Acceleration due to gravity 'g' by Kater's Pendulum

Object: |To determine the value of acceleration due to gravity with Kater's pendulum.

Apparatus used: Kater's pendulum, a stop watch and a meter rod.

Formula: The following formula is used for the determination of acceleration due to gravity 'g':

$$g = \frac{8\pi^2}{\frac{T_1^2 + T_2^2}{l_1 + l_2} + \frac{T_1^2 - T_2^2}{l_1 - l_2}} \qquad (1)$$

Here, T_1: time periods of the oscillating pendulum from knife-edge K1

T_2: time periods of the oscillating pendulum from knife-edge K2

l_1: distances between knife-edges K1 and CG of the pendulum

l_2: distances between knife-edges K2 and CG of the pendulum

When T_1 and T_2 are very close to each other (difference less than 1 percent), the above expression becomes as:

$$g = \frac{8\pi^2}{\frac{T_1^2 + T_2^2}{l_1 + l_2}} \qquad (2)$$

Procedure:

1. Fix the weights as shown in figure. i.e.

{one end→M→K_1→m→w→K_2→W→other end)

2. Make sure that the distances from big masses to ends and big masses to knife edges should be symmetrical.

3. Balance the pendulum on a sharp wedge such that the smaller weights are at symmetrical distant from CG. Now mark the position of its centre of gravity and measure the distance of the knife-edges K_1 and K_2 CG. This will give you value of l_1 and l_2.

4. Suspend the pendulum with the knife-edge K_1 and set it to oscillate with small amplitude. Note the times for 15, 20 and 25 oscillations respectively.

5. Now suspend the pendulum with the knife-edge K_2 and set it to oscillate with small amplitude. Note the times for 15, 20 and 25 oscillations respectively.

6. The oscillations should be seen with the help of a telescope for accuracy.

Figure

Observation:

1. Least count of stop watch=……..sec
2. Distance between K_1 and CG (l_1)=……..cm
3. Distance between K_2 and CG (l_2)=……..cm
4. *Table for time period T_1(oscillation about K_1):*

Sr. No.	*Number of Oscillation n*	*Time of Oscillation t_1(sec)*	*Time Period $T_1=t_1/n$*	*Mean T_1 (sec)*
1.	*15*			
2.	*20*			
3.	*25*			

5. *Table for time period T_2(oscillation about K_2):*

Sr. No.	*Number of Oscillation n*	*Time of Oscillation T_2(sec)*	*Time Period $T_2=t_2/n$*	*Mean T_2 (sec)*
1.	*15*			
2.	*20*			
3.	*25*			

Calculation: Using equation (1) or (2) {depending on value of T_1 and T_2} calculate the value of g.

Result: Acceleration due to gravity 'g'=……..m/s^2

Standard value of 'g' = ……..m/s^2

Percentage error: $\frac{\Delta g}{g}\times 100 = \frac{g_{s\tan dard} - g_{measured}}{g}\times 100. = ...\%$

Precautions:

1. The two knife-edges should be parallel to each other.
2. The amplitude of vibration should be small so that the motion of the pendulum satisfies the condition of simple harmonic motion.
3. To avoid any irregularity of motion the time period should be noted after the pendulum has made a few oscillation.
4. To avoid friction there should be glass surface on rigid support.