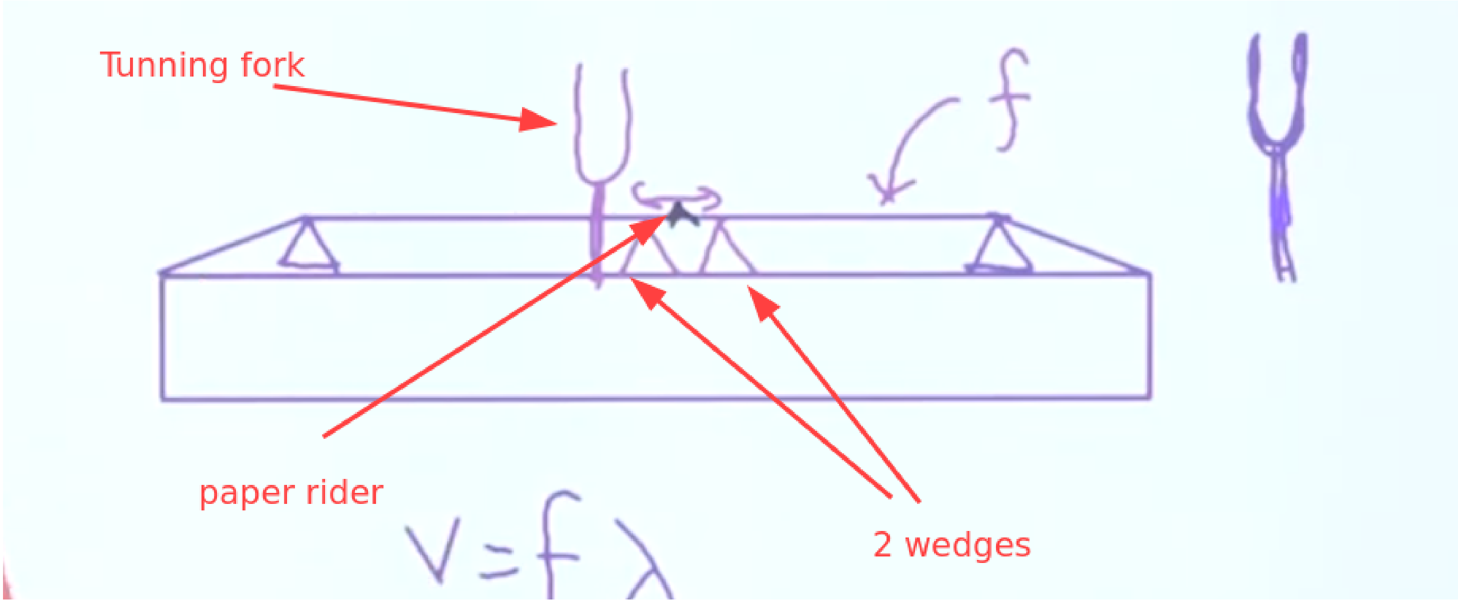
- Initial setup



First, you make the length between the 2 wedges as small as possible and keep the paper rider in between them. Then you vibrate the tunning fork and keep in so that it touches the sonometer box. You increase the length between the wedges till the paper rider moves away from the string due to resonation.

We know,

$$v = \sqrt{(\frac{T}{M})}$$

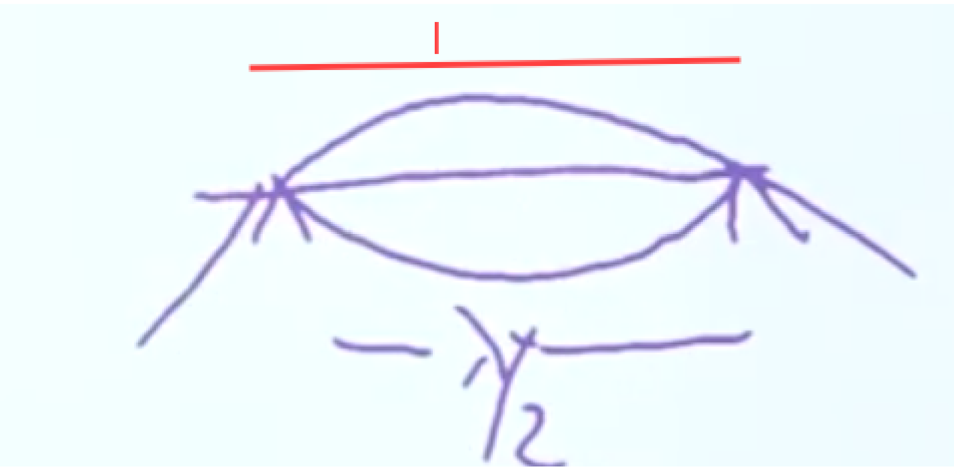
Here v is a constant as we are doing this experiment under constant tension T. We also know,

$$v = f\lambda$$

And since v is a constant, when λ changes, f should change accordingly to keep v constant.

- How do we measure the wave length λ from this experiment?

> When the strings resonates its going to create a standing wave as below. That the wave length is twice of the length between the 2 wedges.



Here because of that, $\lambda = 2l$

$$\lambda = 2l$$
$$v = f\lambda$$
$$\therefore v = f(2l)$$
$$l = \frac{v}{2}\frac{1}{f}$$
$$v = constant$$
$$\therefore l \propto \frac{1}{f}$$

> Therefore, length is inversely proportional to frequency

> When doing the experiment, we can find the wave length using the length between 2 wedges, the frequency is same as the frequency of the tunning fork (as the string resonates) and by using that we can find the velocity of with $v = f\lambda$

But since we are going for a graphical method, **we use 5 different tunning forks** and get 5 different wave lengths and draw a graph according to the following equation

$$\lambda = 2l$$
$$v = f\lambda$$
$$\therefore v = f(2l)$$
$$l = \frac{v}{2}\frac{1}{f}$$
$$y = mx$$

Therefore, the gradient will give the velocity of the standing wave.

$$\frac{v}{2} = Gradient$$
$$v = 2.Graduent$$

Important points

- Why are there holes in the box of the sonometer?

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Because when the string vibrates, the air inside the box vibrates accordingly, the holes in the box are used to produce a sound based on that vibration.
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- Due to the vibrations of the tunning fork, what types of waves are generated?

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logitudinal standing waves
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- Why do we use the paper rider?

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To know when the string resontates according to the frequency of the tunning fork.

To know when the amplitude of the standing wave generated is maximum.
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- Why does the paper rider get thrown away?

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When the strings resontates, the engery transfer from the tuning fork will be maximum.
Therefore the amplitude of the standing wave will be the highest. This will result in throwing
the paper rider.
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- Why should we keep the paper rider in the middle of the 2 wedges?

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Because in the fundemental node, the middle of the 2 fixed points (wedges) is a anti node
which gets the highest amplitude. To get the paper rider thrown away easily, it should be
places in the middle.
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- Why wouldn't the paper rider not get thrown away even though it experiences the highest amplitude?

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When the frequency is high, the wave length is lower. Therefore, the amplitude is also lower.
Due to that, the amplitude (energy transfered) may not be enough to throw the paper rider
away. Even though, we can see the maximum movement of the paper rider at this position.
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- When we start getting the readings, we usually start with the tunning fork with the highest frequency first, why?

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Since the frquency is high, the length between the wedges would be lower. That way we can
gradually increase the length between the wedges. So you don't have to start from a random
place.

If you start from a random place and the string resonates, you can't ensure that it is
resonating for the fundemental node. To ensure that, we start from the lowest length and the
highest frequency.
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- When we vibrate the tunning fork, why should we place it on the box but not just closer to the string?

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To make sure the energy transfer from the tunning fork to the sonometer is direct and
efficient.
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- If we are asked to find the material density of the string using this experiment, we can do it like this.

$$v = f\lambda$$
$$v = \sqrt{(\frac{T}{M})}$$
$$\lambda = 2l$$
$$\therefore \sqrt{(\frac{T}{M})} = f(2l)$$
$$then\ M = \frac{T}{4f^2l^2}$$

- What do we do if the length of the sonometer wire we have is not enough for the frequency of the tunning fork?

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We can increase the tension of the wire
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$$l = \frac{1}{2f}\sqrt{(}\frac{T}{M})$$

> Here as l and T are positively correlated, when we increase T to l also has to increase.