Subject:
In the context of kinematics it is common to introduce the physical quantity “acceleration”. We distinguish between instantaneous and average acceleration, tangential, radial and normal acceleration, angular acceleration, centrifugal, centripetal and Coriolis acceleration. The students also learn that a uniform circular motion is an accelerated motion.

Deficiencies:
1. Technical terms are useful, because with them a scientific statement can be formulated in a succinct manner. Often one can pack in one word what would otherwise require a whole sentence. Thus, a statement can get clearer when employing a well-defined technical term. However, there is an optimum number or concentration of technical terms. When there are too many, it happens that the understandability gets worse again. A statement may get shorter, but since each technical term has to be defined, the whole text may not. Understandability may get worse, since the reader must know the definitions. An example is the proliferation of distinct names for one and the same physical quantity, the acceleration.

2. The motion of a point can be described by various different functions of time. The most commonly used are position \( s(t) \), velocity \( v(t) = \frac{ds}{dt} \), and acceleration \( a(t) = \frac{dv}{dt} = \frac{d^2s}{dt^2} \). One can introduce even higher order time derivatives. The third order time derivative of the position is sometimes called jerk. The word clearly expresses the meaning of the concept. However, if the intention is not to run riot at the kinematic playground, we may ask which of these functions are really needed.

Let us consider one of the most important types of motion: a motion with uniform acceleration. A description by means of the function \( s(t) \) is, at least for High school pupils, rather complicated, since \( s \) is a quadratic function of time. \( v(t) \) is simpler, since it is linear with time. Mathematically even more simple is the acceleration, since \( a(t) \) is constant. But it is the third time derivative which displays the greatest simplicity: it is zero for any \( t \). A lot can be learnt when comparing these four functions. If, however, one is only interested in a succinct description of the motion, one will try to limit the discussion to those functions that give the best intuitive access to the phenomenon. In our opinion these are \( s(t) \) and \( v(t) \). In our example \( v(t) \) tell us, that the velocity increases uniformly with time. We believe that this statement is easier to grasp than that of saying the acceleration is constant. This becomes evident when asking technically versed people to specify the performance of a car. They do not say that the car’s maximum acceleration amounts to a certain number of meters per squared seconds, but they say that the car accelerates from 0 to 100 km/h in so many seconds. Thus they argue with velocity instead of acceleration. They express acceleration in terms of velocity.

One might believe that a physics teacher simply cannot do without acceleration, since the quantity appears in Newton’s second law. Actually, there is no acceleration in Newton’s works. He formulates his second law with the time rate of change of the quantity of motion.
3. The name acceleration for the quantity \( a \) is the cause of several incongruities. Recently in a paper in a physical magazine I read: “Charged particles emit radiation whenever they are accelerated or decelerated or when they change their direction of motion.” There is certainly nothing wrong with this formulation. However, the next sentence says: “Particles that move on a circular trajectory – even when their velocity is constant – are accelerated and emit radiation...”. Whereas in the first sentence the author distinguishes between accelerating, decelerating and changing direction, in the next sentence each particle without further ado executes an accelerated motion whenever \( a(t) \) is different from zero.

We know this problem from elsewhere. In the colloquial language we often have different expressions for the positive and the negative values of a physical quantity: acceleration and deceleration, pressure and tension, hotness and coldness... Physics, however needs one single name for a quantity.

**Origin:**

Contrary to popular belief Newton did not use a quantity “acceleration”. According to his formulation of the Second law, the change of the “motion” (motus) of a body is proportional to the force that is acting on it. He employed the word motus as an abbreviation for quantitas motus, the amount of motion, today called momentum. Also Huygens did not use a quantity “acceleration” [1]. In a publication from 1754, Euler used the differential quotient \( \frac{d^2s}{dt^2} \), but he gave it neither a proper name nor a proper symbol [2]. The earliest citation of acceleration as a physical quantity that we have found is in the Opera omnia by Johann Bernoulli from 1742 [3]. Apparently it was introduced in the course of the increasing mathematization of mechanics which took place after Newton.

**Disposal:**

We do not introduce a quantity acceleration. As kinematics is concerned we limit ourselves to discuss position and velocity as functions of time. But also in dynamics we do not need acceleration. We formulate Newton’s second law as \( F = \frac{dp}{dt} \).


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