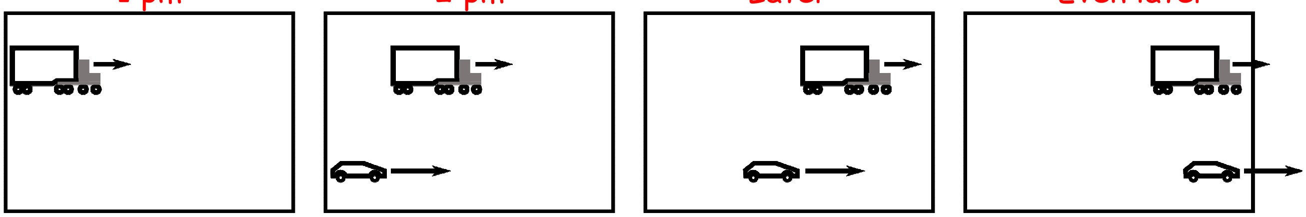
Situation:
A truck leaves Champaign at 1 pm heading north at 55 miles per hour. A car leaves Champaign at 2 pm heading north at 65 miles per hour. We want to know at what time the car catches the truck.

a) (*Facilitator*) Let's make a sketch of this situation to help visualize and understand what's going on.



b) (*Evaluator*) What do we mean when we say that "the car catches the truck"?

We mean that the car and the truck are in the same place at the same time. This happens at one particular time, then the car passes the truck and gets farther ahead.

c) (*Facilitator*) How can we use this idea to find the time it takes the car to catch the truck?

We're looking for the time at which the car and truck have the same position. To find this time, we could write the position of the truck and car as functions of time. Then we could equate them to find the time or times that makes their positions the same.

i. Write an equation that relates the truck's distance from Champaign to the time since the truck left.

Symbols	Description
x_T	Position of the truck
v_T	Truck's velocity (55 mi/hr)
t	Elapsed time (after 1 pm)

Equation
$x_T = v_T\, t$

ii. (*Evaluator*) Let's do a quick check. If the truck has been driving for 1 hour, what distance does our equation give us? Does this agree with what we know about the truck's speed?

$x_T = v_T\, t$

$x_T = (55 \text{ miles/hr})(1 \text{ hour}) = 55 \text{ miles}$ ✓

iii. Write an equation that relates the car's distance from Champaign to the time since the ***truck*** left.

Symbols	Description
x_C	Car's position
v_C	Car's velocity (65 mi/hr)
T	Elapsed time (after 1 pm)

Equation
$x_C = v_C\,(t\text{-}1\text{ hr})$

iv. (*Evaluator*) Is this reasonable? If the truck has been driving for 2 hours, how long has the car been driving? How far should the car have gone in this time? Does our equation agree?

Car left 1 hour later than truck. If the truck has been driving for 2 hours, then the car has been driving for (2 hrs – 1 hr) = 1 hour only. It should therefore have driven 65 miles in that 1 hour.

Let's check:

$x_C = v_C\,(t\text{-}1\text{ hour}) = (65\text{ mi/hr})\,(2\text{ hr} - 1\text{ hr}) = 65\text{ miles}$ ✓

d) (*Checker/Recorder*) Ok, so we have written the position of the car and truck as functions of time. Are we all agreed on the expressions? What are we trying to do?

(*Facilitator*) How can we use these to find the time when the car and truck meet? Let's do it!

Let's equate the car and truck's positions and solve for the time at which they meet:

$$x_C = x_T$$

$$v_C\left(t - 1\text{ hr}\right) = v_T t$$

$$\left(v_C - v_T\right)t = v_C\left(1\text{ hr}\right)$$

$$t = \frac{v_C}{v_C - v_T}\left(1\text{ hr}\right)$$

$$= \frac{65\,\frac{\text{mi}}{\text{hr}}}{65\,\frac{\text{mi}}{\text{hr}} - 55\,\frac{\text{mi}}{\text{hr}}}\left(1\text{ hr}\right)$$

$$= 6.5\text{ hr}$$

Time when car catches truck = _______6.5________ hours after truck leaves

e) (*Evaluator*) Wait… are we done? The problem asks for a time, as in a time of day. Shouldn't we turn this number of hours into the time on the clock when they meet?
(*Facilitator*) Ok, how could we do that?

We need to add 6.5 hours to 1 pm:
1 pm + 6.5 hours = 7:30 pm

Time on the clock when the car catches the truck = _____7:30 pm__________