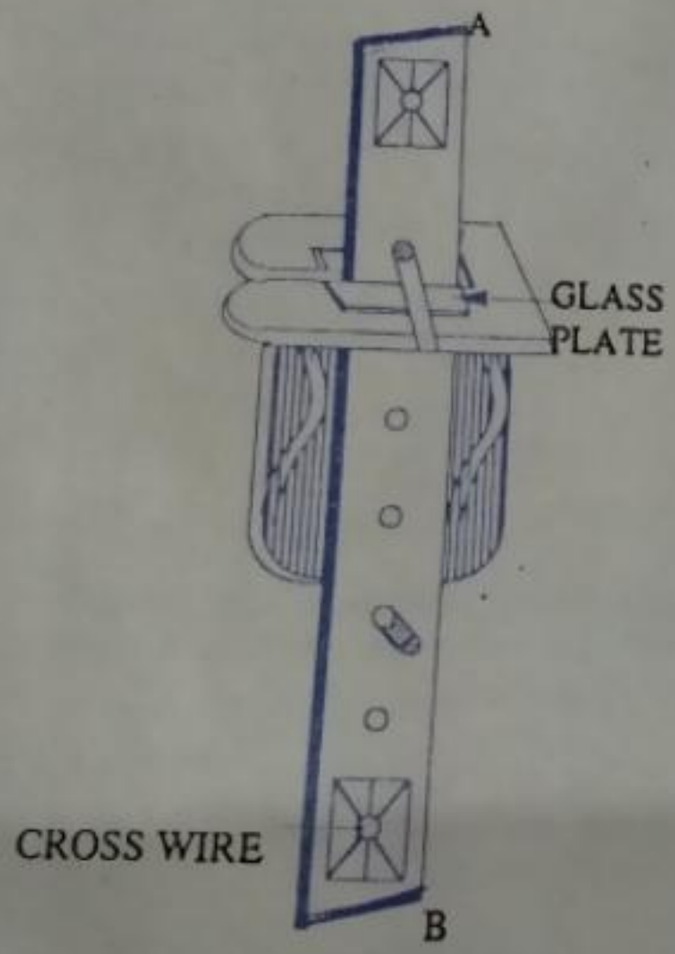
Q.3 What is the angle of contact of water?

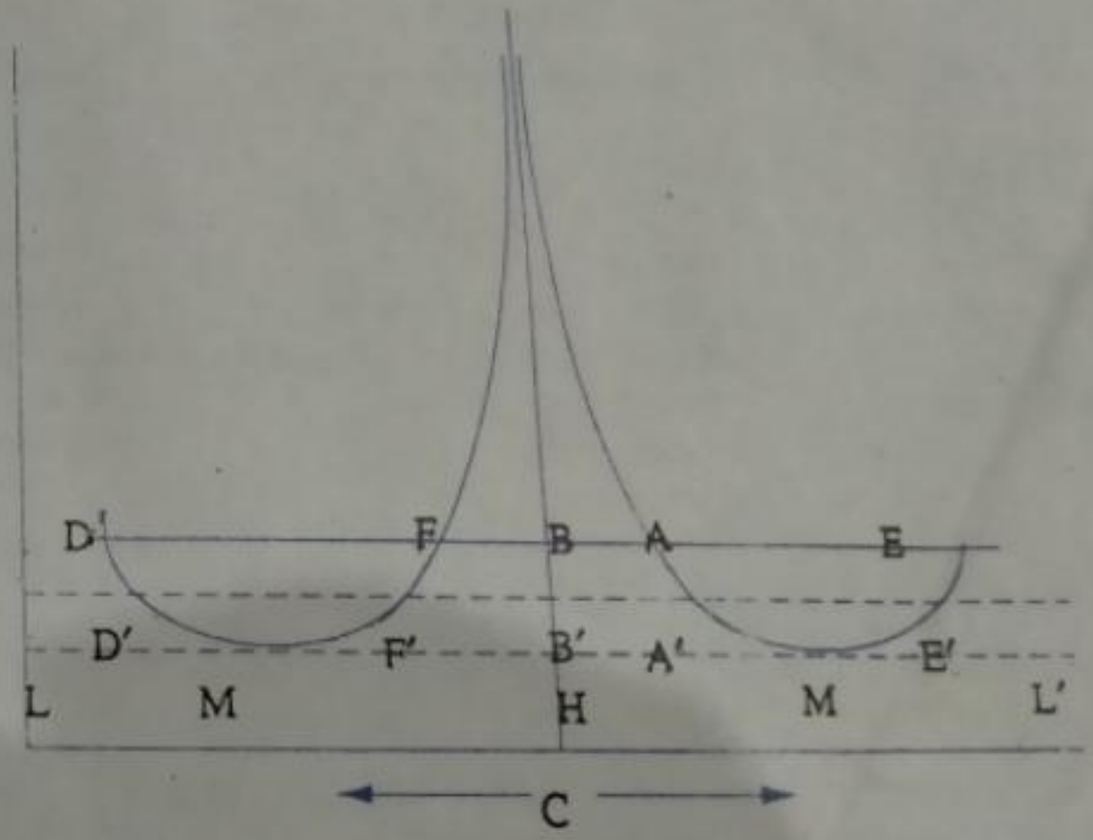
Ans. It is almost zero because water wets the glass.

Ans. It may contain traces of grease leading to a wrong result.

Expt. No. 2. To determine the value of 'g' by a compound pendulum.

Apparatus. Compound pendulum, wedge, spirit level, telescope, stop-watch, and beam compass.





Observations and Calculations:

S.No.	Side A					Side B				
	Distance from c.g.	Times for 20 vibrations			Time period	Distance from c.g.	Times for 20 vibrations			Time period
		1	2	Mean			1	2	Mean	
	cm.	sec.	sec.	sec.	sec.	cm.	sec.	sec.	sec.	sec.

Calculations of 'g':

Sr. No.	Line	Length l	Length l'	Length $L = l + l'$	Time period T	$g = \frac{4\pi^2 L}{T^2}$
		cm.	cm.	cm.	sec.	cm/sec^2.
1.	EABFD	$BD =$	$AB =$	$AB + BD =$	$BC =$	
2.	,,	$BE =$	$BF =$	$BE + BF =$	$BC =$	
3.	$E'A'B'F'D'$	$B'D' =$	$A'B' =$	$A'B' + B'D' =$	$B'C =$	
4.	,,	$B'E' =$	$B'F' =$	$B'E' + B'F' =$	$B'C =$	
5.	$L'M'HML$	$HM' =$	$HM =$	$HM' + HM =$	$HC =$	

Mean g = ... cm/sec^2.

Correct value of g = ... cm/sec^2 = ... m/sec^2
Percentage error = ... %

Radius of gyration k:

Value of k from observation No. (1) = $\sqrt{AB \times BD}$ =
(2) = $\sqrt{BF \times BE}$ =
(3) = $\sqrt{A'B' \times B'D'}$ =
(4) = $\sqrt{B'F' \times B'E'}$ =
(5) = $\sqrt{HM \times HM'}$ =

Mean value of radius of gyration = k =
Mass of the pendulum = M = ... gm.
Moment of intertia = $I = Mk^2$ = ... gm. cm^2

Procedure:

1. Paste a small piece of paper on either end of the compound pendulum and draw a line parallel to the edge of the pendulum to serve as a reference mark.

2. Place the knife-edge in the first-hole on each side parallel to each other with their sharp edges facing the c.g. of the pendulum. Balance the pendulum on a wooden prism and mark its c.g. and also check the support for horizontal level with the help of a spirit level.

3. Suspend the pendulum from the knife-edge on the side of end A with the knife-edge perpendicular to the edge of the slot and the pendulum hanging in the plane of the wall.

4. Adjust the telescope eye-piece for the cle visibility of its cross-wires. Focus it on the referen marks of the pendulum.

5. Set the pendulum into vibration with small amplitude of about 5° and pause for a few minu to get regular vibrations.

6. Look through the telescope and start the s watch when the image of the reference mark passes ac the point of inter-section of the cross-wires and c *zero*. Count *one* when the pendulum crosses the position in the same direction and so on. Record tim 20–30 vibrations. Repeat the same observation and out the mean time period.

7. Measure the distance between the c.g. and the inner edge of the knife-edge (i.e. from the bottom of the hole).

8. Now turn the pendulum upside down and suspended it on the knife-edge placed symmetrically on the side *B* and repeat the above process. Record a number of observations with the knife-edge in the 2nd, 3rd, 4th. . . so on holes on either side of the c.g. of the pendulum.

9. Plot a curve with periodic times T as ordinates and the distances on either side of c.g. as abscissae. A curve as shown in the Fig. (b) will be obtained. Note that the line CG represents the centre of gravity of the pendulum and the curve is found to be symmetrical about CG. Draw any line $EABFD$ parallel to the axis which cuts the curve in four points. See that FB

$= CA$ and $BE = BD$. Take either set in pairs, say BA, BD and get $AB + BD = \frac{k^2}{l} + l = L$, the length of equivalent simple pendulum. Its time period T is numerically equal to BC. Hence in the relation $T = 2\pi\sqrt{\frac{L}{g}}$, all factors except g are known, whence g may be calculated. It is preferable to draw several lines parallel to DE and for each to obtain the corresponding values of L and T. The mean value of $\frac{4\pi^2 L}{T^2}$ is used to calculate the value of g. Now draw the line $LMIIM'L'$ tangential to the curve to get $IIM = IIM' =$ radius of gyration about an axis through the c.g. This shows that the centres of suspension and oscillation coincide at M and M′ i.e. $l = \frac{k^2}{l} = l'$.

Thus $L = l + l' = 2l = 2k$ and the corresponding periodic time is numerically equal to the length of $IIC = T_1$, say. Hence the least time period $T_1 = 2\pi\sqrt{L/g} = 2\pi\sqrt{2k/g}$ which gives $k = \frac{T_1^2}{8\pi^2}g$. For the 1st line calculate k by the relation $k = \sqrt{AB \times BD}$. Use the mean value of k in the relation $I = Mk^2$ to work out the moment of inertia about a parallel axis through the c.g. where M is obtained by direct weighing. Make a record of your observations as shown above.

Sources of error and precautions

1. The knife edge should be horizontal and the pendulum parallel to the wall.
2. The amplitude of swing should be small.
3. The two knife-edges should be placed symmetrically with respect to the c.g. of pendulum.
4. The distance should be measured from the inner edge of the knife-edge.
5. Time period should not be determined for the holes close to c.g. on either side.

Viva Voce :

Q.1. What is compound pendulum?
Ans. A compound pendulum consists of a rigid body, capable of oscillating freely about a horizontal axis passing through it.

Q.2. What is a simple pendulum?
Ans. A simple pendulum consists of a heavy particle (a point-mass) suspended from one end of an inextensible, perfectly flxible and weightless string whose other end is fixed to a rigid frictionless support.

Q.3. What is second's pendulum?
Ans. A pendulum whose time period is 2 seconds is called a second's pendulum.

Q.4. What is meant by length of a compound pendulum?
Ans. It is the distance between its axis of suspension and its centre of gravity.

Q.5. What do you mean by an equivalent simple pendulum?
Ans. A simple pendulum whose time period is the same as that of a compound pendulum, is called an equivalent simple pendulum.

Q.6. What are the drawbacks of a compound pendulum?
Ans. (i) The C.G. of a compound pendulum cannot be located with great precisian from where the distances are measured.
(ii) The pendulum drags some volume of air along with it which may increase the moment of inertia of the moving system.
(iii) The amplitude is finite which need correction.

Q.7. What do you mean by 'g' i.e., the acceleration due to gravity?
Ans. It is the acceleration produced by the gravitation pull of the earth in a freely falling body.