Chapter 4

Vectors (6)

Vectors provide a compact language to describe and work with quantities which have both *magnitude* and *direction* (e.g. Force, velocity, electric field).

4.1 Components of a vector (6.31–38)

We'll work in two dimensions for now (I can draw the pictures).

Since a vector is a quantity with magnitude and direction, we can represent it by a line, starting at the origin, pointing in the direction of the vector, and with length the magnitude of the vector. Draw picture. Vectors are written with lines under them, and printed with bold letters.

We can thus represent vectors by the endpoint of the line: $\mathbf{a} = (1, 2)$ in the example.

In general, the vector $\mathbf{a} = (a_1, a_2)$ has *magnitude* or *size* $|\mathbf{a}| = \sqrt{a_1^2 + a_2^2}$ and *direction* given by $\tan\theta = a_2/a_1$ (note connection with polar coordinates).

Example The vector $\mathbf{a} = (1, 2)$ has magnitude $|\mathbf{a}| = |(1, 2)| = \sqrt{1^2 + 2^2} = \sqrt{5}$, and its direction is given by $\theta = \tan^{-1}(2/1) = 1.107\ldots$.

If k is a number (often called a *scalar* to distinguish it from a vector), then $k\mathbf{a}$ is the vector with components $k\mathbf{a} = (ka_1, ka_2)$. If $k > 0$ then this has the same direction as $\mathbf{a}$ but k times the magnitude (pics). If $k < 0$, then $k\mathbf{a}$ has the opposite direction to $\mathbf{a}$. For example, if $k = -1$ then we get $-\mathbf{a} = (-a_1, -a_2)$, which has the same magnitude as $\mathbf{a}$ but opposite direction.