Question #53208, Physics / Mechanics | Kinematics | Dynamics

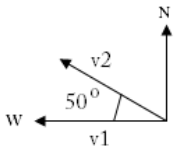
A ladybug with a velocity of 10.0 mm/s [W] crawls on a chair that is being pulled [W 50° N] at 40.0 mm/s. What is the velocity of the ladybug relative to the ground?

Answer:

The figure for the velocities can be drawn as follows:

Depicted parameters are:

v_1 is the velocity of the ladybug and v_2 is the velocity of chair.



The projection of v_2 to W direction is defined by the equation:

$v_2(W) = \cos 50^o \times v_2$

Thus, for the West direction, the velocity of the ladybug relative to the ground equals:

$v(W) = v_1 + v_2(W) = v_1 + \cos 50^o \times v_2$,

$v(W) = 10$ mm/s + 0.642788×40 mm/s = 35.71 mm/s

For the North direction is defined: $v(N) = v_1(N) + v_2(N)$.

Taking into account that $v_1(N) = 0$, $v_2(N) = \sin 50^o \times v_2$, the velocity in the North direction equals:

$v(N) = v_1(N) + \sin 50^o \times v_2 = 0 + 0.766 \times 40$ mm/s = 30.64 mm/s.

The total the velocity of the ladybug relative to the ground is determined by the equation:

$v^2 = v(N)^2 + v(W)^2$

Thus, $v = \sqrt{v(N)2 + v(W)2} = \sqrt{1275.2041 + 938.8096}$ = 47.053 mm/s