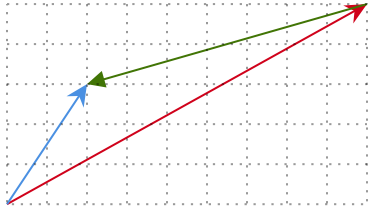
$$v_{2|1} = -7i - \sqrt{3}\,j$$

$$v_2 = 2i + 2\sqrt{3}$$



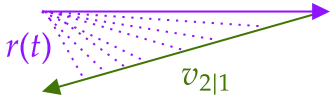
$$v_{2|1} = v_1 - v_2$$
$$v_{2|1} = 9i + 3\sqrt{3}\,j - 2i - 2\sqrt{3}\,j$$
$$v_{2|1} = -7i - \sqrt{3}\,j$$

$$v_1 = 9i + 3\sqrt{3}\,j$$

recall parametric equation of motion

$$r(t) = r_0 + vt$$
$$r_{2|1} = 52i + v_{2|1}t$$
$$r_{2|1} = 52i - 7t\,i - \sqrt{3}\,t\,j$$
$$r_{2|1} = (52 - 7t)i - \sqrt{3}\,t\,j$$

$$r_{2|1}(0) = 52i$$



we want $v_{2|1}$ and $r_{2|1}$ to be perpendicular
that is, have a dot product = 0

recall component foruma for dot product

$a = a_1\,i + a_2\,j, \quad b = b_1\,i + b_2\,j$

then

$a \cdot b = (a_1 \times b_1) + (a_2 \times b_2)$

so :

$$r_{2|1} \cdot v_{2|1} = (52 - 7t)(-7) + \left(-\sqrt{3}\,t\right)\left(-\sqrt{3}\right)$$
$$r_{2|1} \cdot v_{2|1} = -364 + 49t + 3t$$
$$r_{2|1} \cdot v_{2|1} = -364 + 52t = 0$$

$$52t = 364$$
$$t = 7s$$

At this time the position of the cyclist relative to the car ($r_{2|1}$) is :

$$r_{2|1}(7) = (52 - 7(7))i - \sqrt{3}\,(7)\,j$$
$$r_{2|1}(7) = 3i - 7\sqrt{3}\,j$$

Find mengitude to express in metres :

$$d = |3i - 7\sqrt{3}\,j\,|$$

$$d = \sqrt{3^2 + \left(7\sqrt{3}\right)^2} = \sqrt{156}\ m$$