**Determine gravitational acceleration using a U-shaped tube**

***Apparatus:*** A U-tube, stop watch, ruler.

***Method:***

1- Let the length of water in first time be 10 cm.

2- Displace the water from the equilibrium position,

 then measure the time of 10 oscillations

 which take the average.

3- Repeat step 2 with the length increased by 5 cm in

 steps up to 40 cm.

4- Tabulate the results as:

|  |  |  |  |
| --- | --- | --- | --- |
| T2/s2 | Time of 1 oscillation | Time of 10 oscillations | L /cm |
|  |  | 7.76 | 15 |
|  |  | 8.97 | 20 |
|  |  | 10 | 25 |
|  |  | 10.98 | 30 |
|  |  | 11.86 | 35 |
|  |  | 12.68 | 40 |

#

1. plot a graph with values of *T2/s2* as ordinates against the corresponding values of *L*/m as abscissas.

***Theory and calculation:***

 When a column of water in a U-tube is displaced by a distance Y from its equilibrium, as shown in fig. any cross section in the water is then subject to a result force arising from the pressure difference AP on that section. The pressure difference depends on the difference in water height in the two arms of the tube. Assume that the pressure on surface B is P as shown in fig. on C is P then the pressure difference on the water column is:

  ……………..(1)

 Where *ρ* is water density.

 The pressure difference due to air column is neglected.

Then the resultant force on the water column is:

 ……………………….(2)

Where(A) is cross- sectional area of the tube.

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According to Newton’s second law:

  ……………………………..(3)

We get:

 ………………………….(4)

Where *m* and *L* are the mass and length of the entire column of water. Eq. (4) implies that the motion of the water column is a simple harmonic motion with the period:

 ……………………………..(5)

  ……………………………..(6)

From which it is seen that the graph of *T2* against *l* will be a straight line whose slope  measured from two convenient and well-separated points P and Q on the line, is numerically equal to 

 Thus 

 ms-2*T2*/s2

 P

 Q

 N

 *L*/cm