PRACTICAL PHYSICS QUESTIONS

• Determination of diameter of a sphere using vernier callipers.

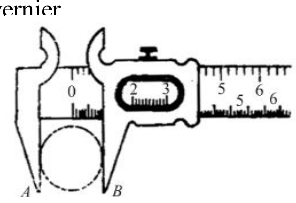
It consists of two scales. One is fixed called main scale (M.S.) and the other sliding over it is called vernier scale (V.S.) having 10 dimensions. In common type of vernier callipers the 10 divisions of V.S. coincide with 9 division of main scale each. It is general rule that *N* division of V.S. coincide with (*N* – 1) division of main scale.

Find the least count of callipers using the formula

$$\text{L.C.} = \frac{\text{value of 1 division of vernier scale}}{\text{Divisions on vernier scale}}$$

$$\text{L.C.} = \frac{1\text{mm}}{10} = 0.1\text{m} = 0.01\text{cm}$$

Hold the sphere between two jaws of the callipers. Read the main scale before 0 of the vernier and then find out which number of vernier is coinciding with any of the division of main scale. Multiply this number by L.C. and add to the reading of main scale. Repeat the observations several times by holding sphere between jaws at perpendicular positions.



Zero error of the instrument is also noted before measuring diameter. Bring two jaws in contact and zero of two scale must coincide. If zero of two scales does not coincide then zero error is measured. It is subtracted from the final measurement.

QUESTIONS

1. What is the least count of a meter scale having 20 divisions in a centimeter?
(a) 0.05 cm (b) 0.5 cm (c) 0.01 cm (d) 0.1 cm

2. Zero of vernier scale is after 3.1 cm of main scale of a vernier scale and 6th division of vernier is coinciding with 3.7 of main scale division. The reading is
(a) 3.1 cm (b) 3.6 cm (c) 3.7 cm (d) 3.9 cm

3. There are 20 divisions in 4 cm of the main scale. The vernier scale has 10 divisions. The least count of the instrument is
(a) 0.05 cm (b) 0.01 cm (c) 0.005 cm (d) 0.001cm

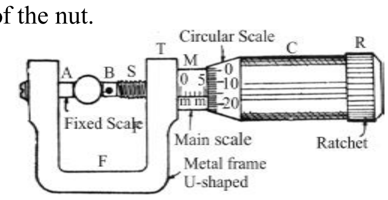
4. The sphere is held in two perpendicular positions at each place between jaws of the vernier callipers because,
(a) sphere may not be uniform
(b) sphere is held along the chord
(c) sphere is not held along the chord
(d) to avoid personal error in holding the sphere between jaws

5. Vernier constant of the callipers is
(a) least count
(b) value of 1 div of main scale
(c) value of 1 div of vernier scale
(d) all of the above

Answers : 1. (a), 2. (b), 3. (c), 4. (d), 5. (a)

• Measurement of diameter of thin wire using screw gauge

It consists of a U-shaped metal frame carrying with a fixed plane surfaced carbide tip on one side and a fixed nut on the other with a scale on a line called index line parallel to the axis of the nut.



The millimeter scale on the nut is called the main scale. Through the nut moves an accurate screw fitted with at flat stud at end towards U-shaped frame and a cap on the other. When cap is turned it moves forward or backward depending on the direction in which cap is turned. Sloping edge of the cap is graduated having 100 or 50 divisions. It is called circular scale. Rare end of cap has a ratchet. First cap is moved to catch the wire between two plugs then ratchet is moved to finally tight firmly to hold the wire on its own.

Before using the instrument, the least count is calculated by finding the pitch of screw-gauge. Suppose the circular scale has 100 revolutions and main scale is divided in millimeters. The pitch is the distance travelled by circular scale in one complete revolution. Thus,

least count of the screw gauge is $\frac{1\text{mm}}{100} = 0.01$ mm.

Now zero error of the instrument is to be calculated. For this, bring plugs A and B very close to each other without anything between them. Zero of two scales should coincide. In that case the instrument has no zero error. In case the zero of main scale beyond zero of main scale the zero error is negative. Otherwise the zero error is positive. Zero error is always subtracted from the final reading of measurement. Various readings are taken holding the wire in two perpendicular directions at each place between the plugs. Mean is taken at the end to get more accurate value of the diameter.

QUESTIONS

1. The main scale of a screw gauge has 20 divisions in 1cm and circular scale has 100 divisions. The least count of the instrument is :
(a) 0.5 mm (b) 0.05 mm
(c) 0.005 mm (d) 0.0005 mm

2. The main scale of a screw gauge has divisions in millimeters and circular scale has 100 divisions. The pitch of screw gauge is
(a) 1mm (b) 0.1mm
(c) 0.01mm (d) 0.001 m

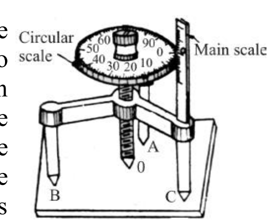
3. The reading of the screw gauge shown in fig. is
(a) 5.1 cm (b) 5.01 cm
(c) 5.16 mm (d) 5.16 cm

4. When plugs of screw guage are brought very close without wire the zero of screw gauge moves such that 18 divisions of circular scale go beyond it. When diameter of wire is measured the reading is 5.16 mm. The true value of diameter of wire is
(a) 4.92mm (b) 5.16 mm
(c) 5.34mm (d) 5.18mm

Answers : 1. (c), 2. (a), 3. (c), 4. (c)

• Determination of thickness of a thin plate with the help of spherometer.

Spherometer works on the principle of screw gauge. It has rigid frame work as shown in fig. supported on three fixed legs of equal lengths whose pointed ends forming three corners of an equilateral triangle. A micrometer screw passes through a nut at the center of the frame. It has circular disc having 100 divisions at periphery. The lower end of the screw forms the central leg and goes deep down. At one end of the frame has fixed standing millimeter scale. It is very close to the circular scale. Main scale has zero in the middle and 2 cm up and 2 cm down with divisions in millimtere.



First of all least count of the instrument is found. For this, zero of disc is brought in contact with vertical main scale. Note the reading of main scale. Rotate the disc through a number of five complete turns by means of its head and again note the reading on main scale. Pitch of the screw is difference of two readings divided by number of rotations. Least count is pitch divided by number of divisions on disc. Turning the disc clockwise marking in 10, 20, 30, 40..........90.

To measure the thickness of a thin plate put it on a plane shining surface with central leg quite up and three legs on the surface. Now the plate is slipped between three legs. Now the screw is moved down till it just touches the plate. Reading is noted. Find the division of disc against main scale. Multiply it by least count and add it to the reading of main scale which is just up to the disc level. Remove the plate and move central leg further to coincide with the surface. Difference of two readings give the thickness of the plate.

QUESTIONS

1. Main scale has marking in millimeters. The circular disc is between 2 and 3 millimeter mark above zero and 30th division of disc in contact with scale having 100 diminisions on it. Then reading is
(a) 2.003mm (b) 2.3mm
(c) 2.7 mm (d) 3.3mm

2. Main scale has marking in millimeters and disc has 100 divisions in a spherometer. If disc is between 0 and 1 mm of main scale with 60th division of disc conciding it then reading is
(a) 0.6 mm (b) 0.4 mm
(c) 0.3mm (d) 0 mm

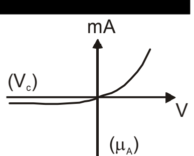
3. With central leg of spherometer on plane surface the disc of 100 division lies between 2mm and 3mm line above zero at 35 division. If central leg on thin plate above the plane surface the disc lies between 4 mm & 5mm at 65 division then thickness of the thin plate is
(a) 2.3 mm (b) 2.35 mm
(c) 2.65 mm (d) 3.0 mm

4. When central leg of spherometer touching plane surface the disc is below zero between 0 and 1mm with 45 divisions against it. After glass slab inserted under central leg the disc goes above zero between 3mm and 4mm having 45 division against main scale. The thickenss of the plate is
(a) 3mm (b) 3.1 mm
(c) 3.45 mm (d) 4.45 mm

5. Main scale has 20 divisions in 1 cm in a spherometer and the disc has 100 divisions, the least count of the instrument is
(a) 0.01 mm (b) 0.05mm
(c) 0.005mm (d) 0.001mm

Answers : 1. (c), 2. (a), 3. (a), 4. (b), 5. (c)

• Study of characteristic curve of p-n junction diode



A battery with a potential divider is used for baising of p-n junction. An ammeter is put in series to the battery and voltmeter is connected in parallel to the divider to read voltage across the junction. Reading of ammeter in forward bias for changing voltage in step of 0.2 volt are recorded. Graph between current (in mA) and voltage (in volt) is drawn. Similarly current in μA in step of 1 volt in reverse bias across junction is recorded. Graph in forward bias is parallel to voltage axis below 1 volt but rises steeply beyond that. In reverse bias, it is parallel to voltage axis for many volt of reverse bias and then increases suddenly at around 10 volts. Few readings can be obtained if micro ammeter is replaced by milliammeter for plotting the graph.

QUESTIONS

1. *p* region of a *p-n* junction has
(a) holes as charge carriers
(b) holes and electrons, both type of equal charge carriers
(c) majority of positive carriers
(d) majority of negative charge carriers.

2. Diode current I_d in forward bias changes with voltage V against p-n junction as
(a) $I_r e^{V/KT}$ (b) $I_r e^{-V/KT}$ (c) $I_r e^{KT/V}$ (d) $I_r e^{-KT/V}$

3. Diode current in reverse bias follows the rule with voltage V across it as

(a) $-I_r e^{V/KT}$ (b) $-I_r$ (c) $-I_r e^{KT/V}$ (d) $I_r e^{V/KT}$

4. Resistance of junction diode in reverse and forward bias are of the order of
(a) ohm, k ohm (b) k ohm, ohm
(c) k ohm, k ohm (d) ohm, ohm

5. Diode current in p–n junction is due to
(a) drift and diffusion of charge carriers
(b) drifting of charge carriers only
(c) diffusion of charge carriers only
(d) drift motion in forward and diffusion in backward biasing.

6. When reverse bias is applied across p-n junction, then thickness of depletion layer and barrier height
(a) both increase (b) both decrease
(c) thickness increases, height decreases
(d) thickness decrease, height increases

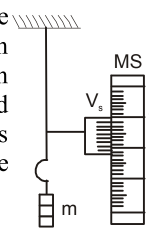
7. The current in the internal circuit of p–n junction is due to movement in forward biasing
(a) free electrons
(b) free electrons in n-region and holes in p-region.
(c) holes in n, region and electron in p-region
(d) holes in both regions but electrons in outer circuit.

8. In p-n junction during forward biasing
(a) drift current dominates diffusion current
(b) drift current is only present
(c) diffusion current is only present
(d) diffusion current dominates drift current.

Answers: 1. (c), 2. (a), 3. (b), 4. (b), 5. (c), 6. (a), 7. (b), 8. (d)

• Determination of Young's Modulus of a wire

Suppose a wire of length L uniform area of cross section A is hanging vertically from a rigid support. Other end is attached to a hanger on which known weights can be placed. A pointer attached to the hanger has vernier which moves on a fixed main scale. Extension in wire is noted by placing increasing weight on the hanger. From the straight part of the graph between pointer reading and mass, we can get amount of extension x and corresponding increase in mass. Young's modulus of wire is calculated using the relation.



$$Y = \frac{mg}{A} \Big/ \left(\frac{\Delta x}{L}\right) = \frac{Lmg}{A\Delta x}$$

QUESTIONS

1. Young's modulus of steel wire in the experiment is independent of
(a) length (b) area of crossesection
(c) mass attached (d) none of the above

2. We note readings for increasing and decreasing load to avoid error due to
(a) elastic fatigue (b) elastic after effect
(c) erratic length change (d) elastic hyptersis

3. Which of the following is most elastic
(a) quartz (b) copper (c) rubber (d) wood

4. If two wires of same material and length but diameter in ratio 1 : 2 are stretched by same amount. Work done in two cases will be in the ratio
(a) 1 : 4 (b) 4 : 1 (c) 1 : 2 (d) 2 : 1

5. Find the elongation of a wire of length L due to its own weight if density of material is ρ and young's modulus is Y.
(a) $egL^2/2Y$ (b) egL^2/Y (c) $\frac{egL}{YA}$ (d) $\frac{gL^2}{eY}$

6. Depression δ in case of bending of a beam of length L breadth b and thickness d by a load Mg at the middle is
(a) $\frac{MgL^3}{bd}$ (b) $MgL^3/4bd^3Y$
(c) $\frac{MgL^3}{bd^3Y}$ (d) $\frac{bd^3Y}{MgL^3}$

7. Energy stored per unit volume in a stretched wire is :
(a) $\frac{1}{2}$ load × strain (b) Load × strain
(c) $\frac{1}{2}$ stress × strain (d) stress × strain

8. The property due to which a material can be hammered into thin sheet is called :
(a) Ductility (b) malleability
(c) Brittleness (d) Elasticity

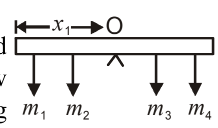
9. Two wires A and B of the same material and same length are stretched between two same fixed supports. A is thicker than B. When their temperatures are increased by same amount the tension in them are
(a) equal
(b) increases in A more than in B
(c) increase in B more than A
(d) remain unchanged.

10. Isothermal bulk modulus of a perfect gas at pressure P and temperature T is
(a) P (b) PT (c) P/T (d) rP

Answers : 1. (d), 2. (d), 3. (a), 4. (a), 5. (a), 6. (b), 7. (c), 8. (b), 9. (b), 10. (a)

• Verification of Law of Moment

Law of moment states that a body capable of rotating about a fixed axis will remain in equilibrium if sum of total torque is zero.



A horizontal beam is supported and balanced at its centre of mass. Now masses m_1, m_2 m_3 and m_4 are hanging at different positions at distances x_1, x_2, x_3 and x_4 respectively from the centre of the beam. Now for the balance, the clockwise couple are equal to anti clockwise couples.

$$m_1 x_1 + m_2 x_2 = m_3 x_3 + m_4 x_4$$

QUESTIONS

1. The dimensions of moment of force are :
(a) ML^2T^{-2} (b) MLT^{-2} (c) $ML^{-2}T^{-2}$ (d) $M^2L^2T^{-2}$

2. Various forces acting on a body are f_1, f_2, f_3..... whose torque about a point are τ_1, τ_2, τ_3 .... Then for equilibrium of the body the condition is/are
(a) $\Sigma \vec{f_i} = 0, \Sigma \tau_i \neq 0$ (b) $\Sigma \vec{f_i} \neq 0, \Sigma \vec{\tau_i} = 0$