Task. 1. Vinay rides his bicycle and covers a distance of $d = 100\ m$ in $t = 20$ seconds. Calculate speed in

a) m/s
b) km/hr
c) km/min
d) km/sec
e) m/min.

Solution. The velocity of the bicycle can be computed by the formula

$$v = \frac{d}{t}.$$

a) Substituting values we get that

$$v = \frac{d}{t} = \frac{100\ m}{20\ sec} = 5\ m/s.$$

b) To convert the velocity to km/hr notice that $1\ km = 1000\ m$ and $1\ hr = 3600\ sec$, so

$$1m = 0.001\ km, \qquad 1s = \frac{1}{3600}\ hr.$$

Hence

$$v = 5m/s = 5 * \frac{0.001\ km}{1/3600\ hr} = 5 * 3.6\ km/hr = 18\ km/hr.$$

c) Similarly, $1\ min = 60\ sec$, so

$$1\ sec = \frac{1}{60}\ min.$$

Hence

$$v = 5m/s = 5 * \frac{0.001\ km}{1/60\ min} = 5 * 0.06\ km/min = 0.3\ km/min.$$

d) Let us convert the velocity to km/sec:

$$v = 5m/s = 5 * \frac{0.001\ km}{1\ sec} = 0.005\ km/sec.$$

e) Let us convert the velocity to m/min:

$$v = 5m/s = 5 * \frac{1\ m}{1/60\ min} = 5 * 60\ m/min = 300\ m/min.$$

Task 2. A body moves $a = 4$ m towards east, and then $b = 3$ m towards north in total time of $t = 10$ seconds. Find

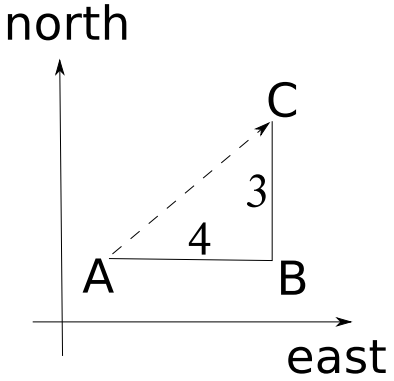
(a) displacement

(b) distance

(c) velocity

(d) average speed

Solution. Let us choose coordinates as shown in the following figure:



(a) The displacement of the body is the distance between the initial and final position, i.e. the distance AC. Since the triangle ABC is right, we have from Pythagorean theorem that

$$AC = \sqrt{AB^2 + BC^2} = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5\ m.$$

(b) The distance passed by the body is

$$d = AB + BC = 4 + 3 = 7\ m.$$

(c) By definition, the velocity $v(t)$ of the body at time t is the vector given by the formula

$$v(t) = s'(t),$$

where $s(t)$ is the position of the body at time t. In fact, we have no information about the position $s(t)$ of the body, so the velocity can not be computed. All that we can say is that the velocity is directed along trajectory of the move: so first the velocity was directed to the east (along AB) and then it was directed to the north (along BC).

(d) The average speed is computed by the formula:

$$v_{avg} = \frac{\text{total distance}}{\text{total time}} = \frac{7\ m}{10\ s} = 0.7\ m/s.$$