The following questions consists of two statements each, printed as Assertion/Statement and Reason/Statement. While answering these questions you are to choose any one of the following four responses/Statement.

(A) If both Assertion/Statement and Reason/Statement are true and the Reason/Statement is correct explanation of the Assertion/Statement.

(B) If both Assertion/Statement and Reason/Statement are true but Reason/Statement is not correct explanation of the Assertion/Statement.

(C) If Assertion/Statement is true but the Reason/Statement is false.

(D) If Assertion/Statement is false but Reason/Statement is true.

Q.1 **Assertion** : When the studs are in contact either with each other or with some other object placed in between, the ratchet slips over the screw cap without moving the screw forward.
Reason : It avoids un due pressure between the studs or on the object. **[A]**

Q.2 **Assertion** : The time period of a second pendulum is 1 sec.
Reason : The length of a second pendulum is approximately 1m. **[D]**

Q.3 **Assertion** : Vernier calipers cannot measure the depth of a cylinder.
Reason : The upper jaws of varnier calipers are used to measure the internal diameter of the cylinder. **[D]**

Q.4 **Assertion** : When the two jaws of vernier caliper are brought together to touch each other, then it may happen that the zero of the vernier scale does not coincide with the zero of main scale.
Reason : The cause of zero error may be improper handling of the instrument or manufacturing defect. **[A]**

Q.5 **Assertion** : The tuning fork is struck against a rubber pad and the vibrating tunning fork is placed just above the open end of the resonance tube so that the prongs of the fork vibrate inavertical plane.
Reaons : A tuning fork emits a single frequency, that is a fundamental with no overtones. **[D]**

Q.6 **Assertion :** In meter bridge experiment a high resistance is always connected in series with a galvanometer.
Reason : As resistance increases current through the circuit increases. **[C]**

Sol. The resistance of the galvanometer is fixed. In meter-bridge experiments, to protect the galvanometer from a high current, high resistance is connected to the galvanometer in order to protect it from damage.

Q.7 **Statement-I :** The pitch of a screw gauge is 0.5mm and the head scale contains 100 divisions. The pitch of a spherometer is 1mm and head scale contains 250 divisions. Screw gauge has the lesser least count.
Statement-II: least count

$$= \frac{\text{No. of division on main scale}}{\text{total no. of divisions on circular scale}}$$

(A) If both Statement-I and Statement-II are true, and Statement-II is the correct explanation of Statement-I.
(B) If both Statement - I and Statement-II are true but Statement-II is not the correct explanation of Statement-I.
(C) If Statement-I is true but Statement-II is false.
(D) If Statement-I is false but Statement-II is true.

Sol. [D] Least count(L.C.)

$$= \frac{\text{Value of 1 main scale division}}{\text{No. of divisions on circular scale}}$$

L.C. of screw gauge = $\frac{0.5}{100}$ mm = 0.005 mm.

L.C. of spherometer = $\frac{1}{250}$ mm = 0.004 mm

PHYSICS

Q.1 Which of the following is true ?
(A) The order of magnitude of 501 is 3
(B) The order of magnitude of 499 is 2
(C) The order of magnitude of 2^{30} is 10^{90}
(D) The unit of reduction factor of a tengent galvanometer is ampere **[A,B,D]**

Q.2 One torr is–
(A) a unit of pressure
(B) equal to 133.4 Nm^{-2}
(C) equal to 1 mm of Hg column
(D) equal to 13.6 mm of oil column
[A,B,C]

Q.3 Which of the following is a unit of mass ?
(A) kgf (B) metric ton
(C) quintal (D) amu
[B,C,D]

Q.4 In which of the following instruments is zero error taken into account for measurements–
(A) slide callipers (B) screw gauge
(C) only screw gauge (D) none of these
[A,B]

PHYSICS

Q.1 A student performs experiment with common emitter npn transistor which is working as amplifier then which is not correct -

(A) $A_V > 1$ (B) $\beta > 1$

(C) $R_i = \frac{\Delta V_b}{\Delta I_b}$ (D) $R_G = R_i R_0$

[D]

Sol. $R_G = \frac{R_0}{R_i}$ so R_G is incorrect

Q.2 In a semiconductor diode, the barrier potential offers opposition to -

(A) holes in P-region only

(B) free electrons in N-region only

(C) majority carriers in both regions

(D) majority as well as minority carriers in both regions **[C]**

Sol. In depletion zone, internal electric field is directed from n to P side which opposes diffusion of majority charge carriers

Q.3 When both the studs are in contact in a screw gauge then a student finds that 96^{th} division of circular scale is in line with the reference line then the conclusion would be -

(A) the instrument has no zero error, it is perfact

(B) It has +ve zero error, 4 L C

(C) It has –ve zero error, 4 L C

(D) It has –ve zero error, 96 LC **[C]**

Sol. It is –ve zero error. 4 × LC

Q.4 If the zero of the vernier lies on the right hand side and fourth division coincide with the main scale division when the jaws are in contacts so the correction will be -

(A) + 0.04 cm (B) + 0.06 cm

(C) –0.04 cm (D) –0.06 cm **[C]**

Sol. e = 4 × LC = 4 × 0.01 cm = 0.04 cm

c = –0.04 cm

Q.5 An unknown body is measured with a meter scale of unequal length if the mass appears 10g and 11g when it is kept on both the pans respectively. The true mass is -

(A) 10.48 g (B) 10.00 g

(C) 11.00 g (D) 10.50 g **[A]**

Sol. mass = $\sqrt{10\times11}$ = 10.48

Q.6 A Daniel cell is balanced on 125 cm lengths of a potentiometer wire. Now the cell is short circuited by a resistance 2Ω and the balance is obtained at 100 cm. The internal resistance of the Daniel cell is

(A) 0.5 Ω (B) 1.5 Ω

(C) 1.25 Ω (D) 4/5 Ω **[A]**

Sol. $r = \left(\frac{\ell_1}{\ell_2} - 1\right) R$

$= \left(\frac{125}{100} - 1\right) 2 = 0.25 \times 2 = 0.5\ \Omega$

Q.7 In a potentiometer experiment the balancing with a cell is at a length of 240 cm. On shunting the cell with a resistance of 2 Ω the balancing length becomes 120 cm. The internal resistance of the cell is –

(A) 4 Ω (B) 2 Ω

(C) 1 Ω (D) 0.5 Ω **[B]**

Q. 8 The pitch of a screw gauge is 1 mm and there are 50 divisions on its cap. When nothing is put in between the studs, 44^{th} division of the circular scale coincides with the reference line. When a glass plate is placed between the studs, the main scale reads three divisions and the circular scale reads 26 divisions. Calculate the thickness of the plate –

(A) 3.52 mm (B) 3.26 mm

(C) 3.40 mm (D) 3.64 mm **[D]**

Sol. LC = $\frac{1}{50}$ mm = 0.02 mm

error = – 6 × 0.02 = – 0.12

observed reading = 3 mm + 26 × (0.02) mm

= 3.52 mm

true reading = 3.52 – (– 0.12)

= 3.64 mm

Q. 9 In experiments using the metre bridge, post office box and potentiometer, a galvanometer is used. Which property of the galvanometer makes it suitable for these experiments ?

(A) It has a relatively high coil resistance

(B) It indicates rather than measures the magnitude of the current

(C) It can indicate currents flowing through it in either direction

(D) It can be made very sensitive to small currents **[C]**

Sol. In the three experiments, the jockey is moved according to the direction of the deflection of the galvanometer

Q. 10 N division on the main scale of a vernier callipers coincide with (N+1) divisions of the vernier scale. If each division of main scale is x unit, then least count of the instrument is -

(A) $\frac{x}{N}$ (B) x

(C) $\frac{x}{N+1}$ (D) $\left(\frac{N}{N+1}\right)x$ **[C]**

Q. 11 A resistance of 2 Ω is connected across one gap of a meter–bridge (the length of the wire is 100 cm) and an unknown resistance, greater than 2 Ω, is connected across the other gap. When these resistances are interchanged, the balance point shifts by 20cm. Neglecting any correction, the unknown resistance is **–**

(A) 3 Ω (B) 4 Ω

(C) 5 Ω (D) 6 Ω **[A]**

Sol. $\frac{\ell}{(100-\ell)} = \frac{2}{S}$ ….(1)

$\frac{\ell+20}{100-(\ell+20)} = \frac{S}{2}$

$\frac{\ell+20}{80-\ell} = \frac{S}{2}$ …..(2)

by (1) × (2)

$\left(\frac{\ell}{100-\ell}\right) \times \left(\frac{\ell+20}{80-\ell}\right) = 1$

$\Rightarrow \ell^2 + 20\,\ell = 8000 - 180\,\ell + \ell^2$

$\Rightarrow 200\,\ell = 8000$

$\ell = 40$

so $S = \frac{2\times 60}{40} = 3\,\Omega$

Q. 12 Which of the following is the most preferred instrument for measuring length ?

(A) A vernier of least count 0.01 cm

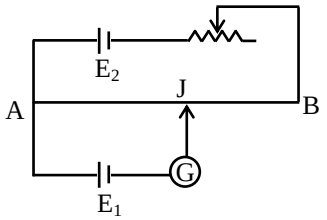
(B) A vernier having 20 divisions on the sliding scale

(C) A vernier having 9 divisions on the sliding scale

(D) A scale having 3 equal parts of each mm **[B]**

Sol. Most preferred should have least least count. So vernier of 20 division

Q. 13 In the potentiometer circuit shown, if for cell E_1 = 5V, the balanced point is at 40 cm from A, then for another battery E_2 = 10 V, the balanced point would be at -



(A) 20 cm from A

(B) 40 cm from A

(C) 80 cm from A

(D) None of these **[C]**

Q. 14 To reduce the pressure on the object we should tighten the screw with -

(A) holding the U frame

(B) holding the circular scale

(C) holding with ratchet

(D) any of the above method **[C]**

Sol. Holding with ratchet

Q. 15 The pitch of a screw gauge is 0.5 mm and there are 50 divisions on circular scale when there is

nothing between the two studs of screw gauge 46th division of circular scale is coinciding with reference line. When a wire is placed between the studs the linear scale reads 2 divisions and 20th division of circular scale coincides with the reference line. The correct statement is -

(A) least count 0.01 cm

(B) zero correction – 0.04 mm

(C) radius is 0.65 mm

(D) all of the above **[C]**

Q. 16 While measuring the speed of sound by performing a resonance column experiment a student gets the first resonance condition at a column length of 18 cm during winter. Repeating the same experiment during summer, she measures the column length to be x cm for the second resonance then -

(A) $x > 54$

(B) $54 > x > 36$

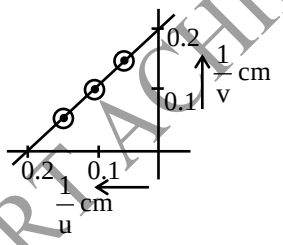
(C) $36 > x > 18$

(D) $18 > x$ **[A]**

Sol. As temperature increases, frequency increases so it will be more than thrice the length, hence (A)

$x > 54$

Q. 17 An experiment with convex lens gives certain result which is represented by a student in the shown graph. What would be the power of the lens used ?



(A) 0.2 D (B) 1 D

(C) 0.1 D (D) 20 D **[D]**

Q. 18 For the half deflection method which of the following stands correct, where G, R and S has the usual meaning ?

(A) $G = \frac{RS}{R-S}$ (B) $R = \frac{GS}{G-S}$

(C) $S = \frac{RG}{R+G}$ (D) All of these **[D]**

Q.19 A small, hollow metal cylinder is closed at one end. Its mass is known. Which of the following instruments are required to find the density of the metal ?

(A) Slide callipers only

(B) Slide callipers and screw gauge

(C) Screw gauge and screw spherometer

(D) Slide callipers and spherometer **[A]**

Q.20 A screw gauge is provided with a "ratchet" arrangement, in the form of a knob at the right end of the spindle. The screw should be rotated by this knob only. The purpose of the is device is–

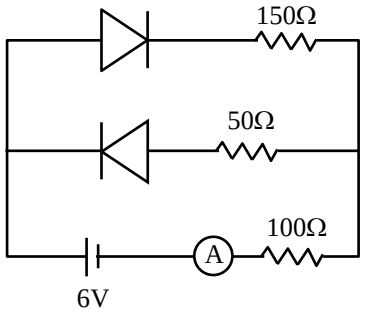
(A) to reduce zero error

(B) to prevent backlash error

(C) to control the rate of rotation of the screw

(D) to prevent damage to the pitch of the screw **[D]**

Q.21 In the given experiment two diodes each with a forward resistance of 50 Ω and with infinite backward resistance are used as shown in the figure. If the battery voltage is 6V, what will be the ammeter reading ?



(A) 0.00 A (B) 0.01 A

(C) 0.03 A (D) 0.02 A **[D]**

Sol. $I = \frac{V}{R} = \frac{6}{150+100+50} = \frac{6}{300} = 0.02$ A

Q.22 A vernier callipers has its main scale of 10 cm equally divided into 200 equal parts. Its vernier scale of 25 divisions coincides with 12 mm on the main scale. The least count of the instrument is–

(A) 0.020 cm (B) 0.002 cm

(C) 0.010 cm (D) 0.001 cm **[B]**

Q.23 In a vernier callipers, ten smallest divisions of the vernier scale are equal to nine smallest

division on the main scale. If the smallest division on the main scale is half millimeter, then the vernier constant is–

(A) 0.5 mm (B) 0.1 mm

(C) 0.05 mm (D) 0.005 mm **[C]**

Q.24 The total length of potentiometer wire is 10 m. The distance between the null points on the potentiometer wire for two cells is 60 cm. If the difference between the emfs of the cells be 0.4 V, the potential qradient along the wire is –

(A) $\frac{3}{2}$ V / m (B) $\frac{1}{3}$ V / m

(C) $\frac{2}{3}$ V / m (D) $\frac{1}{2}$ V / m **[C]**

Sol. $\ell_1 - \ell_2 = 60$ cm

$E_1 - E_2 = 0.4$

$k\ell_1 - k\ell_2 = 0.4$

$k(\ell_1 - \ell_2) = 0.4$

$k = \frac{0.4}{60} = \frac{2}{3}$ V/m

Q.25 A vernier calliper has 20 divisions on the vernier scale, which coincide with 19 on the main scale. The least count of the instrument is 0.1 mm. The main scale divisions are of–

(A) 0.5 mm (B) 1 mm

(C) 2 mm (D) 1/4 mm **[C]**

Q.26 The least count of vernier callipers is 0.1 mm. The main scale reading before the zero of the vernier scale in 10 and the zeroth division of vernier scale coincides with the main scale division. Given that each main scale division is 1 mm. The measured value should expressed as -

(A) 0.01 cm (B) 0.001 cm

(C) 0.1 cm (D) 1.00 cm **[D]**

Sol. Least count = 0.1 mm

Main scale reading = 10 × 1 mm = 10 mm

Vernier scale reading = 0 × 0.1 = 0

So, Reading = 10mm + 0 = 10 mm = 1.00 cm

Q.27 A plane mirror, a metre scale, a plumb line and a vertical pin are required to measure the focal length of which of the following ?

(A) Convex lens (B) Concave lens

(C) Concave mirror (D) Convex mirror **[D]**

Q.28 In an experiment to measure the focal length of a convex lens, the data for image distances (v) for different object distances (u) are plotted to obtain the three graphs of (1) v against u, (2) 1/v against 1/u, and (3) u + v against u. It is possible to find the focal length directly, without any further calculations, from which of these graphs ?

(A) All (B) 1 and 2

(C) 2 and 3 (D) 1 and 3 **[A]**

Q.29 To measure the refracting angle (A) of a prism, the paths of rays reflected from the prism surface are traced using vertical pins placed on a sheet of paper. If the angle of minimum deviation for the prism is δ_m then the angle between the rays reflected from two surfaces of the prism will be–

(A) $A + \delta_m$ (B) $2(A + \delta_m)$

(C) 2A (D) A **[C]**

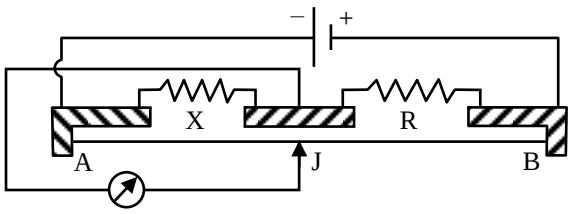
Q.30 A student measured the diameter of a wire using a screw gauge with least count 0.001 cm and listed the measurements. The correct measurement is -

(A) 5.320 cm (B) 5.3 cm

(C) 5.32 cm (D) 5.3200 cm **[A]**

Sol. Least count is 0.001 cm, so 5.320 cm

Q.31 The figure shows a metre-bridge circuit, with AB = 100 cm, X = 12 Ω and R = 18 Ω, and the jockey J in the position of balance.



If R is now made 8 Ω, through what distance will **J** have to be moved to obtain balance?

(A) 10 cm (B) 20 cm

(C) 30 cm (D) 40 cm **[B]**

Sol. $\frac{X}{R} = \frac{l}{100 - l}$ for balance

Initially, $\frac{12}{18}=\frac{l}{100-l}$, finally $\frac{12}{8}=\frac{l'}{100-l'}$

Or JJ′ = $l' - l$ = 20 cm

Q.32 Vernier scale of Vernier calipers has 50 divisions which coincide with 49 main scale divisions. Find the Vernier constant. Given: there are 20 main scale divisions cm^{-1}.

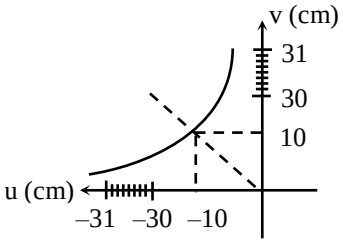
(A) 100 µm (B) 1000 µm

(C) 10 µm (D) None of these **[C]**

Sol. VC = $\frac{1}{50}$ × (value of 1 MSD)

$= \frac{1}{50}\times\frac{1}{20} = 0.001$ cm

Q.33 Graph of position of image vs position of a point object from a convex lens is shown in the figure. The focal length of the lens is –



(A) (0.50 ± 0.05) cm (B) (5.00 ± 0.05) cm

(C) (0.50 ± 0.10) cm (D) (5.00 ± 0.10) cm **[B]**

Sol. 2f = 10

f = 5 cm

$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

$\frac{df}{f^2}=\frac{dv}{v^2}+\frac{du}{u^2}$

$df = f^2\left(\frac{dv}{v^2}+\frac{du}{u^2}\right)$

u = 10, v = 10, du = $\frac{1}{10}$, dv = $\frac{1}{10}$

so $df = 25\left(\frac{1}{10(10)^2}+\frac{1}{10(10)^2}\right) =$

$25\left[\frac{2}{10\times100}\right]$

df = 0.05 so (5.00 ± 0.05) cm.

Q.34 The arms of a physical balance are equal but an object weighs 7.00 kg when placed in the left pan and 7.50 kg placed in the right pan. What is the actual mass of the object ?

(A) 7.00 kg (B) 7.25 kg

(C) 7.50 kg (D) 7.15 kg **[B]**

Sol. $M = \frac{M_1+M_2}{2}$

$M = \frac{7.00+7.50}{2}$ = 7.25 kg.

Q.35 In an experiment surface tension of water at 20°C is found 7.26×10^{-2} N/m. If he does the experiment at a temperature 30°C, then the surface tension of water will be –

(A) more than 7.26×10^{-2} N/m

(B) less than 7.26×10^{-2} N/m

(C) equal to 7.26×10^{-2} N/m

(D) can't say anything **[B]**

Sol. As temperature increases, surface tension decreases.

Q.36 A pendulum is vibrating in a medium. The amplitude of vibrations becomes $\frac{1}{2}$ after 40 sec. Its amplitude will be $\frac{1}{8}$ of its initial amplitude after -

(A) 80 seconds

(B) 120 seconds

(C) 40 seconds

(D) 160 seconds **[B]**

Sol. $A^2 = A_0^2 e^{-\lambda t}$

$\left(\frac{A_0}{2}\right)^2 = A_0^2 e^{-40\lambda}$

……(1)

$\left(\frac{A_0}{8}\right)^2 = A_0^2 e^{-\lambda t}$

……(2)

so by (1) and (2)

3 × 40 = t

t = 120 sec

Q.37 Voltmeter reads the potential difference across the terminal of an old battery as 1.40 volt while a potentiometer reads its voltage to be 1.55 volt. The voltmeter resistance is 280 Ω. Then:

(A) the emf of the battery is 1.4 V

(B) the emf of the battery is 1.55 V

(C) the internal resistance r of the battery is 30 Ω

(D) the internal resistance r of the battery is 5 Ω

[C]

Sol. The potentiometer measures the exact value of emf of a battery.

$\therefore$ E = 1.55 V

Also, 1.4 = I(280)

$\therefore$ I = 0.005 A

Also, V = E – Ir

$$\therefore r = \frac{E-V}{I} = \frac{1.55-1.40}{0.005} = \frac{0.15}{0.005} = 30\ \Omega$$

Q.38 A screw gauge has a least count of 0.001 cm. The number of devisions through which zero mark of circular scale has crossed the refrence line is 2. The zero error is –

(A) –0.02 mm (B) –0.005 cm

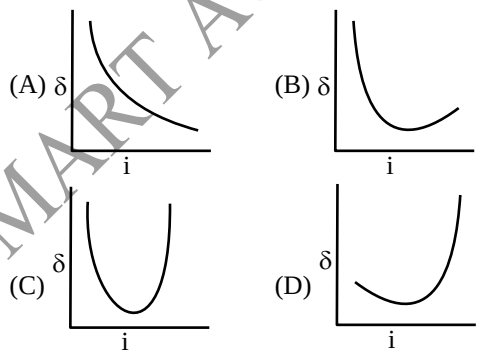
(C) + 0.02 (D) + 0.02 cm **[A]**

Sol. Least count = 0.001 cm

Zero Error = – (2 × 0.001)

= – 0.002 cm = –0.02 mm

Q.39 In the experiment to find the minimum deviation for a galss prism, by ray tracing, the deviation (δ) is measured for different values of the angle of incidence (i). Which of the following plots of δ against i is closest to the experimental result ?



[B]

Q.40 A tangent galvanometer has a coil of 50 turns and a radius of 20 cm. The horizontal components of the earth's magnetic field is $B_H = 3 \times 10^{-5}$ T, the current which gives the deflection of 45° is -

(A) 0.12 A

(B) 0.19 A

(C) 0.32 A

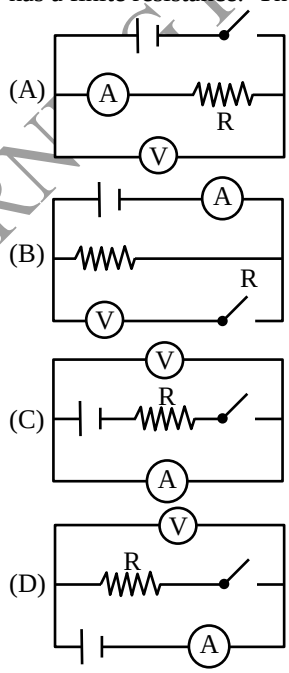
(D) 0.21 A **[B]**

Sol. i = K tan θ

$$= \frac{2rB_H}{\mu_0 n} \tan\theta$$

$$= \frac{2\times0.2\times3\times10^{-5}}{4\pi\times10^{-7}\times50} \tan 45° = 0.19\ A$$

Q.41 Which of the circuits shown below is best suited to measure the resistance of a coil, R ? The symbols have their usual meanings. The ameter has a finite resistance. The voltmeter is ideal.



[D]

Q.42 The smallest division on the main scale of a vernier callipers is 1 mm, and 10 vernier division coincide with 9 scale divisions. While measuring the diameter of a sphere, the zero mark of the vernier scale lies between 2.0 and 2.1cm and the fifth division of the vernier scale coincide with a scale division. What is the diameter of the sphere ?

(A) 2.15 cm (B) 2.00 cm

(C) 2.05 cm (D) 2.10 cm **[C]**

Sol. LC = $\frac{1}{10}$ mm = 0.01 cm

diameter = 2 + 5 × (0.01)

= 2.05 cm

Q.43 The legs of a spherometer are 5 cm apart. There are 10 division cm^{-1} on linear scale and circular scale has 100 divisions. The height **h** of a convex mirror measured in 2 MSD + 37 circular scale divisions. Find radius of curvature of convex mirror.

(A) 20.003 cm (B) 18.408 cm

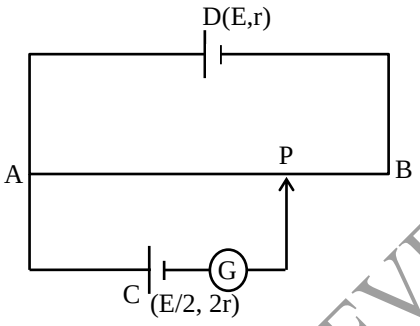
(C) 17.399 (D) 17.983 cm **[B]**

Sol. Least count = $\frac{1/10}{100} = 10^{-3}$ cm

$h = 2 \times (0.1) + 37\,(10^{-3}) = 0.237$ cm

$R = \frac{l^2}{6h} + \frac{h}{2} = \frac{25}{1.362} + 0.118 = 18.408$ cm

Q.44 In the potentiometer arrangement shown, the driving cell D has e.m.f. E and internal resistance r. The cell C whose e.m.f. is to be measured has e.m.f. E/2 and internal resistance 2r. The potentiometer wire is 100 cm long. If the balance is obtained the length AP = ℓ, then-



(A) $\ell = 50$ cm

(B) $\ell > 50$ cm

(C) $\ell < 50$ cm

(D) Balance will not obtained **[B]**

Sol. $V_A - V_B < E$

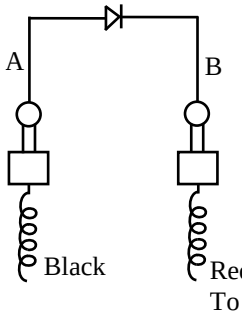
$V_A - V_P = E/2$

$\frac{V_A - V_B}{V_A - V_P} = \frac{\ell_0}{\ell}$

$V_A - V_B = \frac{\ell_0}{\ell}\frac{E}{2} < E$

$\ell > \frac{\ell_0}{2} \Rightarrow \ell > 50$ cm

Q.45 A diode is checked with multimeter as shown, no deflection is obtained. Red and Black wires are interchanged at A and B to find nil deflection. The diode is -



(A) healthy (B) probably faulty

(C) decidedly faulty (D) weak **[C]**

Sol. It is in open condition in both way so it is Faulty

Q.46 The main scale of a vernier callipers reads in millimeter and its vernier in divided into 10 divisions which coincide with a division of the main scale. When the two jaws of the instrument touch each other the seventh division of the vernier scale coincide with a scale divisions and the zero of the vernier lies to the right of the zero of mains scale. Furthermore when a cylinder is tightly placed along its length between the two jaws, the zero of the vernier scale lies slightly to the left of 3.2 cm and the fourth vernier division coincides with a scale division. What is the length of the cylinder?

(A) 3.14 cm (B) 3.07 cm

(C) 3.2 cm (D) 3.04 cm **[B]**

Sol. LC = 0.1 mm

The error = $7 \times 0.1 = 0.7$ mm = 0.07 cm

True reading = 3.1 + 4 (0.01) – 0.07 = 3.07 cm

Q.47 The distance advanced by screw of a screw gauge is 2mm in four rotation. Its cap is divided into 50 division. There is no zero error. If the screw reads 3 divisions on the main scale and 32 divisions on the cap, then the diameter of the wire is -

(A) 3.32 mm (B) 1.82 mm

(C) 2.82 mm (D) 4.7 mm **[B]**

Sol. pitch = 2/4

LC = $\frac{2/4}{50}$ = .01 mm

diameter = $3 \times 0.5 + 32 \times .01$

= 1.5 + .32

= 1.82 mm

Q.48 A body weights 24.2g when placed in one pan of a balance and 20g when placed in other. What is the true mass of the body if the arms have unequal length ?

(A) 24.2g (B) 20 g

(C) 22 g (D) 22.1 g **[C]**

Sol. $M = \sqrt{M_1 M_2}$

$M = \sqrt{24.2 \times 20} = \sqrt{484} = 22$ g

Q.49 The internal resistance of a cell is determined by using a potentiometer. In an experiment, an internal resistance of 100 Ω is used across the given cell. When the key K_2 is closed, the balance length on the potentiometer decreases from 90 cm to 72 cm. Calculate the internal resistance of the cell -

(A) 100 Ω (B) 75 Ω

(C) 50 Ω (D) 25 Ω **[D]**

Sol. $r = R\left(\frac{\ell_1}{\ell_2} - 1\right) = 100\left(\frac{90}{72} - 1\right)$

$r = 25\ \Omega$

Q.50 Following observation are taken from a travelling microscope to determine the refractive index of a liquid. Reading for the bottom of an empty beaker = 12.324 cm. Reading for the bottom of the beaker when partially filled with the liquid = 12.802 cm. Reading for the liquid surface = 13.895 cm. What is the refractive index of the liquid ?

(A) 1.232 (B) 1.389

(C) 1.437 (D) 1.208 **[C]**

Sol. Real depth = $x_3 - x_1 = 13.895 - 12.324 = 1.571$ cm

Apparent depth = $x_3 - x_2 = 13.895 - 12.802 = 1.093$ cm

Refractive index = $\frac{1.571}{1.093} = 1.437$

PHYSICS

Q.1 The dimensions of a rectangle are measured with a scale of least count 1 mm. The length is measured as ℓ = 9.2 cm and the breadth is measured as 3.3 cm.

(i) Determine the uncertainty in each dimension of the rectangle

(ii) Also determine the uncertainty in its area

Ans. (i) The uncertainity in the length and breadth are 0.5 % and 0.2 % respectively

(ii) $A = 30.36 \pm 0.15\ cm^2$

Q.2 The smallest division on the main scale of a vernier callipers is 1 mm and 10 vernier divisions coincide with 9 scale divisions. While measuring the diameter of a sphere, the zero mark of the vernier scale lies between 2.0 and 2.1 cm and the fifth division of the vernier scale coincide with a scale division.

(i) Determine the vernier constant

(ii) Find the diameter of the sphere

Ans. (i) x = 0.10 cm (ii) d = 2.05 cm

Q.3 The length of a cylinder is measured with the help of a vernier calipers whose smallest division on the main scale is 0.5 mm, and nine divisions of the main scale are equal to ten divisions of the vernier scale. It is observed that 78th divisions of the main scale coincides with the sixth division of the vernier scale. Calculate the length of the cylinder.

Ans. L = 3.63 cm

Q.4 In four complete revolutions of the cap, the distance traveled on the pitch scale is 2mm. If there are fifty divisions on the circular scale, then

(i) Calculate the pitch of the screw gauge

(ii) Calculate the least count of the screw gauge

Ans. (i) Pitch = 0.5 mm (ii) Least count = 0.01 cm

Q.5 The pitch of a screw gauge 0.5 mm and there are 50 divisions on the circular scale. In measuring the thickness of a metal plate, there are five divisions on the pitch scale (or main scale) and thirty fourth division coincides with the reference line. Calculate the thickness of the metal plate.

Ans. 2.84 mm

Q.6 The pitch of a screw gauge is 1mm and there are 100 divisions on its circular scale. When nothing is put in between its jaws, the zero of the circular scale lies 4 divisions below the reference line. When a steel wire is placed between the jaws, two main scale divisions are clearly visible and 67 divisions on the circular scale are observed. Determine the diameter of the wire.

Ans. 2.63 mm

Q.7 In a barometer, 20 divisions are found to be equal to 19 main scale division. One main scale division is equal to 1mm. Find the least count of the instrument.

Ans. 0.05 mm

Q.8 In a certain barometer, the least reading on the main scale is 0.5 mm and 50 divisions on the vernier coincide with 49 main scale divisions. What is the vernier constant ?

Ans. 0.001 cm

Q.9 A circular scale is marked in degree and each is divided into 3 parts. There are 20 divisions on the vernier scale which coincide with 19 scale divisions. The reading of an angle is 2.5 degree and 2 small divisions and 17 division of the vernier scale coincides.

(a) Determine the vernier constant

(b) Find the value of the angle

Ans. (a) 1' (b) 25º57'

Q.10 The distance advanced by the screw of a screw gauge is 2mm in four rotations. Its cap is divided into 50 divisions. There is no zero error.
(a) Find the pitch of the screw gauge
(b) Find the least count of the instrument
(c) Find the diameter of a wire, if the screw reads 3 divisions on the main scale and 32 divisions on the cap

Ans. (a) 0.5 mm (b) 0.01 mm (c) 1.82 mm

Q.11 The main scale of a screw gauge in millimeter. The cap of the instrument is divided into 100 equal parts. Find the diameter of a wire if no division on the main scale is completed and the cap has been moved through 37 divisions, the zero error being –3 division.

Ans. 0.40 mm

Q.12 An object is weighed on a balance whose pans are not equal in masses when placed in the left pan, the object appears to weigh 10.30 g but when placed in the right pan, it appears to weigh 12.62 g. Determine the correct mass of object.

Ans. 11.46 g

Q.13 A body weigh's 24.2 g when placed in one pan of a balance and 20 g when placed in other. What is the true mass of the body if the arms have unequal lengths ?

Ans. 22 g

Q.14 A physical balance has arms of unequal lengths. An object placed on the left pan is balanced by 17.5 g. If the left arms is ℓ_1 = 12.5 cm and the right arm is ℓ_2 = 12.3 cm, then
(a) determine the reading of the balance if the object is placed on the right pan
(b) determine the actual mass of the object

Ans. (a) 16.7 g (b) 17.1 g

Q.15 Two moving coil galvanometers are identical in all respects except that one has a coil of 100 turns of resistance 20 Ω and the other has a coil of 200 turns of resistance 50 Ω.
Compare
(i) Their current sensitivities, and
(ii) Their voltage sensitivitities

Ans. (i) 1/2 (ii) 5/4

Q.16 In an experiment, the following values are observed for the circuit arrangement shown in in the figure

G = 100 Ω R = 900 Ω
r_1 = 2 Ω $r_2 = 10^5$ Ω
V = 2 volt q = 20 division

Determine the current and voltage sensitivity of the galvanometer.

Ans. 5×10^8 div/amp. and 5×10^6 div/volt

Q.17 If n^{th} division of main scale coincides with $(n + 1)^{th}$ divisions of vernier scale. Given one main scale division is equal to 'a' units. Find the least count of the vernier. **[IIT-JEE2003]**

Ans. $\frac{a}{n+1}$

Q.18 A screw gauge having 100 equal divisions and a pitch of length 1 mm is used to measure the diameter of a wire of length 5.6 cm. The main scale reading is 1 mm and 47^{th} circular division coincides with the main scale. Find the surface area of wire in cm^2 to appropriate significant figure. **[IIT-JEE2004]**

(use $\pi = \frac{22}{7}$)

Ans. 2.6 cm^2

Q.19 The side of a cube is measured by vernier callipers (10 divisions of a vernier scale coincide with 9 divisions of main scale, where 1 division of main scale is 1mm). The main scale reads 10 mm and first division of vernier scale coincides with the main scale. Mass of the cube is 2.736 g. Find the density of the cube in appropriate significant figures. **[IIT-JEE2005]**

Ans. 2.66 gm/cm^3

Q.20 If the lengths of the arms of a physical balance are l_1 and l_2 and a salesman weighs out twice to a customer articles of mass M by putting weights first in one pan and then in the other, show that the salesman in a loser by $M\left[\frac{(l_1 - l_2)^2}{l_1 l_2}\right]$.

Sol. For a physical balance of unequal arm, we have

$l_1M = l_2M_1 \quad \Rightarrow M_1 = M\frac{l_1}{l_2}$

and $l_1M_2 = l_2M \quad \Rightarrow M_2 = M\frac{l_2}{l_1}$

With this false balance, the salesman gives ($M_1 + M_2$) instead of $M + M = 2M$

Loss of the salesman = $M_1 + M_2 - 2M$

or Loss = $M\frac{l_1}{l_2} + M\frac{l_2}{l_1} - 2M$

$= M\left[\frac{l_1^2 + l_2^2 - 2l_1l_2}{l_1l_2}\right]$

$= M\left[\frac{(l_1 - l_2)^2}{l_1l_2}\right]$