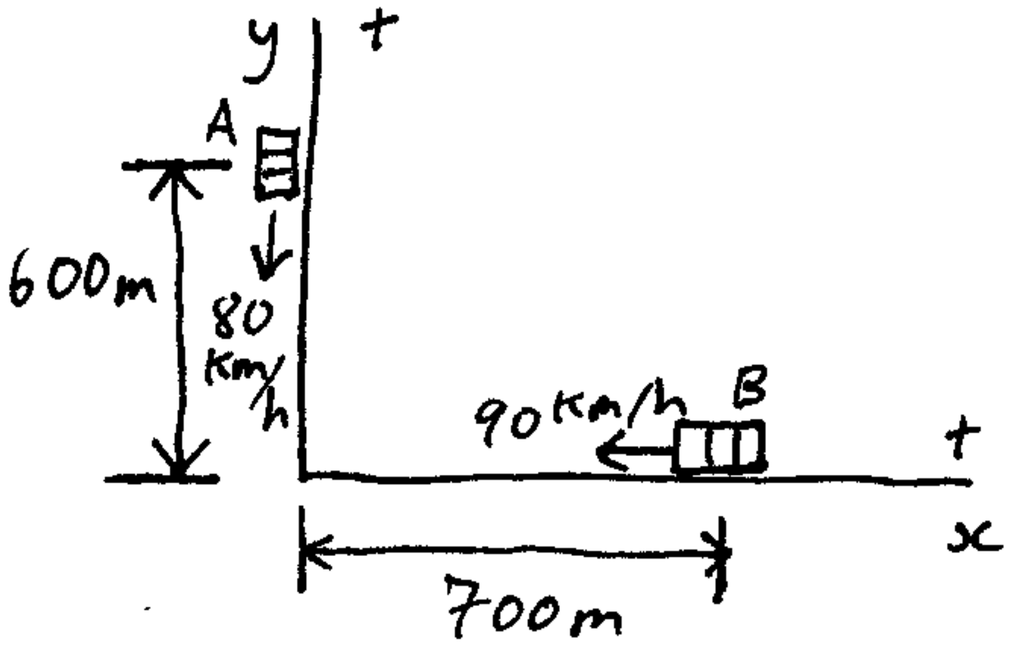
Feb. 17, 2020

This is a 2-D problem involving relative motion.



Two cars, A and B, are approaching an intersection as shown. Car A is 600m from the intersection and is moving at 80 km/h. Car B is 700m from the intersection and is moving at 90 km/h.

(a) In unit vector notation, what is the velocity of car A with respect to car B?

(b) How does the direction of the velocity found in (a) compare to the line of sight between the two cars?

(c) How does the answer to (a) and (b) change as the cars move closer to the intersection?

Solution:

(a) Use the vector equation: $\vec{v}_P = \vec{v}_B + \vec{v}_{PB}$

$\vec{v}_P = -80\hat{j}$ (velocity of car A with respect to ground)

$\vec{v}_B = -90\hat{i}$ (velocity of car B with respect to ground)

$\vec{v}_{PB} = ?$ (velocity of car A with respect to car B)

Substitute:

$-80\hat{j} = -90\hat{i} + \vec{v}_{PB}$

$\vec{v}_{PB} = 90\hat{i} - 80\hat{j}$ (answer)

(units in km/h)

(b) At the instant shown the line of sight between the two cars is $\pm 700\hat{i} \mp 600\hat{j}$, which reduces to $\pm 7\hat{i} \mp 6\hat{j}$ (different direction than in (a))

(c) The answer to (a) does not change, but the answer to (b) does change.