Exercise - III

Q.2 In a vernier callipers, n divisions of its main scale match with (n + 1) divisions on its vernier scale. Each division of the main scale is a units Using the vernier principle, calculate its least count. [JEE 2003]

Q.3 A wire has a mass 0.3 ± 0.003 g, radius 0.5 ± 0.005 mm and length 6 ± 0.06 cm. The maximum percentage error in the measurment of its density is [JEE 2004] (A) 1 (B) 2

| (A) I | (B) Z |
|-------|-------|
| (C) 3 | (D) 4 |

Q.4 In a Searle's experiment, the diameter of the wire as measured by a screw gauge of least count 0.001 cm is 0.050 cm. The length, measured by a scale of least count 0.1 cm, is 110.0 cm. When a weight of exactly 50 N is suspended from the wire, the extension is measured to be 0.125 cm by a micrometer of least count 0.001 cm. Find the maximum error in the measurment of Young's modulus of the material of the wire from these data. **[JEE 2004]**

Q.5 The pitch of a screw gauge is 1 mm and there are 100 divisions on the circular scale. While measuiring the diameter of a wire, the linear scale reads 1 mm and 47^{th} division on the circular scale coincides with the reference line. The length of the wire is 5.6 cm. Find the curved surface area (in cm²) of the wire in appropriate number of significant figures. **[JEE 2004]**

Q.6 Draw the circuit for experimental verification of Ohm's law using a source of variable D.C. voltage, a main resistance of 100 Ω , two galvanometers and two resistances of values $10^6 \Omega$ and $10^{-3} \Omega$ respectively. Clearly show the positions of the voltmeter and the ammeter. **[JEE 2004]**

| (A) 256 cm/sec | (B) 92 cm/sec |
|----------------|------------------|
| (C) 128 cm/sec | (D) 204.8 cm/sec |

Q.8 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. **[JEE 2005]**

Q.9 Graph of position of image vs position of point object from a convex lens is shown. Then, focal lnegth of the lens is





Q.10 The circular divisions of shown screw gauge are 50. It moves 0.5 mm on main scale in one rotation. The diameter of the ball is [JEE 2006]



Q.11 A student performs an experiment for determination of

$$g\left(=\frac{4\pi^2 l}{T^2}\right) l = 1m$$
 and he commits an error of Δl . For the

experiment takes the time of n oscillations with the stop watch of least count ΔT and he commits a human error of 0.1 sec. For which of the following data, the measurement of g will be most accurate ? ΔI ΔTn Amplitude of oscillation [JEE 2006] (A)5 mm 0.2 sec 10 5 mm (B) 5 mm 0.2 sec 20 5 mm

(C) 5 mm 0.1 sec 20 1 mm (D) 1 mm 0.1 sec 50 1 mm

Q.12 In an experiment of determine the focval length (f) a concave mirror by the u-v method, a student places the object pin A on the principal axis at a distance x from the pole P. The student looks at the pin and its inverted image from a distance keeping his/her eye in line iwth PA. When the student shifts his/her eye towards left, the image appears to the right of the object pin. Then, [JEE 2007] (A) x < f (B) f < x < 2f

| A) X < I | |
|-----------|--|
| C) x = 2f | |

Q.13 Some physical quantities are given in Column I and some possible SI units in which these quantities may be expressed are given in Column II. Match the physical quantities in Column I with the units in Column II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the ORS. [JEE 2007]

(D) x > 2f

Q.14 A student performs an experiment to determine the Young's modulus of a wire, exactly 2 m long, by Searle's

MOTION Nurturing potential through education 394,50-Rajeev Gandhi Nagar Kota, Ph. No. : 93141-87482, 0744-2209671 IVRS No : 0744-2439051, 52,53, www. motioniitjee.com, info@motioniitjee.com method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of \pm 0.05 mm at a load of exactly 1.0 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of \pm 0.01 mm. Take g = 9.8 m/s² (exact). The Young's modulus obtained from the reading is **[JEE 2007]**

(A) $(2.0 \pm 0.3) \times 10^{11} \text{ N/m}^2$ (B) $(2.0 \pm 0.2) \times 10^{11} \text{ N/m}^2$ (C) $(2.0 \pm 0.1) \times 10^{11} \text{ N/m}^2$ (D) $(2.0 \pm 0.05) \times 10^{11} \text{ N/m}^2$

Q.15 Students I, II and III perform an experiment for measuring the acceleration due to gravity (g) using pendulum. They use different lengths of the pendulum and/or record time for different number of oscillations. The observations are shown in the table.

Least count for length = 0.1 cm Least count for time = 0.1 s



If E₁, E₁₁ and E₁₁₁ are the percentage error in g, i.e., $\left(\frac{\Delta g}{2} \times 100\right)$

for student I, II and III, respectively,

- (A) $E_1 = 0$
- (B) E₁ is minimum
- $(C) E_{I} = E_{II}$
- (D) E_{II} is maximum

16. A student performed the experiment of determination of focal length of a concave mirror by u-v method using an optical bench of length 1.5 meter. The focal length of the mirror used is 24 cm. The maximum error in the location of the image can be 0.2 cm. The 5 sets of (u, v) values recorded by the student (in cm) are (42,56) (48,48), (60,40), (66, 33) (78,39). The data set(s) that cannot come from experiment and is (are) incorrectly recorded, is (are)

| (A) (42 56) | ` | , | (B) (48 48) |
|-------------|---|---|-------------|
| (A)(42,30) | | | (D) (40,40) |
| (C) (66,38) | | | (D) (78,39) |
| | | | |

17. A student uses a simple pendulum of exactly 1 m length to determine g, the acceleration due to gravity. He uses a stop watch with the least count of 1 sec for this and records 40 seconds for 20 oscillations. For this observation which of the following statement(s) is (are) true ?

(A) Error ${\scriptstyle\Delta}T$ in measuring T, the time period, is 0.05 seconds

(B) Error ΔT in measuring T, the time period, is 1 second

(C) Percentage error in the the determination of g is 5 %

(D) Percentage error in the determination of g is 2.5 %

18. A Vernier callpers has 1 mm marks on the main scale. It has 20 equal divisions on the Vernier scale which match with

16 main scale division. For this Vernier calipers the least count is

| A) 0.02 mm | (B) 0.05 mm |
|------------|-------------|
| C) 0.1 mm | (D) 0.2 mm |

19. The density of a solid ball is to be determined in an experiment. The diameter of the ball is measured with a screw gauge. whose pitch is 0.5 mm and there are 50 divisions on the circular scale. The reading on the main scale is 2.5 mm and that on the circular scale is 20 divisions. If the measured mass of the ball has a relative error of 2% the relative percentage error in the density is:

| A) 0.9 % | (B) 2.4 % | |
|----------|-----------|--|
| C) 3.1 % | (D) 4.2 % | |

20. In the determination of young's modulus

 $\left(Y = \frac{4MLg}{\pi \ell d^2}\right)$ by using Searle's method, a wire of

length L= 2 m and diameter d = 0.5 mm is used. For a load M = 2.5 kg, an extension I = 0.25 mm in the length of the wire is observed. Quantities d and Iare measured using a screw gauge and a micrometer, respectively. The have the same pitch of 0.5 mm. The number of divisions on their circular scale is 100. The contributions to the maximum probable error of the Y measurement

(A) due to the errors in the measurements of d and *l* are the same

(B) due to the error in the measurement of d is twice that due to the error in the measurement of *l*.(C) due to the error in the measurement of *l* is twice that due to the error in the measurement of d.

(D) due to the error in the measurement of d is four times that due to the error in the measurement of *I*.

394,50 - Rajeev Gandhi Nagar Kota, Ph. No. : 93141-87482, 0744-2209671 IVRS No : 0744-2439051,52, 53, www.motioniitjee.com, info@motioniitjee.com

