time. Illustrated in Fig. 4.1 are the velocity vectors $\vec{v_1}$ and $\vec{v_2}$ of a body for two nearby instants of time t and $t+\Delta t$. The change in velocity during the time Δt is the vector $\Delta\vec{v} = \vec{v_2} - \vec{v_1}$.

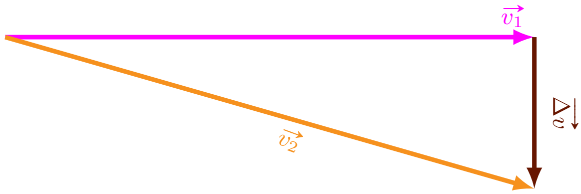

Figure 4.1: Change in the velocity vectors in unit time is acceleration

By definition, the acceleration is

$$\vec{a}(t) \cong \lim_{\Delta t \to 0} \frac{\Delta \vec{v}}{\Delta t} \tag{4.3}$$

or, more rigorously,

$$\vec{a}(t) = \lim_{\Delta t \to 0} \frac{\Delta \vec{v}}{\Delta t} \tag{4.4}$$

It follows that the acceleration vector is directed along vector Δv, which represents the change in velocity during a sufficiently short interval of time. It is evident from Fig. 4.1 that the velocity vectors and the change in velocity vector can be oriented in entirely different directions. This means that, *in the general case, the acceleration and velocity vectors are also differently oriented.* Is that clear ? ◊

. Yes, now I understand. For example, when a body travels in a circle, the velocity of the body is directed along a tangent to the circle, but its acceleration is directed along a radius toward the center of rotation (I mean centripetal acceleration). ■

4.9. Your example is quite appropriate. Now let us return to relationship (Eq. (4.2)) and make it clear that it is precisely the acceleration and not the velocity that is oriented in the direction of the applied force, and that it is again the acceleration and not the velocity that is related to the magnitude of this force. On the other hand, the nature of a body's motion at any given instant is determined by the direction and magnitude of its velocity at the given instant (the velocity vector is always tangent to the path of the body).

Since the acceleration and velocity are different vectors, the direction of the applied force and the direction of motion of the body may not coincide in the general case. Consequently, the nature of the motion of a body at a given instant is not uniquely determined by the forces acting on the body at the given instant. ◊

. This is true for the general case. But, of course, the direction of the applied force and the velocity may coincide. ■