

vectors, and just enough calculus to read the rest of physics

Scalars and vectors

Scalar

- magnitude and a unit only, no direction
- mass, time, speed, work, energy, temperature, density, electric charge
- adds and subtracts by ordinary algebra

Vector

- magnitude and direction, both needed to describe it
- displacement, velocity, acceleration, force, angular velocity
- drawn as an arrow: length to scale is the magnitude, tail to head is the direction

the distance a man walks is a scalar, where he ends up relative to where he started is a vector. Same number, different question

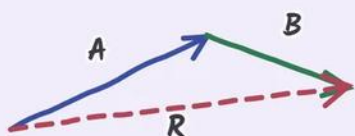
Types of vector *

- zero (null) vector: magnitude zero, direction arbitrary
- e.g. the velocity of a body at rest, the acceleration of one moving uniformly
- negative vector: same magnitude, opposite direction
- equal vectors: same magnitude and same direction, and they must describe the same physical quantity
- position vector: from the chosen origin to the particle
- unit vector: magnitude 1, direction only, $\hat{M} = \frac{M}{|M|}$.
So $M = |M|\hat{M}$
- resultant: the single vector that does what all of them together do

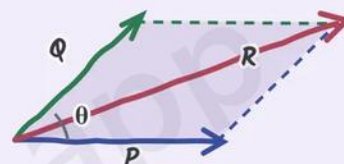
Multiplying a vector by a scalar

- $Q = sP$ keeps the direction of P and multiplies the magnitude by s
- a negative s reverses the direction as well
- $\hat{i}, \hat{j}, \hat{k}$ are the unit vectors along x, y and z of a rectangular coordinate system
- only vectors of the same type may be added: force to force, never force to velocity

Triangle law and parallelogram law



triangle law: tail of B at the head of A , and the third side closes the triangle as the resultant



parallelogram law: P and Q from one point, and the diagonal through that point is the resultant R

the two laws always agree, since the parallelogram is the same triangle with the second vector shifted to a common tail. Addition is commutative, $P+Q = Q+P$, and associative, so three vectors may be grouped in any order