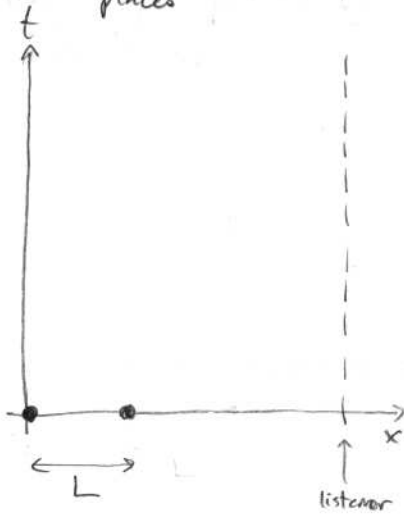
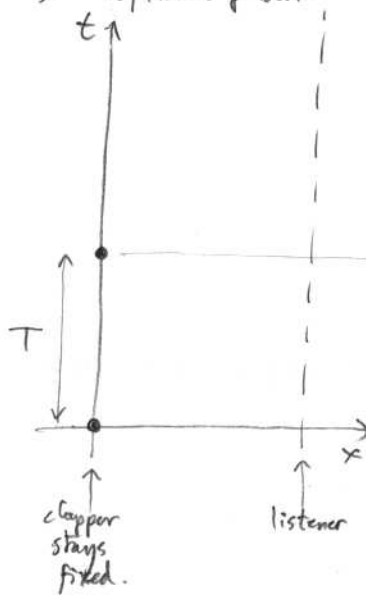


Draw on the spacetime diagrams the sound pulses produced by two 'claps':

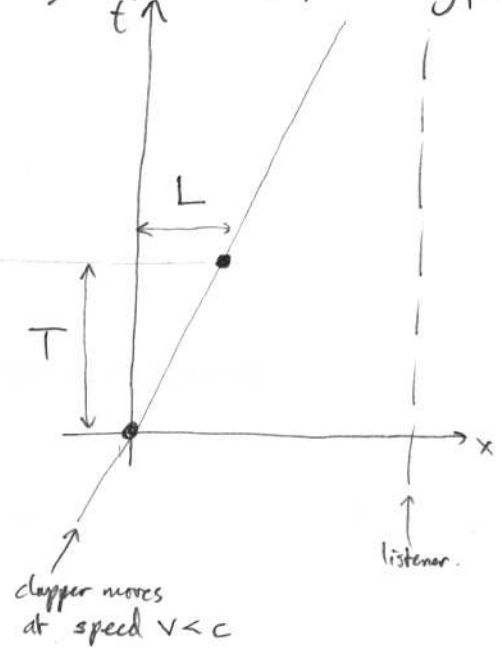
a) Simultaneous claps at different places



b) Repeated clap from a fixed person



c) Repeated clap from moving person



• Circle the two hearing events in each diagram a), b), c), and label the delay (height) between them in each diagram by  $T'$  like this:

• Calling the speed of sound  $c$ , express  $T'$  using  $c$  &  $L$ , for diagram a):

• In diagram b), how does  $T'$  relate to  $T$ ?  
(does this depend on distance?)

• For diagram c), is  $T'$  greater, less, or equal to  $T$ ?

Compute  $T'$  in this case using  $T$  &  $L$ :  
[Hint: 'combine' diagrams a) & b)]

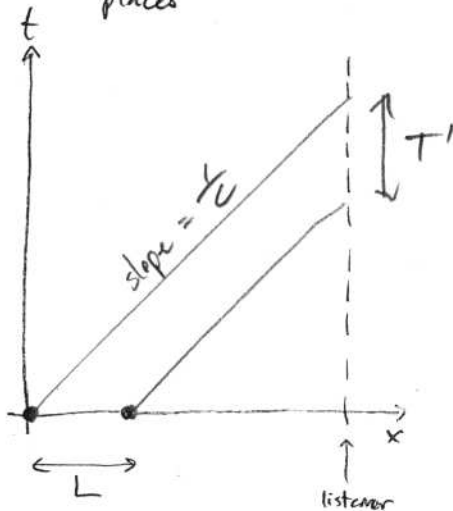
• Write  $L$  in terms of  $T$  &  $v$ , substitute into the above:

• If the claps were crests of a pure tone at freq  $f = \frac{1}{T}$ , what freq  $f' = \frac{1}{T'}$  do you hear?

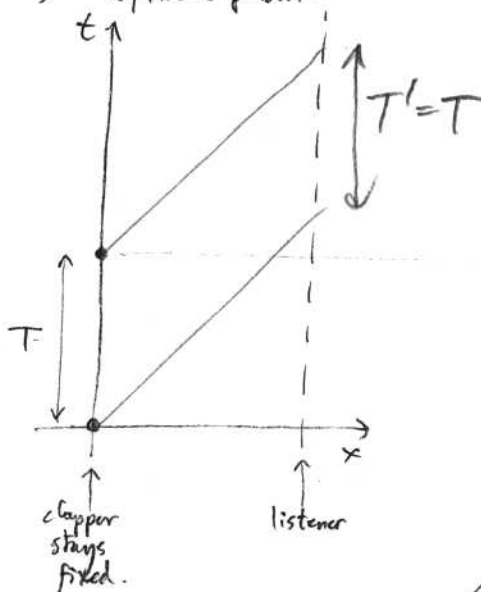
SOLUTIONS

Draw on the spacetime diagrams the sound pulses produced by two 'claps':

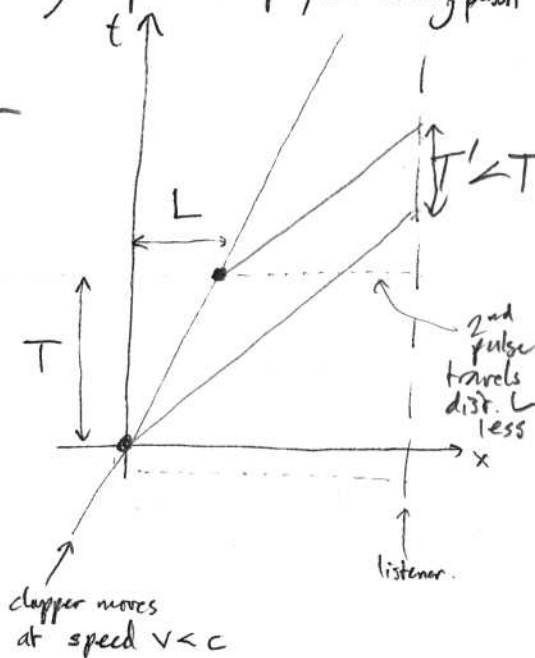
a) Simultaneous claps at different places



b) Repeated clap from a fixed person



c) Repeated clap from moving person



- Circle the two hearing events in each diagram a), b), c), and label the delay (height) between them in each diagram by  $T'$  like this:

- Calling the speed of sound  $c$ , express  $T'$  using  $c$  &  $L$ , for diagram a):  
 $cT' = L$  so  $T' = L/c$

- In diagram b), how does  $T'$  relate to  $T$ ?  $T' = T$   
(does this depend on distance?) → no since pulses travel the same distance

- For diagram c), is  $T'$  greater, less, or equal to  $T$ ?  $T' < T$   
since 2nd pulse travels shorter dist.

Compute  $T'$  in this case using  $T$  &  $L$ :  $T' = T - L/c$   
[Hint: 'combine' diagrams a) & b)]

- Write  $L$  in terms of  $T$  &  $v$ , substitute into the above:  $T' = T - \frac{vT}{c} = (1 - \frac{v}{c})T$   
 $L = vT$

- If the claps were crests of a pure tone at freq  $f = \frac{1}{T}$ , what freq  $f' = \frac{1}{T'}$  do you hear?  
 $f' = \frac{f}{(1 - \frac{v}{c})}$