Equation of motion

Uniform motion

Motion with constant velocity is called Uniform. **Equation of motion** gives position of a particle as a function of time. This equation for the movement along a straight line can be described by a formula:

$$x(t) = x_0 + vt$$

Here $x_0 = x(0)$ is coordinate x at time $t = 0$,

v is the constant velocity (can be positive or negative)

Acceleration

In everyday life we use the word acceleration to describe increase of the speed of a moving object. More specifically in physics, it is a change in velocity per unit time. Any time the speed and/or direction of motion of an object changes we deal with **accelerated motion**.

$$a = \frac{\text{change in velocit y}}{\text{change in time}} = \frac{\Delta v}{\Delta t}$$

Standard units of acceleration is m/s^2. And it is a vector quantity.

An example of acceleration motion is falling. We know that any object falls with acceleration of ~$10 m/s^2$ ($9.81 m/s^2$, to be exact). It is a **gravitational acceleration**, and it is directed downward.

If we know acceleration and initial velocity, we can easily find the velocity at any later moment:

$$\vec{V} = \vec{V}_0 + \vec{a} \cdot t$$

Velocity after the time *t* = Initial velocity + Acceleration multiplied by the time.

For example, if you just let a pebble go down, the initial velocity is zero. But you can throw the pebble down. In this case the pebble starts accelerating from nonzero velocity.

Homework:

1) The largest passenger airplane, Airbus A380, has acceleration $a = 2$ m/s^2 during its take-off. How much time does it need to reach the take off speed $v = 280$ km/hr ?

2) Imagine that you dropped a penny from Empire State Building (please, don't do it in real life!). Calculate the speed of the coin in 5 seconds.

3) Explain (and make a scheme) what happens to a pebble if you throw it vertically up?

4) A ball is thrown vertically upwards with initial speed of $v_0 = 30$m/s. Gravitational acceleration is $g = 10$ m/s^2, and is directed downward. What will be the velocity of the ball after time $t = 4$s ?