

Vectors

Definition

A **vector** is defined as a quantity having both magnitude and direction. For example, 88 km/hr East or 200N 20° North of East are vectors. (By contrast, a *scalar* is a quantity that has magnitude only. For example, 35 meters, 50 ft/sec, and 100N are all *scalars* . . . numbers with no direction.) Typical vectors encountered in physics studies include displacement, velocity, acceleration, force, impulse, momentum, angular momentum, work, magnetic fields, and electric fields.

Displacement is the straight line connecting starting and ending points.

Velocity is speed *with direction*.

Acceleration is the change in velocity with respect to time.

A **force** is a push or a pull in a particular direction.

Impulse is the force acting on an object multiplied by the time the force acts. Impulse gives an object momentum.

Momentum is an object's mass multiplied by its velocity.

Angular Momentum is rotational inertia I multiplied by angular velocity Ω .

Work is the product of force and distance moved.

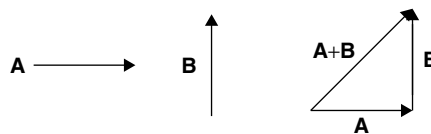
Magnetic and **electric** fields both have directional orientations.

All are *vectors* because they have *magnitude and direction*.

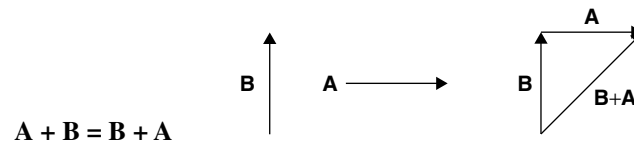
Addition and Subtraction

Geometric Addition of Vectors

Add "head to tail" as follows:



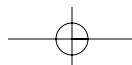
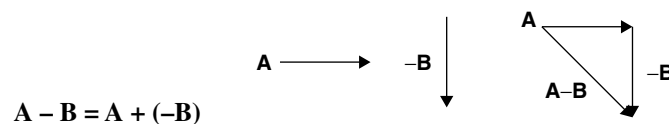
Following the commutative law:

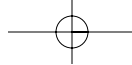


Magnitude of $\mathbf{A} + \mathbf{B} = \sqrt{\mathbf{A}^2 + \mathbf{B}^2}$ (Pythagorean Theorem)

Geometric Subtraction of Vectors

Subtraction of vectors is accomplished by adding the opposite of the vector to be subtracted.

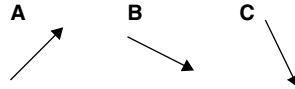




Part II: Subject Area Reviews with Sample Questions and Answers

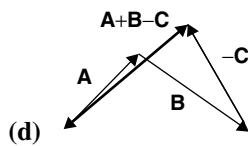
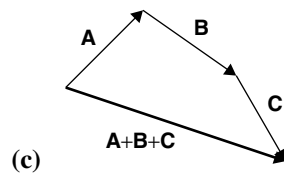
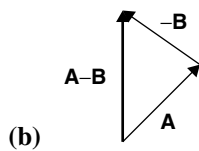
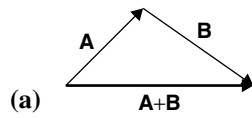
Example

Using the following three vectors, find:



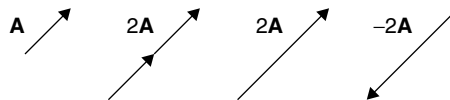
- (a) $A + B$
- (b) $A - B$
- (c) $A + B + C$
- (d) $A + B - C$

Solution



Simple Multiplication of Vectors

Doubling the size of vector A , for instance, results in it being labeled $2A$ and being twice as long as A and in the same direction. A negative sign indicates opposite direction. An antiparallel vector is an oppositely directed vector. For example, $-2A$ is antiparallel to $2A$.



Vector Components in Two and Three Dimensions (C Exam)

In the following diagrams, the unit vector for the x component is i , for the y component is j , for the z component is k .

