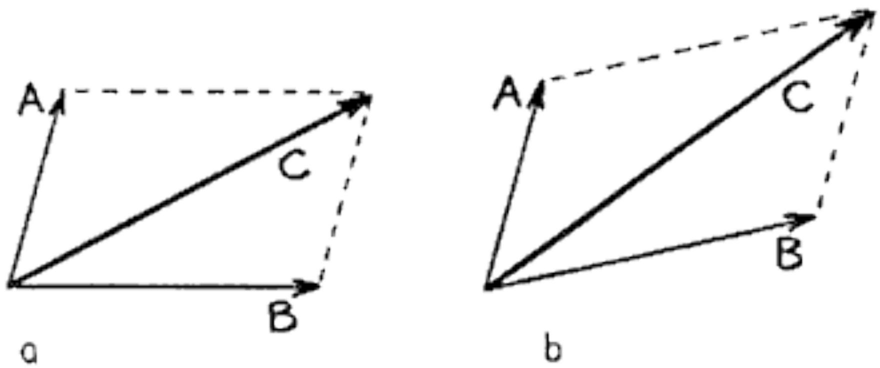
Parallelogram Rule for Vector Addition

When you did the force table lab, you learned that the resultant or vector sum of two force vectors (**a** + **b** found by using the parallelogram rule) was equal and opposite to the third force vector, **c.** All three forces then added to a net force of zero. This system is at rest and is said to be in **static equilibrium**.

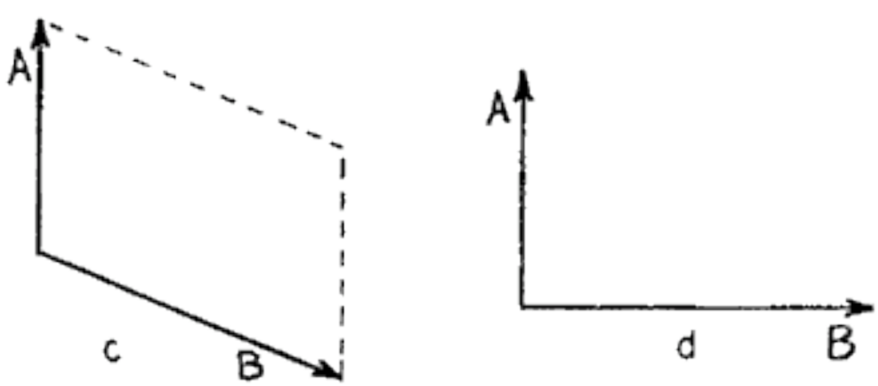




When vectors A and B are at an angle to each other, they add to produce the resultant C by the parallelogram rule. Note that C is the diagonal of a parallelogram where A and B are adjacent sides. Resultant C is shown in the first two diagrams, a and b.

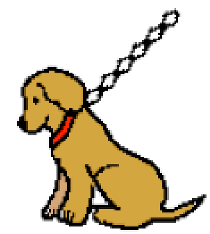


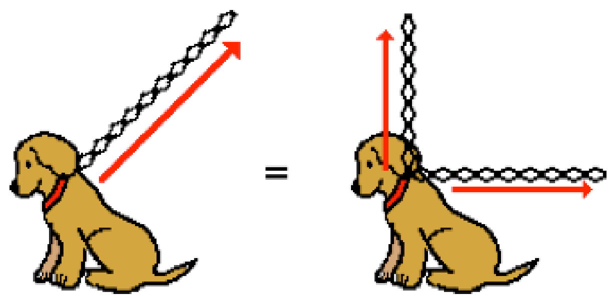
Construct the resultant C in diagrams c and d. Note that in diagram d you form a rectangle (a special case of a parallelogram). After you have finished your constructions, state in the blanks which resultant is the longer and which one is shorter.



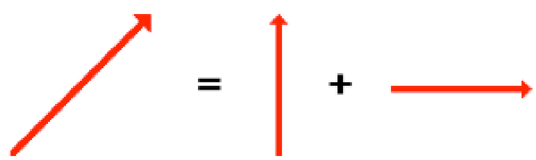
Vector Components:

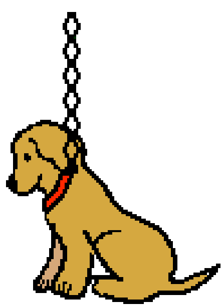
If Fido's dog chain is stretched upward and rightward and pulled tight by his master, then the tension force in the chain has two components - an upward component and a rightward component. To Fido, the influence of the chain on his body is equivalent to the influence of two chains on his body - one pulling upward and the other pulling rightward. If the single chain were replaced by two chains. with each chain having the magnitude and direction of the components, then Fido would not know the difference. This is not because Fido is *dumb* (a quick glance at his picture reveals that he is certainly not that), but rather because the combined influence of the two components is equivalent to the influence of the single two-dimensional vector.



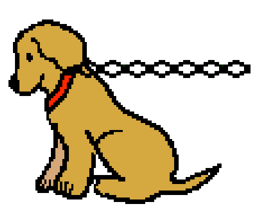


The upward and rightward force of the chain is equivalent to an upward force and a rightward force by two chains.

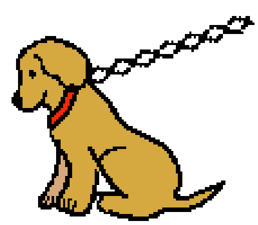




This force exerts no horizontal influence.

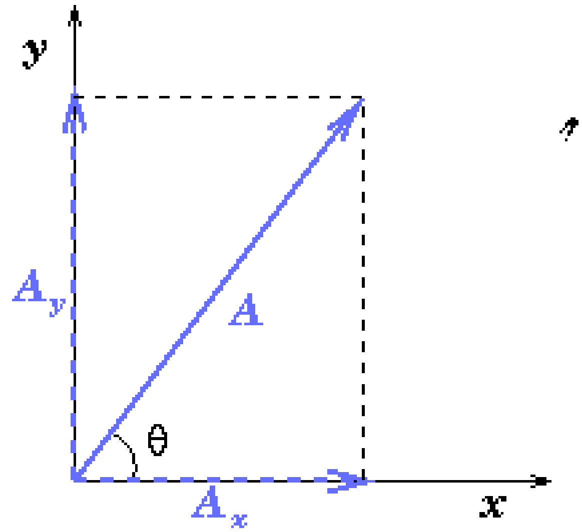


This force exerts no vertical influence.

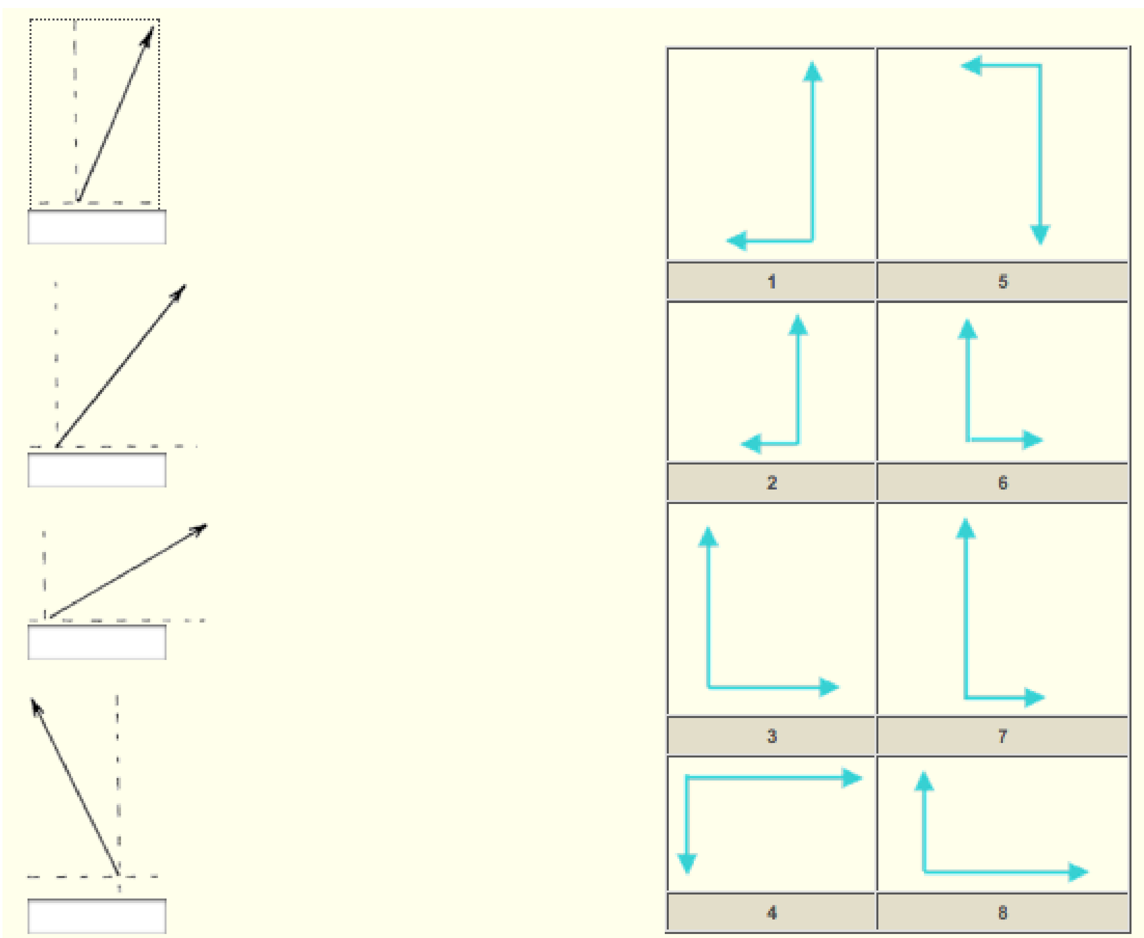


This force exerts both a horizontal and vertical influence, but mostly a horizontal one.

The method of drawing components is show in the diagram to the right, $\mathbf{A}_x$ is the component of **A** along the x-axis and $\mathbf{A}_y$ is the component of **A** along the y-axis. θ is the direction of the vector from the x-axis.



Match the vector (1-8) that best represents the components of each vector. Notice in the "choices table" that the components are in the row above their number!



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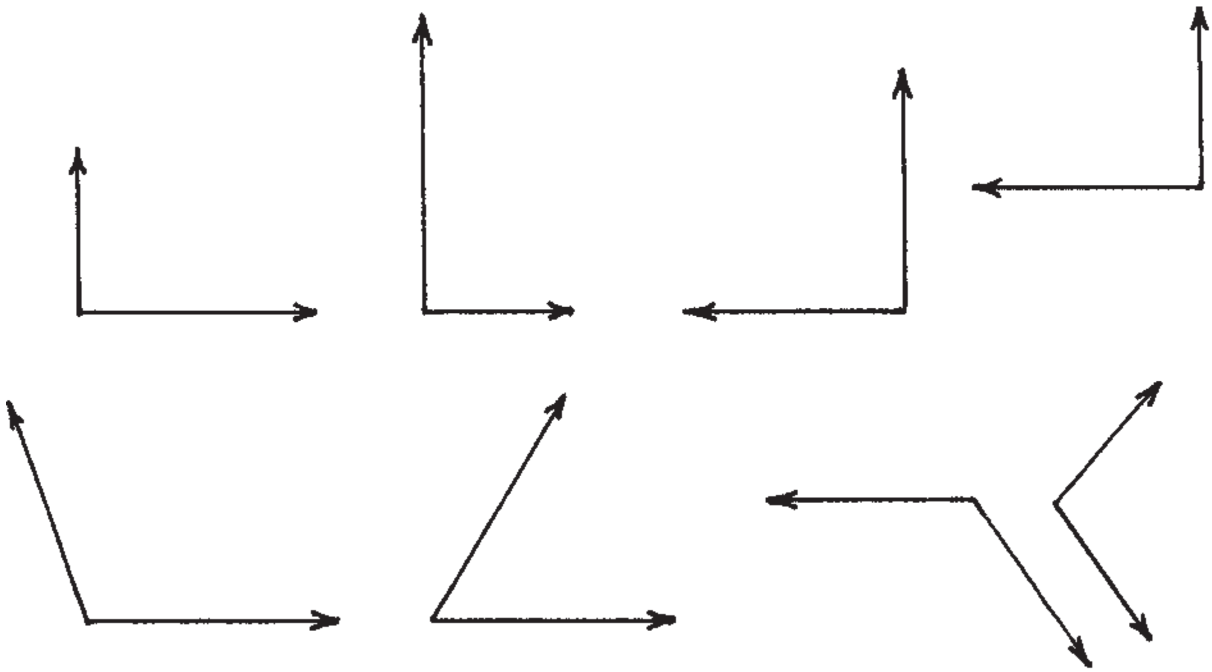
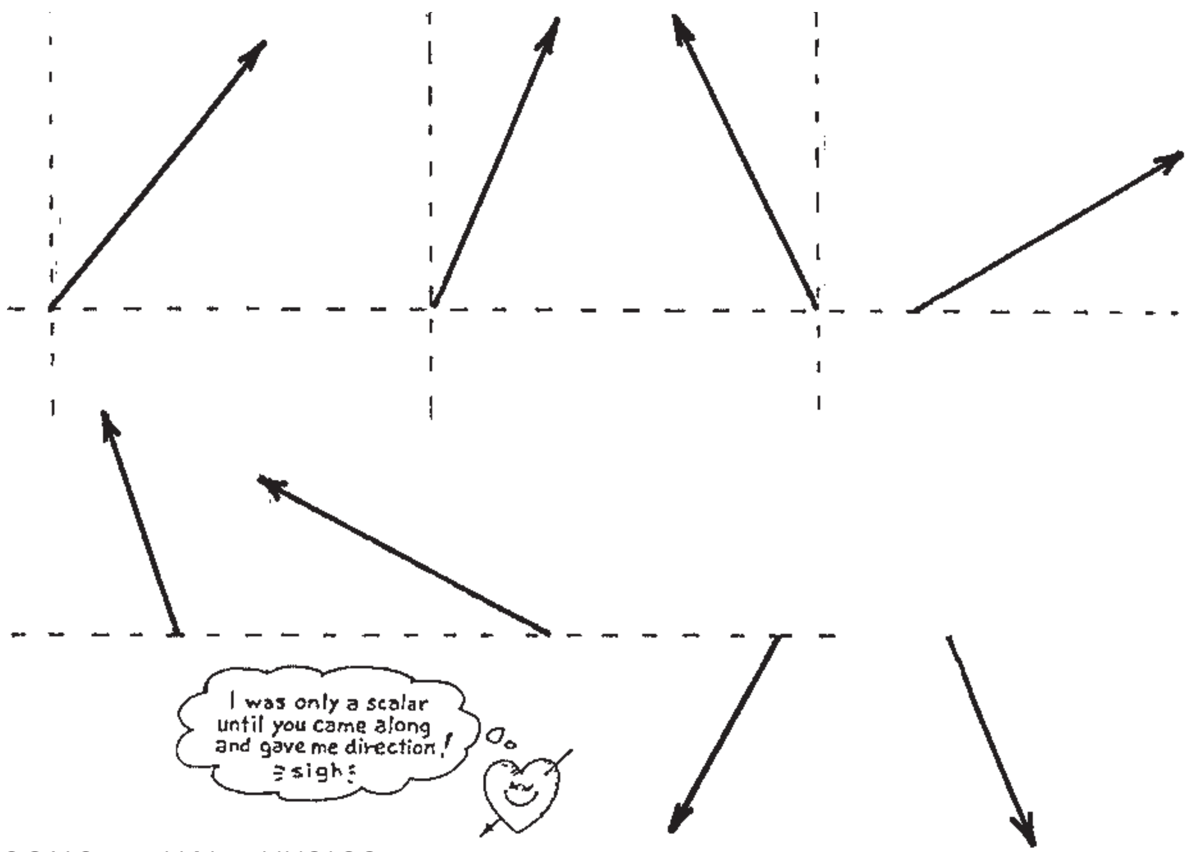
Vectors

Use the parallelogram rule to carefully construct the resultants for the eight pairs of vectors.



Carefully construct the vertical and horizontal components of the eight vectors.



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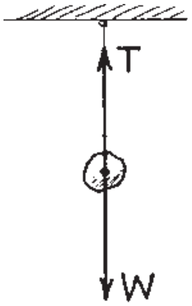
Vectors and Equilibrium



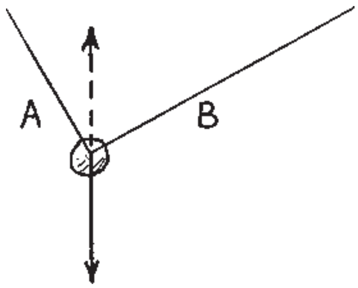
The rock hangs at rest from a single string. Only two forces act on it, the upward tension **T** of the string, and the downward pull of gravity **W**. The forces are equal in magnitude and opposite in direction.

Net force on the rock is (zero) (greater than zero).

Here the rock is suspended by 2 strings. Tension in each string acts in a direction along the string. We'll show tension of the left string by vector **A**, and tension of the right string by vector **B**. The resultant of **A** and **B** is found by the **parallelogram rule**, and is shown by the dashed vector. Note it has the same magnitude as **W**, so the net force on the rock is

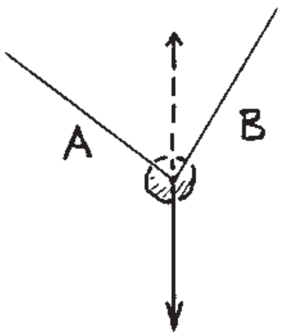
(zero) (greater than zero).

Consider strings at unequal angles. The resultant **A + B** is still equal and opposite to **W**, and is shown by the dashed vector. Construct the appropriate parallelogram to produce this resultant. Show the relative magnitudes of **A** and **B**.

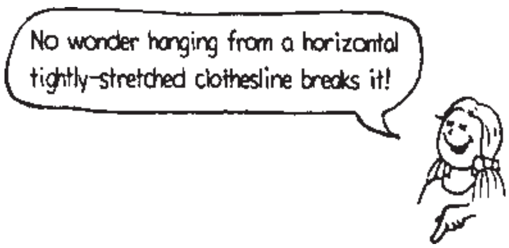


Tension in **A** is (less than) (equal to) (greater than) tension in **B**.

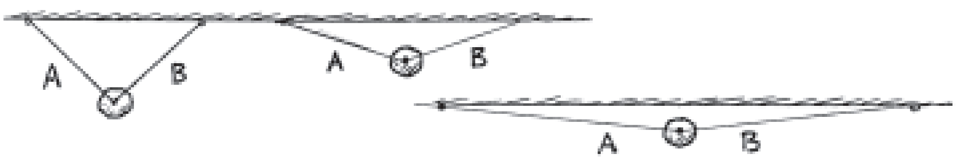
Repeat the procedure for the arrangement below.



Here tension is greater in ________.



Construct vectors **A** and **B** for the cases below. First draw a vector **W**, then the parallelogram that has equal and opposite vector **A + B** as the diagonal. Then find approximate magnitudes of **A** and **B**.



CONCEPTUAL PHYSICS