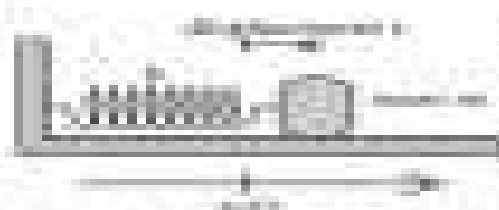


Simple Harmonic Motion: A Spring and the Simple Harmonic Oscillator

What characterizes Simple Harmonic Motion, which means that the force exerted by the spring is proportional to the displacement of compression or extension of the spring? It can be expressed as follows:

(1)

$$F = -kx$$



A coiled spring system used in a suspension of the bottom of the spring. The characteristic feature of the displacement of the mass is proportional to the displacement of the displacement. For the x system, the force of spring exerted is $-kx$ where k is the spring constant. The value of displacement is x units. The displacement of the mass is x units and the spring force is $-kx$ units. If the spring is compressed, then x is

(2) the spring constant k .

Simple harmonic motion occurs whenever there is a restoring force which is proportional to the displacement from equilibrium, as in the example. Assuming no friction, there are no damping of the spring is constant. The equation of motion is:

(3)

$$m \frac{d^2 x}{dt^2} = -kx \quad \text{or} \quad \frac{d^2 x}{dt^2} = -\frac{k}{m} x$$

The solution of this second-order differential equation is:

(4)

$$x(t) = A \cos(\omega t + \phi) \quad \text{or} \quad x = \sqrt{\frac{E}{k}} \cos(\omega t + \phi)$$

where A is the amplitude of the motion, which depends on the initial conditions, the initial position and initial velocity of the mass. The period T of the spring is 2π units, which is constant, as we can see from (4).

(5)

$$\omega = \frac{2\pi}{T} = \sqrt{\frac{k}{m}}$$

Then the period T is given by:

(6)

$$T = 2\pi \sqrt{\frac{m}{k}}$$

It is an important property of simple harmonic motion is that the period T does not depend on the amplitude of the motion, A .

Thus, (6) is:

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SECTION A EXPERIMENTS

- 1 To determine resistance per cm of a given wire by plotting a graph for potential difference versus current
- 2 To find resistance of a given wire using meter bridge and hence determine the specific resistance Resistivity of its material
- 3 To verify the laws of combination Series Parallel of resistance using ammeter bridge
- 4 To compare the e m f of two given primary cells using potentiometer
- 5 To determine the internal resistance of a given primary cell e g Leclanche cell using potentiometer
- 6 To determine the resistance of a galvanometer by half deflection method and to find its figure of merit
- 7 A To convert a given galvanometer of known resistance and figure of merit into an ammeter of desired range and to verify the same
- 7 B To convert a given galvanometer of known resistance and figure of merit into a voltmeter of desired range and to verify the same
- 8 To find the frequency of AC mains with a sonometer and horse shoe magnet

SECTION B EXPERIMENTS

- 1 To find the value of v for different values of u in case of a concave mirror and to find the focal length
- 2 To find the focal length of a convex lens by plotting graph between u and v or $1/u$ and $1/v$
- 3 To find the focal length of a convex mirror using a convex lens
- 4 To find the focal length of a concave lens using a convex lens
- 5 To determine the angle of minimum deviation for a given prism by plotting a graph between the angle of incidence and angle of deviation
- 6 To determine refractive index of a glass slab using a travelling microscope
- 7 To find the refractive index of a liquid by using a convex lens and a plane mirror
- 8 To draw I V characteristics curve of a p n junction in forward bias and reverse bias
- 9 To draw the characteristics curve of a zener diode and to determine its reverse break down voltage
- 10 To study the characteristics of a common emitter n p n or p n p transistor and to find out the values of current and voltage gains

SECTION A ACTIVITIES 1 To measure the resistance and impedance of an inductor with or without iron core 2 To measure resistance voltage AC DC current AC and check continuity of given circuit using multimeter 3 To assemble a household circuit comprising of three bulbs three on off switches a fuse and a power source 4 To assemble the components of a given electrical circuit 5 To study the variation in potential drop with length of a wire for a steady current 6 To draw the diagram of a given open circuit comprising atleast a battery resistor rheostat key ammeter and voltmeter Make the components that are not connected in proper order and correct the circuit and also the circuit diagram SECTION B ACTIVITIES 1 To study effect of intensity of light by varying distance of the source on an LDR Light Depending Resistor 2 To identify a diode a LED a transistor an IC a resistor and a capacitor from mixed collection of such items 3 Use a multimeter to i identify the transistor ii distinguish between n p n and p n p type transistor iii see the unidirectional flow of current in case of a diode and a LED iv Check whether a given electronic components e g diode transistor or IC is in working order 4 To observe refraction and lateral deviation of a beam of light incident obliquely on a glass slab 5 To observe polarisation of light using two polaroids 6 To observe diffraction of light due to a thin slit 7 To study the nature and size of the image formed by i convex lens ii concave mirror on a screen by using candle and a screen for different distance of the candle from the lens mirror 8 To obtain a lens combination with the specified focal length by using two lenses from the given set of lenses SUGGESTED INVESTIGATORY PROJECT 1 To Study Various factors on which the Internal Resistance EMF of a cell depends 2 To study the variations in current following in a circuit containing L D R because of variation a In the power of incandescent lamp used to illuminate the L D R Keeping all the lamps in fixed position b In the Distance of a incandescent lamp of fixed power used to illuminate the L D R 3 To find the refractive indices of a Water b Oil Transparent using a plane mirror an equiconvex lens made from a glass of known refractive index and an adjustable object needle 4 To design an appropriate logic gate combination for a given truth table 5 To investigate the relation between the ratio of i Output and Input voltage ii Number of turns in secondary coils and primary coils of a self designed transformer 6 To Investigate the dependence of angle of deviation on the angle of incidence using a hollow prism filled one by one with different transparent fluids 7 To Estimate the charge induced on each one of the two identical styrofoam balls suspended in a vertical plane by making use of coulombs Law 8 To study the factors on which the self inductance of a coil depends by observing the effect of this coil when put in series with a resistor bulb in a circuit fed up by an a c source of adjustable frequency 9 To study the earth s magnetic field using a tangent galvanometer APPENDIX Some Important Tables of Physical Constants Logarithmic and other Tables *Practical/Laboratory Manual* Physics Class - 12 Er. Meera Goyal, 2023-04-30 Sections A 1 Experiments 2 Activities Sections B 1 Experiments 2 Activities 3 Suggested Investigatory 4 Project Work **A Laboratory Manual of Experiments in Physics** Leonard Rose Ingersoll, 1925 *A Laboratory Manual in Physics* Newton Henry Black, 1913 *A Laboratory Manual in Physics to Accompany Black [and] Davis "Practical Physics."* Newton Henry Black, 1918 **Core Laboratory Manual of Physics for**

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SECTION A EXPERIMENTS

1 Measurement of Length 1 To measure the diameter of a small spherical cylindrical body by using a vernier callipers 2 To measure the dimensions of a given regular body of known mass using vernier callipers and hence find its density 3 To measure the internal diameter and depth of a given cylindrical vessel say calorimeter beaker by using vernier callipers and hence find its internal volume i.e. capacity Viva voce 2 Screw Gauge Micrometer 4 To determine the diameter of a given wire using a screw gauge and find its volume 5 To find the thickness of a given sheet with the help of screw gauge 6 To measure the volume of an irregular lamina by using a screw gauge Viva voce 3 Spherometer 7 To measure the radius of curvature of a given spherical surface convex lens by using a spherometer Viva voce 4 Mass and Weight 8 To determine the mass of two different objects using a beam balance Viva voce 5 Parallelogram Law of Vectors 9 To find the weight of a given body using parallelogram law of vectors Viva voce 6 Simple Pendulum Measurement of Time 10 Using a simple pendulum plot L vs T and L vs T^2 graphs Hence find the effective length of a second's pendulum using appropriate graphs Viva voce 7 Friction 11 To study the relationship between force of limiting friction and normal reaction and to find the coefficient of friction between a block and a horizontal surface Viva voce 8 Motion of a Body Along an Inclined Plane 12 To find the downward force along an inclined plane acting on a roller due to gravitational pull of the earth and study its relationship with the angle of inclination by plotting graph between force and \sin Viva voce

SECTION B EXPERIMENTS

1 Elasticity 1 To determine the Young's modulus of elasticity of the material of the wire using Searle's apparatus Viva voce 2 Spring Constant 2 To find the spring constant of a helical spring by plotting load extension graph Viva voce 3 Boyle's Gas Law 3 To study the variation in volume with pressure for a sample of air constant temperature by plotting graphs between P and V and between P and $1/V$ 18 Viva voce 4 Surface Tension 4 To determine the surface tension of water by capillary rise method Viva voce 5 Viscosity 5 To determine the coefficient of viscosity of given liquid by measuring the terminal velocity of a given spherical body in it Viva voce 6 Newton's Law of Cooling 6 To study the relationship between temperature of a hot body and time by plotting a cooling curve Viva voce 7 Vibrations of Strings 7 To study the relation between frequency and length for a given wire under constant tension using a sonometer Viva voce 8 To study the relation between the length of a given wire and tension for constant frequency using sonometer Viva voce 8 Vibrations of Air Columns 9 To find the velocity of sound in air at room temperature using a resonance tube by two resonance position Viva voce 9 Specific Heat 10 To determine specific heat of a given solid by the method of mixture 11 To determine the specific heat of a given liquid by method of mixture Viva voce

SECTION A ACTIVITIES

1 To make a paper scale of given least count e.g. 0.2 cm, 0.5 cm and use it to measure the length of a given object 2 To determine the mass of a given body using a metre scale and by applying principle of moments Viva voce 3 To plot a graph for a given set of data using proper

choice of scales and error bars Viva voce 4 To measure the force of limiting friction for rolling of a roller on horizontal plane Viva voce 5 To study the variation in the range of a jet of water with angle of projection Viva voce 6 To study the conservation of energy of a ball rolling down on inclined plane using a double inclined plane Viva voce 7 To study dissipation of energy of a simple pendulum by plotting a graph between square of amplitude and time Viva voce SECTION B ACTIVITIES 1 To observe the change of the state and plot a cooling curve for molten wax Viva voce 2 To observe and explain the effect of heating on a bimetallic strip Viva voce 3 To note the change in level of liquid in a container on heating and interpret the observations Viva voce 4 To study the effect of detergent in surface tension by observing capillary rise Viva voce 5 To study the factors affecting the rate of loss of heat of a liquid Viva voce 6 To study the effect of load on depression of a suitably clamped meter scale loaded i at its end ii in the middle Viva voce 7 To observe the decrease in pressure with the increase in velocity of the fluid Viva voce APPENDIX Some Important Tables of Physical Constants Log Antilog and other Tables **Hard Bound Lab**

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Cole, 2024-05-31 How do we reclaim our innate enchantment with the world And how can we turn our natural curiosity into a deep abiding love for knowledge Frank Oppenheimer the younger brother of the physicist J Robert Oppenheimer was captivated by these questions and used his own intellectual inquisitiveness to found the Exploratorium a powerfully influential museum of human awareness in San Francisco that encourages play creativity and discovery all in the name of understanding In this elegant biography K C Cole investigates the man behind the museum with sharp insight and deep sympathy The Oppenheims were a family with great wealth and education and Frank like his older brother pursued a career in physics But while Robert was unceasingly ambitious and eventually came to be known for his work on the atomic bomb Frank's path as a scientist was much less conventional His brief fling with the Communist Party cost him his position at the University of Minnesota and he subsequently spent a decade ranching in Colorado before returning to teaching Once back in the lab however Frank found himself moved to create something to make the world meaningful after the bombing of Hiroshima and Nagasaki He was inspired by European science museums and he developed a dream of teaching Americans about science through participatory museums Thus was born the magical world of the Exploratorium forever revolutionizing not only the way we experience museums but also science education for years to come Cole has brought this charismatic and dynamic figure to life with vibrant prose and rich insight into Oppenheimer as both a scientist and an individual **The**

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