Experiment 1a : The Compound Pendulum: *Graduated Bar*

- **Determine the value of acceleration due to gravity g and radius of gyration k using bar pendulum.**
- Estimate limits on angular displacement for SHM by measuring the time period at different angular displacements and compare it with the expected value of time period for SHM.

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1. **SETUP & FORMULAE:** The compound pendulum is a graduated bar pendulum which is reversible. It is called a **reversible pendulum** because it can oscillate from either of its two knife edges, and its behavior remains symmetric under reversal.

   - If the distance of the point of suspension (knife edge) from the CG is $l_1 = l$ and that of the point of oscillation from CG is $l_2 = k^2/l$ (to be determined from graph of T vs l_1) then the following formula is employed to determine **the value of acceleration due to gravity (g) and radius of gyration (k) of the bar pendulum**

   $$g = \frac{4\pi^2(l_1 + l_2)}{T^2} = \frac{4\pi^2 L}{T^2}; \quad k = \sqrt{l_1 l_2}$$

   where $L = l_1 + l_2$ is the equivalent length of pendulum and T is the measured time period.

   - *At the condition where the time period is minimum, denoted as T_{min}, the pendulum exhibits a symmetrical oscillation, and the equivalent length becomes L = 2k. In this special case:*

   $$g = \frac{8\pi^2 k}{T_{min}^2} = \frac{4\pi^2 L}{T_{min}^2}$$

   where $k = \frac{k_1+k_2}{2}$ where $k_1 + k_2$ is the distance between the minimas on the T versus l_1 graph.

   - In the Ferguson method we plot l_1^2 versus $l_1 T^2$ and the slope predicts the value of g

2. **Tables: Observations and Graphs** Make a

   (a) Table for l_1 & T and l_2 & T. Plot time period T versus (l_1, l_2) and extract L value for different T. From this graph also find at T_{min} the $k_1 + k_2$ value.

   (b) Plot l_1^2 versus $l_1 T^2$.

3. **Calculations from Table and Graphs**

   - From Table 2(a) evaluate g and k. Corresponding to T_{min} evaluate the g value
   - From graph 2(b) report the slope and intercept and evaluate g and k

4. **APPLICATIONS**

   (a) Estimate limits on angular displacement for SHM by measuring the time period **at different angular displacements and compare it with the expected value of time period for SHM**.

   (b) Any other

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