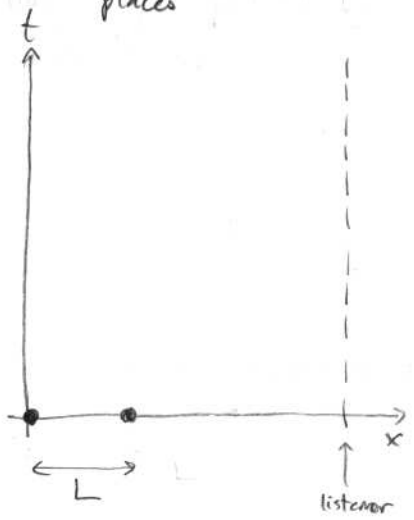
MATH 5 WORKSHEET : Doppler effect.

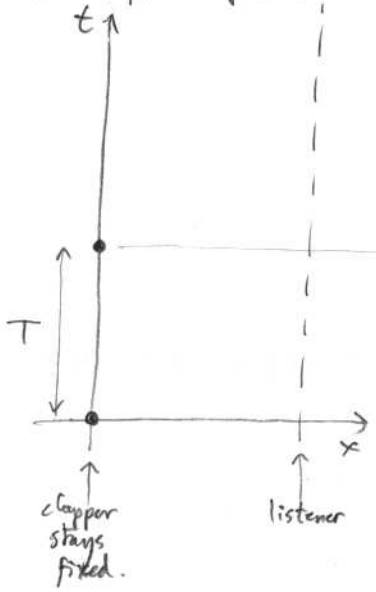
10/15/08
Barnett.

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

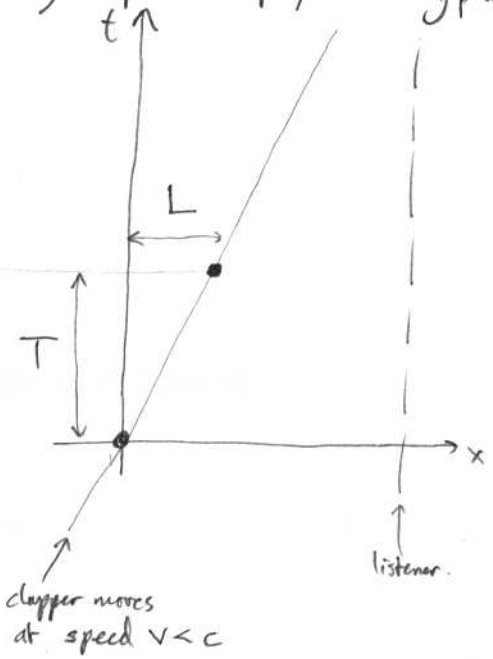
a) Simultaneous claps at different places



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 made of a pure tone at freq. $f = \frac{1}{T}$, what freq $f = \frac{1}{T'}$ do you hear?

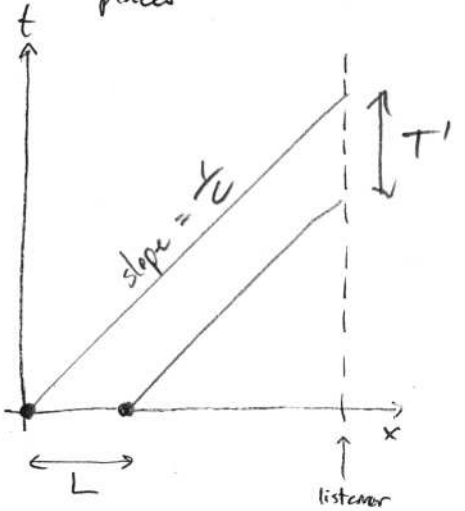
MATH 5 WORKSHEET : Doppler effect.

10/15/08
Barnett.

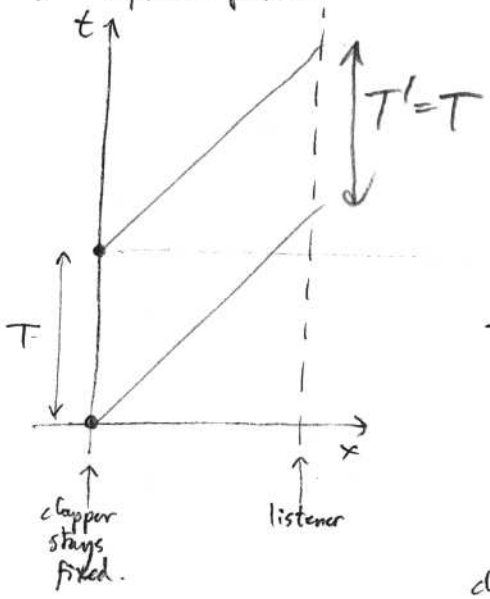
SOLUTIONS

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

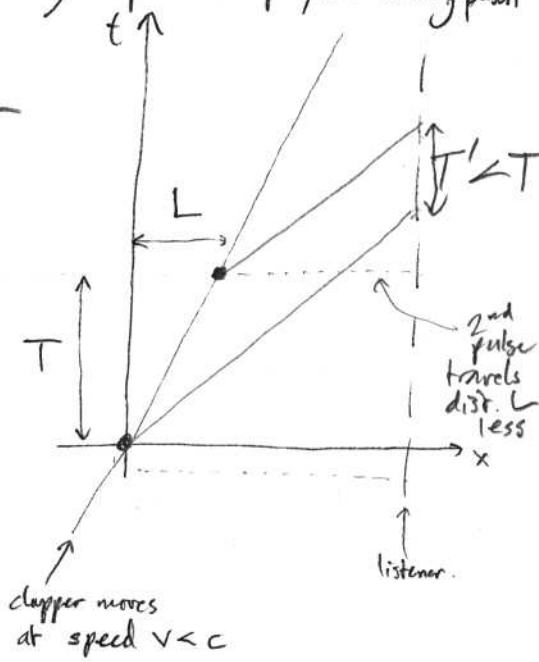
a) Simultaneous claps at different places



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):

$$cT' = L \quad \text{so} \quad T' = L/c$$

- 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: $T' = T - \frac{L}{c}$

[Hint: 'combine' diagrams a) & b)]

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

$L = vT$

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

$f' = \frac{f}{1 - v/c}$