Guru Nanak Vidyak Society's

GURU NANAK COLLEGE OF ARTS, SCIENCE & COMMERCE

2019-20

DBT- Star College Scheme

S. Y. B. Sc. Practical Manual

Department of Physics

INDEX

EXPERIMENT NO. 1

Polarimeter

Aim: To determine the specific rotation of sugar using Laurent's half shade polarimeter.

Apparatus: Laurent's half shade polarimeter, a sodium lamp, sugar, a balance, a weight box, a graduated cylinder, two beakers, filter paper, a funnel, an eye piece, a pipette and a glass rod.

Theory:

Laurent's half shade polarimeter: It is an instrument used for finding the optical rotation of certain solutions. When used for finding the optical rotation of sugar is called polarimeter. If the specific rotation of sugar is known, the concentration of the sugar solution can be determined.

Construction: The optical parts of the polarimeter are shown in Fig. in which S is a source of monochromatic light usually a sodium lamp. The light from the source after passing through

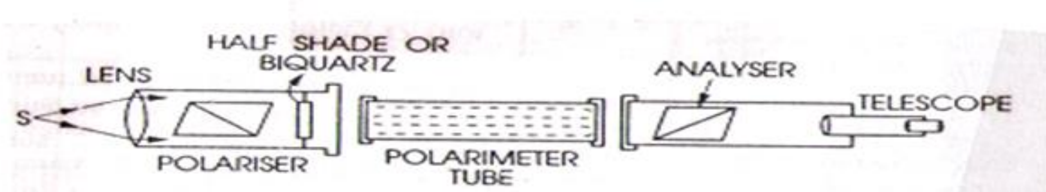


Fig.

a narrow slit is rendered into a parallel beam by the lens L. The light is made plane polarised by the nicol prism P and after passing through the half shaded device, a polarimeter tube containing the solution is made to fall on the nicol analyzer. The light is viewed through a telescope. The analyzing nicol can be rotated about the axis of the tube and its rotation can be measured on the graduated circular scale divided in degrees, with the help of a Vernier.

The position of the analyser is the adjusted so that the field of view is completely dark. The tube is filled with the required solution and placed in position. The field now becomes illuminated darkness can again be achieved by rotating the analyzing nicol through a certain angle which gives the optical rotation for the solution.

It is found that when the nicol A is rotated, the total darkness of the field of view is attained rather gradually and hence it is difficult to find the exact position correctly for which complete darkness is achieved. Laurent devised an ingenious method to achieve this. This arrangement is known as Laurent's half shade device.

If θ is the optical rotation produced by l decimeter of a solution and c the concentration in gram per c.c., then specific rotation S at a given temperature t and corresponding to a wavelength λ is given by

$$[S]_{\lambda}^{t} = \frac{\theta}{lc} = \frac{Rotation\ in\ degrees}{length\ in\ decimeters \times concentration gm/cc}$$

Procedure:

1. Preparation of 20% solution. Taken a dry clean beaker and weight it. Add about 20gm of sugar in it and weight again. Calculate the volume of solution to have a 20% strength as follows:-

   Volume required = $\frac{m \times 100}{20}$c.c.

   Where m is the mass of sugar in the beaker.

   Add nearly half this volume of water in the beaker and stir well till the whole of sugar is dissolve. Add more water, if necessary taking care that the volume of solution is less than the calculated value of the volume. Transfer the solution into a graduated cylinder. Make the require volume by adding more water little by little with a pipette. Filter the solution in a clean beaker and cover it.
2. **Setting:** find the vernier constant of circular scale. Place the polarimeter so that the aperture is in front of the sodium lamp. Look through the telescope and adjust the position of the eye piece so that the two halves of the half shade device are clearly in focus.
3. Remove the brass cap of the polarimeter tube. Clean the tube as well as the glass windows. Now replace one of the cap in position taking care that no strain is exerted on the glass window. Hold the tube in a vertical position and fill it with water. Slip the second glass window gently on the tube taking care that no bubbles are left underneath it. Screw the cap gently taking care that no strain is exerted on the glass window.
4. Place the tube in position in the polarimeter and cover it. Rotate the analysing nicol by rotating the circular scale till the two halves of the half shade device are in equally dark position. In this position there will be an abrupt change in the intensity of the two halves when slightly rotation on either side is given. Note the reading on the scale. Turn through 180^0, set the analyser again for equally dark position and note the reading on the scale.
5. Now fill the tube with 20% sugar solution prepared. Place it in position and note the scale reading when the two halves are in equally dark position. Repeat by turning through 180^0.
6. Take 30 c.c. of the 20% sugar solution and make the volume to 60 c.c. so as to reduce the strength to one half. Fill the tube with this 10% solution and take the reading.
7. Similarly repeat with 5% and 2.5% solutions.

Observations: weight of the beaker =

Weight of beaker+ sugar =

Weight of sugar = m =

Volume of solution required = $\frac{m}{20} \times 100 c.c.$ =

Vernier constant =

Observation table:

Sr. No.	Strength of solution in gram		Scale readings through solution		Rotation		Mean	$\frac{\theta}{c}$
1								
2								
3								
4								
5								
6								
7								

Length of the tube l =

Mean θ

Result:

EXPERIMENT NO. 2

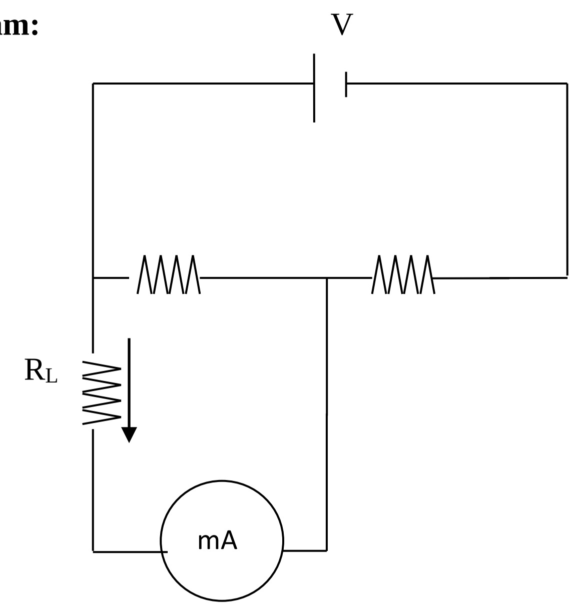
Maximum Power Transfer Theorem

Aim: To verify maximum power transfer theorem.

Apparatus: Digital milliammeter, Regulated DC power supply, 3 resistance boxes, connecting wires, multimeter.

Statement of Theorem: Maximum power will be transferred to a resistive load from a network, when the load resistance is equal to the internal resistance of the network as viewed from the output terminals.

Circuit Diagram:



Formula:

- $R_{in} = \frac{R_1 R_2}{R_1 + R_2}$

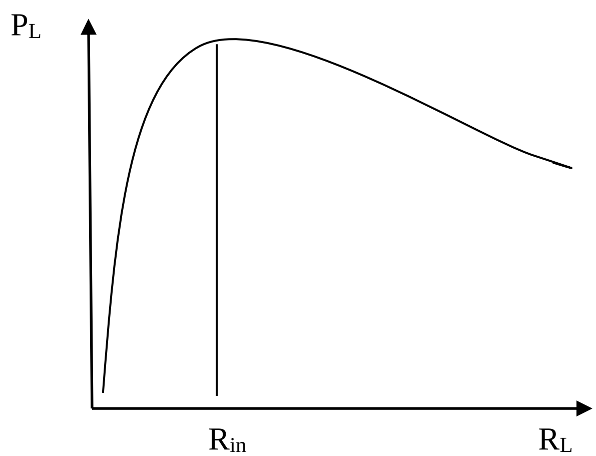
Procedure:

1. Connect the circuit as shown in the circuit diagram.
2. Take V = 10 Volts, $R_1 = 100\Omega$ and $R_2 = 100\Omega$ & calculate the Thevenin's resistance ($R_{TH} = R_{in}$) .
3. Note down I_L for different values of R_L.
4. Calculate P_L using the formula $P_L = R_L I_L^2$.
5. Plot a graph of P_L Vs R_L and find out the value of R_L where P_L is maximum.

Observation Table:

Obs. No.	R_L (Ω)	I_L (mA)	I_L (Amp)	$P_L = R_L I_L^2$
1	10			
2	20			
3	30			
4	40			
5	50			
6	60			
7	70			
8	80			
9	90			
10	100			

Graph:



Result:

From the graph it is seen that P_L is maximum at $R_L = R_{in}$. Hence the maximum power transfer theorem is verified.

- R_{in} (Calculated) = …………………….Ω
- R_{in} (From Graph) = …………………….Ω

EXPERIMENT NO. 3

Absorption of Acoustic Material

Aim: To calculate the coefficient of absorption for acoustical materials.

Theory:

Absorption of sound

When a sound wave strike a surface, part of it is transmitted and the remaining part is reflected. The property of a sound energy is converted in other form of energy is known as absorption.

The coefficient of absorption:

The coefficient of absorption ‘a’ of it is transmitted is defined as the ratio of sound energy absorbed by its surface to that of the total energy incident on the surface. Thus,

a = sound energy absorbed by the surface / total sound energy incident on the surface

The coefficient of absorption is expressed in ‘open window unit’(O.W.U.) or ‘Sabine/m^2’

Absorbent or Acoustic materials:

Materials having more capacity to absorb the incident sound are called ‘absorbent ‘ or ‘acoustical- materials’.

Examples: Porous materials, resonant panels, cavity resonators, composite types.

Apparatus:

Portable sound source, Portable decibel-meter, different surfaces
(thermocol, curtains, pressed wood fibers),
and prefabricated half cylindrical panel.

Procedure:

1) Measure the amount of sound energy received by the decibel-meter from source of sound.
2) For this measurement keep the distance between source (S) and receiver(R) 1m.
3) Note down the reading in decimal(dB)Say S.
4) Mount plaster material (sheet) on the panel.
5) Using sound source (S) and receiver (R) note down sound energy received after reflection from the surface. Repeat the observation for two more readings. Note down reading and calculate the average value. Say S1.
6) Now remove plaster material sheet and place thermo cole sheet. Take three calculate the average value. Say S2.
7) Finally replace plaster material sheet by curtain (cotton) by mounting it on panel. Take three reading in receiver R. Calculate the average value says S3.
8) Using the formula calculate coefficient of absorption for Sponge – material, Thermocol and Wood material.

Observations:

Reading I decibel meter when sound energy is received directly=S=_______ dB.

Table for sound energy received after absorption from different surfaces.

Sound energy absorbed Name of material	**Reading in decibel – meter**	**Average reading**
1)Sponge(S)		
2)Thermocole(T)		
3)Wood(W)		

Sample Calculations:

The absorption coefficient (a) for

1) Sponge Material:=a(s)=s1/s

=__________

=__________ 0.W.U or Sabine/m^2.

2)Thermocol Material:=a(T)=s2/s

=________

=________ O.W.U or Sabine/m^2.

Result

Coefficient of absorption is found to be

1)sponge=__________

2)Thermocole=________

3)Wood=_________

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EXPERIMENT NO. 4

Law of Malus

Aim: To study the law of Malus

Apparatus: Diode laser, polarizes, analyser, sensor, LBA meter.

Figure:

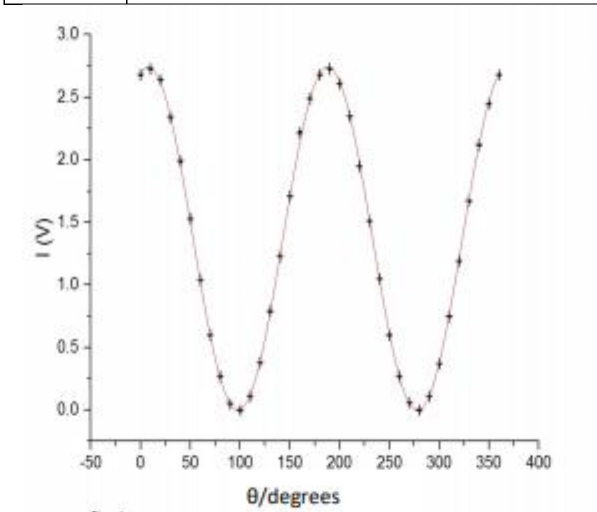
Procedure:

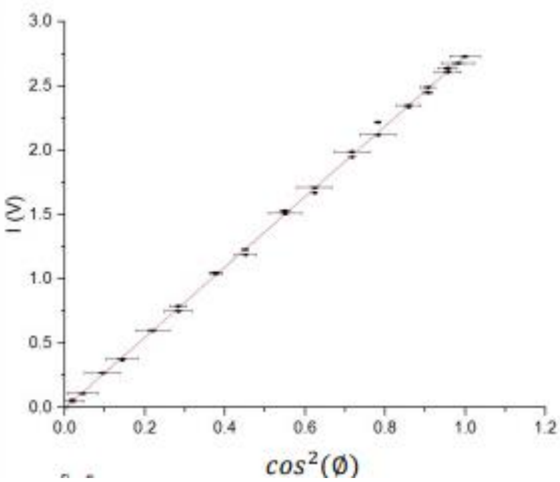
1) Arrange the set-up on an optical bench.
2) Keep the polarizer and Analyzer at a 0^o note down the reading of powermeter.
3) Keep the angle of analyser fix and rotate the angle of polarizer with a 10o and note down the reading of power meter.
4) Plot the graph of $\cos^2 \theta$angle power Vs power.

Observation table:

Sr. No.	Polarizer reading	Power meter reading
1	0	
2	10	
3	20	
4	30	
5	40	
6	50	
7	60	
8	70	
9	80	
10	90	
11	100	
12	110	
13	120	
14	130	
15	140	

16	150	
17	160	
18	170	
19	180	





Result: Law of Mauls is verified

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EXPERIMENT NO. 5

h/e using vacuum photo cell

Aim: To study h/e using vacuum photo cell.

Apparatus: Experimental set up for h/e.

Theory:

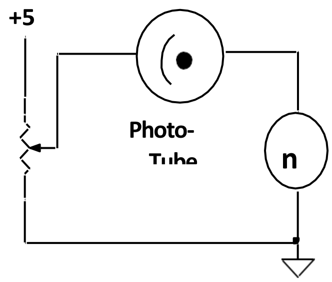
Max Planck's Quantum Theory: In 1900, in order to explain the distribution of energy in the spectrum of black body, its assumed that atoms in the walls of the black body behave Like a simple harmonic oscillator each has a characteristics frequency of oscillation. These oscillators cannot have any arbitrary values of energy that are given by E = nhv, where n = O, 1, 2, E = energy of the oscillator; h = Planck's constant; v = frequency of oscillation) when an oscillation jumps from higher state n_2 to lower state n_1, it emits energy in the form of electromagnetic radiation given by $E = (n_2 — n_1)$ hv.

Photoelectric Effect: Photoelectric effect was discovered by Heinrich Hertz in 1887 and then studied in detail by Lenard. When a light of suitable frequency falls on a metal surface, electros are emitted from metal surface. This phenomenon is known as "Photoelectric Effect'.

Photo tube:

A photo tube consists of two electrodes contained in an evacuated container in which there may be vacuum or traces of inert gas (argon) at low pressure [3].There are three types of photo tubes: with vacuum, gas filled and photo multiplier tube. Figure-1 shows

the GD-28 vacuum photo tube used in this experiment. The cathode is coated with Cesium, a photo sensitive semiconductor material, which emits photo-electrons when light impinges on it. A low positive potential on the anode is required to attract photo-electrons on to it. The anode voltage is kept low, in the range 0-10V. Vacuum photo tubes are more stable compared to the other two. A photo tube is specified by its luminous sensitivity represented in micro-ampere /lumen. The photo tube GD-28 used by us is of 30.2µA/lumen.



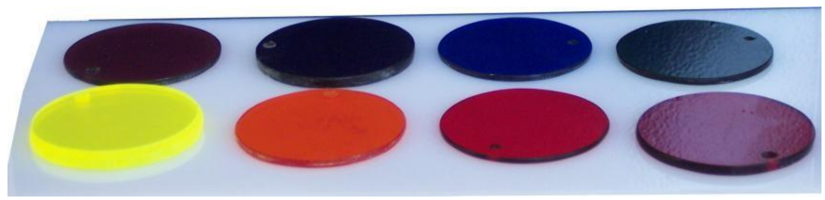
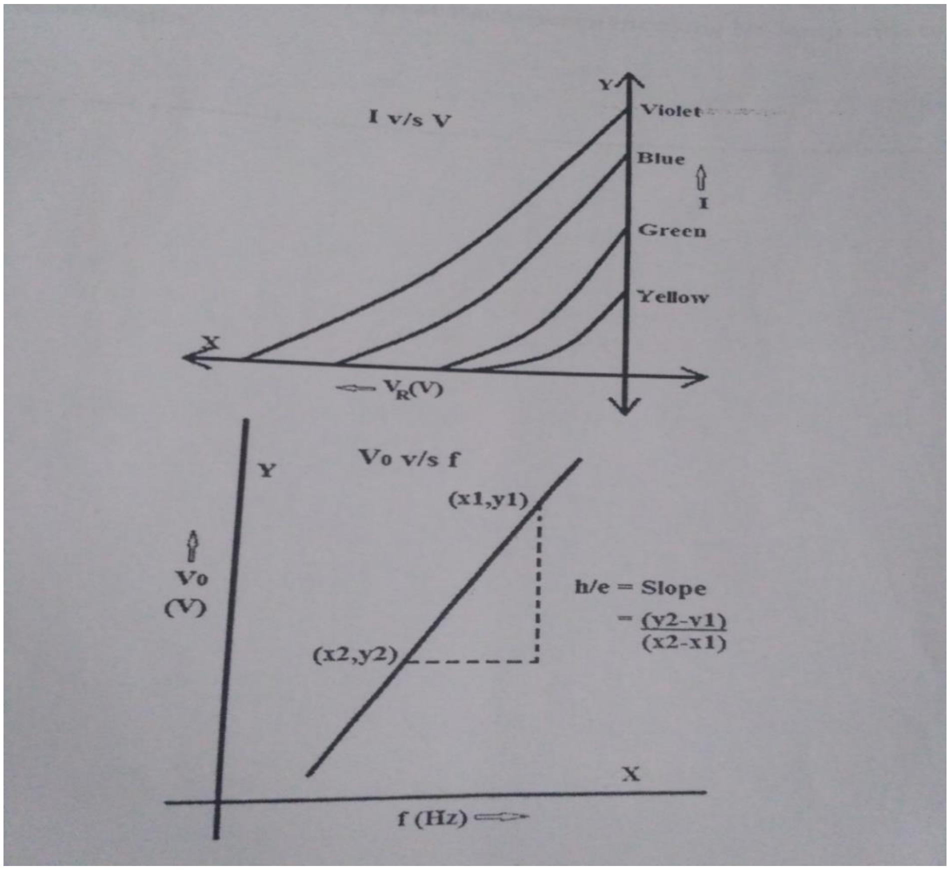


Fig. Circuit connections   Fig.: Color filters used in the experiment

Observation table:

Sr. No.	V_R (volts)	I (μA)			
		Yellow λ_y =----------Å f_y = ---------Hz	Green λ_g = ----------Å f_g = ----------Hz	Blue λ_b = ----------Å f_b = ----------Hz	Violet λ_V = ------------Å f_v =--------------Hz

Graph:



Result:

1) h/e (by calculation) = _________________ J_s /coulomb
2) h/e (by graph) = _________________ J_s/coulomb

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EXPERIMENT NO. 6

Thermal Conductivity be Lee' s Method

Aim: To determine coefficient of thermal conductivity 'k' of a bad conductor by Lee's method

Apparatus: Lee' s apparatus, bad conductor, bad conductor who' s coefficient has to be determined, thermometers, stop-watch, screw gauge, Vernier calipers etc.

Theory: The coefficient of thermal conductivity, sometime called the K-factor, is expressed as the quantity of heat that passes through a unit cube of the substance in a given unit of time when the difference in temperature of the tow faces is 1 ^{o}C

OR

> The coefficient of thermal conductivity is a number indicating the quantity of heat passing in a unit of time through a unit thickness of a substance when the difference in temperature is 1 ^{0}C.

Formula: The coefficient of thermal conductivity is given as :

$K = \frac{4Msx}{\pi D(\theta 1 - \theta 2)}(\frac{d\theta}{dt})$ $\frac{d\theta}{dt}$ is the value of slope at θ2

Where, M = mass of lower disc
S = specific heat of the material of the lower disc 418 J Kg^{-1} K^{-1}
X = thickness of bad conductor
D = diameter of bad conductor
Θ_1 = steady state temperature of upper conducting disc
Θ_2 = steady state temperature of lower conducting
$\left(\frac{d\theta}{dt}\right)$ θ_2 = rate of fall in temperature in ^{0}C

Procedure:

1. First find the thickness of the bad conductor with the the help of screw gauge. Take at least 8 readings at different places of the bad conductor.

1. With the help of Vernier calipers find at find the diameter of the bad conductor. Take at least 5 readings at different places af the bad conductor.
2. Keep the bad conductor on top of the lower conducting disc of the Lee' s apparatus and then place the upper conducting disc on the bad conductor viz. the bas conductor is placed between the upper and lower conducting disc of the Lee's apparatus.
3. Insert tow thermometers. One in the upper conducting disc and the other in the lower conducting disc of the Lee's method.
4. Pass steam through the Lee's apparatus.

5. After some time, the upper and lower conducting discs will "start showing steady temperature values. Note these steady temperature values as θ_1 and θ_2 resp.
6. Now remove the bad conductor and then place the upper conducting disc on the lower conducting disc. Continue passing the steam.
7. When the temperature of the lower conducting disc rises by about 10°C above the steady temperature θ_2, stop passing the steam.
8. Now allow to it to cool under identical conditions of exposure

   (i.e. keep the bad conductor on the lower conducting disc). Start

   noting the temperature after every 30 seconds till the temperature reaches the room temperature.
9. Plot a graph of Temperature ‘θ' v / s time ‘t' . From the graph determine the rate of fall of temperature at temperature θ_2, i.e. $\left(\frac{d\theta}{dt}\right)$ θ_2

Observations :

Mass of lower conducting disc, M = ____________ gms.

Thickness of bad conductor x = ______________ cms (mean)

X_1 = _________ cms, X_2 = ______________cms .... , X_8 = _______ cms.

Diameter of bad conductor D = ________cms (mean)

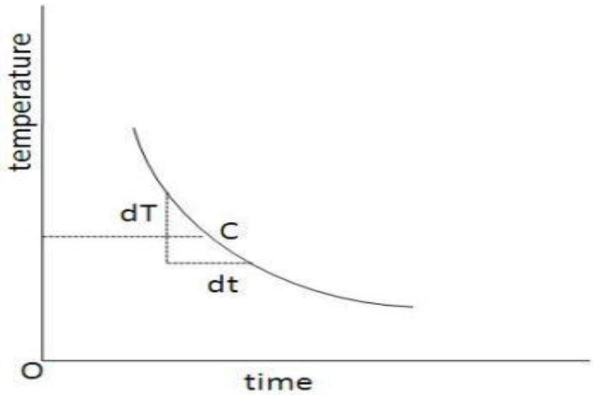
D_1 = __________cms, D_2 = ___________cms .... , D_5 = _________cms.

Steady state temperature of upper conducting disc = θ_1 = _______ ^{0} C .

Steady state temperature of lower conducting disc = θ_2 = _______ ^{0} C .

Time in secs	Temperature in ^{0} C
0	
30	
60	
90	
:	
:	

Graph:



Result: The coefficient of thermal conductivity in SI units is k = __________ J/mKs

Experiment no.7

Helmholtz Resonator

A Helmholtz resonator is a cavity that resonant with a frequency that depends on the dimensions of the cavity. The name comes from an acoustic device created in the 1850âs by the German physicist Herman von Helmholtz (1821 - 1894).

Aim: To determine the relation between the frequency & the resonating volume of air using narrow necked resonator & to determine the unknown frequency of tuning fork as well as the neck correction.

Apparatus: A narrow necked resonator, asset of tuning fork, measuring cylinder, striking pad, beaker, water.

Formulae:

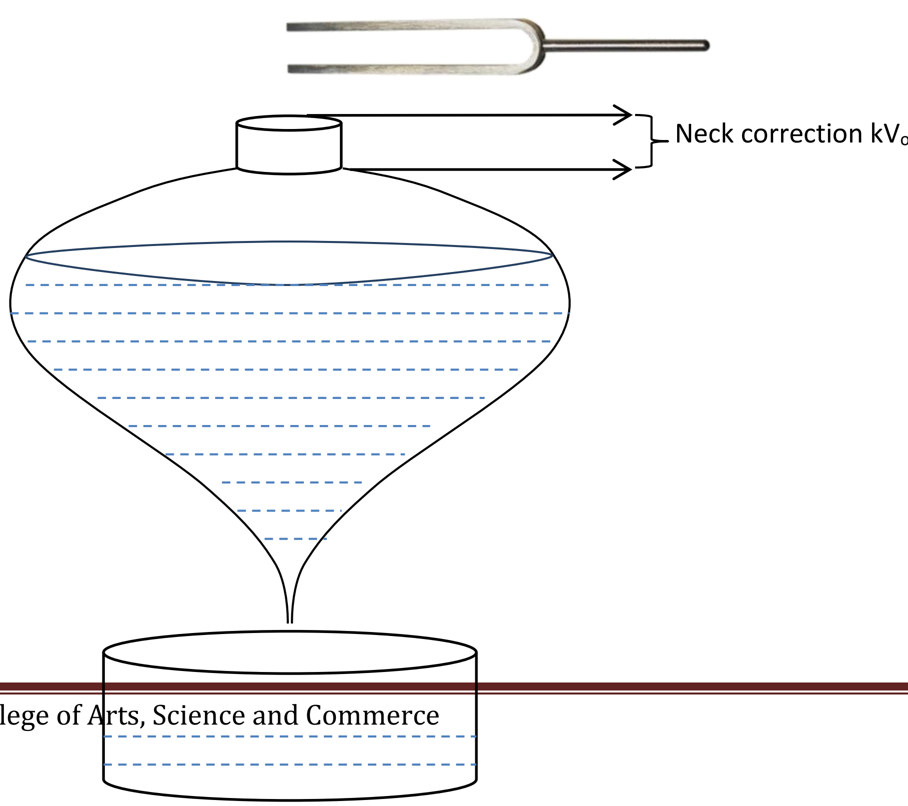
1) $n^2(V + kV_0)$ = constant

Where, n = frequency of tuning fork, V = volume of resonating air

V_0=volume of neck k = neck correction factor

2) $k = \frac{intercept\ on\ Y\ axis}{V_0}$

Diagram:



Procedure:

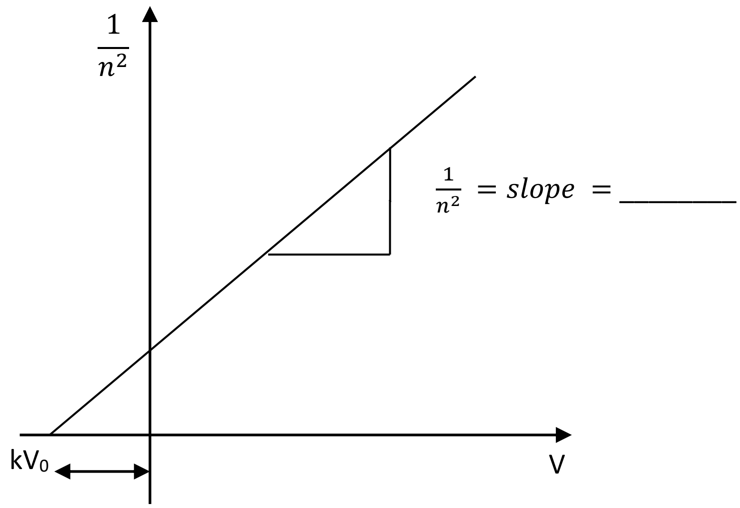
1. Fill the resonator completely with water. Keep an empty measuring cylinder below the resonator. Now allow the water to flow out at a slow rate by using a pinch cock. When the water level comes to the base of a neck, stop the flow of water and record the volume in cylinder. This volume is a neck volume V_0 .
2. Arrange the tuning fork in the ascending order of frequencies.
3. Set the tuning fork of highest frequency into vibration and hold it just above the mouth of the resonator filled with water up to the base of the neck.
4. Allow the water to flow out of the bottle at slow rate. Collect the water in a empty measuring cylinder which is kept below the resonator. When resonance occurs (i.e. loud sound is heard), stop the flow of water and record volume V of water collected. Repeat this process three times & find the mean volume.
5. Repeat this step for other tuning fork including the tuning fork of unknown frequency.
6. Plot a graph of $\frac{1}{n^2}$against V& calculate the value of k by using above formula.
7. Repeat the same procedure for shape 2.

Observations:

- Volume of the neck =V_0 =…………….c.c.

Obs no.	n (Hz)	Volume of resonating air V (c.c.)				n^2	$\frac{1}{n^2}$
		Shape 1		Shape 2			
1							
2							
3							
4							
5							

Graph:



Result:

- Slope of graph =………………
- Neck correction factor= k =…………………
- Unknown frequency=………………Hz

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