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- POLYTECHNIC OF EGYPT -

Principle of Physics

Lab 3: Bar Pendulum Experiment

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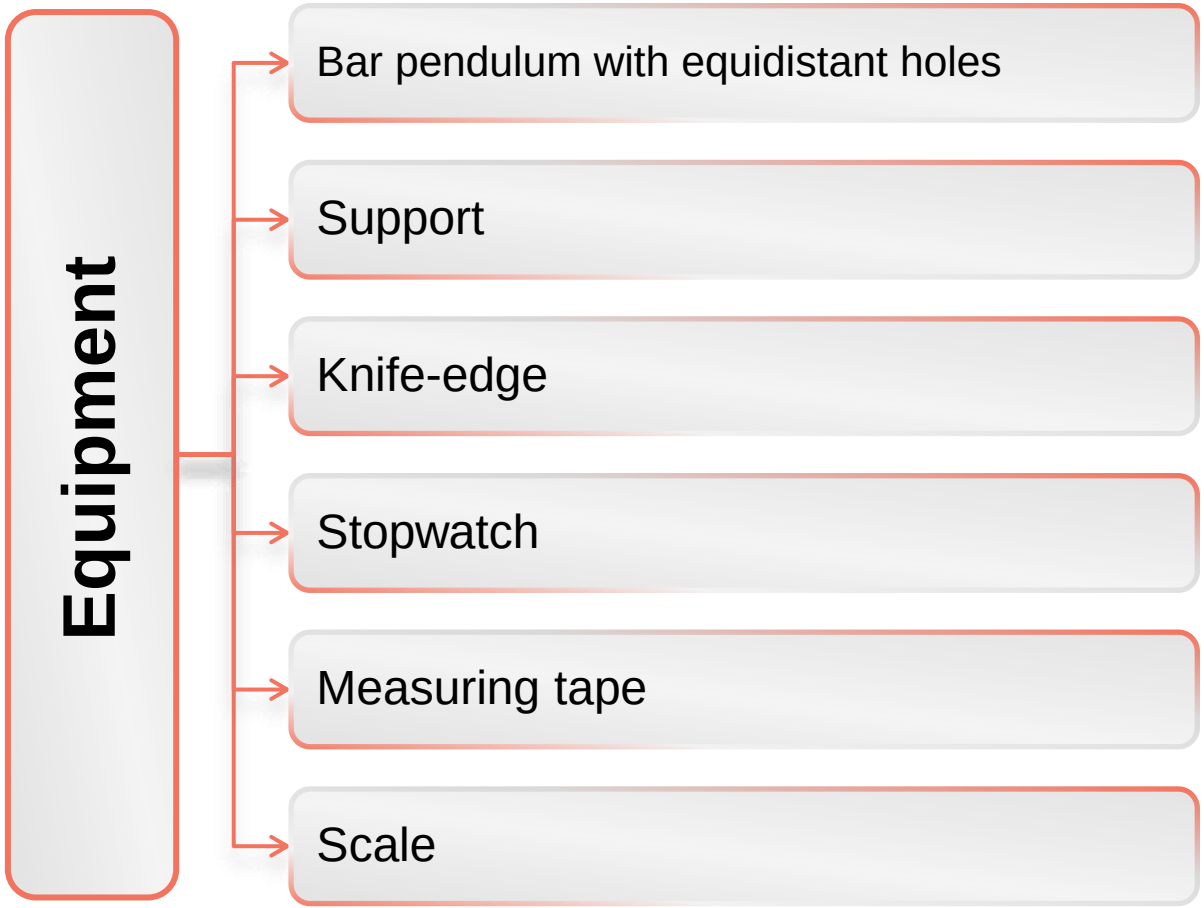
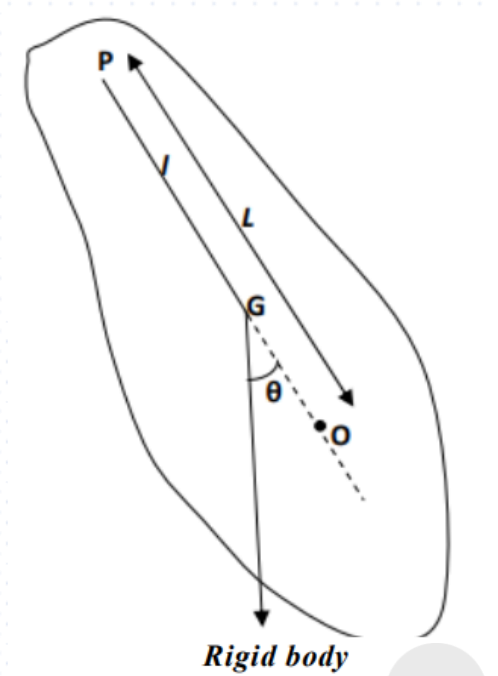
Objective

Measure the acceleration due to gravity using the period of oscillation of a compound pendulum


Equipment
Bar pendulum with equidistant holes
Support
Knife-edge
Stopwatch
Measuring tape
Scale

Theoritical Analysis

- The rigid body (pendulum) is of mass 'm' and it is allowed to oscillate around a horizontal axis passing through the center of suspension marked as 'P.' The center of gravity of the body is denoted as 'G,' and the distance from the center of suspension (P) to the center of gravity (G), known as 'GP' is equal to ' l'.
- In the equilibrium position, the body's center of gravity (G) is situated directly beneath point P.



Theoritical Analysis

$$g = \frac{4\pi^2}{T^2}\, l$$

- g: the acceleration due to gravity (m/sec^2)
- l: s the effective length of the compound pendulum arm (m)
- T: the oscillation period (sec)

$$l_1 = AC + CD$$

$$l_2 = BC + CE$$

$$l = \frac{AD + BE}{2} = \frac{l_1 + l_2}{2}$$

Procedure

1. Measure the bar pendulum length & distances between holes.
2. Find the center of gravity or mid-point of the bar.
3. From the pendulum center of gravity, we have nine holes at either side which we term as “Side A” and “Side B”.
4. Arrange and clamp the support to hold the pendulum.
5. Fix the knife-edge at Side A, first at the hole closest to center of gravity. And balance the knife edge at wedge of clamp stand.
6. Displace the compound pendulum setup with a small angle. Now note the time for 10 oscillations 3 times.
7. Take the mean of these oscillations and divide the mean calculated by 10 to get the time period of one oscillation.
8. Repeat step 5-7 for all other holes on side A and B.
9. Draw a graph by taking distance from G on x-axis and time period “T” on y-axis.

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Observation

No. of holes from G	Distance of knife edge from G (cm)	Time for 10 Oscillations (s)				Time Period T (s)
		1	2	3	Mean	
1						
2						
3						
4						
5						
6						
7						
8						
9						

“Side A”

No. of holes from G	Distance of knife edge from G (cm)	Time for 10 Oscillations (s)				Time Period T (s)
		1	2	3	Mean	
1						
2						
3						
4						
5						
6						
7						
8						
9						

“Side B”

Calculations

1. Create a straight horizontal line ABCD parallel to the X-axis. Points A, B, C, and D on this line indicate where it crosses the curves.
2. The curves are symmetrical around a vertical line that intersects the X-axis at point G, which designates the position of the bar's center of gravity (C.G). This vertical line also intersects with the line ABCD at point P.
3. Determine the length AC and BD and find the length L of the equivalent simple pendulum then acceleration due to gravity:

$$l = \frac{AD + BE}{2} \qquad g = \frac{4\pi^2}{T^2}\, l$$

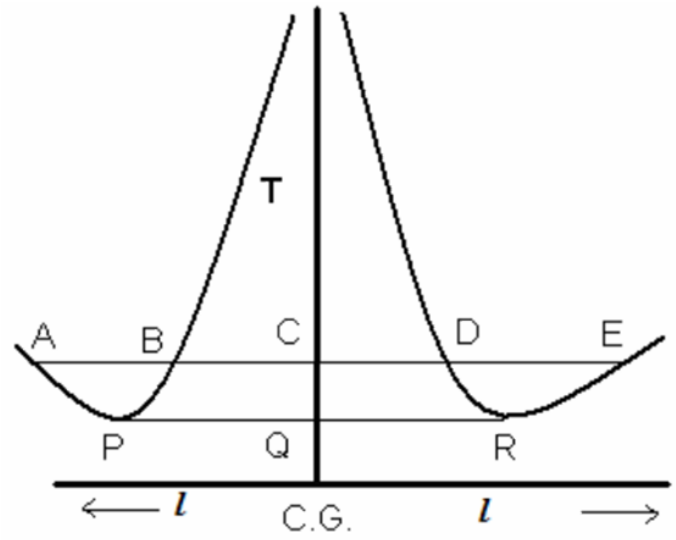

Fig. 2

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Conclusion

Conclusion

The acceleration due to gravity is 9.988 m/sec² is consistent (within experimental error) with the accepted value for the acceleration due to gravity on Earth (approximately 9.81 $m\ s\ 2/$).

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Thank You