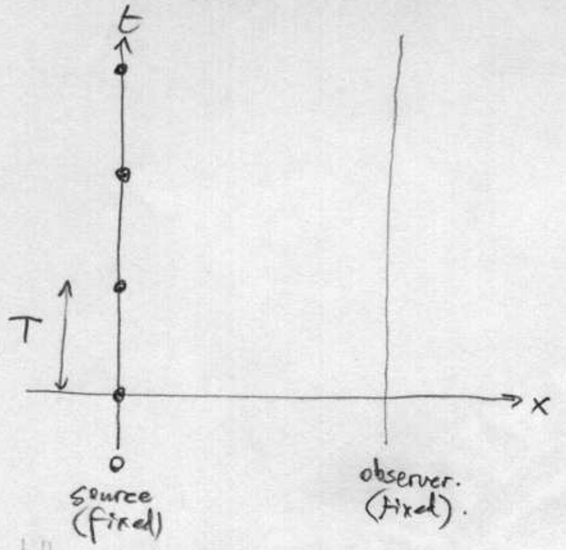
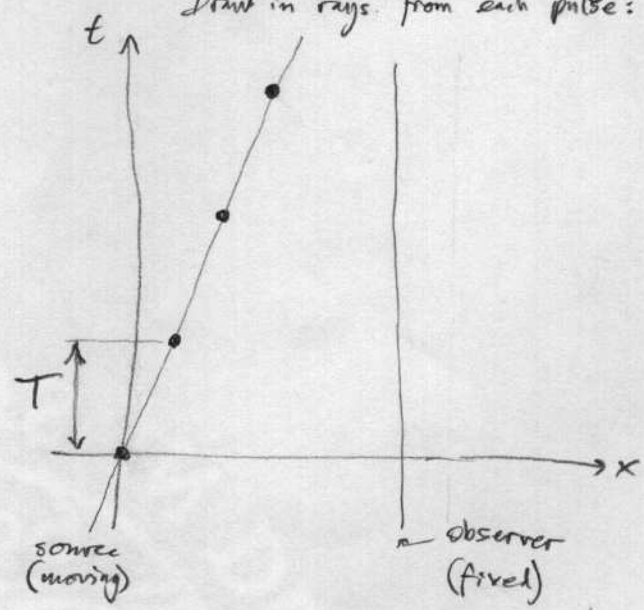
Math 5 WORKSHEET : Doppler effect.

Consider a fixed period source.
Draw in the rays from each 'pulse':



Now consider the source moving at speed v.
Draw in rays from each pulse:



For fixed source, what is the period T_{obs} between pulses arriving at observer?

Answer the same question for moving source case: first, is $T_{obs} = T$? $T_{obs} > T$? $T_{obs} < T$?

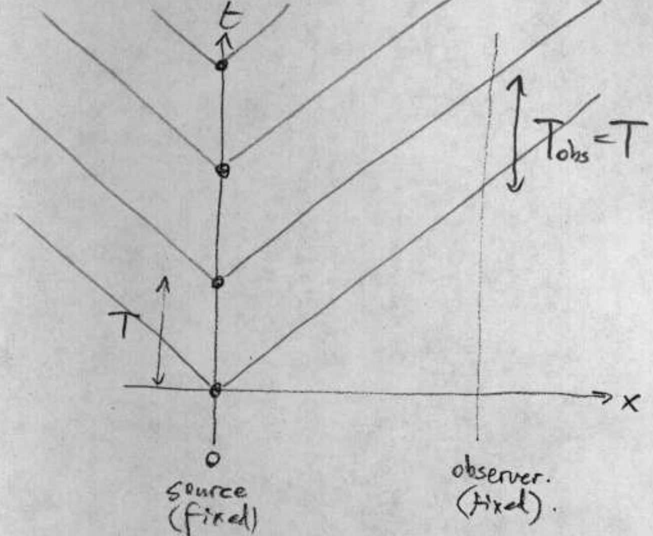
[Hint: how much closer is the source in the time between pulses?]

So, what is the frequency observer hears compared to frequency emitted?

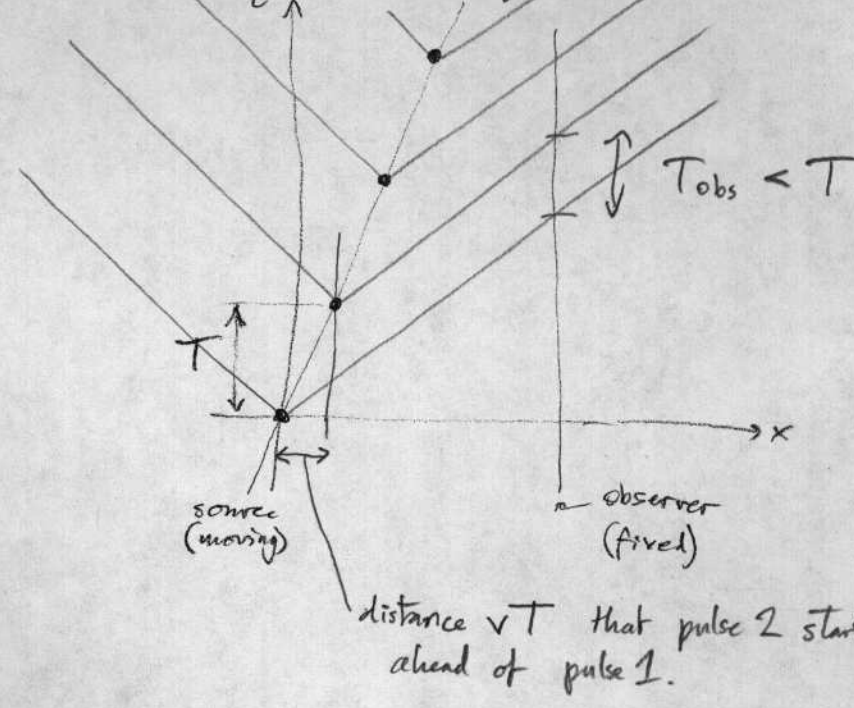
What if moving away now?

Math 5 WORKSHEET : Doppler effect. SOLUTIONS

Consider a fixed period source.
Draw in the rays from each pulse:



Now consider the source moving at speed v
Draw in rays from each pulse:



For fixed source, what is the period T_{obs} between pulses arriving at observer?

$$T_{obs} = T$$ since all pulses have to travel same distance

Answer the same question for moving source case: first, is $T_{obs} = T$? $T_{obs} > T$? $T_{obs} < T$?

The only relevant distance is how much closer the 2nd pulse is emitted relative to the 1st one.

[Hint: how much closer is the source in the time between pulses?] → it is a distance vT closer since source moves at speed v.

$$T_{obs} = T - \underbrace{\boxed{\frac{vT}{c}}}_{\text{amount that travel time shortened.}} = T\left(1 - \frac{v}{c}\right)$$

So, what is the frequency observer hears compared to frequency emitted?

$$f_{obs} = f\,\frac{1}{1 - \frac{v}{c}}$$

What if moving away now? replace v by −v.