EXPERIMENT 11

AIM

To determine the surface tension of water by capillary rise method.

APPARATUS

Capillary tube and a tipped pointer clamped in a stand, travelling microscope, clean water in a beaker.

THEORY

Surface tension, $T = r\,h\,\rho g / 2\cos\Theta$

PROCEDURE

Measurement of capillary rise

1. Find the least count of the travelling microscope for the horizontal and the verticalscale. Record the same in the note-book.
2. Raise the microscope to a suitable height, keeping its axis horizontal and towards the capillary tube.
3. Bring the microscope in front of first capillary tube.
4. Make the horizontal cross wire just touch the central part of the concave meniscus.
5. Note the reading of the position of the microscope on the vertical scale.
6. Lower the stand so that pointer tip becomes visible.
7. Move the microscope horizontally and bring it in front of the pointer.
8. Lower the microscope and make the horizontal cross wire touch the tip of the pointer. Note the reading.

OBSERVATIONS

Serial. No.	Reading of meniscus			Reading of pointer tip			Height h_1-h_2= h (cm)
	M.S.R	V.S.R	T.R(h_1)	M.S.R	V.S.R	T.R(h_2)	

CALCULATIONS

Radius of the capillary tube =……….m

Height of water in the capillary tube =…………….m

Surface tension=

RESULT

The surface tension of water =…………..Nm^{-1}.

PRECAUTIONS

1. Capillary tube and water should be, free from grease -.
2. Capillary tube should be set vertical.
3. Microscope should be moved in lower direction only to avoid back lash e
4. Temperature of water should be noted.

SOURCES OF ERROR

Water. and capillary tube may not be free from grease.

EXPERIMENT 12

AIM

To study the relation between frequency and length of a given wire under constant tension using sonometer.

APPARATUS

A sonometer, a set of tuning forks, 1 kg hanger, slotted weights, rubber pad, paper rider, metre scale.

THEORY

If stretched wire (string) vibrates in resonance with a tuning fork of frequency v, then the
string also has same frequency ν.
If the string has a length l, then
νl = Constant.

PROCEDURE

1. Place the sonometer on the table.
2. Test the pulley and make it frictionless by oiling.
3. Put suitable maximum weight in the hanger.
4. Move wooden bridges outward to include maximum length of wire between them.
5. Take a tuning fork of least frequency from among the set. Strike its prong rubber pad to make it vibrate. Listen the sound produced by tuning fork.
6. Since the long wire may have less frequency, decrease its length by moving the bridges inwardly. Check the frequencies again.
7. Go on decreasing the length till frequency of vibrating wire AB becomes equal to frequency of the tuning fork.
8. Put an inverted V shape paper rider R on the wire AB in its middle. Vibrate tuning fork and touch the lower end of its handle with sonometer board. The wire vibrates due to resonance and paper rider falls.
9. Note the length of the wire AB between the edges of the two bridges and record it in 'length decreasing' column.
10. Bring the two bridges closer and then adjust the length of the wire by increasing it little by little till rider falls.
11. Note the length of the wire and record it in 'length increasing' column.
12. Repeat steps 5 to 11 for different tuning forks.

OBSERVATIONS

Serial. No.	Frequency(Hz)	Resonant length			vl (cms^{-1})
		l_1	l_2	Mean l(cm)	

RESULT

vl is a constant.

PRECAUTIONS

1. Tuning fork should be vibrated by striking its prongs against soft rubber pad.
2. Readings for length decreasing and increasing should be noted and their mean used
in calculations.
3. Weight of hanger should be included in the load.
4. Load should be removed after the experiment.

SOURCES OF ERROR

1. Wire may not be rigid and of uniform cross-sectional area.
2. Pulley may not be frictionless.
3. Weights used may not be correct.
4. Bridges may not be sharp.

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EXPERIMENT 13

AIM

To determine the mass of a given body using a metre scale by principle of moments.

APPARATUS

A metre scale, a stand, a weight box, a body of unknown mass.

THEORY

According to principle of moments,

effort × effort arm = load × load arm

$$W_1 d_1 = W_2 d_2$$

PROCEDURE *(Stepwise)*

1. Suspend the metre scale horizontally by using a strong cord and note the position of its centre of gravity G.
2. Suspend a body of known mass by a loop of thread at a fixed mark on the left of G such that the length of the arm is 10 cm (d_1) .
3. Suspend the given body of unknown mass on the right of G.,
4. Adjust the length of the arm on the right (d_2) till the metre scale becomes horizontal.
5. Note the readings.
6. Repeat steps 2 to 5, three times by increasing the length of the arm on the left in equal steps.
7. Record the observations as given below in table.

OBSERVATIONS

Trial No.	W_1(g)	d_1(cm)	d_2(cm)	$W_2 = \frac{W_1 d_1}{d_2}$ (g)

Mean value of unknown mass = g.

RESULT

The unknown mass of the body, m = g.

PRECAUTIONS· *(to be taken)*

1. The wedge should be broad and heavy with sharp edge.
2. Metre scale should have uniform mass distribution.
3. Threads used for loops should be thin, light and strong.

SOURCES OF ERROR

1. The wedge may not be sharp.
2. Metre scale may have faulty calibration.

3. The threads used for loops may be thick and heavy.

EXPERIMENT 14

AIM

To determine the terminal velocity of a given spherical body falling through a viscous medium.

APPARATUS

A half metre high 5 cm broad glass cylindrical jar with millimetre graduations along its
height, transparent viscous liquid, one steel ball, screw gauge, stop clock/watch.

THEORY

The constant velocity with which a spherical body falls through a viscous fluid is called terminal velocity.

$v = \frac{d}{t}$ where d is the distance through which it falls and t is the time taken.

PROCEDURE *(Stepwise)*

1. Clean the glass jar and fill it with the viscous liquid, which must be transparent.
2. Check that the vertical scale along the height of the jar is clearly visible. Note the
least count.
3. Test the stop clock/watch for its tight *spring*. Find its least count and zero error.
4. Drop the ball gently in the liquid. It falls down in the liquid with accelerated velocity
for about one-third of the height. Then it falls with uniform terminal velocity.
5. Start the stop clock/watch when the ball reaches some convenient division . Note its fall.
6. Stop the stop clock/watch just when the ball reaches lowest convenient division .
7. Find and note the distance fallen and time taken by the ball.
8. Repeat steps 4 to 7 two times more.
9. Record your observations as given ahead.

OBSERVATIONS

Terminal velocity of spherical ball

Trial No.	Distance (cm)	Time(s)	Terminal velocity(ms^{-1})

Mean terminal velocity =

RESULT

The *terminal velocity of a given spherical body falling through a viscous medium = ms^{-1}*

PRECAUTIONS *(to be taken)*

.1. Liquid should be **transparent** to watch motion of the ball.
2. Ball should be perfectly **spherical.**
3. Velocity should be noted only when it becomes constant.

SOURCES OF ERROR

1. The liquid may not have uniform density.
2. The ball may not be perfectly spherical.
3. The noted velocity may not be constant.

.EXPERIMENT 15

AIM :***To find the speed of sound in air at room temperature using a resonance tube by two resonance positions.***

APPARATUS

Resonance tube, tuning forks of known frequencies, a pad, water in a beaker.

THEORY

Let l_1 and l_2 be the length of the air column for the first and the second resonance
respectively with a tuning fork of frequency v.
Then, velocity $v = 2\,v\,(l_2 – l_1)$ can be calculated.

PROCEDURE

1. Set the resonance tube vertical by making the base horizontal, using levelling screws.
2. Fix the reservoir R in the upper most position and fill the reservoir and metallic tube completely
with water by a beaker.ss
3. Lower the reservoir and fix it in the lowest position.

4. Take tuning fork of more frequency. Vibrate it with a rubber pad and hold it with its vibrating prongs in vertical plane just over the end of the metallic tube.
5. Loose the pinch cock to make water level fall down in the metallic tube. Tight the
pinch cock when some sound is heard in metallic tube.
6. Vibrate the tuning fork again and put it as before. Loose the pinch cock a little to
make water level fall by 1 mm. Note change in loudness of sound.
7. Repeat step 6 till sound heard from the metallic tube has maximum loudness.
8. Note the position of water level in glass tube against metre scale S. Record it in 'first resonance column
9. Lower the water level to about three times the reading for first resonance.
10· Repeat steps 4 to 7. Record the water level position in 'second resonance column. .
11. Repeat the steps with second tuning fork of lower frequency.
12. Note and record frequency of tuning forks which is engraved on them.

.OBSERVATIONS

Frequency(Hz)	Resonance	Position of water level	Velocity of sound(ms^{-1})
	First		
	Second		
	First		
	Second		
	First		
	Second		

.

RESULT

Velocity of sound in air=……………………ms^{-1}.

PRECAUTIONS *(to be taken)*

1. Resonance tube should he vertical.
2. Pinch cock should be tight.
3. Tuning fork should be vibrated gently by a rubber pad.
4. Prongs should be vibrated in a vertical plane. above the mouth (end) of the metallic tube.

SOURCES OF ERROR

1. Resonance tube may not be vertical.
2. Pinch cock may be loose.
3. The edge of open end of metallic tube may not be at zero of metre scale
4. Air in air column is denser than open air outside. This may reduce velocity.