Manonmaniam Sundaranar University,
Directorate of Distance & Continuing Education,
Tirunelveli - 627 012 Tamilnadu, India

OPEN AND DISTANCE LEARNING (ODL) PROGRAMMES
(FOR THOSE WHO JOINED THE PROGRAMMES FROM THE ACADEMIC YEAR 2023–2024)

B.Sc. Physics
Course Material
Physics practical -II
Heat, Oscillations, waves and sound

Prepared
By

Dr. V. Sabarinathan

Department of Physics
Manonmaniam Sundaranar University
Tirunelveli - 12

Experiment 1.

Determination of specific heat by cooling- graphical method

Aim

To determine the specific heat capacity of an unknown liquid by cooling method

Apparatus required

A calorimeter with Stirrer, Thermometer, Stopwatch, Heating setup, etc.

Formula

Average rate of heat loss $(M_1S_1 + ms)\frac{(\theta_1-\theta_2)}{t_1}$

Average rate of heat loss $(M_2S_2 + ms)\frac{(\theta_1-\theta_2)}{t_2}$

$$(M_1S_1 + ms)\frac{(\theta_1-\theta_2)}{t_1} = (M_2S_2 + ms)\frac{(\theta_1-\theta_2)}{t_2}$$

$$Specific\ heat\ capacity, S_1 = \frac{M_2S_2t_1 + ms(t_1 - t_2)}{M_1t_2} calg^{-1}/°C$$

Where,

$(M_1S_1 + ms)$ → Thermal capacity of the system

M_1, S_1 → Mass and Specific heat of liquid one

M_2, S_2 → Mass and Specific heat of liquid two

m → Mass of calorimeter and stirrer

s → Specific heat of calorimeter

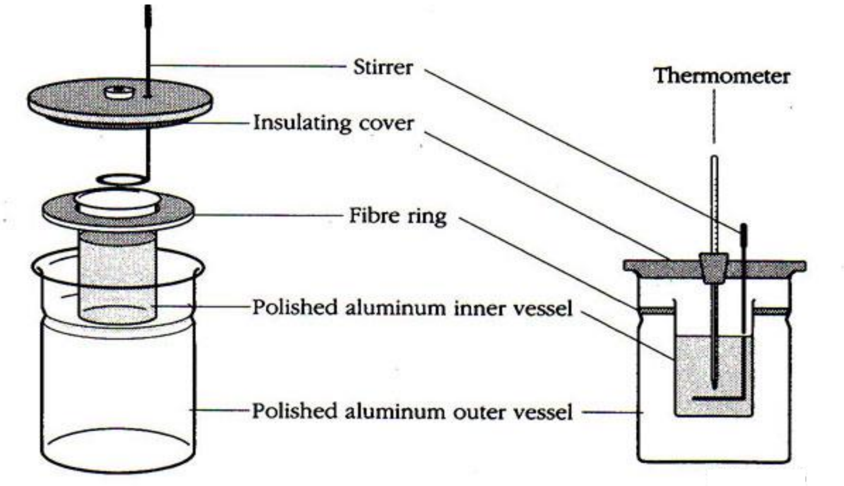
θ_1 → Initial temperature before cooling

θ_2 → Final temperature after cooling

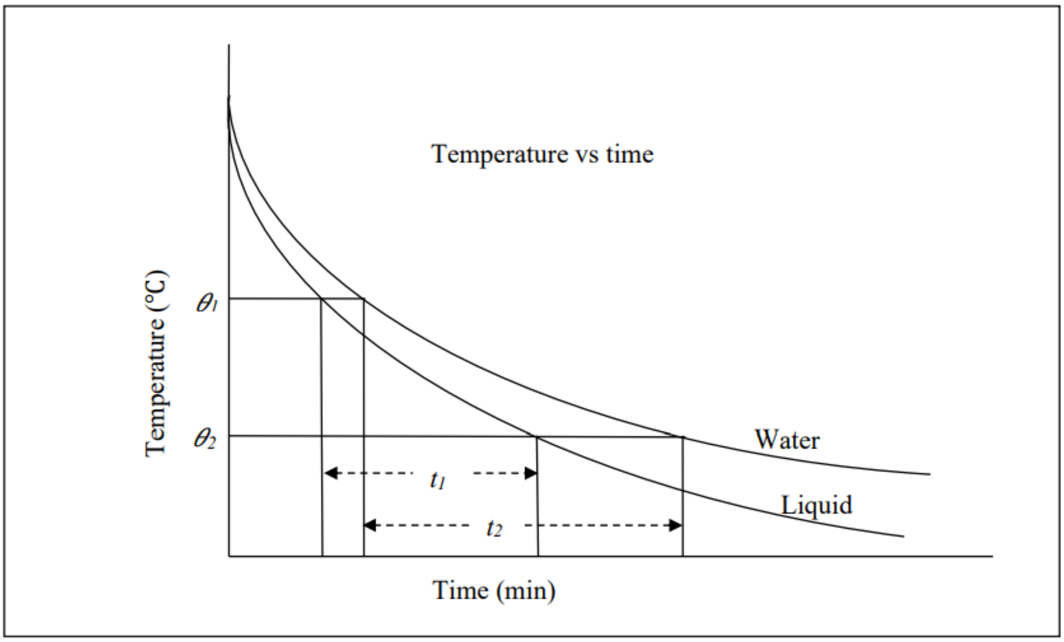
t_1 → Time taken by liquid 1 to reach the temperature from θ_1 to θ_2

t_2 → Time taken by liquid 2 to reach the temperature from θ_1 to θ_2

Experimental setup



Model graph



Procedure

1. Clean and dry the calorimeter and measure the mass (m) of the calorimeter and stirrer using a balance.
2. Pour water up to two- third volume of the calorimeter. Measure the total mass M^{11} (mass of water, calorimeter, stirrer) to calculate the mass M_2 of water.
3. Raise the temperature to approximately 62 °C by placing the calorimeter on the heater and holding the thermometer bulb in the centre of the water. Using tongs, hold the calorimeter inside the double-walled enclosure. When the thermometer's bulb is in the centre of the water, close the lid and secure it with its holder.
4. When the temperature is almost 60 °C, start the stopwatch. Note this temperature in the table.
5. Continue taking minutes-long records of the water's temperature for up to 25 or more. All throughout the operation, gently stir the water.
6. Empty the calorimeter of its water and give it a thorough cleaning. Consider the experimental liquid to be the same volume of water in the calorimeter. For experimental liquid, repeat steps 2, 3, and 4.
7. Plot curves (for both water and liquid) on a graph paper with temperature as the Y-axis and time as the X-axis. Determine t1 and t2 based on the graph.
8. Using the given formula, determine the specific heat of the given liquid.

Table 1

No. of. Obs	Time (min)	Temperature of water (°C)	Temperature of liquid (°C)
1	0		
2	1		
3	2		
4	3		
5	4		
6	5		
7	6		
8	7		
9	8		
10	9		
11	10		
12	11		
13	12		
14	13		
15	14		
16	15		
17	16		
18	17		
19	18		
20	19		

21	20		
22	21		
23	22		
24	23		
25	24		
26	25		

Observation

Mass of the calorimeter + stirrer, **m** = g

Mass of the calorimeter + stirrer + liquid, $\mathbf{M^1}$ = g

Mass of the liquid, $\mathbf{M1 = M^1 - M^{11}}$ = g

Mass of the calorimeter + stirrer + water, $\mathbf{M^{11}}$ = g

Mass of the water, $\mathbf{M2 = M^{11} - m}$ = g

Specific heat capacity of water, $\mathbf{S_2}$ = 1.00 **Cal g^{-1} °C^{-1}**

Specific heat capacity of calorimeter Aluminum, **S** = 0.2096 **Cal g^{-1} °C^{-1}**

Specific heat capacity of calorimeter Copper, **S** = 0.0909 **Cal g^{-1} °C^{-1}**

Water's cooling time from θ1 =___°C to $\theta 2$ =_____°C, as determined by graph,

t2 =_____ min

Liquid’s cooling time from θ1 =___°C to $\theta 2$ =_____°C, as determined by graph,

t1 =_____min

Calculation

$$Specific\ heat\ capacity, S_1 = \frac{M_2 S_2 t_1 + ms(t_1 - t_2)}{M_1 t_2}$$

Result

Specific heat capacity of an unknown liquid S =____________Cal g^{-1} °C^{-1}

Experiment 2.

Determination of thermal conductivity of good conductor by Searle's method.

Aim

To determine the thermal conductivity of a good conductor by Searle's method.

Apparatus required

Searle’s thermal conductivity apparatus, steam generator, four thermometers, beaker, stopwatch, slide callipers and constant pressure head apparatus.

Formula

Thermalconductivity,

$$k = \frac{m\, d(T_4 - T_3)}{At(T_1 - T_2)}$$

Where,

m - Mass of water collected.

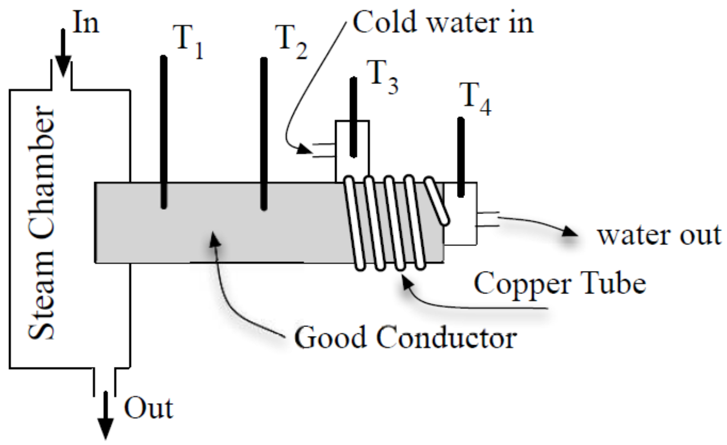
d - Distance between the holes T1 and T2.

A - Area of cross-section of the cylinder.

t - Time of collection.

T1,2,3,4 -Thermometers.

Diagram



Schematic representation of Searle's apparatus setup

Procedure

1.Once the steam generator is halfway full with water, heat it up.

2.Along the copper bar, position thermometers T1 and T2. Place the remaining two thermometers, T3 and T4, at the coil's water entry and exit points.

3.Attach a rubber tubing from the steam generator to the steam chamber's inlet.

4.Attach the coil's water entrance end to the water tank with constant level. To get a trickling outflow of water, adjust the water flow through the coil.

5.Hold on until the point of equilibrium is attained. A steady state is achieved when the thermometers read the same after ten or so minutes. About thirty minutes will pass during this.

6.Weigh a beaker that has been cleaned and dried. Gather roughly 100 cc of water in it, then record how long it takes to fill it. Observe the same thing several times.

7.To get the copper bar's cross-sectional area A, measure the bar's diameter. Measure the distance (d) as well between the holes in the bar that are home to the thermometers T1 and T2.

Observation

Diameter of the cylinder, = cm

Radius of the cylinder, r = cm

Area of cross-section of the cylinder, A = πr^2 cm^2

Distance between the holes, d = cm

Mass of water collected, m = gm

Time of collection, t = s

Table 1 **Temperature**

No. of Obs.	Time (min)	T1	T2	T3	T4
1	0				
2	5				
3	10				
4	15				
5	20				

Calculations

Thermal conductivity of the given material,

$$k = \frac{m\,d(T_4 - T_3)}{At(T_1 - T_2)}$$

Result

Thermal conductivity of a good conductor K =

Experiment 3.

Determination of thermal conductivity of bad conductor by Lee's disc method

Aim

To determine the coefficient of thermal conductivity of a bad conductor using Lee's disc apparatus.

Apparatus required

1. Lee’s disc apparatus
2. Bad conductor in the form of thin disc
3. Steam generator
4. Two thermometers of 110 □C range
5. Stop watch
6. Screw gauge
7. Rough balance.

Formula

The thermal conductivity of bad conductivity,

$$k = \frac{MS\left(\frac{d\theta}{dt}\right)d(r+2h)}{\pi r^2(\theta_1 - \theta_2)(2r+2h)}\,wm^{-1}k^{-1}$$

Where,

M - Mass of the metallic disc in kg.

S - Specific heat capacity of the material of the disc in $Jkg^{-1}K^{-1}$.

$(\frac{d\theta}{dt})$ - Rate of cooling at steady temperature in K/s.

θ_1 - Steady temperature of a steam chamber K.

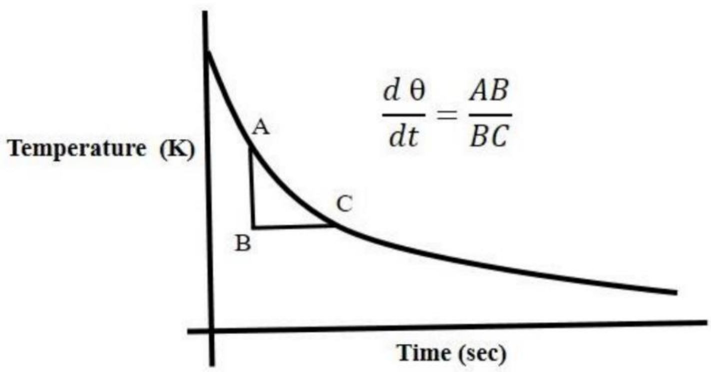
θ_2 - Steady temperature of the metallic disc K.

r - Radius of the metallic disc m.

h - Thickness of the metallic disc m.

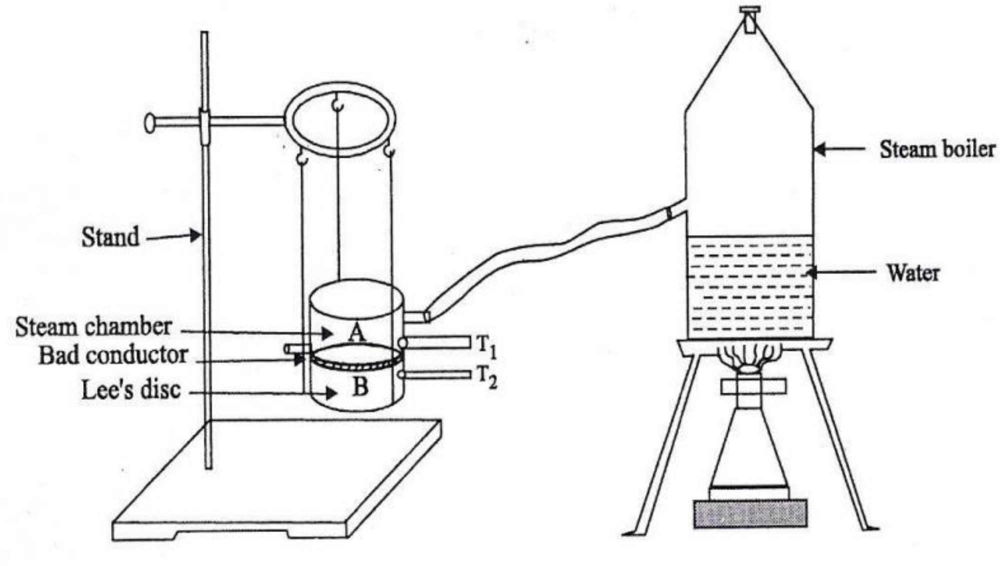
d - Thickness of the bad conductor m.

Model graph:



From graph, $\left(\frac{d\theta}{dt}\right)$ = 0.036 K/s

Experimental setup:



Experimental setup of lee's disc apparatus

Observation:

Steady temperature of steam chamber θ1 = ________________K

Steady temperature of the metallic disc θ2 = ________________K

Mass of the metallic disc M = ________________x 10–3kg

Specific heat capacity of the metallic disc S = ________________Jkg-1K-1

Thickness of the bad conductor d = ________________x 10-3 m

Thickness of the metallic disc h = ________________x 10-3 m

Radius of the metallic disc r = ________________x 10-2 m

Mean rate of fall of temperature at a mean $(\frac{d\theta}{dt})$ = ________________(K/s) temperature θ2

To determine the radius of the metallic disc(r)

Circumference of the metallic disc, 2πr = __________x 10–2 m

r = __________ x 10–2 m

Table 1:

To measure the thickness of the given bad conductor (d) using screw gauge

Least Count = 0.01 mm Zero Error (ZE): _______division

Zero Correction (ZC):________mm

S.No	(PSR) in mm	(HSC) in div	HSR= (HSC×LC)	Observed reading OR=PSR+HSR	Correct Reading =OR±ZC
1					
2					
3					
4					
5					

Mean d = _______ x 10–3 m

Table 2:

To determine the thickness of the metallic disc (h) using screw gauge

Least Count = 0.01 mm Zero Error (ZE): _______division

Zero Correction (ZC):___mm

S.No	(PSR) in mm	(HSC) in div	HSR= (HSC×LC)	Observed reading OR=PSR+HSR	Correct Reading =OR±ZC
1					
2					
3					
4					
5					

Mean d = _______ x 10–3 m

Table 3:

To determine the rate of cooling of disc at θ

S. No.	Temperature in K	Time in Sec
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Procedure:

1. Allow the steam to pass through the inlet of the vessel B and it escapes out through the outlet. The temperature indicated by the two thermometers will start rising.
2. After the steady state is reached (there will be no change in the temperature with time), the temperatures in both the thermometers are noted as θ1and θ2respectively. This is the static part of the experiment.

3. The bad conductor is removed by gently lifting the upper steam chamber. Now the lower metallic disc is allowed to be directly in contact with the steam chamber.

4. When the temperature of the lower disc attains a value of about 10o C more than its steady state temperature (θ2), the steam chamber is then removed and the lower metallic disc is allowed to cool down on its own.

5. A stop watch is started when the temperature is 5ºC above the steady temperature θ2 and time is noted for every 1ºC fall in temperature until the metallic disc attains 5ºC below θ2.
6. A graph between temperature and time is drawn. Rate of cooling dθ/dt at θ2 is calculated from the graph.

7. The mass of the disc (M) is found using rough balance and the thickness (d) of the bad conductor and thickness of the metallic disc (h) are measured using screw gauge.

Calculations:

$$k = \frac{MS\left(\frac{d\theta}{dt}\right)d(r+2h)}{\pi r^2(\theta_1-\theta_2)(2r+2h)} wm^{-1}k^{-1}$$

Result

Thermal conductivity of the given bad conductor, by lee's disk method

K = ………Wm-1K-1.

Experiment 4.

Determination of thermal conductivity of bad conductor by Charlton's method.

Aim

To determine the thermal conductivity of bad conductor by Charlton's method.

Apparatus required

Lee and Charlton's apparatus, circular disc of the same diameter as the disc in apparatus of a bad conductor, two thermometers, steam generators, stent and threads, a stopwatch, a screw gauge, vernier calliper, a weigh balance.

Formula

$$K = \frac{msd}{A(T_1 - T_2)} \left(\frac{dT}{dt}\right)_{T_2}$$

Where,

m - Mass of metallic disc

s - Specific heat capacity of metallic disc

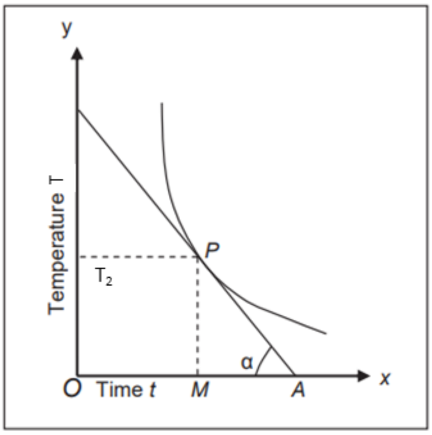
A - Area of cross section of specimen

d - Thickness of the specimen

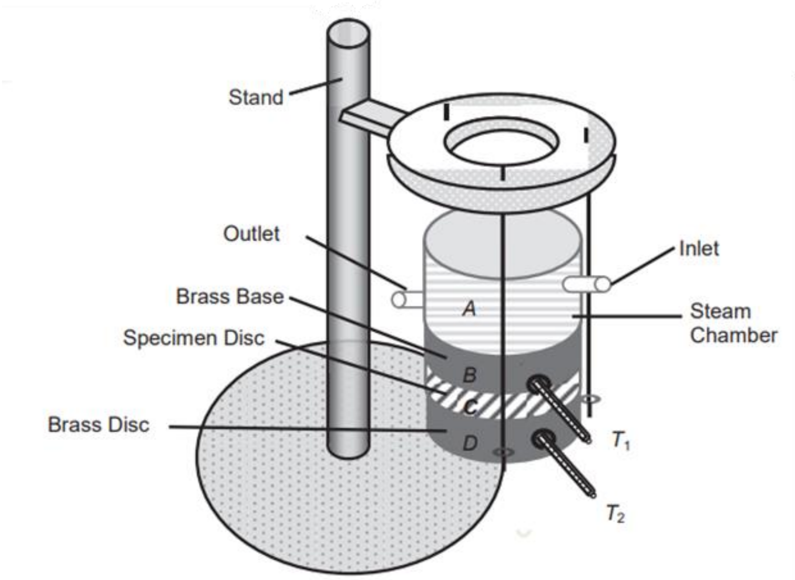
T1, T2 - Steady state temperature of thermometer 1 and 2 respectively.

$\left(\frac{dT}{dt}\right)_{T_2}$ - Rate of fall of temperature T2.

Model graph



Experimental setup



Procedure

1. Weigh the metallic disc D and determine the mass (m)
2. Measure the thickness (d) of the disc C using the screw gauge.
3. Measure the diameter of the disc C and determine the cross- sectional area (A) using a vernier calliper.
4. Set the apparatus as shown in the experimental setup and suspend the disc D with the help of the three threads attached to the stand.
5. Place the disc C (specimen bad conductor), On top of the metallic disc D.
6. Make sure the diameter of disc C and D are equal and the thickness of the disc C is uniform.
7. Place the steam chamber on top of disc C and attach the inlet to the steam generator and outlet to a pipe to allow steam escape from D.
8. Place the thermometers T1 and T2 in position at the bases of B and D.
9. Pass the steam using steam chamber. Heat will conduct from C to D and the temperature on both the thermometers were reach a steady state after rising for a while.
10. Note the temperatures at sixty seconds interval till the steady state reached.
11. Record the readings T1 and T2 and stop the flow steam immediately.
12. Remove the bad conductor disc C and place the steam chamber directly on D and pass the steam so that the temperature of D rises 10-15 °C above the steady state temperature of disc D.
13. Note the temperatures at regular interval of thirty seconds and record the readings in table. Continue till the temperature of disc D falls 10 °C below T2.
14. Draw the graph with reference to the model graph the temperature T2 with respect to the cooling curve shows a distinct change.
15. Draw a tangent at the point with respect to the distinct change of T2. Extent the tangent to meet the X-axis and mark the point as A.

16. Draw PM perpendicular to OA. Slope of the tangent,

$$\left(\frac{dT}{dt}\right)_{T_2} = \tan\alpha = \frac{PM}{MA}$$

Observation

Mass of the disc D = gm

Table 1

Measurement of thickness of the specimen d

Least count of screw gauge = cm

Zero error of screw gauge = cm

S.No	(PSR) in mm	(HSC) in div	HSR= (HSC×LC)	Observed reading OR=PSR+HSR	Correct Reading =OR±ZC
1					
2					
3					
4					
5					

Mean d = ________ cm

Table 2

Measurement of diameter of specimen

Least count of vernier calliper = cm

Zero error of vernier calliper = cm

S.No	(MSR) in cm	(VSC) in div	VSR= (MSR×LC)	Observed reading OR= MSR + VSR	Correct Reading =OR±ZC
1					
2					
3					
4					
5					

Mean diameter = cm

Mean radius = cm

Area of cross section, = cm^2

A= πr^2

Table 3

March towards steady state

Least count of thermometer T1 = …………… °C

Least count of thermometer T2 = …………… °C

SI.No	Time (S)	Temperature	
		T1 (°C)	T2 (°C)
1	60		
2	120		

3	180		
4	240		
.	.		
.	.		
.	.		
.	.		
	Steady state		

Steady state temperature T1 and T2 are =_________°C and ___________°C respectively.

Table 4

Variation of temperature of metallic disc D with time

SI. No.	Time (s)	Temperature (°C)
1	30	
2	60	
3	90	
4	120	
.	.	
.	.	
.	.	
.	.	

Calculation

Slope of the tangent from graph,

$$\left(\frac{dT}{dt}\right)_{T_2} = \tan\alpha = \frac{PM}{MA}$$

To find the thermal conductivity substitute the values,

$$K = \frac{msd}{A(T_1 - T_2)}\left(\frac{dT}{dt}\right)_{T_2}$$

Result

Thermal conductivity of bad conductor by Charlton's method

=____________________ $Js^{-1}m^{-1}k^{-1}$.

Experiment 5.

Determination of specific heat capacity of solid.

Aim

To determine the specific heat capacity of the given solid

Apparatus required

Regnault's apparatus, Balance, two thermometers, steam boiler, pieces of solid, stopwatch.

Formula

Heat loss by solid $= MS(T_2 - T)$

Heat gained by calorimeter and its contents $= (w + w_1 s_1)(T - T_1)$

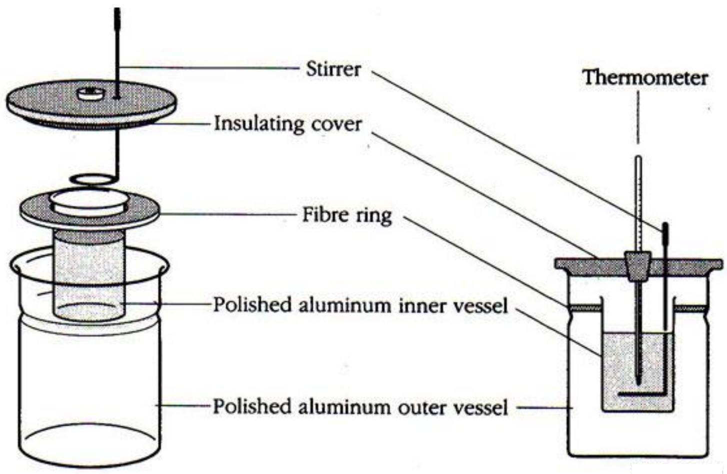
Heat loss = Heat gain

$$MS(T_2 - T) = (w + w_1 s_1)(T - T_1)$$

Specific heat capacity of the given solid,

$$S = \frac{(w + w_1 s_1)(T - T_1)}{M(T_2 - T_1)}$$

Experimental setup



Procedure

1. Clean and dry the calorimeter and measure the mass (M) of the calorimeter and stirrer using a balance.
2. Pour water up to two- third volume of the calorimeter. Measure the total mass (mass of water, calorimeter, stirrer) to calculate the mass W of water.
3. Raise the temperature to approximately 62 °C by placing the calorimeter on the heater and holding the thermometer bulb in the centre of the water. Using tongs, hold the calorimeter inside the double-walled enclosure. When the thermometer's bulb is in the centre of the water, close the lid and secure it with its holder.
4. When the temperature is almost 60 °C, start the stopwatch. Note this temperature in the table.
5. Continue taking minutes-long records of the water's temperature for up to 25 or more. All throughout the operation, gently stir the water.
6. Using the given formula, determine the specific heat of the given solid.

Experimental data

Mass of the solid, M = gm

Weight of the calorimeter + stirrer, W1 = gm

Weight of the calorimeter + stirrer + water, W2 = gm

Weight of water, W = W2 - W1 = gm

Specific heat of the material of the calorimeter + stirrer, S1 =

Temperature of the hot solid, T2 = °C

Initial temperature of water + calorimeter, T1 = °C

Final temperature of the mixture after applying radiation correction, T = °C

Calculation

Specific heat capacity of the given solid,

$$S = \frac{(w + w_1 s_1)(T - T_1)}{M(T_2 - T_1)}$$

Result

The specific heat capacity of the given solid S = Cal g^{-1} $°C^{-1}$

Experiment 6.

Determination of specific heat of liquid by Joule's electrical heating method

Aim

To determine the specific heat of liquid by joule's heating method

Apparatus required

Calorimeter with heating coil, a sensitive thermometer, stirring rod, DC power supply, stop watch, ammeter (0-5A), voltmeter (0-5V), rheostat, graph paper, metre scale.

Formula

Change in heat,

$$\Delta Q = ms\Delta t$$

Specific heat capacity of liquid by the principle of law of conservation of energy

Heat lost = Heat gain

Heat provided by electric heater = Heat received by water

Heat produced is given by,

$$\Delta Q = I^2 R\Delta t$$

Heat received by liquid,

$$I^2 R\Delta t = (ms\Delta t)_w + (ms\Delta t)_C$$

$$s_w = \frac{I^2 R\Delta t - (ms\Delta t)_c}{(m\Delta t)_w}$$

$$= \frac{I^2 R\Delta t}{(m\Delta t)w}\frac{-m_c sc}{m_w}$$

Specific heat capacity of the liquid (water)

$$\boldsymbol{s_w = \frac{I^2 R\Delta t}{m_w(\Delta T)_w} - \frac{m_C s_C}{m_w}}$$

Where,

(W, C) - Denotes water and calorimeter respectively.

(I) - Current passing through the circuit

(R) - Resistance

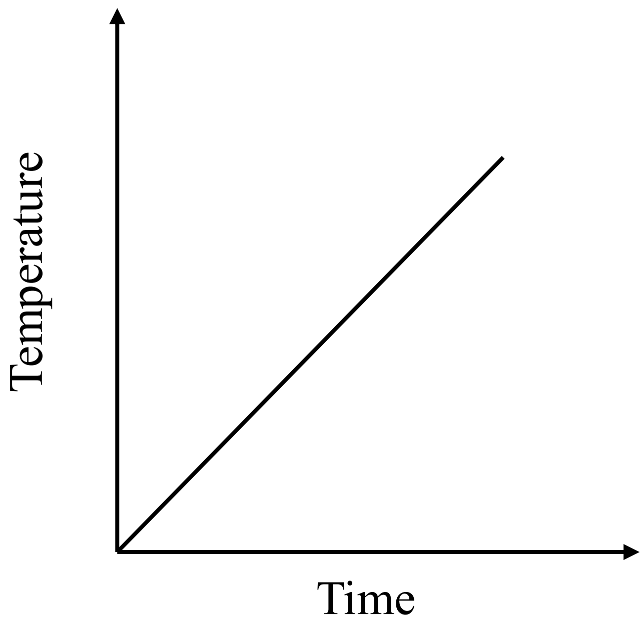
(V) - Voltage across the heater coil

(m_w) - Mass of water

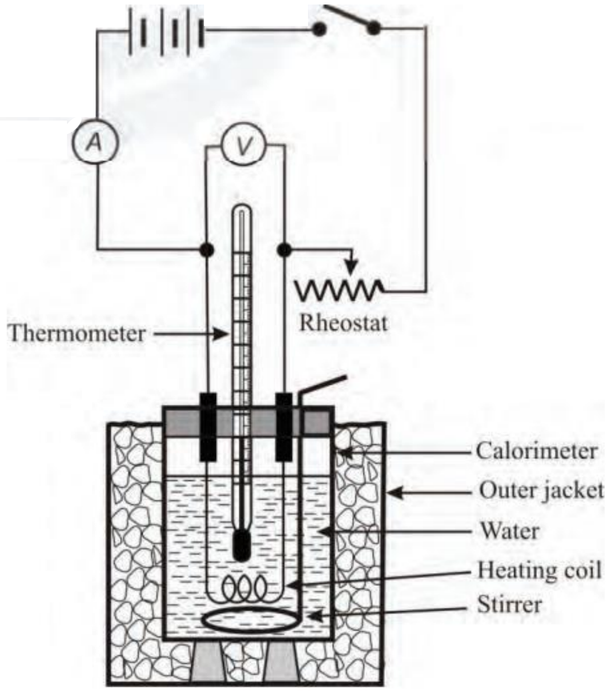
(m_c) - Mass of calorimeter cup

$\frac{(\Delta T)w}{\Delta t}$ - Rate of change of temperature with respect to the change in time

Model graph



Experimental setup



Experimental arrangement of joule heating

Procedure

1.Using a beam balance, determine the mass of the calorimeter's empty metal cup.

2. Reassess the mass of the cup after adding cold water to two-thirds of the way. To find the mass of water in the cup, deduct the mass of the calorimeter cup from this amount. Note these measurements in Observation.

3. Inside the calorimeter outer jacket, place the stirrer, sensitive thermometer, and calorimeter cup filled with water. Establish the circuit as experimental setup illustrates. Don't turn on the power just yet.

4. Take note of the water's starting temperature as indicated by the thermometer and note it down in Observation.

5. Turn on the power source and set the stopwatch in motion at the same time. Up until the ammeter reaches 3.0A, adjust the power supply and rheostat. Take note of the matching voltmeter reading.

6. To guarantee a consistent temperature rise, stir water often. For fifteen minutes, record the water's temperature once every minute. Verify that the voltage and current, as shown by the voltmeter and ammeter, respectively, stay constant.

7. After obtaining the final reading, turn off the power source.

8.Plot the temperature versus time graph

Observation

Specific heat capacity of water (s)	=	
Mass of calorimeter cup (m_C)	=	g
Mass of calorimeter + water ($m_C + m_W$)	=	g
Mass of water (m_W)	=	g
Initial temperature of water	=	°C
Current passing through the circuit (I)	=	A
Voltage across the heater coil (V)	=	V
Resistance in the circuit (V / I)	=	Ω

Table

SI.No.	Time (t)	Temperature (°C)
1.		
2.		
3.		
4.		
5.		
6.		
7.		

Calculation

Specific heat capacity of the liquid (water)

$$s_w = \frac{I^2 R\Delta t}{m_w(\Delta T)_w} - \frac{m_C s_C}{m_w}$$

Result

The specific heat capacity of water = $\pm$ $Jkg^{-1}k^{-1}$

Experiment 7.

Determination of Latent heat of a vaporization of a liquid

Aim

To Determine of Latent heat of a vaporization of a liquid

Apparatus required

Electric water heater, A container, water, heat insulators, stop watch, balance etc.,

Formula

Electrical energy	E = Pt
Heat energy gained by water	H = mc (T2-T1)

By law of conservation of energy,

Heat energy gained by water = Electrical energy supplied

$$Pt = mc\ (T2-T1)$$

$$Pt = mL_V$$

Specific latent heat of vaporization of a liquid,

$$L_V = Pt/m$$

Where,

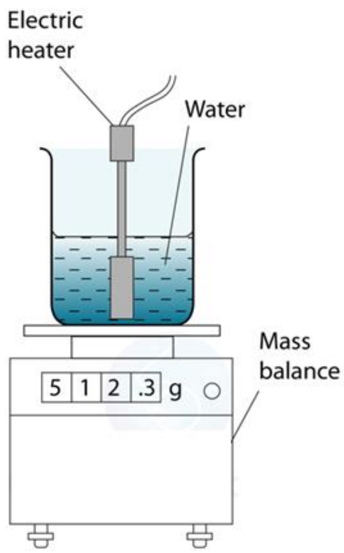
E	- Electrical energy.
P	- Power in watts.
t	- time in seconds.
H	- Heat energy gained by liquid (water) in joules.
m	- Mass of liquid (water) in Kg.

c - specific heat capacity of liquid (water) J/KgC.

T2 – T1 - difference between the after and before heating of the liquid respectively in degree Celsius.

L_V - Specific latent heat of vaporization of a liquid in J/Kg.

Experimental apparatus



Procedure

1. Assemble all necessary instruments and supplies.
2. Build the experiment as it is shown.
3. Fill the container with a certain amount of water.
4. Calculate the mass of the container and water and note it as M1.
5. Submerge the electric heater in the container's water.
6. Turn the heater on.
7. Set the stopwatch to record the boiling water.
8. After a few minutes, turn off the heating and remove the Observe and note the water's mass, or "M2."

9. Note down the watch's time as "t."
10. Determine the water's mass that has evaporated and note it as "m."
11. Repeat steps 7 through 11 to evaluate the latent heat of vaporisation from Lv=pt/m. Enter three measurements in the table.
12. Determine the mean of the three obtained values, Lv.

Observation

Heater power P = watts

Mass of water M1 = kg

Table

SI. No.	Stop-Watch time (t)	Mass of the Container + Liquid (M2)	Mass of evaporated water M = M1+M2	Calculated L_V (L_V =Pt/m)
1.				
2.				
3.				
4.				
5.				

Average

Calculation

L_V =Pt/m

Result

Latent heat of a vaporization of a liquid (water) = _______________J/kg

Experiment 8.

Determination of Stefan's constant for Black body radiation.

Aim

To determine the Stefan's constant for Black body radiation.

Formula

Emissive power of black body,

$$Q \ \alpha \ A \times T^4$$

$$Q = \sigma \times A \times T^4$$

σ = 5.67 × 10−8 is the Stefan’s constant

$$m \cdot C_P \cdot \frac{dT}{dt} = \sigma A\left(T_{Avg}^4 - T_1^4\right)$$

Stefan’s constant,

$$\sigma = \frac{m \cdot C_p \cdot \left(\frac{dT}{dt}\right) t = 0}{A \cdot \left(T_{Avg}^4 - T_5^4\right)}$$

Where,

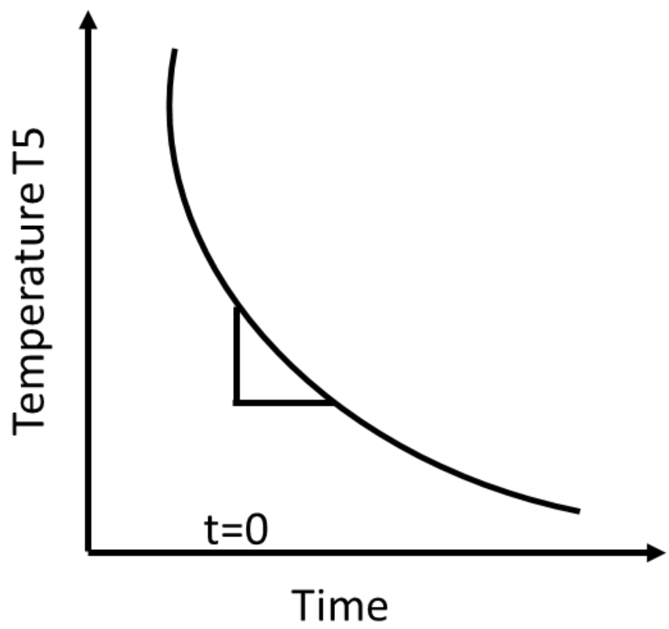
M	-	Mass of the flat disc
C_P	-	Specific heat of flat disc
A	-	Area of the flat disc

σ - Stefan's constant

T - Temperature

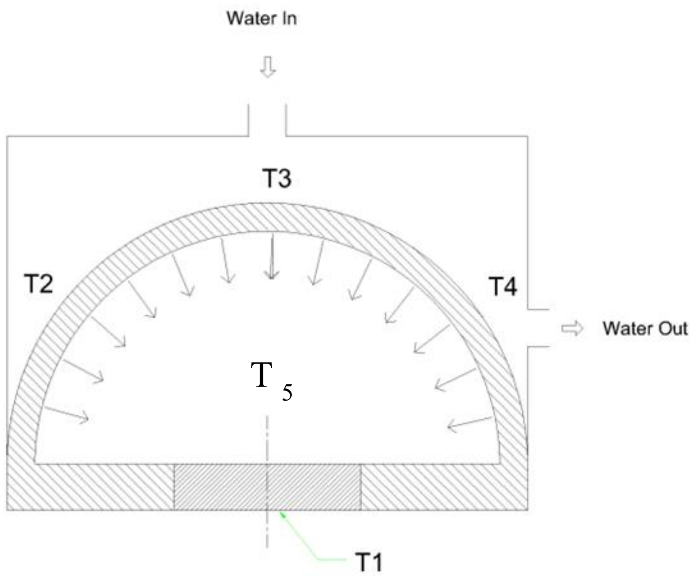
$\left(\frac{dT}{dt}\right) t = 0$ – Slope at time t = 0

Model graph



Plot the temperature of the test disk against time and find out the slope of the curve at t =0 as $\left(\frac{dT}{dt}\right) t = 0$

Experimental setup



$T_{1,2,3,4}$ are thermocouples

The outer surface of copper hemisphere is enclosed in a metallic water jacket.

Observation

i. Hemisphere dia. 0.2 m
ii. Base Bakelite plate 0.3 m
iii. Test disc diameter 0.02 m
iv. Thickness of test disc 0.002 m
v. Mass of the test disk 0.007 kg
vi. Specific heat of the test disk material 380 J kg−1

Procedure

1. First, use an immersion heater to get the water in the water tank to a boiling temperature of about 90 °C.

Next, place the test disc inside the backlite; if it isn't inserted (test disc is blackened totally). Note the hemisphere's temperatures as well as its temperature (T1). that is, T2 to T5.

3. Let the hemisphere fall onto the boiling water.

4. Using the stop watch, note the test disk's temperature as soon as it begins to rise and every ten seconds thereafter. The following five readings should show the same temperature until the steady state is attained, for 5 consequent readings.

Table 1 – Temperature of the hemisphere

SI. NO.	Water temperature	Temperature of the hemisphere			
	T6	T1	T2	T3	T4
1.					
2.					
3.					
4.					
5.					

Table 2 – Temperature of the test disk

Temperature of location T5	Time in sec
	5
	10
	30
	60
	120
	.
	.

Calculations

Stefan’s constant,

$$\sigma = \frac{m \cdot C_p \cdot \left(\frac{dT}{dt}\right) t = 0}{A \cdot \left(T_{Avg}^4 - T_5^4\right)}$$

Result

Stefan's constant for Black body radiation σ = 5.67 × 10−8

Experiment 9.

Verification of Stefan's Law

Aim

To verify Stefan's law of radiation.

Apparatus required

Complete set-up make Raman consists of one 0- 6 V regulated power supply, Filament bulb 6V, Digital Voltmeter and Ammeter.

Formula

According to Stefan's law,

$$P = \mu T^4$$

$$log\, p = \mu\, 4 \log T$$

$$\frac{log\, P}{4} = \mu\, log\, T \rightarrow 1$$

Resistance of the tungsten filament in electrical bulb,

$$R = \mu T$$

$$log\, R = \mu\, log\, T \rightarrow 2$$

From 1 and 2,

$$\frac{log\, P}{log\, R} = 4$$

Where,

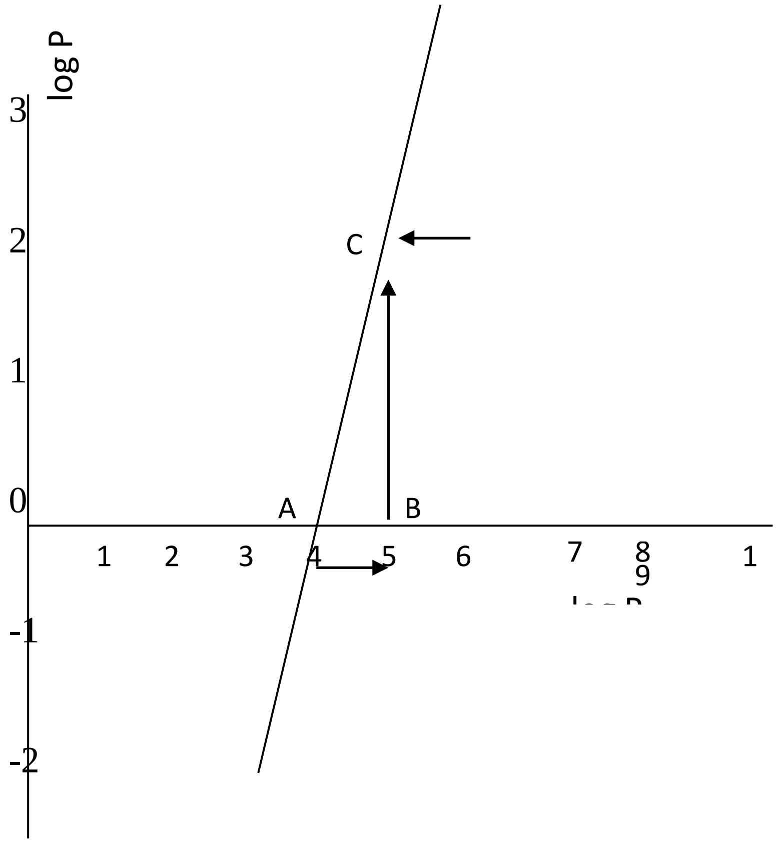
P - power radiated from a black body

R - Resistance of the tungsten filament in electrical bulb

T - Absolute temperature

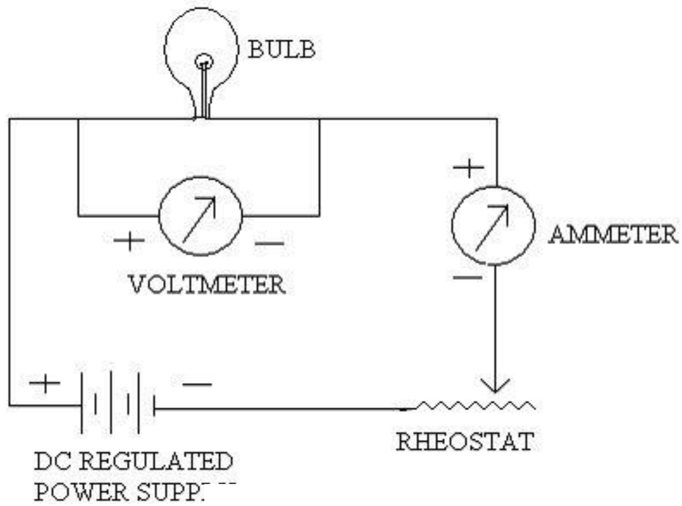
Model graph

Slop of the graph = 4, which verifies the Stefan's law



Graph log P Vs log R

Experimental setup



Table

S. No.	Filament Voltage Vf Volt	Filament Current If Amp.	Filament Resistance R = V/I	Power Radiated P = VI	log R	Log P
1.	1.0	0.21	4.76	0.21	0.678	-0.678
2.	1.5	0.25				
3.	2.0	0.27				
4.	2.5	0.31				
5.	3.0	0.33				
6.	3.5	0.35				
7.	4.0	0.38				
8.	4.5	0.41				
9.	5.0	0.43				
10.	5.5	0.45				
11.	6.0	0.47				

Procedure

1. Set the power supply to the minimum anticlockwise position and connect the setup to the mains.
2. Turn the setup "ON" and raise the power supply voltage until the lightbulb illuminates. Take note of the ammeter and voltmeter values. As indicated below, record these readings in the table.
3. Step-by-step increase the power source voltage by1,1.5,2.0, and so on.

Record the associated current for each voltage level. Note these values in the table.

4. Determine the power radiated (P = VI) and the filament resistance (R = V/I). Put these computations in a table.
5. Determine log P and log R. As indicated below, record these readings in the table.
6. Make a graph.
7. Place log P on the Y-axis and log R on the X-axis to plot the graph.

Calculation

Calculate slop from the graph as BC/AB =

Result

From Graph the slope of the curve is 3.75 close the 4. Hence, Stefan's Law verified.

Experiment 10.

Determination of thermal conductivity of rubber tube

Aim

To determine the thermal conductivity of rubber tube.

Apparatus required

Calorimeter, stirrer, thermometer, wooden box, insulating material etc.,

Formula

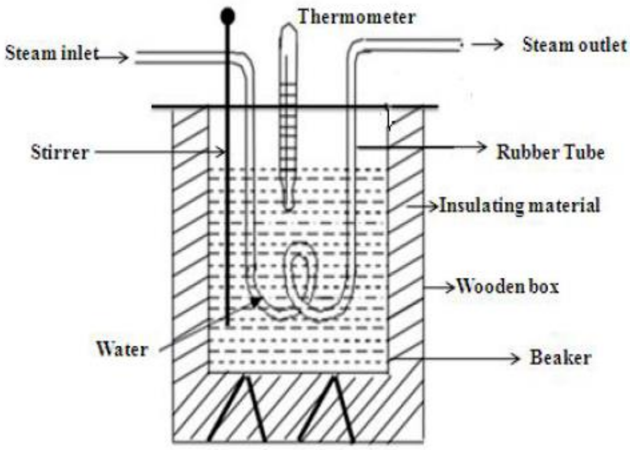
Thermal conductivity of rubber tube,

$$k = \frac{(\theta_2 - \theta_1)\log\left({}^{r_2}/_{r_1}\right)(w_1 s_1 + (w_2 - w_1)S_2)}{2\pi l t[\theta_s - \frac{(\theta_1 + \theta_2)}{2}]} wm^{-1}k^{-1}$$

Where,

w1	-	Weight of calorimeter
w2	-	Weight of calorimeter and water
w2 – w1	-	Weight of the water alone
θ_1	-	Initial temperature of the water
θ_2	-	Final temperature of the water
$\theta_2 - \theta_1$	-	Rise in temperature of the water
θ_S	-	Temperature of the steam
l	-	Length of the rubber tube (immersed)
r1	-	Inner radius of the rubber tube
r2	-	Outer radius of the rubber tube
s1	-	Specific heat capacity of the calorimeter
s2	-	Specific heat capacity of the water

Experimental setup



Procedure

1. Weighing the empty calorimeter, let it be (w1).
2. After adding two thirds of water and weighing it once again, let it be (w2)
3. A measured length of rubber tubing is submerged in the calorimeter's water.
4. The rubber tube is used to transfer steam through one end and release it through the other.
5. Radiation is produced as heat moves from the rubber tube's inner to outer layers.
6. The water in the calorimeter absorbs the heat that is radiated.
7. Note how long it takes the steam flow to get the water's temperature up by roughly 10C; let's say it takes t seconds in table.

Observation

Weight of calorimeter (w1)	=		gm
Weight of calorimeter and water(w2)	=		gm
Weight of the water alone (w2 – w1)	=		gm

Inner radius of the rubber tube r1 = cm

Outer radius of the rubber tuber2 = cm

Length of the rubber tube immersed(l)= cm

Initial temperature of the water(θ_1) = °C

Final temperature of the water(θ_2) = °C

Table

Time (Sec)	Temperature (Celsius)
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10

Calculation

$$k = \frac{(\theta_2 - \theta_1)\log\left({}^{r_2}/_{r_1}\right)(w_1 s_1 + (w_2 - w_1)S_2)}{2\pi l t[\theta_s - \frac{(\theta_1 + \theta_2)}{2}]} wm^{-1}k^{-1}$$

Result

Thermal conductivity of rubber tube = $wm^{-1}k^{-1}$

Experiment 11.

Helmholtz resonator

Aim

To determine the velocity of sound using the Helmholtz resonator

Apparatus required

Helmholtz resonator, tuning forks, rubber pads, beaker, measuring cylinder, vernier calliper, water.

Formula

Resonant frequency of the cavity,

$$f = \frac{\nu}{2\pi}\sqrt{\frac{A}{VL_E}}$$

Squaring on both sides and rearranging,

$$f^2 = \frac{\nu^2 A}{4\pi L_E}.\frac{1}{V}$$

On graph $f^2V/S\,\frac{1}{V}$,

$$Slope = \frac{\nu^2 A}{4\pi L_E}$$

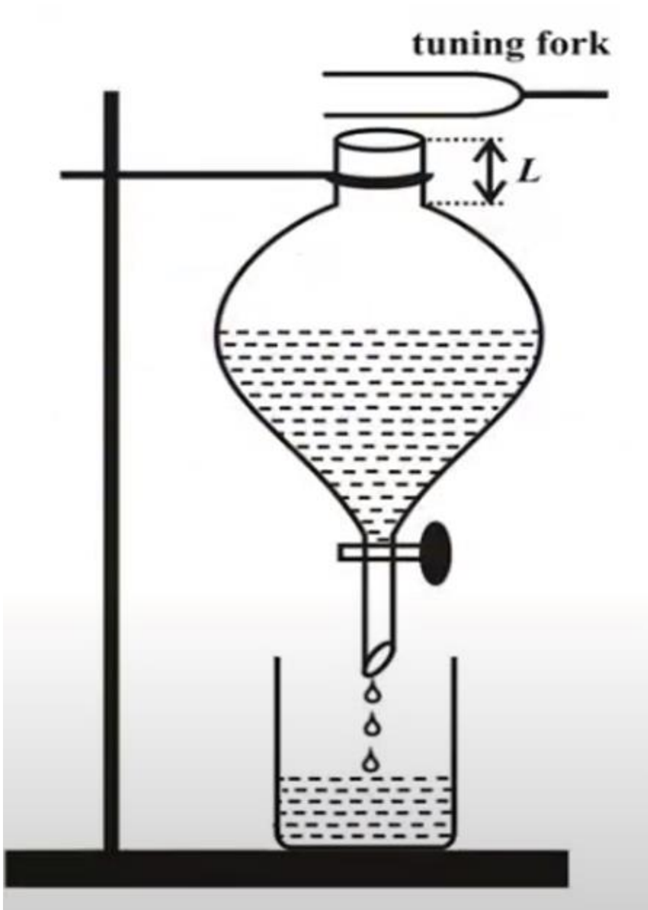
Velocity of the sound ν

$$\nu = 2\pi\sqrt{\frac{slope \times L_E}{A}}$$

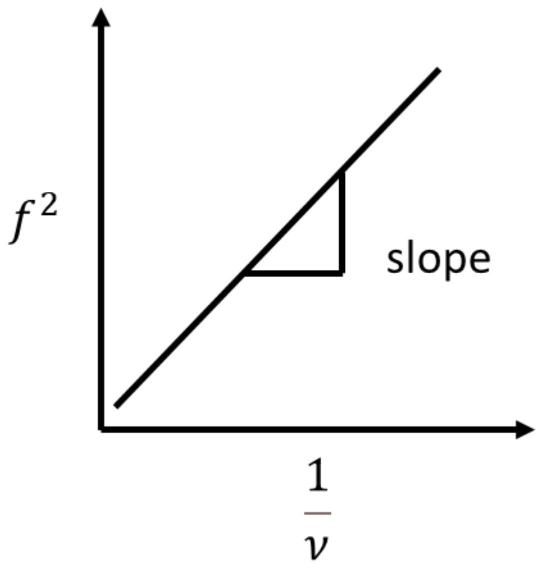
Where,

ν	-	velocity of sound in air.
A	-	cross-sectional area of the tuning fork.
V	-	volume of the air cavity.
L_E	-	effective length off the neck.

Experimental setup



Model graph



Procedure

1. Measure the diameter and length of the neck of the resonator using vernier callipers
2. Fill the Helmholtz resonator with the water till the neck
3. Take the smallest tuning fork (highest frequency), keep on striking it on the rubber pad and hold it above the neck of the resonator.
4. Open the cork of the resonator to allow the water to fall into the beaker. Close the cork when the resonance sound becomes loudest.
5. Measure the volume of the water collected in the beaker using measuring cylinder.
6. Repeat the experiment for the other tuning forks in increasing order of size (decreasing order of frequency). Also do for unknown tuning fork.
7. Tabulate the readings and plot the graph f^2 V/s 1/V

Observation

Diameter of the neck d = cm

Radius of the neck r = cm

Cross-sectional area, A= πr2= cm^2

Length of the neck L = cm

Effective length of the neck, L_E=L+1.5r= cm

Table 1

SI.No.	Frequency of the tuning fork f (Hz)	Resonant volume V(cm^3)	f^2	1/V

Table 2

Least count of vernier calliper = cm

Zero error of vernier calliper = cm

S.No	(MSR) in cm	(VSC) in div	VSR= (MSR×LC)	Observed reading OR= MSR + VSR	Correct Reading =OR±ZC
1					
2					
3					
4					
5					

Mean diameter d = cm

Mean radius r = cm

Area of cross section, = cm^2

A= πr^2

Calculation

$$\nu = 2\pi \sqrt{\frac{slope \times L_E}{A}}\, Cm / S$$

Result

Velocity of sound determined using the Helmholtz resonator $\nu =$ Cm / S

Experiment 12.

Velocity of sound through a wire using Sonometer

Aim

To determine the Velocity of sound through a wire using Sonometer.

Apparatus required

Sonometer, tuning fork, screw gauge, measuring tape etc.,

Formula

Linear density of the wire,

$$m = \pi r^2 d \qquad kgm^{-1}$$

Frequency of the tuning fork,

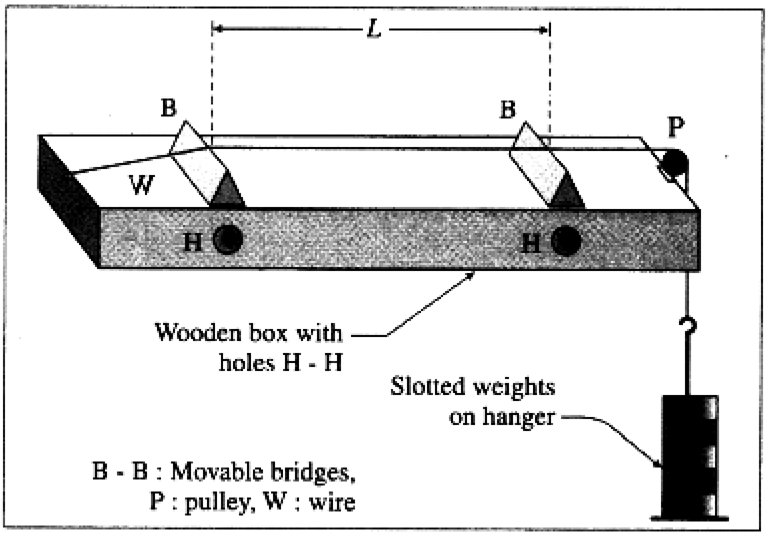
$$n = \frac{1}{2\sqrt{m}} \frac{\sqrt{T}}{l} \; hertz$$

Velocity of sound, v = 2Lf

where:

- V = velocity of sound through the wire
- L = resonant length of the wire
- f = frequency of the tuning fork

Experimental setup



Sonometer

Procedure

1. Setup the experimental as shown
2. Measure the length L of the wire between the bridges by using the difference between the knife edges position.
3. Measure the diameter of the wire using the screw gauge.
4. Tension of the wire is calculated via T = Mg, where M is the mass of the load and hanger and g is the acceleration due to gravity.
5. Linear density of the wire and the frequency of the tuning fork is calculated
6. Calculated values used to determine the velocity of the sound

Table 1

To determine the diameter of the wire using screw gauge

Least count of screw gauge = cm

Zero error of screw gauge = cm

S.No	(PSR) in mm	(HSC) in div	HSR= (HSC×LC)	Observed reading OR=PSR+HSR	Correct Reading =OR±ZC
1					
2					
3					
4					
5					

Mean D = ________ cm

Table 2

To find $\frac{\sqrt{T}}{L}$

SI.No.	Total mass loaded = Mass of hanger + Mass (Kg)	Tension in wire T = Mg (Newton)	$\sqrt{T}$ (N)	Position of first bridge a (cm)	Position of second bridge b (cm)	Length of wire between two bridges l=a-b (cm)	$\frac{\sqrt{T}}{l}$
1.							
2.							
3.							
4.							

Calculation

$$m = \pi r^2 d$$

$r = \frac{D}{2}$

d – density of metal wire

$$n = \frac{1}{2\sqrt{m}}\frac{\sqrt{T}}{l}\ hertz$$

Velocity of sound, v = 2Lf m/s

Result

Velocity of sound through a wire using Sonometer v = m/s

Experiment 13.

Determination of velocity of sound using Kundt's tube

Aim

To find the velocity of sound waves in a given rod with Kundt's tube apparatus.

Apparatus required

A long glass tube, piston, metal rod, powdered cork, ruler, clamps and leather piece.

Formula

Speed of sound in air or a solid rod,

$$V = f\lambda$$

Substitute value of lambda,

$$\lambda_r = 2l_r$$

$$V_r = 2fl_r$$

$$V_a = 2f_a$$

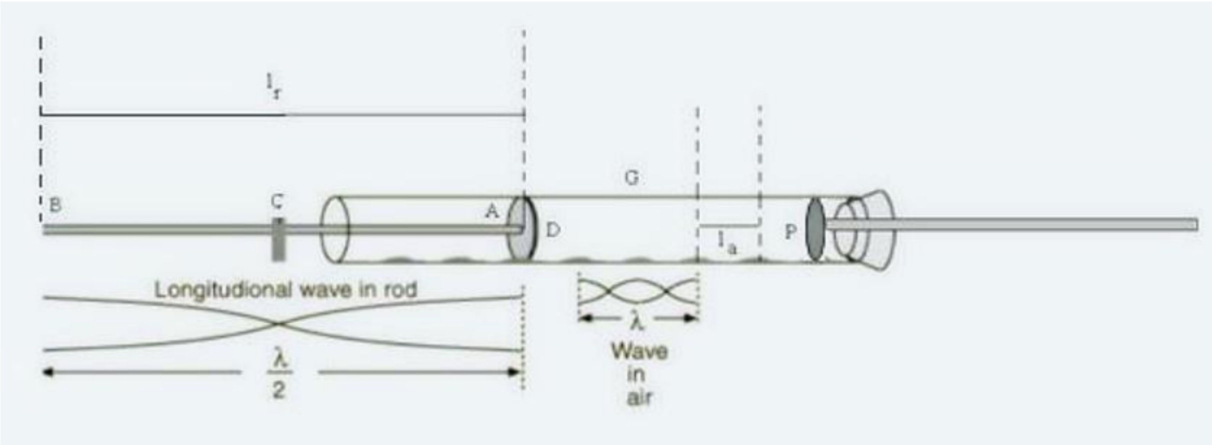
Hence,

$$V_r = V_a \frac{l_r}{l_a}$$

Where,

V	-	velocity of sound
f	-	frequency of sound wave
λ	-	wavelength of sound

Experimental setup



Procedure

1. Fill the glass tube with a small amount of cork dust powder.
2. Using rapid rotation, evenly spread the powder throughout the tube.
3. Using the holder, securely fasten the tube.
4. Securely clamp the metal rod in the middle.
5. The glass tube's opposite end is connected to the piston.
6. A piece of rosined leather is used to rub the rod lengthwise at point B, and longitudinal vibrations at the rod's fundamental frequency are then initiated.
7. Once resonance is achieved, move the piston in and out of the tube.
8. There are now mounds of cork dust inside the tube.

9. Carefully choose where the extreme nodes will be and calculate the separation between them. Count the heaps and determine the typical separation between two successive

10. Measure the distance between the extreme nodes and carefully choose their place. Ascertain the quantity of piles and compute the mean separation between two successive peaks.

11. Repeat the experiment after noting the rod's length.

12. We know that sound travels through air at a speed of 343 m/s.

13. Equation $V_r = V_a \frac{l_r}{l_a}$ can be used to get the sound velocity through the rod..

Observation

Length of the rod, lr= …………… m.

Frequency of sound used, f = ……… Hz.

Velocity of sound in air, Va = 343 m s-1.

Table

SI.No.	Distance between extreme nodes(m)	Number of heaps (n)	Average distance between two consecutive heaps $l_a = \frac{L}{n-1}$ (m)
1.			
2.			
3.			
4.			
5.			
6.			
7.			

Mean l_a= m

Calculation

$$V_r = V_a \frac{l_r}{l_a}$$

Result

The velocity of sound wave through the rod = m/s.

Experiment 14.

Determination of frequency of an electrically maintained tuning fork

Aim

To determine the frequency of an electrically maintained tuning fork by Melde's experiment.

Apparatus required

Electrically maintained tuning fork, stand with clamp, balance, weigh box, cotton string, meter scale, battery, a rheostat and connecting wires

Formula

Wavelength,

$$\lambda = 2l = \frac{2L}{P}$$

Transverse arrangement,

$$\frac{\lambda^2}{T} = \frac{1}{n^2 m} = C_1$$

Longitudinal arrangement,

$$\frac{\lambda^2}{T} = \frac{4}{n^2 m^2} = C_2$$

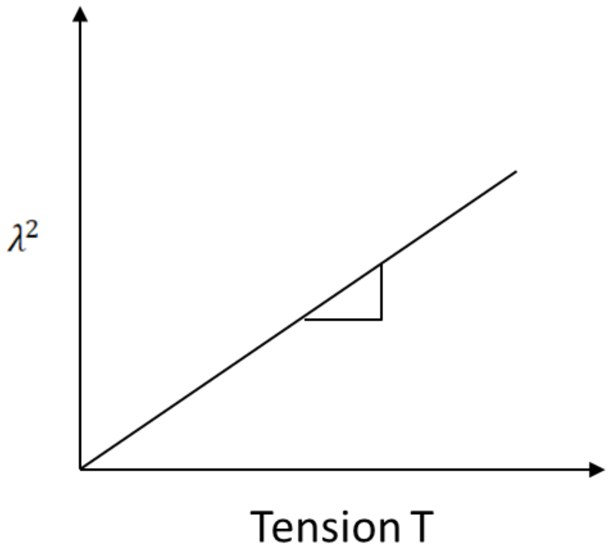
Where,

L - length of P loops

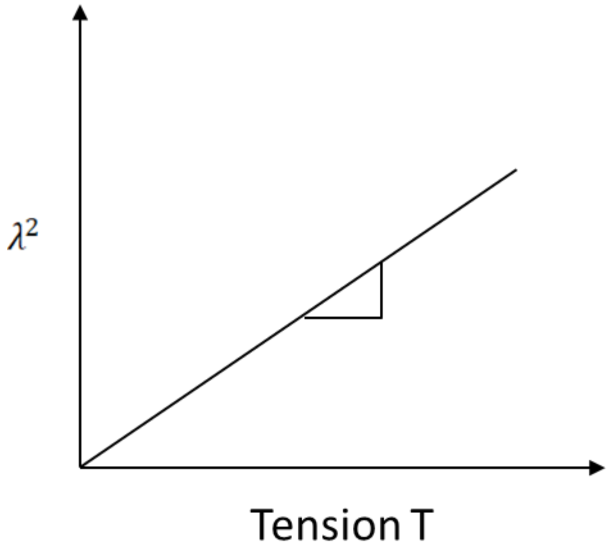
C_1, C_2 - constants

Model graph

i. Longitudinal

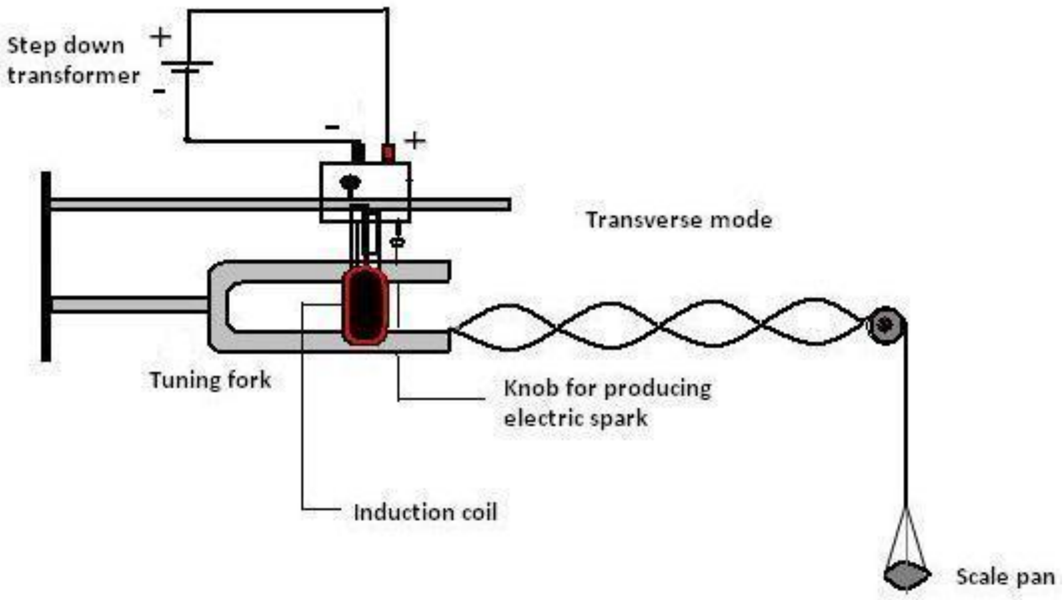


ii. Transverse

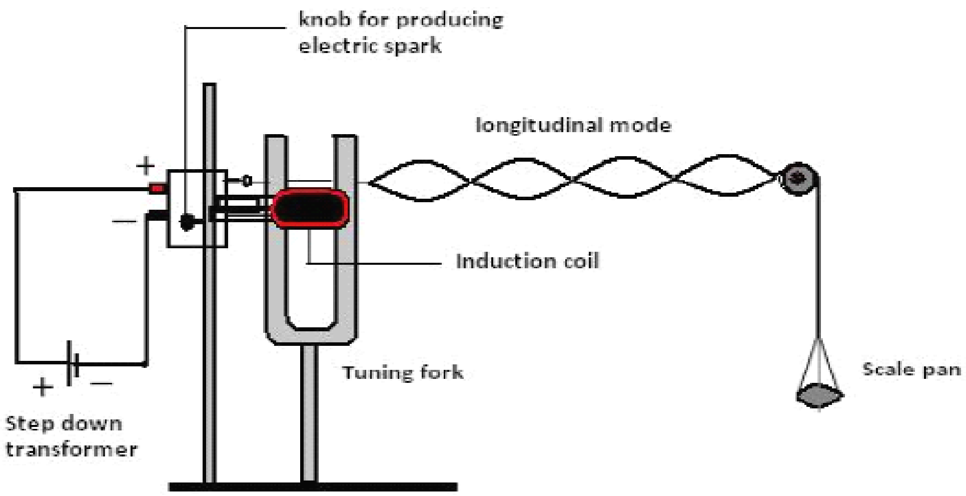


Experimental setup

i. Transverse



ii. Longitudinal



Procedure

1. The apparatus is set up with the string's length aligned parallel to the prong of the tuning fork, with one end of the string attached to the fork's prong.
2. The other end of the string, which carries a scale pan, is passed over a pulley fixed at one end of the table.
3. When the tuning fork is excited, it vibrates perpendicular to the length of the string.
4. The scale pan is then detached from the string, and its mass and length are determined using a common balance and meter scale, allowing for the calculation of linear density.
5. Once measured, the scale pan is reattached to the end of the string, and mass is added to the pan.
6. The circuit is closed, and the tuning fork is set into vibration again.
7. This time, the string vibrates transversely, producing stationary waves.
8. The length of the string is adjusted to achieve well-defined loops, and two long knitting needles are placed at two nodes.
9. The length of N loops is measured, and the average length is calculated.
10. Using the appropriate equation, the frequency/wavelength of the tuning fork is then calculated.

Table 1 - Longitudinal arrangement

No.of. loops P	Length of one loop l=L/P	Load M	Tension $(M+M_P)$ g	Wavelength $\lambda = \frac{2L}{P}$	λ^2

Table 2 - Transverse arrangement

No.of. loops P	Length of one loop l=L/P	Load M	Tension T $(M+M_P)$ g	Wavelength $\lambda = \frac{2L}{P}$	λ^2

Calculation

Transverse arrangement

$$n^2 = \frac{1}{m \times slope}$$

n =

longitudinal arrangement

$$n^2 = \frac{1}{m \times slope}$$

n =

Result

Frequency of an electrically maintained tuning fork

I. Transverse = Hz

II. Longitudinal = Hz

Experiment 15.

To verify the Laws of Transverse Vibration Using Sonometer

Aim

To verify the laws of transverse vibration using sonometer

Apparatus required

Sonometer with metallic wire, tuning fork, meter scale, slotted half Kg weights, two knife edges etc.,

Formula

Law of Length:

$$\nu \propto 1/L$$

Law of Tension:

$$\nu \propto \sqrt{T}$$

Law of Mass:

$$\nu \propto \sqrt{M}$$

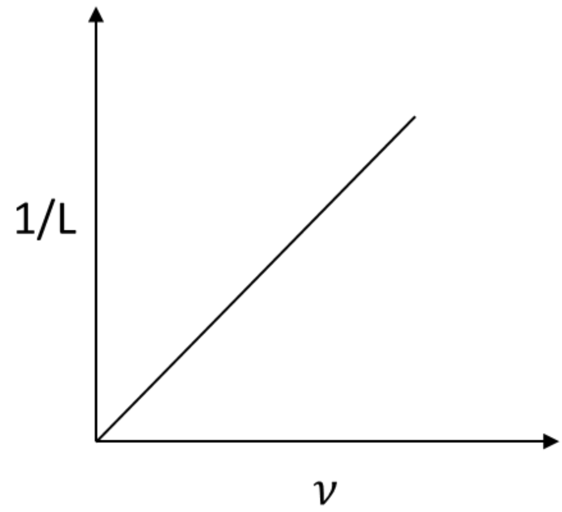
Where,

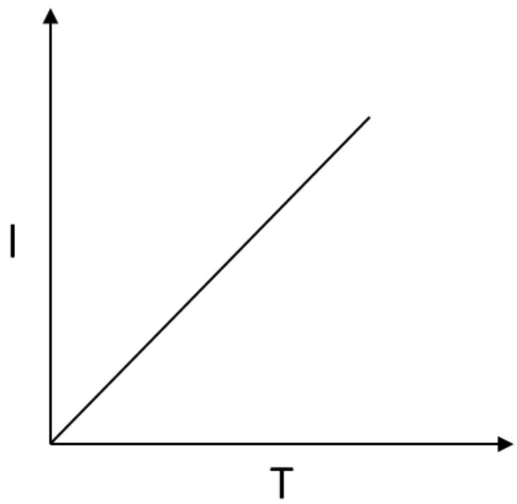
L → Length of the vibrating string.

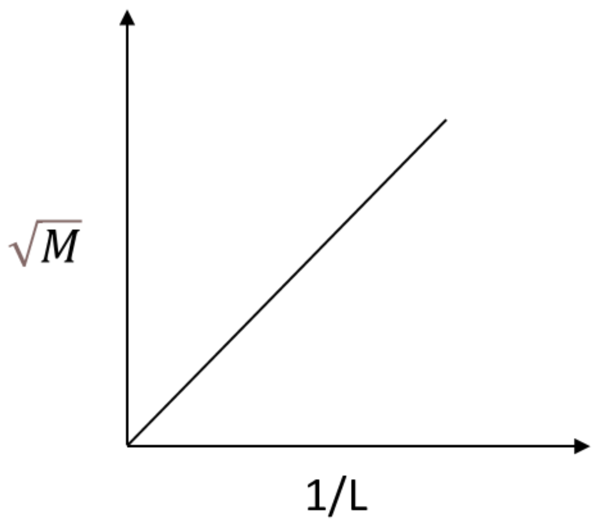
T → Tension of the string.

M → Mass of the string with load.

Model graph







Procedure

1.Assemble the setup as shown in the figure. Firstly, the wire, as its one end fired and other end passing over pulley, carrying a hanger of weights

2.Mount the 1 clamp. of soil with the screws of sonometer base at a distance 2-3 mm above the wire. Now connect mains cord between mains and sonometer

3.Take two patch cords from the accessory box and connect the 6V Ac supply from sonometer to the coil with the polarity.

4.Now hang the weight of 1000 gms to the hanger connected with one end of steel wire switch on the Ac supply.

5.Now adjust two knife edges by slowly increasing the distance between them so that you get some vibrations in wire

6.Now slowly adjust both knife edges for maximum vibration in the wire. Note the length (l1) of wire between two knife edges by given meter scale. Also note load (w) in kg (including weight of hanger)

7.Now increase load by 500 gms and again get the position of maximum vibration by adjusting both knife edges. Note length of wire.

8.Repeat the same procedure by increasing weight by 500 gms and take reading for maximum vibration.

9.Note all values in observation table. Repeat the steps adjusting two knife edges by slowly decreasing the distance between them so that slowly decreasing maximum vibrations.

10.Note the values of length of vibrating for respective loads.

11. Plot the graph and do the calculation to verify the laws.

Table 1: Law of Length

Sl. No	Frequency of Tuning Fork ν (Hz)	Length of the Vibrating segment L (cm)	1/L (cm^{-1})	$\nu \times l = constant$
1.				
2.				
3.				

Table 2: Law of Tension

Sl. No.	Weight	Tension T	√T	Length of the Vibrating segment L (cm)	$\sqrt{\frac{T}{l}} = constant$
1.					
2.					
3.					

Table 3: Law of Mass

Sl. No.	Mass/unit length	√M	Length of the Vibrating segment L (cm)	$L\sqrt{M} = constant$
1.				
2.				
3.				
4.				

Calculation

Frequency of tuning fork,

$$\nu = \frac{1}{2l}\sqrt{T/_{M}}$$

Law of Length,

$$\nu \times l = constant$$

Law of Tension,

$$\sqrt{\frac{T}{l}} = constant$$

Law of Mass,

$$L\sqrt{M} = constant$$

Result

I. $\nu \times l = C1, \sqrt{\frac{T}{l}} =$ C2, L√M=C3 the constants verified the laws of transverse vibrations.

II. A graph between ν and 1/L, T and l and 1/ L and $\sqrt{\boldsymbol{M}}$ is a straight line verified the law of length, tension and mass respectively.

Experiment 16.

To verify the laws of transverse vibration using Melde's string apparatus

Aim

To verify the laws of transverse vibration using Melde's string apparatus.

Apparatus required

Electrically maintained tuning fork, fine thread, scale pan, weights and meter scale.

Formula

Frequency of vibrating wire,

$$F = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$$

Frequency in transverse setup,

$$F = \sqrt{\frac{gM}{4\mu l^2}}$$

Law of length,

$$F \alpha \frac{1}{l}$$

$$F \times l = C1$$

Law of tension,

$$F \alpha \sqrt{T}$$

Where,

F- frequency of tuning fork in Hz

μ - linear density in kg/m - mass of the string / length of the string.

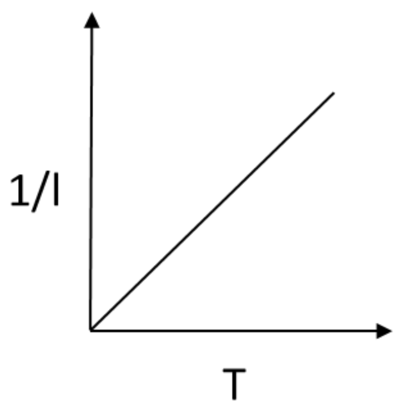
l - length of one loop in m

L- total length

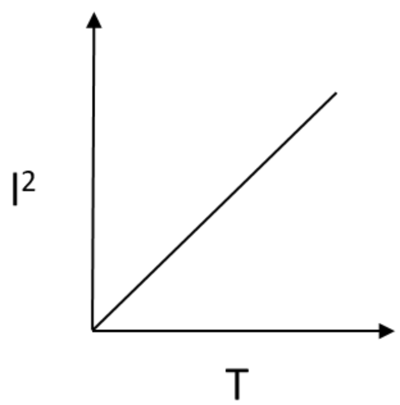
T-Tension of the string

g-Acceleration due to gravity

Model graph

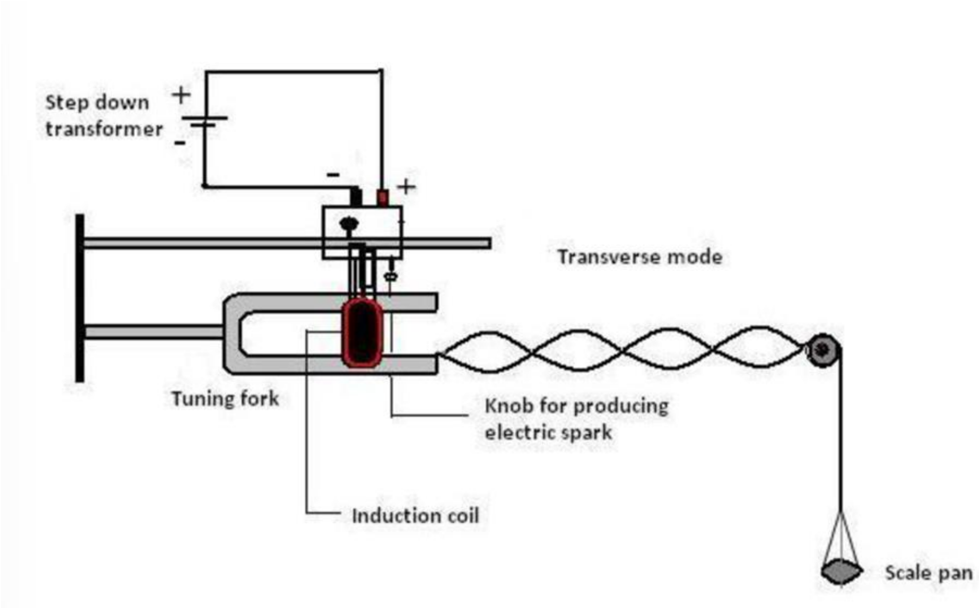


Graph 1



Graph 2

Experimental setup



Procedure

1. The apparatus is set up with the string's length aligned parallel to the prong of the tuning fork, with one end of the string attached to the fork's prong.
2. The other end of the string, which carries a scale pan, is passed over a pulley fixed at one end of the table.
3. When the tuning fork is excited, it vibrates perpendicular to the length of the string.
4. The scale pan is then detached from the string, and its mass and length are determined using a common balance and meter scale, allowing for the calculation of linear density.
5. Once measured, the scale pan is reattached to the end of the string, and mass is added to the pan.
6. The circuit is closed, and the tuning fork is set into vibration again.

7. This time, the string vibrates transversely, producing stationary waves.
8. The length of the string is adjusted to achieve well-defined loops, and two long knitting needles are placed at two nodes.
9. The length of *N* loops is measured, and the average length is calculated.
10. Using the appropriate equation, the frequency of the tuning fork is then calculated.
11. l^2 and 1/l were calculated and plotted against the tension T. The resulting straight line verifies the law of length and tension.

Observation

μ - 1.17 x 10-4 kgm-1; Mass - mg ; length - m

Table

No.of. loops P	Length of one loop l=L/P	Load M	Tension T $(M+M_P)$ g	1/l	l^2	Frequency $F = \sqrt{\frac{gM}{4\mu l^2}}$

Calculation

Frequency F,

$$F = \sqrt{\frac{gM}{4\mu l^2}}$$

Result

Graphs straight line shows the Law of length,

$$F\alpha\frac{1}{l}$$

and Law of tension,

$F\alpha\sqrt{T}$ were verified.

Experiment 17.

To compare the mass per unit length of two strings using Melde's apparatus

Aim

To compare the mass per unit length of two strings using Melde's apparatus

Apparatus required

Electrically maintained tuning fork, two fine thread strings, scale pan, weights and meter scale.

Formula

Linear mass density of string 1 $\mu_1 = M_1/l_1$

Linear mass density of string 2 $\mu_2 = M_2/l_2$

Where,

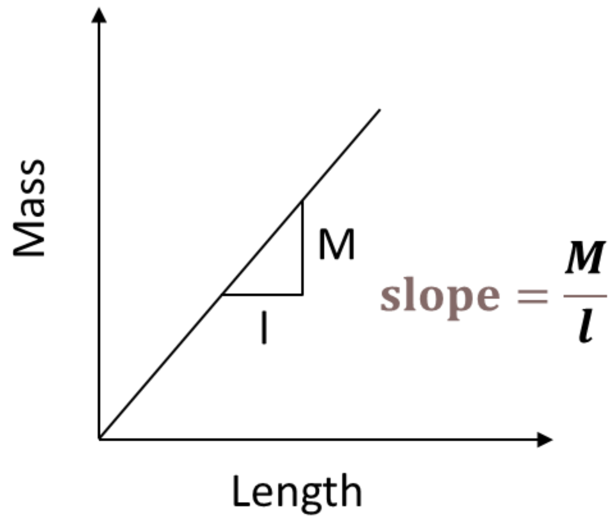
M_1 - Total mass of string 1

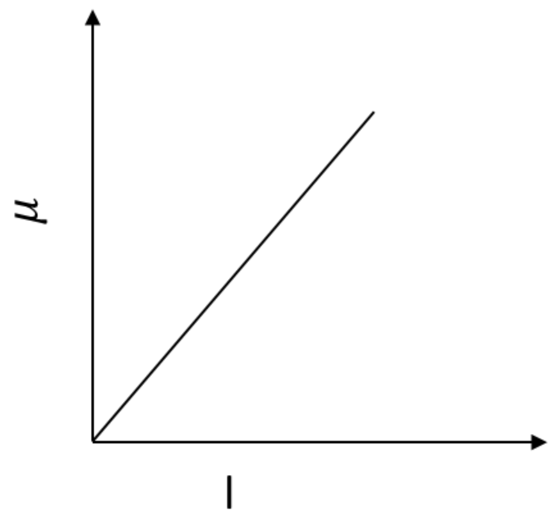
M_2 - Total mass of string 2

l_1 - Length of string 1

l_2 - Length of string 2

Model graph





Observation

Here, M is the total mass - mass of the scale pan + mass suspended.

Mass of the scale pan - g.

Table 1

Linear mass density of string 1

No.of. loops P	Length of one loop l=L/P	Load M	μ_1 = M_1/l_1

Table 2

Linear mass density of string 2

No.of. loops P	Length of one loop l=L/P	Load M	μ_2 = M_2/l_2

Procedure

1. The apparatus is set up with the string's length aligned parallel to the prong of the tuning fork, with one end of the string attached to the fork's prong.
2. The other end of the string, which carries a scale pan, is passed over a pulley fixed at one end of the table.
3. When the tuning fork is excited, it vibrates perpendicular to the length of the string.
4. The scale pan is then detached from the string, and its mass and length are determined using a common balance and meter scale, allowing for the calculation of linear density.
5. Once measured, the scale pan is reattached to the end of the string, and mass is added to the pan.
6. The circuit is closed, and the tuning fork is set into vibration again.
7. This time, the string vibrates transversely, producing stationary waves.
8. The length of the string is adjusted to achieve well-defined loops, and two long knitting needles are placed at two nodes.
9. The length of *N* loops is measured, and the average length is calculated.
10. Plot the graph as shown and calculate the mass per unit length of two strings.
11. Compare the linear mass density of two strings as graph 2.

Calculation

$$\text{Slope} = \frac{M}{l}$$

Result

Linear mass density of two strings results were compared with the graph.

Experiment 18.

Frequency of AC by using sonometer

Aim

To determine the frequency of AC with the help of Sonometer.

Apparatus required

Sonometer with non-magnetic wire (Nichrome), Ammeter, step down transformer (2-10 Volts), Key, Horse shoe magnet, Wooden stand for mounting the magnet, set of 50 gm masses, screw gauge and meter scale (fitted with the sonometer).

Formula

Frequency of AC,

$$n = {}^{1}/_{2l}\sqrt{\frac{T}{M}}$$

Tension T = Mg

Mass per unit length m = $\pi r^2 d$

Where,

l - Length of the sonometer wire between two bridges.

M - Total mass loaded on the wire.

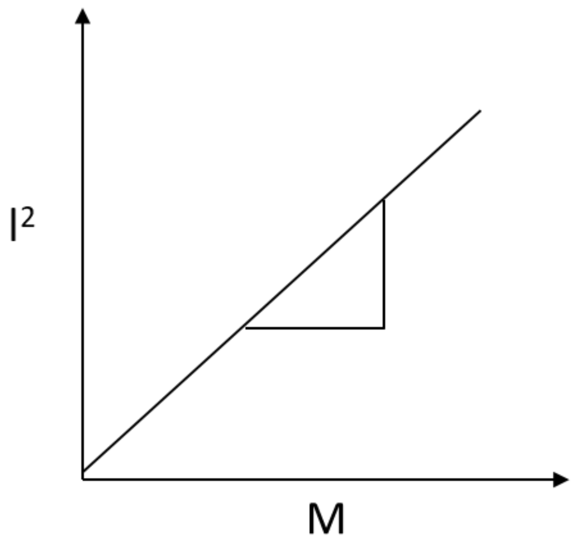
d - density of the wire (Nichrome).

r - Radius of the sonometer wire.

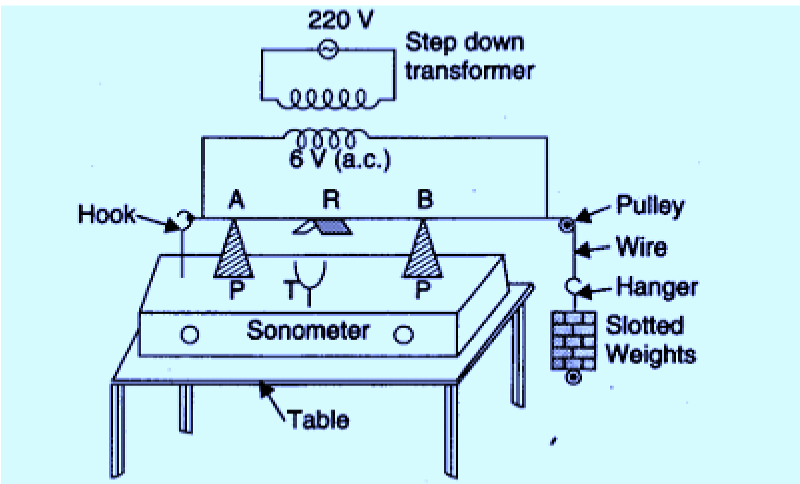
π - 3.14

g - Acceleration due to gravity.

Model graph



Experimental apparatus



Procedure

1. Measure the diameter of the wire with screw gauze at several points along its length. At each point two mutually perpendicular diameters 90 should be measured. Evaluate the radius of the sonometer wire.
2. Connect the step-down transformer to AC mains and connect the transformer output (6 Volts connection) to the two ends of the sonometer wire through a rheostat, ammeter and a key, as shown in the figure.
3. Place the two movable sharp-edged bridges A and B at the two extremities of the wooden box.
4. Mount the horse shoe magnet vertically at the middle of the sonometer wire such that the wire passes freely in between the poles of the magnet and the face of the magnet is normal to the length of the wire. The direction of current flowing through the wire will now be normal to the magnetic field.
5. Apply a suitable tension to the wire, say by putting 100 gm masses on the hanger [tension in the wire = (mass of the hanger + mass kept on the hanger) .g]. Switch on the mains supply and close the key K and then adjust the two bridges A and B till the wire vibrates with the maximum.
6. Amplitude (in the fundamental mode of resonance) between the two bridges. Measure the distance between the two bridges.
7. Increasing the load M by steps of 50 gm, note down the corresponding values of l for maximum amplitude (in the fundamental mode of resonance). Take six or seven such observations.
8. Knowing all the parameters, using the relations given in equations 1 and 2 calculate the frequency of AC mains for each set of observation separately and then take mean.

9. Also plot a graph between the mass loaded, M along the X-axis and the square of the length (l2) along Y-axis. This graph should be a straight line. Find the slope of this line and then using the equations 1 and 2, calculate the frequency of AC mains from this graph also.

Frequency (n) = $\sqrt{\frac{g}{4 \times slope \times m}}$

Observation

Mass of the hanger = 50 gm

Acceleration due to gravity (g) = 980 cm/sec^2.

Density of sonometer wire (nichrome) = 8.18848 gm/cc

Table 1

Measurement of radius of sonometer wire (r)

Least count of screw gauge = cm

Zero error of the screw gauze = cm

S.No	(PSR) in mm	(HSC) in div	HSR= (HSC×LC)	Observed reading OR=PSR+HSR	Correct Reading =OR±ZC
1					
2					
3					

4					
5					

Table 2

Measurement of T, l and frequency of the AC Mains

SI.No.	Total Mass Loaded = Mass of hanger + Mass on its M (gm)	Tension in wire T = Mg (gm cm/s2)	Position of first bridge a (cm)	Position of second bridge b (cm)	Length of wire between two bridges l=a-b (cm)	Frequency (Hz)
1.						
2.						
3.						
4.						
5.						

Mean frequency = Hz

Calculation

Experimental

$$n = {}^{1}/_{2l} \sqrt{\frac{T}{M}}$$

Graphical

$$\text{Frequency (n)} = \sqrt{\frac{g}{4 \times slope \times m}}$$

Result

The frequency of AC as calculated,

Experimental calculations	=		Hz.
Graphical calculations	=		Hz.
Standard Value	=	50	Hz.