1st level Laboratory

Experimental Physics

Preparation
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Table of Contents

The specific heat capacity of a solid body

1

Aim:

Determine the specific heat capacity of a solid body by the method of mixtures.

Discussion:

If we add one body to anther and have two different temperatures, loses a quality of heat and the other body acquires it to the same temperature . the amount of heat that the first body has lost is the amount of heat the other body has acquired this method is to raise the temperature of a solid body to a high temperature and then add it directly to the fluid and set the final temperature of the mixture and fix the way to set the quality heat for any of the body s solid or liquid by the quality of the other's heat, bearing in mind that the body is not capable of being solid soluble in liquid or chemically interacting with it

Tools

1- Caliber filled with enough water to immerse a heating wire made of tungsten, and thermally insulated by placing it in an external caliber and between them (libad) to reduce the loss of heat in pregnancy and radiation.

2-thermometer for measured the temperature.

3- Continuous voltage source or battery.

4- Ammeter.

5- Voltmeter.

6- Resistant.

Mathematical Relationship

we take a solid object mass (m) of material heat quality (s) and heat it in the device shown in the form that the temperature reaches the appropriate value (T) and the temperature of water vapor and take the amount of liquid mass (m) and heat quality (s) in the price (a) of its mass (m) and heat quality (s) and temperature together (T) and when the stability of the temperature of the body steel at the degree (T) we throw it into the liquid quickly and trun the mixture well and set the final temperature (T) and then if we neglect the amount of heat last un the calf and pregnancy so the amount of heat obtained by the colorie and heat equal to the amount of heat last the solid body if the liquid used is water s=1cal/gm/deg and the price is made of copper

$$S = \frac{(m_1 s_1 + m_2 s_2)(T_2 - T_1)}{m\,(T - T_2)}$$

Where

m_1 is the calorimeter mass

m_2 is the water mass

s_1 is the calorimeter specific heat = 0.2 Cal/gm/deg

s_2 is the water specific heat = 1 Cal/gm/deg

T_1 the temperature of water and calorimeter before mixture

T the temperature of the solid before mixture

T_2 the temperature of the group after mixture

m is the solid mass

Procedure:

1. Weight an empty calorimeter with the balance. Ensure that calorimeter is clean and dry. Note the mass m1 of the calorimeter
2. Pour the given water in the calorimeter. Make sure that the quantity of water taken would be sufficient to completely submerge the given solid in it. Weight the calorimeter with water and hence note the mass of the given water quantity m2
3. Place the calorimeter in its insulating cover. Measure the temperature of the water taken in the calorimeter. Record the temperature T1 of the water and the calorimeter.
4. Place a suitable amount of the solid of a specific heat s in the tube C and turn in until it closed and then put a thermometer inside the tube C to measure the temperature of the solid.
5. Start the heating and wait for about 30 min and then record the temperature of the solid T.

6. Let the solid falls in the insulating calorimeter by turning the tube C . and the record the final temperature of the mixture T2
7. Finally, weight the group(calorimeter ,water and the solid) the determine the mass of the solid m.
8. Using the Eq(1), calculate the specific heat capacity S of the solid

Result:

s_1 the calorimeter specific heat = 0.2 Cal/gm. °C

s_2 the water specific heat = 1 Cal/gm. °C

m_1 the calorimeter mass = ………………. gm

m_2 the water mass = ………………. gm

m is the solid mass = …………………………………. gm

T_1 the temperature of water and calorimeter before mixture = …… °C

T_2 temperature of the group after mixture = … °C

T temperature of the solid before mixture = ……°C

Newton's Law Of Cooling

2

Aim:

To verification Newton’s cooling act for liquid (water).

Discussion:

When an object is at a different temperature than its surroundings, it will gradually cool down or heat up until the temperatures are equal. Everyone has experienced this. You boil water to make tea and then wait several minutes until it is at a temperature at which you can drink it. You place a cold turkey in the hot oven for Thanksgiving dinner and after several hours it has reached the desired temperature. Newton’s Law of Cooling relates the rate of change in the temperature to the difference in temperature between an object and its surroundings.

Tools

Thermometer

Stopwatch

Heater

Water bath

Criterion

Prove the Newton low

We choose three points on the curve (a*b*c) and draw tangential for three points and draw a line that parallel the horizontal axis and set the values of (A*B*C) and know (aA)and(bB)and(cC) and set the value of (1/aA)(1/bB)(1/cC)we find that

(1/aA)=(1/bB)=(1/cc) so that the value of (aA)(bB)(cC)

Mathematical Relationship

$\frac{\Delta T}{\Delta t} = c(T_2 - T_1)$ Where

$\frac{\Delta T}{\Delta t}$ is the cooling rate

C is Newton's constant

Procedure:

1. Fill a small calorimeter with water and insert a thermometer inside the calorimeter.
2. Put the calorimeter in wooden base on a heating water bath.
3. Start heating and wait until the water temperature reach to 95 °C.
4. Put the calorimeter in wooden base on a cooling water bath and let the liquid (water) in the calorimeter to cool
5. Record the temperature for every 30 second until the temperature reach to 35 °C
6. Plot the cooling curve.

Cooling Curve

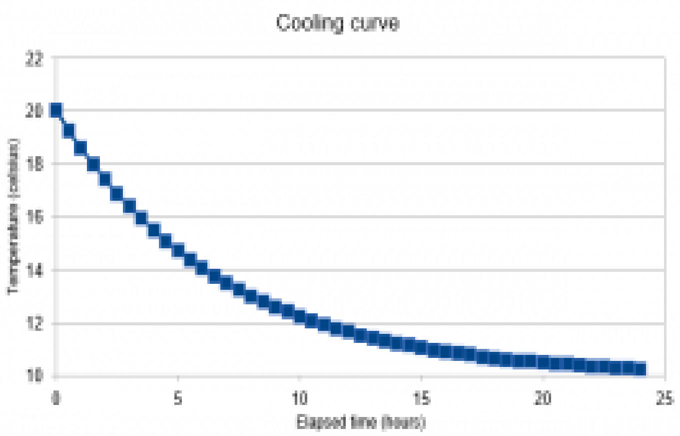


Table:

Time (t)	Temperature (T)	Time (t)	Temperature (T)	Time (t)	Temperature (T)

Speed of Sound in Air - Resonance Tube

3

Aim:

Determine the velocity of sound in air at room temperature using a resonance tube

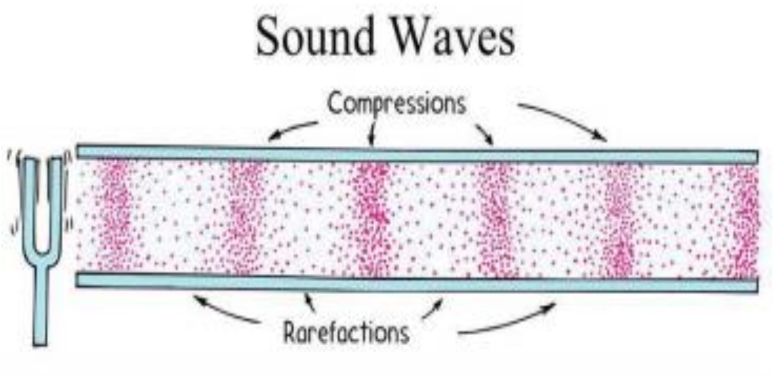
Discussion:

Sound is a form of energy. It can be generated, moved, can do work, can dissipate over time and distance, and can carry tremendous amounts of energy. Also, Sound is defined as something that can be heard. It is a wave that is a series of vibrations traveling through a medium, especially those within the range of frequencies that can be perceived by the human ear.

A wavelength in a transverse wave is the distance from the beginning of the crest to the end of an adjacent trough. It also described as the distance from the point of maximum displacement in one crest to the point of maximum displacement in the next closest crest. λ is the symbol for wavelength.

Sound Waves:

A longitudinal wave consists of compression and rarefaction.



Compression is the part of the longitudinal wave where the particles of the medium are pushed closer together.

Rarefaction is that part of the longitudinal wave where the

particles of the wave are spread apart the most.

The wavelength (λ) in a longitudinal wave is the distance between two consecutive points that are in phase.

Speed of Sound:

- The speed of a sound wave in air depends upon the properties of the air, namely the temperature and the pressure.
- Sound waves will travel faster in solids than they will in liquids and travel faster in liquids than they do in gases.
- Sound travels faster in warmer temperatures than colder temperatures.
- The frequency, or rate at which the waves pass a given point, of the sound does not change due to a change in temperature – that is determined by the frequency at the source of the sound.

Tools

1- A bucket filled with water .
2- Ruler.
3- Four different resonant fork .
4- Open-ended hollow cylinder

Mathematical Relationship

$$L = \frac{V}{4}\frac{1}{\nu} - 0.6\,r$$

Where

L is the air column length

V the speed of sound

ν the fork frequency

r is the radius of the tube

Procedure:

1. Insert the tube of a radius r into the water filled beaker.
2. Activate the tuning fork of a frequency ν and hold it above the tube.
3. Slowly lift the tube & the tuning fork out of the water filled beaker.
4. Listen for resonance and stop.
5. Measure the length of the air column L from the water level to top of the tube.
6. Record: Frequency of tuning fork ν and air column length$L$.

7. Change tuning fork frequency and repeat procedure
8. Draw the relationship between L and $1/\nu$.

Table:

The initial spring length L_o=……. cm

Frequency ν (Hz)	$1/\nu$	Air Column Length L (cm)
512		
384		
320		
256		

The Simple Pendulum 4

Aim:

To determine value of Acceleration Due to gravity g, using simple pendulum.

Discussion:

When an object is at a different temperature than its surroundings, it will gradually cool down or heat up until the temperatures are equal. Everyone has experienced this. You boil water to make tea and then wait several minutes until it is at a temperature at which you can drink it. You place a cold turkey in the hot oven for Thanksgiving dinner and after several hours it has reached the desired temperature. Newton's Law of Cooling relates the rate of change in the temperature to the difference in temperature between an object and its surroundings.

Mathematical Relationship

$$\theta = ma = -mg\sin\theta = f = -mg\sin\theta$$

$$sin\theta = \frac{x}{l}$$

$$ma = mg\frac{x}{l}$$

$$a = g\frac{x}{l}$$

$$a = \frac{g}{l}x$$

$$a = -constant\ x$$

$$\omega = \left(\frac{2\pi}{T}\right) = \sqrt{\frac{g}{l}}$$

$$a = \omega^2 x$$

$$\frac{2\pi}{T} = \sqrt{\frac{g}{l}}$$

$$\tau^2 = \frac{4\pi 2}{g}L$$

Where

τ Time period in seconds

L is the pendulum length

g is the Gravity acceleration

Procedure:

1. Take a strong thread about one meter long and tie its one end to the hook of the bob. Fix the other end of thread in a metal holder. Take care that neither the bob no the thread touches the ground or the table.
2. Set the pendulum length L (from the center of the bob to the fixed point on the metal holder) to 20 cm.
3. Now displace the bob about 5o from its mean position to one side and leave it gently, It should not vibrate sideways.
4. Record the time in seconds which the pendulums take to make 10 full periods.
5. Calculate the Time period $\tau = \tau_{10}/10$.
6. Increase the pendulum length L and repeat steps 3-5.
7. Plot a graph between T2 as ordinate and as abscissa straight line is obtained with slope equals $(4\pi^2)/g$
8. Calculate the acceleration due to gravity g

Table:

Pendulum Length L (cm)	τ_{10} (Sec)	Time period τ (Sec)	τ^2 (Sec)^2
10			
20			
30			
40			
50			
60			
70			
80			
90			
100			

Result:

$$\text{Slope} = \frac{4\pi^2}{g} =$$

$g =$ cm/sec^2

Surface Tension

5

Aim:

Measuring the surface tension by the poetic characteristic

Discussion:

Surface tension is the force that affects the direction of perpendicular to the unit length of the liquid surface. When we put lattice tube in a liquid and its angle is less that go , the liquid rises in the tube until it reach as a certain height (h), the liquid affects by two force , one of them lift the liquid up, the other force law the liquid down and the two forces are equal

Mathematical Relationship

Tools:

1. Lattice tube
2. Water cup
3. Mass of mercury
4. Sensitive balance
5. Glass

Procedure:

1. Specifies the radius of the tube:
   1.1 By means of a rubbers tube fixed on the capillary tube and with drawing the amount of mercury connected
   1.2 Measure the length of the mercury inside the capillary tube
   1.3 The weight of the glass is empty (m)
   1.4 Remove the mercury in the tube in the hourly bottle and eight it (m)

1.5 With his knowledge w , L , p we find values of them

2. Clean the capillary tube well
3. Place the capillary tube in a cup filled with water
4. Slowly move the tube so that the bottom remains submerged in water and fix the tube
5. Notice the height of the water inside the tube to a certain extent and then stabilized it
6. Measure the distance between the water surface of the cup until the end of the height of the water with the paetic tube and record the height (h)

Results :

The radius of the tube = ... cm

The weight of the bottle = ... gm

The weight of the hour lass is mercury = ... gm

Weight of mercury = ... gm

The length of the mercury column in the tube = ... cm

Hooke's Law - Stretching springs

6

Aim:

To determine the spring constant (Hooke's constant) *k*.

Discussion:

An elastic body is one that returns to its original shape after a deformation.

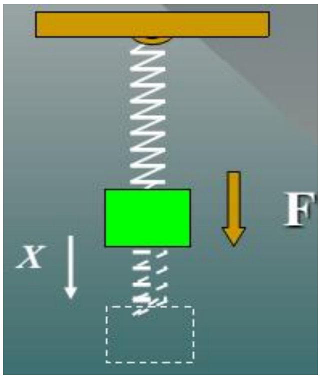
An inelastic body is one that does not return to its original shape after a deformation.

An Elastic Spring: A spring is an example of an elastic body that can be deformed by stretching.

A restoring force, F, acts in the direction opposite the displacement of the oscillating body.

$$F = -kx$$

Hooke's Law When a spring is stretched, there is a restoring force that is proportional to the displacement.



$$F = -kx$$

The spring constant k is a property of the spring given by:

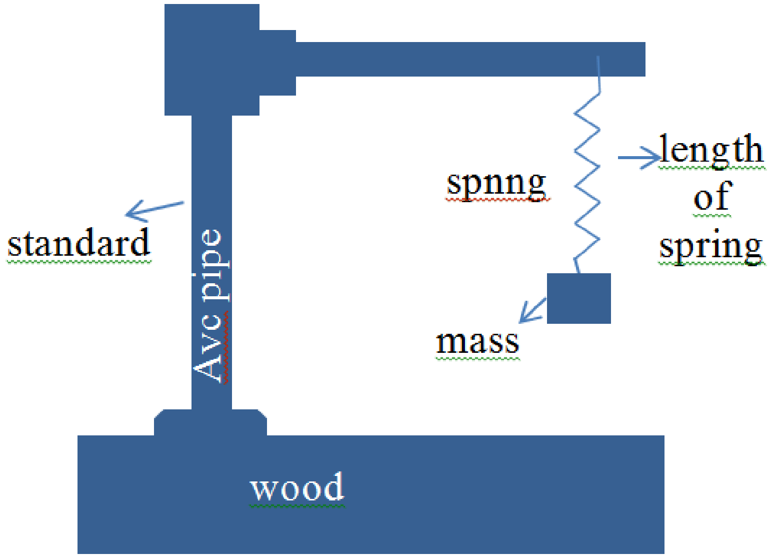
$$k = \frac{\Delta F}{\Delta x}$$

The spring constant k is a measure of the elasticity of the spring.

Tools

1- Spring
2- Stand
3- Ruler
4- Weights

Mathematical Relationship



$$F = k\,\Delta L$$

$$M.g = k\,\Delta L$$

Where

M is the mass suspend in the spring

g the gravity acceleration =980 cm/sec^2

k hooke's constant

ΔL the spring displacement

Procedure:

1. A helical spring was suspended from a screw jutting out of the clamp stand equipment.
2. Measure the initial length of the spring (L_o) .
3. Suspend the hanger, 20g, from the spring causing it to be displaced and record the new length of the spring (L).
4. A 20g mass was then carefully loaded onto the hanger and the reading of the spring length was recorded (L).
5. This step was repeated with more 20g masses until 160g had been added to the hanger.
6. Determine the spring displacement (ΔL) by subtracting the initial spring length (L_o) from the new one (L).

Table:

The initial spring length L_o=……. cm

M	***The new spring length*** L	***The spring displacement*** $\Delta L = L - Lo$
20		
40		
60		
80		
100		
120		
140		

Results:

Stokes's Method

7

Aim:

To determine the viscosity's coefficient of a liquid by stokes's method.

Mathematical Relationship

$$\eta = \frac{2}{9}(\rho_1 - \rho_2) g \frac{r^2}{V}$$

Where

η the coefficient of viscosity of the liquid

ρ_1 the density of the ball.

ρ_2 the density of the liquid.

r is the radius of the ball.

V is the velocity of the ball

Procedure:

1. Fill a glass tube about one meter with the liquid with a density $\boldsymbol{\rho_2}$=1.26

2. Mark two points on the tube, which the distance d between these two points is equal to 50 cm.
3. Using a micrometer, determine the radius of four metal balls and note it.
4. Allow to a metal ball with radius r and density $\boldsymbol{\rho_1 = 7.8}$ to fall inside the filled tube and record the time in seconds t required to pass the distance d.
5. Calculate the velocity V of the ball $V = d/t$
6. Repeat the steps 4 and 5 for different balls.

Table:

Ball radius r (cm)	r^2 (cm^2)	**Time t** (Sec)	**Velocity** $V = d/t$ (cm/sec)

Results:

Durability Coefficient in Static Method

8

Aim:

Determination of the coefficient of durability in static manner.

Discussion:

Determination of durability coefficient directly by observing the incident in wire of metal under the effect of coupling a longitudinal wire is fixed from one end and the effect on the other is double sided around the horizontal axis and because of a cut-off effect along the wire material depending on durability of the wire section rotates angularly and is measurable angle and is connected to angle as the shape

Calculation of the coefficient of durability suppose that we took a loop from the section of the wire radius rand its thickness and that the relation of the second ring under the influence of the force of li on the surface of the ring estimated F

Where it is measured by circular estimation

Durability coefficient: - Power one unit spaces / shear angle

Mathematical Relationship

Where

Tools:

1. The device:

   A thick wire of copper or iron is used in the experiment. It is based on heavy horizontally to the basse and one end of the wire is fixed to the base the other end of the sack is fixed in the center of diameter wheel (D) wrapped around its circumference by strong thread hanging from a hook. if the weight of the hook is place at the end of wire fixed in the center of the wheel double – wire cause the wire to rotate around the horizontal axis at a rate of . To measure the angle of rotation, There is a head sensor that can be fixed anywhere along the wire and the tip of the guide in front of the how is inserted into the stencil degree. It is noted that the part of the wire measured by the angle of rotation is the length between the limb and position of the guide and the torque of the coupling in the wire

2. Weights
3. Micrometers
4. Hook

Procedure:

1. Measure the diameter of the wire in several places of it along the length by a micrometer of feet

2. Install the indicator in the appropriate position of the wire and measure the distance between the fixed end and the position of the anchor
3. Measure the diameter of the wheel in several position and find the overage
4. Hand the hook at the tip of the thread passing around the circumference of the wheel and keep the staging paralle to the and of the bow on the bow in the sixties
5. Add weight to the hook and read the guide each time
6. Reduce weight m the same way then read the guide each time
7. Record the results in a table and take the corresponding denominator of each weight
8. Calculate from the previous average the angle of rotation
9. Draw the relationship between m , and find the slope of the straight line
10. Apply the equation to determines the coefficient of durability

Results:

The average radius if the wire (R)

Length of the active part of the wire (L)

The average radius of wheel (d)

Slope

Durability coefficient

Joule's Equivalent

9

Aim:

Determination Of The Thermal Mechanical Equivalent using Joule Method, Joule's Equivalent (J).

Discussion:

Electric Resistance is known to result from electrons in conduction ions. This means that the free electrons lose their kinetic energy when collided with the ions. The result in the amplitude of the ions around the stability of ions. That is the electric energy turns into thermal energy.

Tools

1- Caliber filled with enough water to immerse a heating wire made of tungsten, and thermally insulated by placing it in an external caliber and between them

(Fibers) to reduce the loss of heat in pregnancy and radiation.

2- Thermometer for measured the temperature.

3- Continuous voltage source or battery.

4- Ammeter.

5- Voltmeter.

6- Resistant.

Mathematical Relationship

Procedure:

1. Weigh the caliber and it is mass is M_1, and take a quantity of water and determine it is mass M_2.
2. Determine water temperature and the initial caliber using the thermometer.
3. Using A caliper, set the value of each r_1, r_2 then set a fixed distance on the rubber tube at the

two point (b,c) so that (bc=1cm) remain attached to the surface of water .

4. Inundate the tube in the caliber so that two labels (b, c) remain attached to the surface of water.
5. When the water vapor comes out of it is rubber tube start recording the time and wait for a sufficient period to rise the temperature of water and the caliber from T_1 to T_2.
6. In the equation we find a coefficient of heat conductivity K for rubber.

Result:

M_1= .... gm

M_2= .... gm

T_1= .... °C

T_2= .... °C

r_1= .... cm

r_2= .... cm

d= r_2-r_1= .... cm

t= .... sec

L= .... cm

Jenter method 10

Aim:

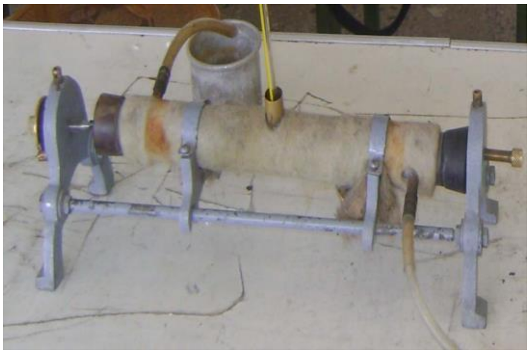
Determination of the linear (longitudinal) expansion coefficient of a rod of copper using Jenter device

Discussion:

As a result of heating a metal rod, the interfaces are increasing between their atoms, it expands. Thus, the length of the rod is greater than the linear length by a certain amount called the longitudinal expansion coefficient. Each metal has its own longitudinal expansion coefficient. Physically known, the material is expanded by heat and shrinks in cold. The phenomenon of thermal expansion of metals in telephone wires can be observed in the summer and shrinking in the winter. It is useful to know the coefficient of longitudinal expansion in the knowledge of the distance to be left between the railway poles.

Tools

Jenter device: Shown as follows and consists of :
1-Copper Rod .
2-Mercury thermometer
3-Spheromter



Mathematical Relationship

If we have a metal rod ,it's length (L_0) at zero temperature and it's length (L_t) at temperature (T) , the increase in length (ΔL)due to temperature rise from (0 °C) to (T °C) is

$$\Delta L = L_T - L_o \qquad ...(1)$$

Thus , the increase unit lengths of the rod per cent °C represents the coefficient of longitudinal expansion (Y) where

$$Y = \frac{(L_T - L_o)}{L_o \ T} \qquad \text{... (2)}$$

$$Y L_o \ T = (L_T - L_o)$$

$$L_T = Y L_o \ T + L_o$$

$$L_T = L_o \, (Y \, T + 1) \qquad \text{... (3)}$$

If we assume that the temperature increase from (0°C) to (T_1°C), the length of the rod (L_1) is applied to equation (3) given by the relationship

$$L_1 = L_o \, (Y \, T_1 + 1) \qquad \text{... (4)}$$

The length (L_2) when (T_2°C) is

$$L_2 = L_o \, (Y \, T_2 + 1) \qquad \text{... (5)}$$

By dividing the equation (5) on equation (4)

$$\frac{L_1}{L_2} = \frac{L_o \, (Y \, T_1 + 1)}{L_o \, (Y \, T_2 + 1)}$$

using the binomial theorem , neglecting the limits greater than (1) by putting ($Y^2 = 0$)

$$Y = \frac{(L_2 - L_1)}{L_1 (T_2 - T_1)} \qquad \text{... (6)}$$

These can be used to find the longitudinal expansion coefficient of the rod .

Procedure:

1. Adjust the tip of the Spherometer on the free rod tip and read it , as well as measure the initial temperature T .
2. Move the tip of the free rod tip until it allows it to stretch.
3. Ignite the flame of benzene until a stream of water vapor passes and wait until the temperature of the rod increase (T_2) greater than 95 °C .
4. Adjust the Spherometer's head , very carefully, again so touch the tip of the free rod and take it again(L_2)
5. The difference between the two Spherometers at T_1, T_2 is the increase in the length of the metal length of the rod (L_2-L_1).
6. By knowing the original length of the rod (L), you can obtain the coefficient of the longitudinal extension of a rod of copper .

Results:

L = ……….. cm

L_1 = ……….. mm

L_2 = ……….. mm

$\Delta L = \frac{L_2 - L_1}{10}$ = ……….. cm

T_1= ……….. °C

T_2 = ……….. °C

$$Y = \frac{\Delta L}{L(T_2 - T_1)} =$$

$$Y = \frac{\dots\dots..}{\dots..(\dots.. - \dots\dots)} = \quad \dots\dots\dots \; deg^{-1}$$

Young's Modulus

a bar fixed on two edges

11

Aim:

To determine the Young's modulus of a metal bar fixed on two knife edges

Discussion:

Stress refers to the cause of a deformation, and strain refers to the effect of the deformation. Thus, Stress is the ratio of an applied force F to the area A over which it acts:

$$Stress = \frac{F}{A} \qquad\qquad Unite: Pa$$

$$= \frac{N}{m^2} \quad or \quad \frac{1b}{in^2}$$

Strain is the relative change in the dimensions or shape of a body as the result of an applied stress, Examples: Change in length per unit length; change in volume per unit volume.

Longitudinal Stress and Strain

For wires, rods, and bars, there is a longitudinal stress F/A that produces a change in length per unit length. In such cases:

$$Stress = \frac{F}{A}$$

$$Strain = \frac{\Delta L}{L}$$

The Modulus of Elasticity

Provided that the elastic limit is not exceeded, an elastic deformation (strain) is directly proportional to the magnitude of the applied force per unit area (stress).

$$Modulus\ of\ Elasticity = \frac{stress}{strain}$$

Young's Modulus

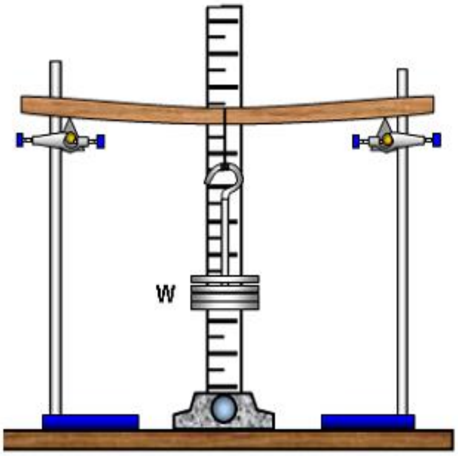
For materials whose length is much greater than the width or thickness, we are concerned with the longitudinal modulus of elasticity, or Young's Modulus (Y).

$$Young's\ Modulus = \frac{longitudinal\ stress}{longitudinal\ strain}$$

$$Y = \frac{F/_A}{\Delta L/_L} = \frac{FL}{A\Delta L}$$

$$Unite: Pa \quad or \quad \frac{1b}{in^2}$$

Mathematical Relationship:



$$Y \quad = \frac{m}{y_o}\frac{gl^3}{4bd^3}$$

Where

l is the length of the bar between the knife edges.

b is the breadth of the bar

d is the thickness of the bar

m is the mass suspended before the end of the bar

y_o is the depression.

Tools:

1- a bar between the knife edges.

2- built –in ruler

3 weight

Procedure:

1. The bar is placed symmetrically on two knife edges.
2. Measure the length (L) , the breadth (b) of and the thickness (d) of the bar.
3. A meter scale fixed vertically behind the bar before its end by about 10 cm and note the read (y)
4. A weight hanger ,50g, is suspended at the midpoint of the bar between the knife edges and record the read (y_1).

5. A 50g mass was then carefully loaded onto the hanger and the reading (y_1) was recorded.
6. After reaching the maximum load, the hanger is unloaded in the same steps of 50 gm and the readings (y_2) are noted again.
7. Calculate (y_o) from the equation $y_o = y - \frac{(y_1+y_2)}{2}$

Table:

The initial reading of the scale y= .... cm

Load M	Scale reading: Loading y_1	Scale reading: Unloading y_2	Scale reading: Mean $= \frac{(y_1 + y_2)}{2}$	The depression $y_o = y - \text{mean}$
50				
100				
150				
200				
250				
300				
350				
400				
450				
500				

Results:

Young's Modulus

a bar fixed from his end

12

Aim:

To determine the Young's modulus of a metal bar fixed from his end.

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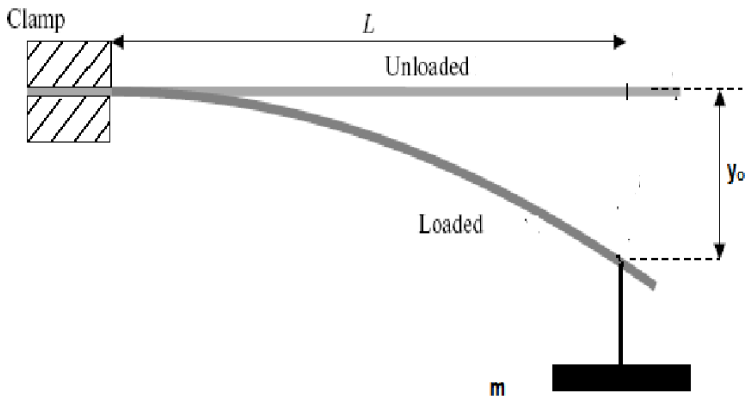
For materials whose length is much greater than the width or thickness, we are concerned with the longitudinal modulus of elasticity, or Young’s Modulus (Y).

$$Young's\ Modulus = \frac{longitudinal\ stress}{longitudinal\ strain}$$

$$Y = \frac{F/_A}{\Delta L/_L} = \frac{FL}{A\Delta L}$$

$$Unite: Pa \quad or \quad \frac{1b}{in^2}$$

Mathematical Relationship



$$Y \ = \frac{m}{y_o} \frac{4gl^3}{bd^3}$$

Where

l is the length of a bar fixed from his end

b is the breadth of the bar

d is the thickness of the bar

m is the mass suspended before the end of the bar

y_o is the depression.

Tools

1- bar fixed from his end

2- built –in ruler

3 weight

Procedure:

1. Fix an end of the bar using a clamp.
2. Measure the length (L) , the breadth (b) of and the thickness (d) of the bar.
3. A meter scale fixed vertically behind the bar before its end by about 10 cm and note the read (y)
4. A weight hanger ,50g, is suspended before the end of the bar and record the read (y_1).
5. A 50g mass was then carefully loaded onto the hanger and the reading y_1 was recorded.
6. After reaching the maximum load, the hanger is unloaded in the same steps of 50 gm and the readings (y_2) are noted again.
7. Calculate (y_o) from the equation $y_o = y - \frac{(y_1+y_2)}{2}$

Table:

The initial reading of the scale y = ……. cm

Load M	**Scale reading**			**The depression**
	Loading y_1	**Unloading** y_2	**Mean** $= \frac{(y_1 + y_2)}{2}$	$y_o = y - \text{mean}$
50				
100				
150				
200				
250				
300				
350				
400				
450				
500				

Results: