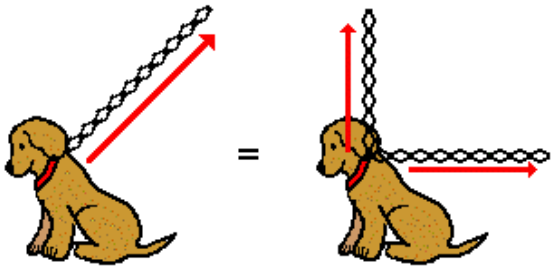
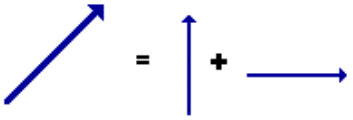
Independence of Perpendicular Components of Motion

A force vector that is directed upward and rightward has two parts - an upward part and a rightward part. That is to say, if you pull upon an object in an upward and rightward direction, then you are exerting an influence upon the object in two separate directions - an upward direction and a rightward direction. These two parts of the two-dimensional vector are referred to as components. A **component** describes the affect of a single vector in a given direction. Any force vector that is exerted at an angle to the horizontal can be considered as having two parts or components. The vector sum of these two components is always equal to the force at the given angle. This is depicted in the diagram below.

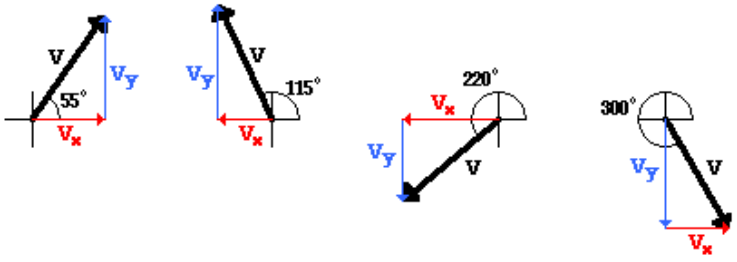


A pull upon Fido's chain in an upward and a rightward direction exerts two separate influences upon Fido - an upward and a rightward influence.



The force exerted at the angle is equal to the vector sum of the two individual forces.

Any vector - whether it is a force vector, displacement vector, velocity vector, etc. - directed at an angle can be thought of as being composed of two perpendicular components. These two components can be represented as legs of a right triangle formed by projecting the vector onto the x- and y-axis.



Four velocity vectors - labeled V - with varying directions are shown. The horizontal and vertical components of these vectors are drawn and labeled. Note that a northwest vector has a north and a west component and a southeast vector has a south and an east component.

The two perpendicular parts or components of a vector are independent of each other. Consider the pull upon Fido as an example. If the horizontal pull upon Fido increases, then Fido would be accelerated at a greater rate to the right; yet this greater horizontal pull would not exert any vertical influence upon Fido. Pulling horizontally with more force does not lift Fido vertically off the ground. A change in the horizontal component does not affect the vertical component. This is what is meant by the phrase "perpendicular components of vectors are independent of each other." A change in one component does not affect the other component. Changing a component will affect the motion in that specific direction. While the change in one of the components will alter the magnitude of the resulting force, it does not alter the magnitude of the other component.

All vectors can be thought of as having perpendicular components. In fact, any motion that is at an angle to the horizontal or the vertical can be thought of as having two perpendicular motions occurring simultaneously. These perpendicular components of motion occur independently of each other. Any component of motion occurring strictly in the horizontal direction will have no affect upon the motion in the vertical direction. Any alteration in one set of these components will have no affect on the other set.