PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

PHYSICAL WORLD, UNITS AND MEASUREMENTS

Jee Main 5 Years At A Glance

1. The percentage errors in quantities P, Q, R and S are 0.5%, 1%, 3% and 1.5% respectively in the measurement of a physical quantity $A = \frac{P^3Q^2}{\sqrt{R}S}$.

The maximum percentage error in the value of A will be :

A. 8.5%

B. 6.0%

C. 7.5%

D. 6.5%

Answer: D

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2. The characteristic distance at which quantum gravitational effect are significant the planck length can be determined form a suitable combination of the fundamental physical constant G h and c which of the followng correctly gives the planck length ?

A. G^2hc

B. $\left(\frac{Gh}{c^3}\right)^{\frac{1}{2}}$

C. $G^{\frac{1}{2}}h^2c$

D. Gh^2c^3

Answer: B

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3. The density of a material in the shape of a cube is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are respectively 1.5% and 1%, the maximum error in determining the density is:

A. 2.5%

B. 3.5%

C. 4.5%

D. 6%

Answer: C

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4. Time (T), velocity (3) and angular momentum (h) are chosen as fundamental quantities instead of mass, length and time. In terms of these, the dimensions of mass would be

A. $[M] = [T^{-1}C^{-2}h]$

B. $[M] = [T^{-1}C^2h]$

C. $[M] = [T^{-1}C^{-2}h^{-1}]$

D. $[M] = [TC^{-2}h]$

Answer: A

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5. The following observations were taken for dtermining the surface tension of water by capillary tube method: diameter of capillary , $D = 1.25 \times 10^{-2}m$ and rise of water in capillary , $h = 1.45 \times 10^{-2}m$. Taking $g = 9.80ms^{-2}$ and using the relation $T = (rgh/2) \times 10^3 Nm^{-1}$, what is the possible error in measurement of surface tension T?

(a) 2.4% (b) 15% (c) 1.6% (d) 0.15%`

A. 2.4%

B. 10%

C. 0.15%

D. 1.5%

Answer: D

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6. In the following $'I'$ refers to current and other symbols have their usual meaning. Chosse the option that corresponds to the dimensions of electrical conductivity:

A. $M^{-1}L^{-3}T^{3}I$

B. $M^{-1}L^{-3}T^{3}I^{2}$

C. $M^{-1}L^3T^3I$

D. $ML^{-3}T^{-3}I^2$

Answer: B

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7. A student measures the time period of 100 ocillations of a simple pendulum four times. The data set is $90s$, 91 s, 95 s, and 92 s $. If the \min i\mu m \div ision \in the measur \in gclockis 1$ s`, then the reported men time should be:

A. $92 \pm 1.8s$

B. $92 \pm 3s$

C. $92 \pm 2s$

D. $92 \pm 5.0s$

Answer: C

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8. If electronic charge e, electron mass m, speed of light in vaccum c and Plank's constant h are taken as fundamental quantities, the permeability of vacuum μ_0 can be expressed in units of :

A. $\left(\frac{h}{me^2}\right)$

B. $\left(\frac{hc}{me^2}\right)$

C. $\left(\frac{h}{ce^2}\right)$

D. $\left(\frac{mc^2}{he^2}\right)$

Answer: C

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9. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. Meaured value of L is $20.0cm$ know to $1mm$ accuracy and time for 100 oscillation of the pendulum is found to be $90s$ using a wrist watch of $1s$ resolution. The accracy in the determinetion of g is :

A. $1\,\%$

B. $5\,\%$

C. $2\,\%$

D. $3\ \%$

Answer: D

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10. The currect voltage relation of diode is given by $1 = \left(e^{1000V/T} - 1\right)mA$, where the applied voltage V is in volt and the temperature T is in degree Kelvin. If a student makes an error measuring $\pm 0.01V$ while measuring the current of $5mA$ at $300K$, what will be error in the value of current in mA?

A. 0.05 mA

B. 0.2 mA

C. 0.02 mA

D. 0.5 mA

Answer: B

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Exercise 1 Concept Builder Topicwise Topic 1 Units Of Physical Quantities

1. ऊष्मीय चालकता की इकाई है

A. $\mathrm{Jm}^{-2}\mathrm{sec}^{-1}(^{\circ}C)^{-1}$

B. $\mathrm{Jm}^{-1}\mathrm{sec}^{-1}(^{\circ}C)^{-2}$

C. J - sec

D. $\mathrm{Jm}^{-1}\mathrm{sec}^{-1}(^{\circ}C)^{-1}$

Answer: D

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2. The SI unit of electric polarization is

A. Cm^{-2}

B. coulomb

C. ampere

D. volt

Answer: A

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3. What is the unit of magnetic permeability μ_0 of vacuum?

A. $\mathrm{Wb\ A^{-1}m^{-1}}$

B. $Wb^{-1}Am$

C. $WbAm^{-1}$

D. WbA^{-1},

Answer: A

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4. The S.I. unit of latent heat is

A. Jkg^{-1}

B. $Jmol^{-1}$

C. Nkg^{-1}

D. $\mathrm{N\ mol}^{-1}$

Answer: A

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5. The unit of self inductance of a coil is

A. henry

B. volt

C. farad

D. weber

Answer: A

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6. The surface tension of a liquid is $70\text{dyne}/cm$. In MKS system its value is

A. 70 N/m

B. $7 \times 10^{-2} N/m$

C. $7 \times 10^{2} N/m$

D. $7 \times 10^{3} N/m$

Answer: B

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7. Joule-second is the unit of

A. energy

B. torque

C. power

D. angular momentum

Answer: D

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8. The SI unit of Stefan's constant is :

A. W/m^2K^4

B. W/m^2

C. W/m^2K

D. W/m^2K^2

Answer: A

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9. S.I. unit of universal gas constant is

A. $JK^{-1}\text{mol}^{-1}$

B. Joule

C. JK^{-1}

D. J mol^{-1}

Answer: A

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10. Young's modulus of steel is $1.9 \times 10^{11} N/m^2$ When expressed is CGS units of $dynes/cm^2$ it will be equal to $\left(1N = 10^5 dyne, 1m^2 = 10^4 cm^2\right)$

A. 1.9×10^{10}

B. 1.9×10^{11}

C. 1.9×10^{12}

D. 1.9×10^{13}

Answer: C

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11. Which one of the following pairs of quantities and their units is a proper match?

A. $\text{Impulse} \quad -\text{N/sec}$

B. $\text{Magnetic flux}-\text{weber}$

C. $\text{Power}-\text{farad}$

D. $\text{Capacitance}-\text{henry}$

Answer: B

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12. The numerical value of Young's modulus in S.I. unit is β. what is its numerical value in CGS system?

A. β

B. 10β

C. $\beta / 10$

D. 100β

Answer: B

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13. If the units of length and force are increased by four times the unit of energy will be incresed by

A. is increased by 4 times

B. is increased by 16 times

C. is increased by 8 times

D. remains unchanged

Answer: B

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14. the density of a material is 8 g/cc. In a system in which units of length is 5 cm and of mass is 20 g, the density of material is :

A. 8

B. 20

C. 50

D. 80

Answer: C

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15. If e is the charge, V the potential difference, T the temperature, then the units of $\frac{eV}{T}$ are the same as that of

A. Planck's constant

B. Stefan's constant

C. Boltzmann's constant

D. gravitational constant

Answer: C

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16. In equation, $r = m^2 \sin \pi t$, where t represent time if the unit of m is N, then the unit of r is

A. N

B. N^2

C. Ns

D. $N^2 s$

Answer: B

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17. If $x = at + bt^2$, where x is the distance travelled by the body in kilometres while t is the time in seconds, then the units of b are

A. km/s

B. kms

C. km/s^2

D. kms^2

Answer: C

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18. Which of the following quantities has not been expressed in proper unit?

A. $\text{torque} \quad : \quad \text{newton metre}$

B. $\text{stress} \quad : \quad \text{newton metre}^{-2}$

C. $\text{modulus of elasticity} \quad : \quad \text{newton metre}^{-2}$

D. surface tension : newton metre^{-2}

Answer: D

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19. In the eqn. $\left(p+\frac{a}{V^2}\right)(V-b)=$ constant constant, the unit of a is

A. dyne $\times cm^5$

B. dyne $\times$ cm^4

C. dyne / cm^3

D. dyne $\times$ cm^2

Answer: B

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20. In CGS system the magnitude of the force is 100 dyne.In another system where the fundamental physical quantities are kilogram, metre and minutc, the magnitude of the force is

A. 0.036

B. 0.36

C. 3.6

D. 36

Answer: C

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1. In an experiment four quantities a,b,c and d are measure with percentage error 1%, 2%, 3%,and 4% respectively quantity is P is calculate as follow

$P = \frac{a^3 b^2}{cd}$ $\%$ error in P is

A. 10%

B. 7%

C. 4%

D. 14%

Answer: D

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2. A body of mass $m = 3.513kg$ is moving along the x-axis with a speed of $5.00ms^{-1}$. The magnetude of its momentum is recorded as

A. $17.6\ \text{kg ms}^{-1}$

B. $17.565\ \text{kg ms}^{-1}$

C. $17.56\ \text{kg ms}^{-1}$

D. $17.57kms^{-1}$

Answer: C

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3. What is the fractional error in g calculated from $T = 2\pi\sqrt{\frac{l}{g}}$? Given that fractional error in T and l are $\pm x$ and $\pm y$ respectively.

A. $x + y$

B. $x - y$

C. $2x + y$

D. $2x - y$

Answer: C

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4. The dimensions of a rectangular block measured with vernier callipers having least count of 0.01 cm are 5 mm $\times$ 10 mm $\times$ 5 mm. What is the maximum percentage error in the measurement of the volume of the block?

A. $5\ \%$

B. $10\ \%$

C. $15\ \%$

D. $20\ \%$

Answer: A

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5. A vernier callipers has its main scale 10 cm equally divided into 250 parts its vernier scale is of 50 division and coincide with 15mm of the main scale the least count of the instrument is

A. 0.01 cm

B. 0.02 cm

C. 0.001 cm

D. 0.002 cm

Answer: A

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6. The length of one rod $l_1 = 3.323cm$ and the other is $l_2 = 3.321cm$ both rods were measured with one measuring instrument with least count 0.001 cm Then $(l_1 - l_2)$ is

A. $(0, 002 \pm 0.001)cm$

B. $(0.002 \pm 0.000)cm$

C. $(0.002 \pm 0.002)cm$

D. None of these

Answer: C

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7. The relative density of material of a body is found by weighting it first in air and then in water . If the weight in air is $(5.00 \pm 0.05)N$ and the weight in water is $(4.00 \pm 0.05)N$. Find the relative density along with the maximum permissible percentage error.

A. $(5.00 \pm 0.05)N$

B. $(5.00 \pm 11\,\%\,)$

C. (5.00 ± 0.10)

D. $(5.00 \pm 6\,\%\,)$

Answer: B

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8. A physical quantity X is represented by $X = \left(M^{x}L^{-y}T^{-z}\right.$. The maximum percantage errors in the measurement of $M, L,$ and $T,$ respectively , are $a\,\%$, $b\,\%$ and $c\,\%$. The maximum percentage error in the measurement of X will be

A. $(ax + by - cz)\,\%$

B. $(ax - by - cz)\,\%$

C. $(ax + by + cz)\,\%$

D. $(ax - by + cz)\,\%$

Answer: C

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9. Percentage error in the measurement of mass and speed are 2% and 3% respectively. The error in the measurement of kinetic energy obtained by measuring mass and speed will be

A. $12\ \%$

B. $10\ \%$

C. $8\ \%$

D. $2\ \%$

Answer: C

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10. The least count of a stop watch is $(1/5)s$. The time 20 oscillations of a pendulum is measured to be $25s$. The maximum percentage error in this measurement is

A. $8\,\%$

B. $1\,\%$

C. $0.8\,\%$

D. $16\,\%$

Answer: C

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11. The internal and external diameters of a hollow cylinder are measured with the help of a Vernier callipers . Their

values are $4.23 \pm 0.01cm$ and $3.87 \pm 0.01cm$, respectively . The thickness of the wall of the cylinder is

A. $0.36 \pm 0.02cm$

B. $0.18 \pm 0.02cm$

C. $0.36 \pm 0.01cm$

D. $0.18 \pm 0.01cm$

Answer: B

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12. The diameter of a sphere is measured with the instrument having least count 0.001 cm. The diameter is 1.933 cm. The radius to be correct significant figures will be

A. 0.965 cm

B. 0.966 cm

C. 0.967 cm

D. None of these

Answer: B

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13. 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

Answer: C

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14. A physical quantity is given by $X = M^a L^b T^c$. The percentage error in measurement of M, L and T are α, β and γ respectively. Then maximum percentage error in the quantity X is

A. $a\alpha + b\beta + c\gamma$

B. $a\alpha + b\beta - c\gamma$

C. $\frac{a}{\alpha}+\frac{b}{\beta}+\frac{2}{\gamma}$

D. None of these

Answer: A

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15. In a simple pendulum experiment for the determination of acceleration due to gravity time period is measured with an accuracy of 0.1% while length was measured with an accuracy of 0.3%. the percentage accuracy in the value of g so obtained is

A. 0.8%

B. 0.7%

C. 0.5%

D. 0.6%

Answer: C

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16. The relative error in the dertmination of the surface area of a sphere is α. Then the relative error in the determination of its volume is :

A. $\frac{2}{3}\alpha$

B. $\frac{2}{3}\alpha$

C. $\frac{3}{2}\alpha$

D. α

Answer: C

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17. The density of a cube is measured by measuring its mass and length of its sides. If the maximum error in the measurement of mass and length are 4% and 3% respectively, the maximum error in the measurement of density will be

A. 7%

B. 9%

C. 12%

D. 13%

Answer: D

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18. 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. 5.3200 cm

B. 5.3 cm

C. 5.32 cm

D. 5.320 cm

Answer: D

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19. In a vernier callipers, N divisions of vernier scale coincide with (N-1) divisions of main scale (in which 1 division represents 1 mm). The least count of the instrument in cm should be

A. N

B. $N - I$

C. $1/10N$

D. $1/N - 1$

Answer: C

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20. A screw gauge has 200 equal divisions marked along the circumference of the disc and one full rotation of the disc advances on the main scale by 0.05 cm. The least count of screw gauge is

A. $2.5 \times 10^{-4} cm$

B. $2.5 \times 10^{-3} cm$

C. $6.25 \times 10^{-4} cm$

D. $6.25 \times 10^{-3} cm$

Answer: A

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21. The refractive index of water measured by the relation $m = \frac{real\ depth}{apparent\ depth}$ is found to have values of 1.34, 1.38, 1.32 and 1.36, the mean value of refractive index with percentage error is

A. $1.36 \pm 1.48\,\%$

B. $1.35 \pm 0\,\%$

C. $1.36 \pm 6\,\%$

D. $1.36 \pm 0\,\%$

Answer: A

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22. N divisions on the main scale of a vernier callipers coincide with $(N+1)$ divisions of the vernier scale if each division of the main scale is 'a' units, then the least count of the instrument is

A. a

B. $\frac{a}{N}$

C. $\frac{N}{N+1} \times a$

D. $\frac{a}{N+1}$

Answer: D

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23. 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 measurement of its density is

A. 1

B. 2

C. 3

D. 4

Answer: D

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24. In a experiment the angle are required to be measured using an instrument. 26 divisions of the main scale exactly

coincide with the 30 divisions of the vernier scale . If the smallest division of the main scale is half -a-degree $(=0.5^{\circ})$ then the least count of the instrument is .

A. half minute

B. one degree

C. half degree

D. one minute

Answer: D

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25. The pressure on a square plate is measured by measuring the force on the plate and the length of the

sides of the plate by using the formula $p = \frac{F}{l^2}$. If the maximum errors in the measurment of force and length are 4% and 2% respectively. Then the maximum error in the measurment of pressure is

A. 1%

B. 2%

C. 8%

D. 10%

Answer: C

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26. A screw gauge gives the following reading when used to measure the diameter of a wire. Main scale reading $= 0mm$, circular scale reading $= 52$ divisions. Given that $1mm$ on main scale corresponds to 100 divisions of the circular scale. The diameter of the wire from the above data is

A. 0.052 cm

B. 0.026 cm

C. 0.05 cm

D. 0.52 cm

Answer: A

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27. A thin copper wire of length l metre increases in length by 2% when heated through $10^{\circ}C$. What is the percentage increase in area when a square copper sheet of length l metre is heated through $10^{\circ}C$

A. 4%

B. 8%

C. 16%

D. 12%

Answer: A

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28. Intensity obseverd in an interferecne pattern is $I = I_0 \sin^2\theta$. At $\theta = 30^\circ$, Intensity $I = 5 \pm 0.002$. The pecentage error in angle is

A. $\frac{4}{\pi}\sqrt{3} \times 10^{-2}\,\%$

B. $\frac{2}{\pi}\sqrt{3} \times 10^{-2}\,\%$

C. $\frac{1}{\pi}\sqrt{3} \times 10^{-2}\,\%$

D. $\frac{3}{\pi}\sqrt{3} \times 10^{-2}\,\%$

Answer: A

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Exercise 1 Concept Builder Topicwise Topic 3 Dimensions Of Physical Quantities

1. Dimensions of ohm are same as that of (where h is Planck's constant and e is charge)

A. $\frac{h}{e}$

B. $\frac{h^2}{e}$

C. $\frac{h}{e^2}$

D. $\frac{h^2}{e^2}$

Answer: C

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2. The solar constant is defined as the energy incident per unit area per second. The dimensional formula for solar constant is

A. $[M^0L^0T^0]$

B. $[MLT^{-2}]$

C. $[ML^2T^{-2}]$

D. $[ML^0T^{-3}]$

Answer: D

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3. Which physical quantities have the same dimension?

A. Moment of couple and work

B. Force and power

C. Latent heat and specific heat

D. Work and power

Answer: A

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4. The dimensions of physical quantity X in the equation Force $= \frac{X}{\text{Density}}$ is given by

A. $\left[ML^4T^{-2}\right]$

B. $\left[M^2L^{-2}T^{-1}\right]$

C. $\left[M^2L^{-2}T^{-2}\right]$

D. $\left[ML^{-2}T^{-1}\right]$

Answer: C

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5. Which of the following units denotes the dimension $\frac{ML^2}{Q^2}$, where Q denotes the electric charge?

A. Wb/m^2

B. Henry (H)

C. H/m^2

D. Weber (Wb)

Answer: B

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6. Which of the following has the same dimensions?

A. Impulse and momentum

B. Specific heat and latent heat

C. Moment of inerita and force

D. Thrust and surface tension

Answer: A

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7. The dimensions of voltage in terms of mass (M), length (L) and time (T) and ampere (A) are

A. $\left[ML^2T^{-2}A^{-2}\right]$

B. $\left[ML^2T^3A^{-1}\right]$

C. $\left[ML^2T^{-3}A^1\right]$

D. $\left[ML^2T^{-3}A^{-1}\right]$

Answer: D

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8. If L denotes the inductance of an inductor through which a current i is flowing, the dimensions of Li^2 are

A. $\left[ML^2T^{-2}\right]$

B. $\left[MLT^{-2}\right]$

C. $\left[M^2L^2T^{-2}\right]$

D. Not expressible in M, L, T

Answer: A

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9. Whether a given relation / formula is correct or not can be checked on the basis of the principle of homogeneity of dimensions. According to this principle, only that formula is correct, in which the dimensions of the various terms on one side of the relation are equal to the respective dimensions of these terms on the other side of the relation. With the help of the compreshension given above, choose the most appropriate alternative for each of the following questions :

The distance travelledl by a body in nth second is given by $S_{nth} = u + \frac{a}{2}(2n - 1)$ where u is initial velocity and a is acceleration. The dimensions of S_{nth} are

A. $\left[M^1 L^0 T^1\right]$

B. $\left[M^0L^1T^0\right]$

C. $\left[M^0L^1T^{-1}\right]$

D. $\left[M^0L^0T^0\right]$

Answer: C

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10. If $p = \frac{RT}{V-b}e^{-\alpha V/RT}$, then dimensional formula of α is same as that of

A. V

B. P

C. T

D. R

Answer: B

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11. Time (T), velocity (3) and angular momentum (h) are chosen as fundamental quantities instead of mass, length and time. In terms of these, the dimensions of mass would be

A. $[M] = [C^{-1}h]$

B. $[M] = [T^{-1}C^{2}h]$

C. $[M] = [T^{-1}C^{-2}h^{-1}]$

D. $[M] = [C^{-2}h]$

Answer: A

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12. suppose the kinetic energy of a body oscillating with amplitude A and at a distance x is given by

$$K = \frac{Bx}{x^2 + A^2}$$

The dimension of B are the same as that of

A. work/time

B. $\text{work} \times \text{distance}$

C. work/distance

D. $\text{work} \times \text{time}$

Answer: B

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13. The dimensions of universal gas constant is

A. $\left[L^2M^1T^{-2}K^{-1}\text{mol}^{-1}\right]$

B. $\left[L^1M^2T^{-2}K^{-1}\text{mol}^{-1}\right]$

C. $\left[L^1M^1T^{-2}K^{-1}\text{mol}^{-1}\right]$

D. $\left[L^2M^2T^{-2}K^{-1}\text{mol}^{-1}\right]$

Answer: A

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14. The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constants. The dimensions of a, b, c are respectively :-

A. $\left[LT^{-2}\right], [L], [T]$

B. $\left[L^2\right], [T]$ and $\left[LT^2\right]$

C. $\left[LT^2\right], [LT]$ and $[L]$

D. $[L], [LT]$ and $\left[T^2\right]$

Answer: A

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15. In the formula $X = 3YZ^2$, X and Z have dimensions of capacitance and magnetic induction respectively . When are the dimensions of Y in MLTQ system ?

A. $\left[M^{-3}L^{-2}T^{-2}Q^{-4}\right]$

B. $\left[ML^{-2}\right]$

C. $\left[M^{-3}L^{-2}Q^4T^8\right]$

D. $\left[M^{-3}L^{-2}Q^4T^4\right]$

Answer: D

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16. The frequency f of vibrations of a mass m suspended from a spring of spring constant k is given by $f = Cm^x k^y$, where C is a dimensionnless constant. The values of x and y are, respectively,

A. $x = \frac{1}{2}, y = \frac{1}{2}$

B. $x = -\frac{1}{2}, y = -\frac{1}{2}$

C. $x = \frac{1}{2}, y = -\frac{1}{2}$

D. $x = -\frac{1}{2}, y = \frac{1}{2}$

Answer: D

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17. If the dimensions of a physical quantity are given by $M^a L^b T^c$, then the physical quantity will be :

A. velocity if $a - 1, b - 0, c - 1$

B. accelerationn if $a = 1, b = 1, c = -2$

C. force if $a = 0, b = -1, c = -2$

D. pressure if $a = 1, b = -2, c = -2$

Answer: D

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18. If the time period t of the oscillation of a drop of liquid of density d, radius r, vibrating under surface tension s is given by the formula $t = \sqrt{t^{2b} s^c d^{a/2}}$. It is observed that the time period is directly proportional to $\sqrt{\frac{d}{s}}$. The value of b should therefore be:

A. $\frac{3}{4}$

B. $\sqrt{3}$

C. $\frac{3}{2}$

D. $\frac{2}{3}$

Answer: C

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19. Given as : $h = \frac{2S\cos\theta}{r\rho g}$ where S is the surface tension of liquid, r is the radius of capillary tube. ρ is the density and g is acceleration due to gravity then dimensional formula for S is:

A. $\left[ML^0T^{-2}\right]$

B. $\left[M^0LT^{-2}\right]$

C. $\left[ML^2T^{-2}\right]$

D. $\left[M^0L^0T^{-3}\right]$

Answer: A

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20. The volume V of water passing and any point of a uniform tube during t seconds is related to the cross-sectional area A of the tube and velocity u of water by the relation $V \propto A^{\alpha} u^{\beta} t^{\gamma}$

Which one of the following will be true?

A. $\alpha = \beta = \gamma$

B. $\alpha \neq \beta = \gamma$

C. $\alpha = \beta \neq \gamma$

D. $\alpha \neq \beta \neq \gamma$

Answer: B

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21. Given that in $(\alpha / p\beta) = \alpha z / K_B\theta$ where p is pressure, z is distance, K_B is Boltzmann constant and θ is temperature, the dimension of β are (useful formula Energy $= K_B \times$ temperature)

(A)

$L^0M^0T^0 \quad (B)L^1M^{-1}T^2 \quad (C)L^2M^0T^0 \quad (D)L^{-1}M^1T^{-2}$

A. $\left[L^0M^0T^0\right]$

B. $\left[L^1M^{-1}T^2\right]$

C. $\left[L^2M^0T^0\right]$

D. $\left[L^{-1}M^1T^{-2}\right]$

Answer: C

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22. The position x of a particle at time t is given by $x = \frac{V_0}{a}\left(1 - e^{-at}\right)$, where V_0 is constant and $a > 0$. The dimensions of V_0 and a are

A. $M^{-0}LT^{-1}$ and T^{-1}

B. M^0LT^0 and T^{-1}

C. M^0LT^{-1} and LT^{-2}

D. M^0LT^{-1} and T

Answer: A

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Exercise 2 Concept Applicator

1. A metal sample carrying a current along x axis with density is subjected to a magnetic field B_z (along z - axis). The electric field E_y developed along Y-axis is directly proportional to J_x as well as B_z. The constant of proportionality has SI unit.

A. $\frac{m^2}{A}$

B. $\frac{m^3}{As}$

C. $\frac{m^2}{As}$

D. $\frac{As}{m^3}$

Answer: B

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2. In an experiment of calibartion of voltmeter, a standard cell of emf $1.1V$ is balanced against $440cm$ of potentiometer wire. The potentilal difference across the ends of a resistance is found to balance against $220cm$ of the wire. The corresponding reading of voltmeter is 0.5 volt. Find the error in the reading of voltmeter.

A. -0.15 volts

B. 0.15 volts

C. 0.5 volts

D. -0.05 volts

Answer: D

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3. The velocity of water wave v may depend on their wavelength λ, the density of water ρ and the acceleration due to gravity g. The method of dimensions gives the relation between these quantities as

A. v

B. $v^2 \propto g\lambda$

C. $v^2 \propto g\lambda^2$

D. $v^2 \propto g^{-1}\lambda^2$

Answer: B

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4. If E, M, L and G denote energy, mass, angular momentum and gravitational constant repectively then the quantity $\left(E^2L^2/M^5G^2\right)$ has the dimensions of :-

A. newton

B. metre

C. kilogram

D. unitless

Answer: D

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5. The potential energy of a point particle is given by the expression $V(x) = -\alpha x + \beta\sin(x/\gamma)$. A dimensionless

combination of the constant α, β and γ is–

A. $\frac{\alpha}{\beta\gamma}$

B. $\frac{\alpha^2}{\beta\alpha}$

C. $\frac{\gamma}{\alpha\beta}$

D. $\frac{\alpha\gamma}{\beta}$

Answer: D

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6. A physical parameter a can be determined by measuring the parameters $b, c, d,$ and e using the relation $a = b^{\alpha}c^{\beta}/d^{\gamma}e^{\delta}$. If the maximum errors in the measurement of $b, c, d,$ and $eareb_1\ \%$, $c_1\ \%$, $d_1\ \%$, and $e_1\ \%$, then

the maximum error in the value of a determined by the experminent.

A. $(b_1 + c_1 + e_1)\ \%$

B. $(b_1 + c_1 - d_1 - e_1)\ \%$

C. $(\alpha b_1 + \beta c_1 - \gamma d_1 - \delta e_1)\ \%$

D. $(\alpha b_1 + \beta c_1 + \gamma d_1 + \delta e_1)\ \%$

Answer: D

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7. The mass of the liquid flowing per second per unit area of cross-section of the tube is proportional to (pressure difference across the ends)^(n) and (average velocity of the

liquid)^(m) . Which of the following relations between m and n is correct?

A. $m = n$

B. $m = -n$

C. $m^2 = n$

D. $m = -n^2$

Answer: B

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8. a quantity X is given by $\varepsilon_0 L \frac{\Delta V}{\Delta t}$ where $\in_0$ is the permittivity of the free space, L is a length, ΔV is a

potential difference and Δt is a time interval. The dimensinal formula for X is the same as that of

A. resistance

B. charge

C. voltage

D. current

Answer: D

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9. In a certain system of units, 1 unit of time is 5 sec, 1 unit of mass is 20 kg and 1 uint of length is 10m. In this system, one unit of power will correspond to :-

A. 16 watt

B. $\frac{1}{16}$ watt

C. 25 watt

D. $\frac{1}{25}$ watt

Answer: B

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10. The frequency (f) of a wire oscillating with a the length l, in p loops, under a tension T is given by $f = \frac{p}{2l}\sqrt{\frac{T}{\mu}}$ where $\mu =$ linear density of the wire, if the error made in determining length, tension and linear density be

$1\%, -2\%$ and 4% then the find the percentage error in the calculated frequency.

A. -4%

B. -2%

C. -1%

D. -5%

Answer: A

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11. The electric field is given by $\vec{E} = \frac{A}{x^3}\hat{i} + By\hat{j} + Cz^2\hat{k}$. The SI units of A, B and C are respectively:

A. $\frac{N - m^3}{C}, V/m^2, N/m^2 - C$

B. $V - m^2, V/m, N/m^2 - C$

C. $V/m^2, V/m, N - C/m^2$

D. $V/m, N - m^3/C, N - C/m$

Answer: A

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12. A formula is given as $P = \frac{b}{a}\sqrt{1 + \frac{k.\theta.t^3}{m.a}}$

where P = pressure, k = Boltzmann's constant,

$\theta =$ temperature, t= time, 'a' and 'b' are constants.

Dimensional formula of 'b' is same as

A. Force

B. Linear momentum

C. Angular momentum

D. Torque

Answer: B

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13. A physical quantity ρ is calculated by using the formula $\rho = \frac{1}{10}\frac{xy^2}{z^{1/3}}$, where x, y and z are experimentally measured quantities. If the fractional error in the measurement of x, y and z are $2\%, 1\%$ and 3%, respectively, then the maximum fractional error in the calculation of ρ is

A. 0.5%

B. 5%

C. 6%

D. 7%

Answer: B

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14. The momentum of an electron in an orbit is h/λ, where h is a constant and λ is wavelength associated with it. The nuclear magneton of electron of charge e and mass m_e is given as $\mu_n = \frac{eh}{3672\pi m_e}$. The dimension of μ_n are $(A \to \text{current})$

A. $[ML^2A]$

B. $\left[ML^3A\right]$

C. $\left[L^2A\right]$

D. $\left[ML^2\right]$

Answer: C

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15. A gas bubble from an explosion under water oscillates with a period T proportional to $P^a d^b E^c$, where P is the pressure, d is density of water and E is the total energy of the explosion. Find the value of a,b and c`.

A. $-5/6, 1/2$ and $1/3$

B. $5/6, 1/3$ and $-1/2$

C. $5/6, 1/3$ and $1/2$

D. None of these

Answer: A

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16. A student performs an experiment to determine the Young's modulus of a wire, exactly$2m$ long, by Searle's method. In a partcular reading, the student measures the extension in the length of the wire to be $0.8mmwithanuncerta \int yof$+- 0.05mm$ataloadofexactly$ 1.0kg

$, thestudentalsomeasuresthediameterofthewire \rightarrow be$

04mm$with an uncerta \int yo f$+-0.01mm. $Take$g=9.8m//s^(2)` (exact). the Young's modulus obtained from the reading is

A. $(2.0 \pm 0.3) \times 10^{11} N/m^2$

B. $(2.0 \pm 0.2) \times 10^{11} N/m^2$

C. $(2.0 \pm 0.1) \times 10^{11} N/m^2$

D. $(2.0 \pm 0.05) \times 10^{11} N/m^2$

Answer: B

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17. An experiment is performed to obtain the value of acceleration due to gravity g by using a simple pendulum of length L. In this experiment time for 100 oscillations is

measured by using a watch of 1 second least count and the value is 90.0 seconds. The length L is measured by using a meter scale of least count 1 mm and the value is 20.0 cm. The error in the determination of g would be:

A. $1.7\,\%$

B. $2.7\,\%$

C. $4.4\,\%$

D. $2.27\,\%$

Answer: B

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18. from the following combinations of physical constants (expressed through their as usual symbols) the only combination, that would have the same value in different systems of units, is:

A. $\frac{ch}{2\pi\varepsilon_o^2}$

B. $\frac{e^2}{2\pi\varepsilon_o G m_e^2}$

C. $\frac{\mu_o\varepsilon_o}{c^2}\frac{G}{he^2}$

D. $\left(2\pi\frac{\sqrt{\mu_o\varepsilon_o}}{ce^2}\frac{h}{G}\right.$

Answer: B

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19. A, B, C and D are four different physical quantities having different dimensions. None of them is dimensionless. But we know that the equation $AD = C1n(BD)$ holds true. Then which of the combination is not a meaningful quantity :-

A. $\frac{C}{BD} - \frac{AD^2}{C}$

B. $A^2 - B^2C^2$

C. $\frac{A}{B} - C$

D. $\frac{(A - C)}{D}$

Answer: D

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20. A famous relation in Physics relates moving mass m to the rest mass m_0 of a particle in terms of its speed v and the sped of light c. (This relaiton first arose as a consequence of special theory of relativity due to Albert Einstein). A boy recalls the relation almost correctly but forgets where to put the constant c. He writes $m = \frac{m_0}{(1-v^2)^{1/2}}$ Guess where to put the missing c?

A. $m = \frac{cm_0}{\sqrt{1-v^2}}$

B. $m = \frac{m_0}{c\sqrt{1-v^2}}$

C. $m = \frac{m_0}{\sqrt{c^2-v^2}}$

D. $m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$

Answer: D

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21. Turpentine oil is flowing through a tube of length L and radius r. The pressure difference between the two ends of the tube is p , the viscosity of the coil is given by $\eta = \frac{p(r^2 - x^2)}{4vL}$, where v is the velocity of oil at a distance x from the axis of the tube. From this relation, the dimensions of viscosity η are

A. $[ML^{-1}T^{-1}]$

B. $[MLT^{-1}]$

C. $[ML^2T^{-2}]$

D. $[M^0L^0T^0]$

Answer: A

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22. The moment of inertia of a body rotating about a given axis is $6.0 kgm^2$ in SI system. What is the value of the moment of inetia in a system of units in which the unit of length is 5 cm and the unit of mass is 10 g?

A. $2.4 \times 10^3 \text{g cm}^2$

B. $2.4 \times 10^5 \text{g cm}^2$

C. $6.0 \times 10^3 \text{g cm}^2$

D. $6.0 \times 10^5 \text{g cm}^2$

Answer: B

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23. The length of a cylinder is measured with the help of a vernier callipers 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 78^{th} division of the main scale coincides with sixth division of the vernier callipers. Find the length of the cylinder.

A. 3.13 cm

B. 3.33 cm

C. 3.63 cm

D. 3.93 cm

Answer: C

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24. A sperical body of mass m and radius r is allowed to fall in a medium of viscosity η. The time in which the velocity of the body increases from zero to 0.63 times the terminal velocity (v) is called constant (τ). Dimensionally , τ can be represented by

A. $\frac{mr^2}{6\pi\eta}$

B. $\sqrt{\left(\frac{6\pi mr\eta}{g^2}\right)}$

C. $\frac{m}{6\pi\eta rv}$

D. None of these

Answer: D

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25. A length -scale (l) depends on the permittivity (ε) of a dielectric material, Boltzmann constant (k_B), the absolute temperature (T), the number pr unit volume (n) of certain charged paticles, and the charge (q) carried by each of the particles. Which of the following expression for l is dimensionally correct?

A. $l = \sqrt{\left(\frac{nq^2}{\varepsilon k_B T}\right)}$

B. $l = \sqrt{\left(\frac{\varepsilon k_B T}{nq^2}\right)}$

C. $l = \sqrt{\left(\frac{q^2}{\varepsilon n^{2/3} k_B T}\right)}$

D. $l = \sqrt{\left(\frac{q}{\varepsilon n^{1/3} k_B T}\right)}$

Answer: B

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26. A spectrometer gives the following reading when used to measure the angle of a prism.

Main scale reading : $58.5 degree$

Vernier scale reading : 09 divisions

Given that 1 division on main scale correspods to 0.5 degree. Total divisions on the vernier scale is 30 and match with 29 divisions of the main scale. the angle of the prism from the above data:

A. 58.59 degree

B. 58.77 degree

C. 58.65 degree

D. 59 degree

Answer: C

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27. The speed of light in vacuum, c, depends on two fundamental constants, the permeability of free space, μ_0 and the permittivity of free space, ε_0. The speed of light is given by $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$. The units for μ_0 are

A. $kg^{-1}m^{-1}C^2$

B. $kgmC^{-2}$

C. $kgms^{-4}C^{-2}$

D. $kg^{-1}s^{-3}C^{-2}$

Answer: B

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28. The length of the string of a simple pendulum is measured with a metre scale to be 90.0 cm.The radius of the bob plus thelength of the hook is calculated to be 2.13 cm using measurements with a slide callipers. What is the effective lengthof the pendulum? (The effective length is defined as the distance between the point of suspension and the centre of the bob.)

A. 87.87 cm

B. 92.1 cm

C. 91.2 cm

D. 90.2 cm

Answer: B

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29. A highly rigid cubical block (A) of small mass (M) and slide (L) is fixed rigidly on to another cubical block (B) of the same dimesions and of low modulus of rigidity (eta) such that the lower face of (A) completely covers the upper face of (B). The lower face of (B) is rigidly held on a horizontal surface. (A) small force (F) is applied perpendicular to one of the sides faces of (A). After the force is withdrawn, block (A) executes small oscillations the time period of which is given by.

A. $2\pi\sqrt{M\eta L}$

B. $2\pi\sqrt{M\eta/L}$

C. $2\pi\sqrt{ML/\eta}$

D. $2\pi\sqrt{M/\eta L}$

Answer: D

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30. Two full turns of the circular scale of a screw gauge cover a distance of $1mm$ on its main scale. The total number of divisions on the circular scale is 50. Further, it is found that the screw gauge has a zero error of $-0.03mm$. While main scale reading of $3mm$ and the number of circular scale divisions in line with the main scale as 35. the dimeter of the wire is

A. 3.32 mm

B. 3.73 mm

C. 3.67 mm

D. 3.38 mm

Answer: D

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