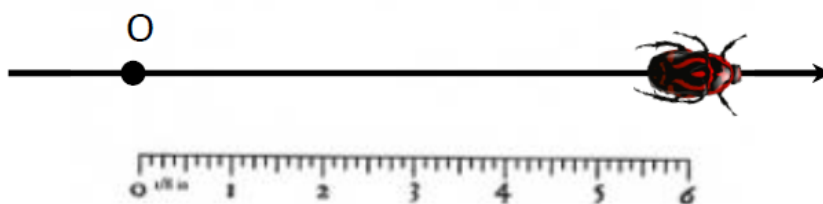


Classwork

Uniform and nonuniform motion

The arrows over the characters show that the corresponding parameters are vectors. If the velocity of the object does not change, the motion is called **uniform**. Since the velocity is a vector, it has, as we already know, both magnitude and direction. If the velocity does not change, both speed and direction of the motion remain constant (which means that they do not change as well). So, uniform motion is motion along a straight line. Motion along a straight line is called *rectilinear motion*. Although any uniform motion is rectilinear, rectilinear motion is not necessarily uniform.

This year we will be mostly studying rectilinear motion. To specify the position of the object moving along a straight line we need a reference point. It is convenient to choose a point at the line of motion and calculate all the distances and displacements with respect to this point. We will call this point “origin” and mark with the character O.



We can use **equation of motion** to do the calculations in case of uniform motion:

$$\vec{d} = \vec{v} \times t$$

Here d – displacement (or distance), v – velocity (or speed), t – time.

Example:

The car is traveling down the highway with the speed of 60mph. How far the car travels in 3 hours?

$$d = v \times t = 60\text{mph} \times 3\text{hrs} = 180 \text{ miles}$$

If it is needed, we can recalculate that into meters or kilometers if it is asked so in the problem.

Most of the motions around us are nonuniform. It means that the speed and /or velocity are changing during the motion. In this case we can introduce **average speed and average velocity**. Average speed is the rate of *total* distance and time interval required to cover this distance.

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

For example, you have to go for 1km. First you run, then stop for a while to take a break and, finally, you walk. It took 15 minutes to cover 1 km. The average speed in this case is:

$$\text{average speed} = \frac{\text{total distance} = 1\text{km} = 1000\text{m}}{\text{total time} = 15\text{min} = 15 \times 60\text{s} = 900\text{s}} \approx 1.11 \frac{\text{m}}{\text{s}}$$

It means that instead of running, taking a rest and, finally, walking you just keep going with a uniform speed of 1,11m/s you will pass 1 km for the same time of 15min.

Homework:

Please do the calculations carefully, step by step, on a separate sheet of paper.

1) A cyclist rides 2 km north, 5 km east, 3 km south, and then 2 km west to avoid a lake. 4

a) Find the total distance traveled.

b) Find the displacement (magnitude and direction).

2) A car passed 30km at the speed of 15m/s. Then the car turned back and spent 1 hour to pass 40 km. Find average speed and average velocity of the car? Draw a picture.

3) A school bus leaves the stop at time $t=0\text{s}$ and drives towards the school with speed $v_1=10\text{m/s}$. Distance from the bus stop to the school is $d=2\text{km}$. How long does it take to ride to the school?

Now, A student arrives to the stop $T=30\text{s}$ late. He runs to school with average speed $v_2=3\text{m/s}$.

a) Write down equation of motion for both the bus and the student, sketch the picture.

b) Calculate how much later the student will reach the school.