

Problem 26

26. Two horizontal needles are used to balance a candle so that it rotates freely. If the candle is lit at both ends, it starts to oscillate. Explain and investigate this effect.

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- From: China-PML

Catalogue

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Theory analysis

Theory analysis

A hard rod that can be rotated about a fixed point under the action of a force is called a **lever**.

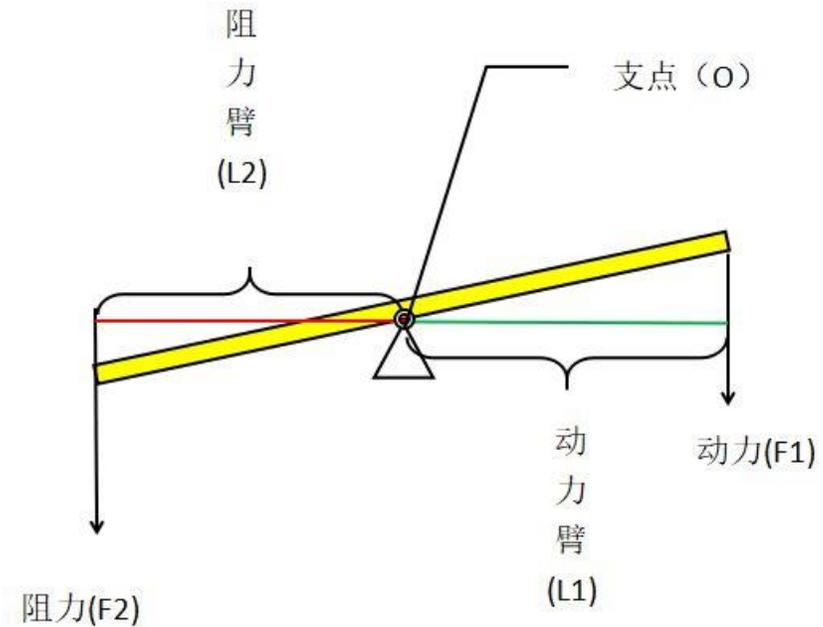
Pivot: The point around which the lever rotates, usually represented by the letter **O**.

Power: The force that causes the lever to rotate, usually expressed in **F1**.

Resistance: The force that hinders the rotation of the lever, usually expressed in **F2**.

Power arm: The distance from the fulcrum to the power line of action, usually expressed in **L1**.

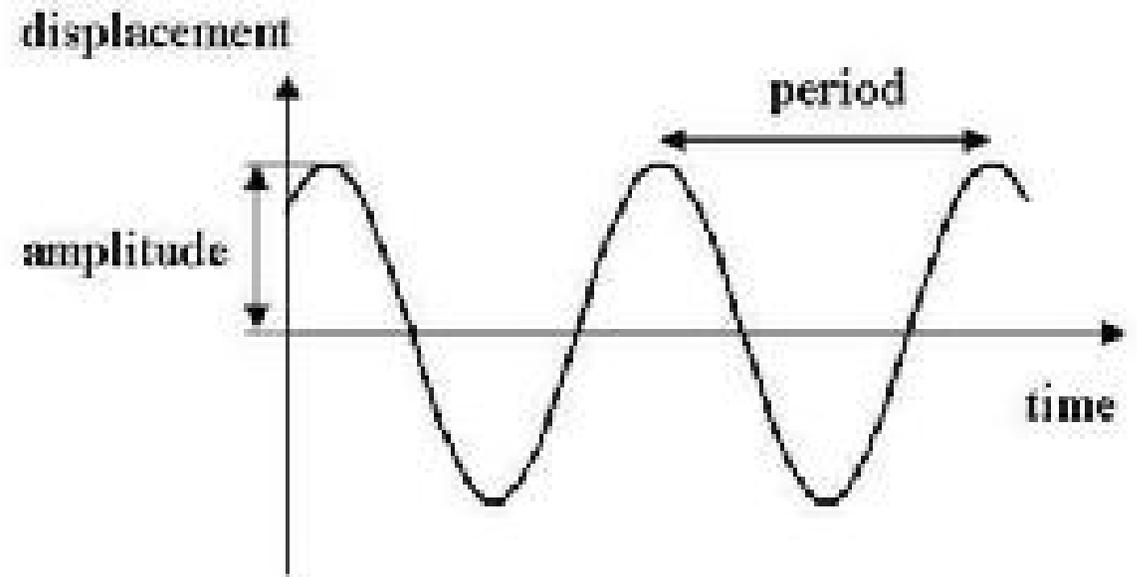
Resistance arm: The distance from the fulcrum to the line of resistance, usually expressed in **L2**.



Theory analysis

Simple harmonic motion is a regular cosine (or sinusoidal) vibration over time.

When an object performs a simple harmonic motion, the force exerted by the object is proportional to the displacement and always points to the equilibrium position.



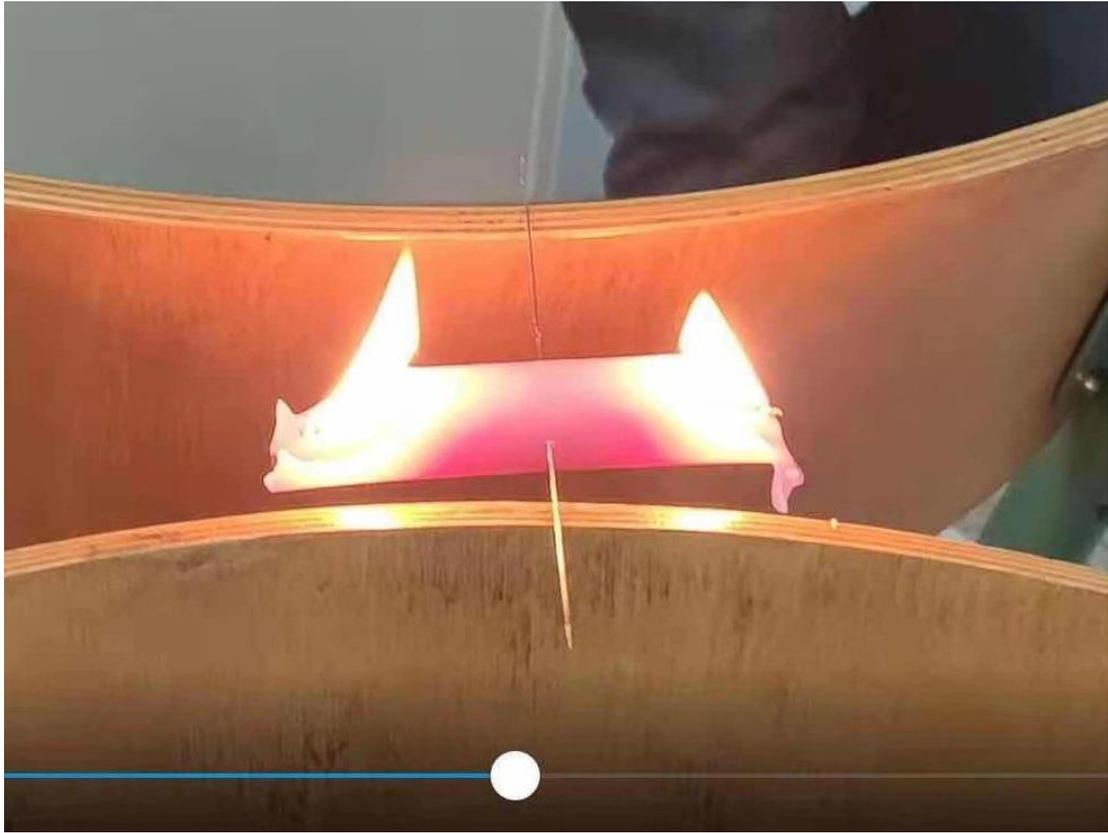


Experiment analysis

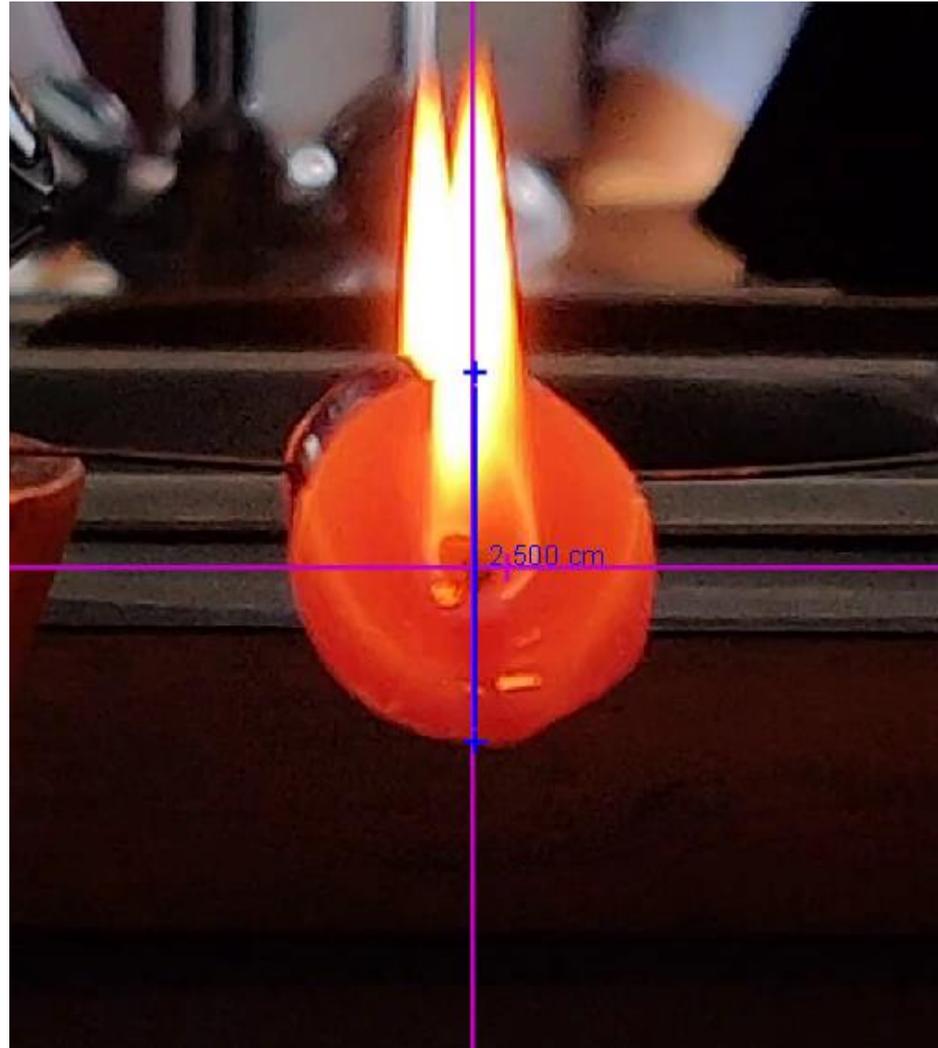
experiment analysis



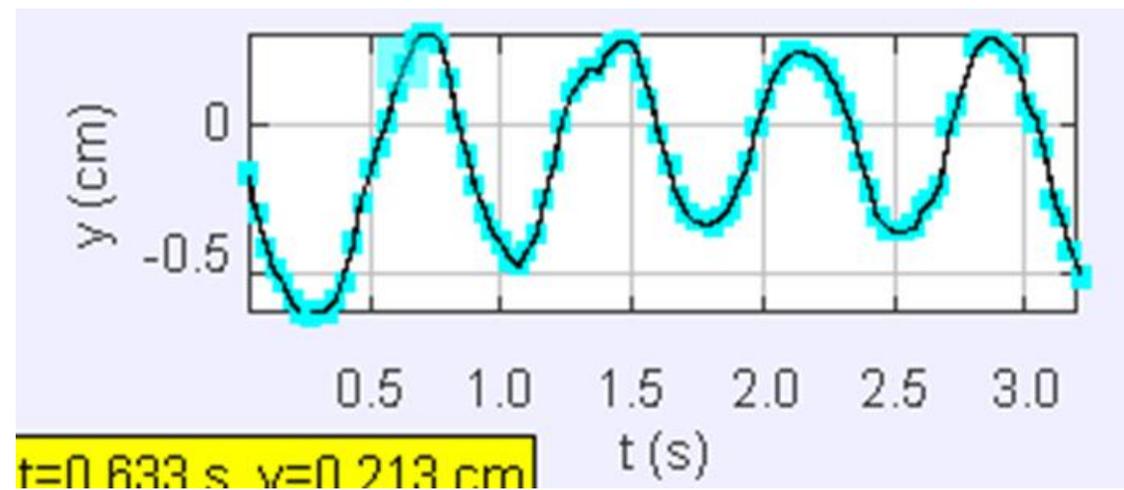
experiment analysis



experiment analysis



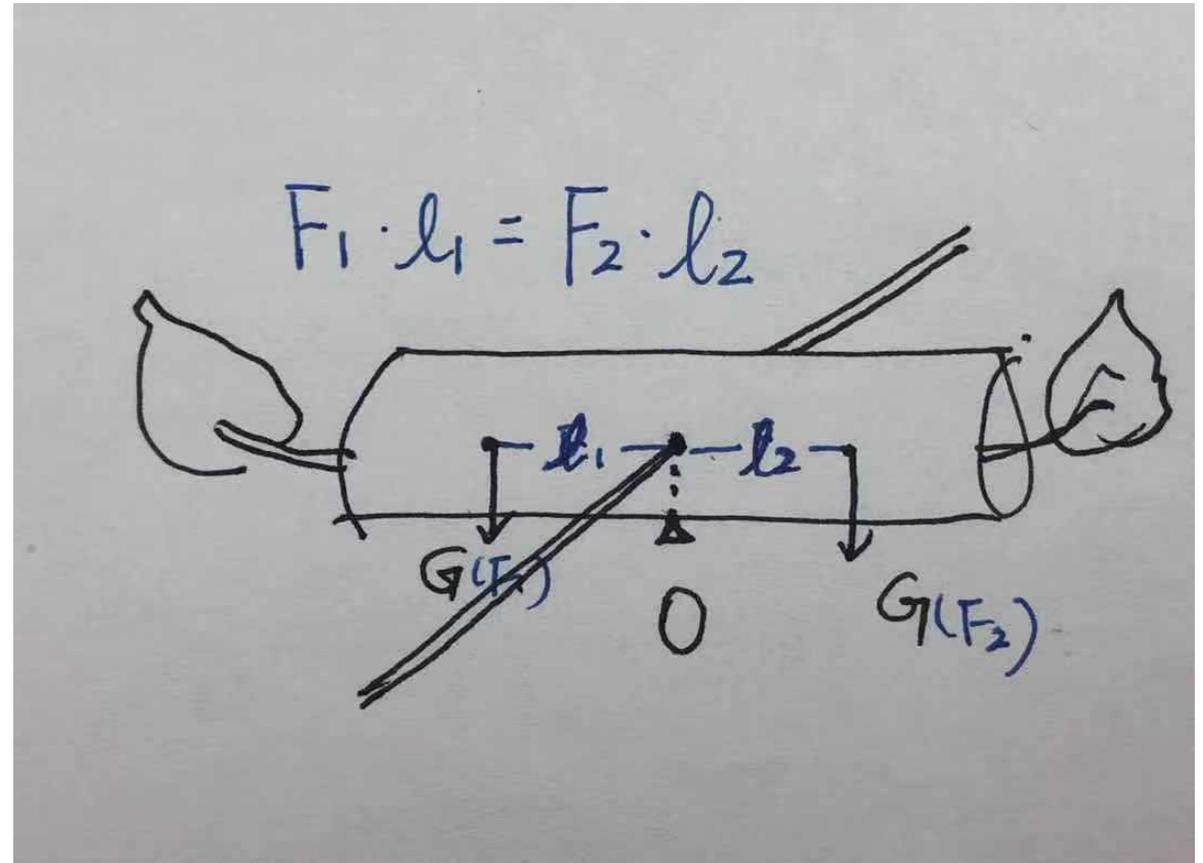
data analysis



model analysis

Suppose Burning on the left faster,
rising on the left,
flame touch the right side,
burning on the right faster,
Right side lighter
reciprocating cycle

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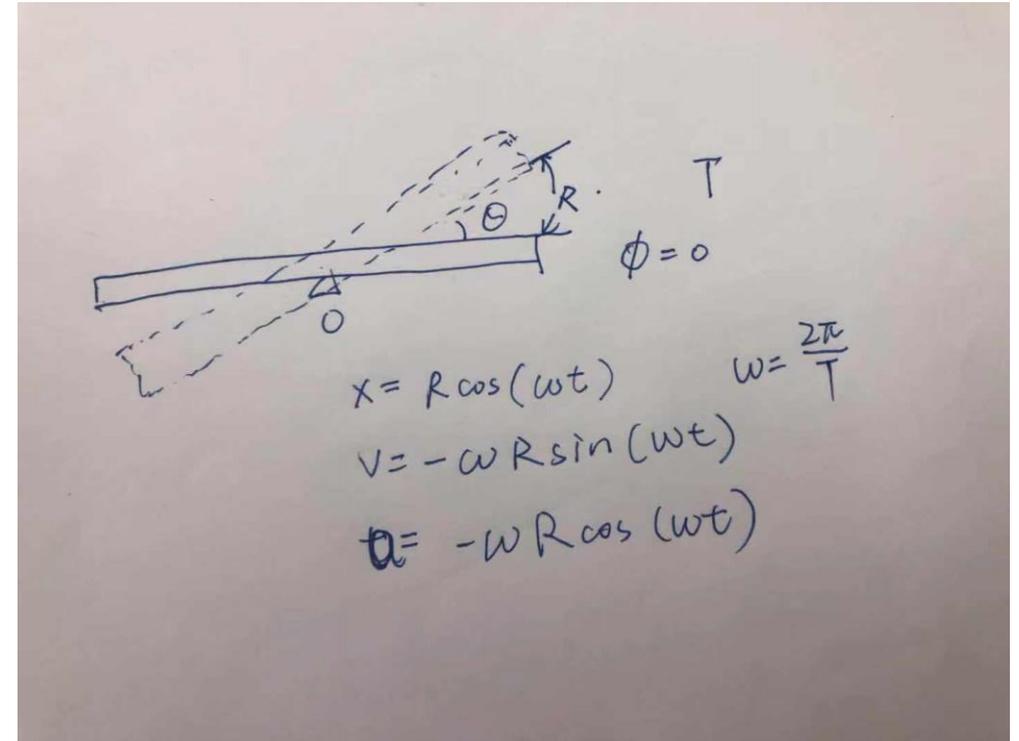
Model analysis

The oscillation of the candle is actually Simple harmonic motion (SHM).

SHM displacement: $x = R \cos(\omega t + \phi)$;

SHM velocity : $v = -\omega R \sin(\omega t + \phi)$;

SHM acceleration : $a = -\omega^2 R \cos(\omega t + \phi)$



error analysis

error analysis

1. The candle is not uniform, so the center of gravity is not accurate.
2. The needle is not kept as 0° horizontal.
3. The speed of burning is not the same at 2 ends, so the center of gravity is not uniformly changed.
4. Effects of Sound waves and air turbulence could not be controlled.
5. Only 1 candle is provided, so the total times of experiments is limited.

conclusion

The candle can be perceived as a kind of lever.
Due to the difference in the burning speed at both ends, the oscillation of the candle is caused.

The kinetic energy of the candle oscillating is converted from gravitational potential energy.

This vibration of candle is similar to the simple harmonic vibration.

The background is a gradient of blue, transitioning from a lighter shade on the left to a darker shade on the right. There are several abstract, curved white and light blue shapes that appear to be overlapping or layered, creating a sense of depth and movement. The text is centered in the middle of the frame.

**THANK YOU FOR
LISTENING!**