

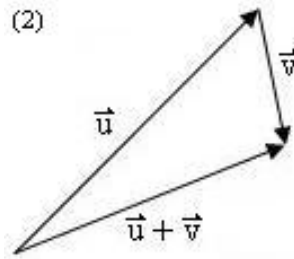
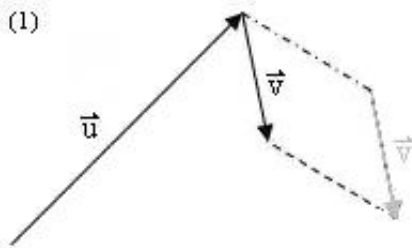
Vector Operations using geometry:

Suppose we have the following vectors \vec{u} and \vec{v} .

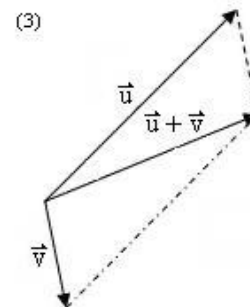
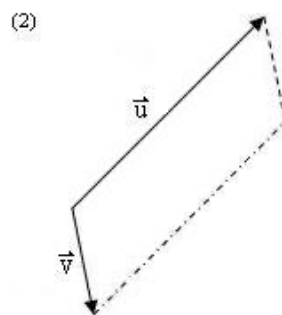
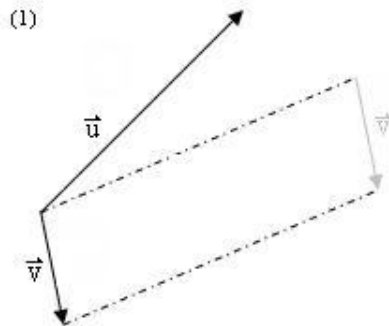


Addition of Vectors:

Triangle Method: (1) Slide \vec{v} over so that its tail coincides with the head of \vec{u} . (2) Draw an arrow starting at the tail of \vec{u} and ending at the head of \vec{v} .

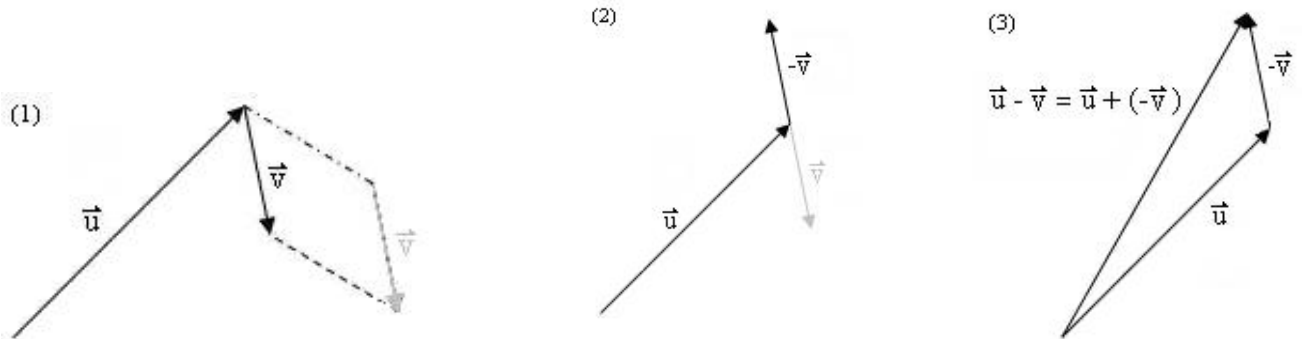


Parallelogram Method: (1) Slide \vec{v} over so that its tail coincides with the tail of \vec{u} . (2) Draw a parallelogram so that vectors \vec{u} and \vec{v} coincide with two of its sides. (3) Draw an arrow starting at the tails of \vec{u} and \vec{v} and ending at the opposite corner of the parallelogram.

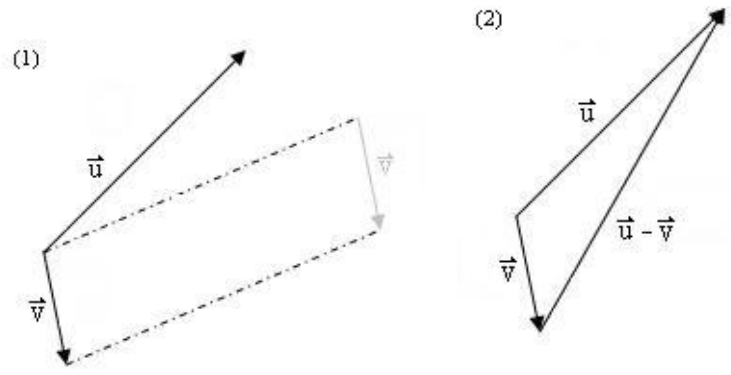


Subtraction of Vectors:

Triangle Method 1: (1) Slide \vec{v} over so that its tail coincides with the head of \vec{u} . (2) Rotate \vec{v} 180 degrees about the head of \vec{u} (do not use \vec{u} as an axis of symmetry). (3) Draw an arrow starting at the tail of \vec{u} and ending at the head of $-\vec{v}$.



Triangle Method 2: (1) Slide \vec{v} over so that its tail coincides with the tail of \vec{u} . (2) Since we subtract \vec{v} from \vec{u} , we want the vector $\vec{u} - \vec{v}$ to point away from \vec{v} . So draw the arrow starting at the head of \vec{v} and ending at the head of \vec{u} .



Scalar Multiplication of Vectors: Let a be any real number. If a is a positive number, the vector $a\vec{v}$ is vector \vec{v} with its magnitude changed by a factor a , pointing in the same direction as \vec{v} . If a is a negative number, the direction is reversed. When $0 < |a| < 1$, the vector shrinks, and when $|a| > 1$, the vector grows.

