PHYSICS

BOOKS - MODERN PUBLISHERS PHYSICS (HINGLISH)

UNITS AND MEASUREMENT

Solved Examples

1. The density of iron is $7.87 g/cm^3$. Express it in SI units.

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2. A man wishes to estimate the distance of a nearby tower from him. He stands at a point A in front of the tower C and spots a very distant object O in line with AC. He then walks perpendicualr to AC upto B, a distaance of 100m and looks at O and C again. Since O is very distant, the direction of BO is practically the same as AO, but he finds the line of sight of C shifted from the original line of sight by an angle $\theta = 40^\circ (\theta \text{is known as parallax})$. Estimate the distance fo the tower C from his original position A.

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3. The moon subtends an angle of 57 minutes at two diametrically opposite points on earth. Calculate the

distance of the moon from the earth. Given, diameter of earth $= 1.276 \times 10^7 m$.

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4. The sun's angular diameter is measured to be 1920''. The distance of the sun from the earth is $1.496 \times 10^{11} m$. What is the diameter of the sun?

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5. A planet revolves around the sun with half as fast as the earth revolves around the sun. Determine its orbital size as compared to that of the earth.

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6. A drop of olive oil of radius $0.20mm$ spreads as a film on the water surface. Calculate the molecular size of the olive oil if the film is

(a) circular, with a radius size of 10 cm

(b) retangular, with size $20cm \times 10cm$.

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7. How many parsec make up 1 metre ? What is the order of magnitude?

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8. Which of these unit is lasrgest: AU, light year and parsec. Express the average distance of earth from the sun in (i) light year (ii) per sec.

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9. The shadow of a tower standing on a level plane is found to be 50 m longer when when sun's elevation is 30° than when it is 60°. Find the height of the tower.

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10. If the size of the nucleus (in the range of 10^{-15} to $10^{-14}m$) is scaled upto the tip of a sharp pin

$(\approx 10^{-5}m)$, what roughly is the size of the atom? Assume tip of the pin to be in the range $10^{5}m \text{ to } 10^{-4}m$.

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11. If the observable universe $(\approx 10^{26}m)$ is shrunk to the size of the earth $(\approx 10^{7}m)$, how large would be milky way on this scale?

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12. If mass of an electron is 9.11×10^{-31}kg, how many electrons will weight 2 kg?

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13. Density of a neutron star is $2.7 \times 10^{17} kgm^{-3}$. Assume the star to be spherical, calculate the radius of the neutron star if its mass is twice the mass of the sun. Take mass of the sun $= 2.0 \times 10^{30} kg$

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14. Write the order of magnitude of the given measurments:

(i) 57

(ii) 1001

(iii) 879000

(iv) 0.04

(v) 38750000

(vi) $0.00000681.$

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15. A human heart beats once in 0.8s. How many times it will beat in the life of 70 years of a man?

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16. Two atomic clocks are allowed to run for 100 years and they differ by 0.1s only. What will be the accuracy of standard atomic clock in measuring 1s?

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17. The age of the universe is about 10^{10} years whereas the mean life for human existance is 10^{6} years. Find the physical meaning of the time interval which is approximately half way between these two on a lagarithmic scale.

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18. The diameter of a wire measured in an experiment was $0.022cm, 0.023cm, 0.026cm, 0.025cm, 0.024cm$ and $0.025cm$ find

(i) the mean value of diameter

(ii) absolute error in a each measurment

(iii) percentage error.

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19. Refractive index of a flint glass (μ) was measured in an experiment and was found to be $1.655, 1.667, 1.655, 1.659, 1.669 \text{ and } 1.654$. Find

(i) the mean value of μ

(ii) mean absolute error

(iii) relative error

(iv) percentage error.

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20. The temperature of two bodies measured by a thermometer are $t_1 = 20^\circ C \pm 0.5^\circ C \text{ and } 50^\circ C \pm 0.5^\circ C$. Calculate the temperature difference and the error therein.

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21. Two resistances of values $150 \pm 2\Omega$ and $250 \pm 5\Omega$ are connected in series. Find their equivalent resistance.

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22. The resistance $R = \frac{V}{I}$, where $V = (100 \pm 5.0)V$ and $I = (10 \pm 0.2)A$. Find the percentage error in R.

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23. The error in measurement of side of a cube is 2%. Find the error in the volume of the cube?

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24. The length, breadth and height of a rectangular block are found to be $15.12 \pm 0.02cm$, $7.86 \pm 0.01cm$ and $4.16 \pm 0.02cm$, respectively. Compute the percentage error in the volume of the block.

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25. Find the relative error in Z, if $Z = A^4 B^{1/3} / CD^{3/2}$.

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26. Two resistors of resistances $R_1 = 100 \pm 3$ ohm and $R_2 = 200 \pm 4$ ohm are connected (a) in series, (b) in parallel. Find the equivalent resistance of the (a) series combination, (b) parallel combination. Use for (a) the relation $R = R_1 + R_2$ and for (b) $\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2}$ and $\frac{\Delta R'}{R}{}^2 = \frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2}$

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27. A physical quantity Y is expressed as $Y = \frac{p^2}{r}\left(\frac{q}{\sqrt{s}}\right)^3$ If the percentage error in the measurement of p,q,r and s are 4%, 2%, 1% and 3% respectively, caluclate the percentage error in Y.

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28. Specify the number of significant figures in the following measurements :

(i) 5.000kg

(ii) 3500 m

(iii) $0.070s$.

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29. State the number of significant figures in the following measurements :

(i) $1.60 \times 10^9 kg$

(ii) $7.036J$

(iii) $0.0003s$.

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30. Add the numbers $8.31, 13.151,$ and 0.0039 and express the result to an appropriate number of significant figures.

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31. Subtract 4.5×10^4 from 7.9×10^5 and express the result to an appropriate number of significant figures.

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32. Round off the following numbers up to 3 digits :

(i) 17.65

(ii) $14, 958$

(iii) $3, 49, 338$

(iv) 11.6

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33. Subtract 2.5×10^{-5} from 8.0×10^{-3} with regards to significant figure.

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34. Solve the following expressions and express the result to an appropriate number of significant figures :

(i) $65.5 \times 135.1 \times 0.61$

(ii) $\frac{4.23 \times 25.68}{658.2}$

(iii) $\frac{3.51 \times 10^{-4} \times 2.71 \times 10^{7}}{0.5562}$.

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35. Calculate the area of a circle of diameter 1.05m and express the result to an appropriate number of significant figures.

Take $\pi = 3.14$.

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36. Each side is measured to be 7.203 m. What are the total surface area and the volume of the cube to appropriate significant figures ?

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37. Name the physical qauantities which have dimensional formulae as given below :

(i) ML^2T^{-2}

(ii) ML^2

(iii) ML^2T^{-3}

(iv) MLT^{-1}.

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38. Deduce the dimensional formula for the following physical quantities :

(i) Young's modulus

(ii) Co-efficient of viscosity

(iii) Surface tension

(iv) Bulk modulus

(v) Force constant.

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39. Deduce the dimensional formulae for the following physical quantities :

(i) Specific heat

(ii) Entrophy

(iii) Thermal conductivity

(iv) Stepan's constant

(v) Boltzmann's constant

(vi) Universal gas constant.

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40. Show that angular momentum has the same dimensions as the Planck's constant.

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41. Taking work, charge and frequency as the fundamental quantities, find the dimensions of resistance.

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42. Taking velocity of light, density and frequency as fundamental quantities, find the dimensions of surface tension.

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43. Check the dimensional consistency of the relations :

(i) $S = ut + \frac{1}{2}at^2$

(ii) $\frac{1}{2}mv^2 = mgh.$

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44. The rate of flow (V) of a liquid flowing through a pipe of radius r and pressure gradient (P/I) is given by Poiseuille's equation$V = \frac{\pi}{8}\frac{Pr^4}{\eta I}$ Chack the dimensional correctness of this relation.

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45. Check the dimensional correctness of the following equations :

(i) $T = K\sqrt{\frac{pr^3}{S}}$ where p is the density, r is the radius and S is the surface tension and K is a dimensionless constant and T is the time period of oscillation.

(ii) $n = \frac{1}{2l}\sqrt{\frac{T}{m}}$, when n is the frequency of vibration, l is the length of the string, T is the tension in the string and m is the mass per unit length.

(iii) $d = \frac{mgl^3}{4bd^3Y}$, where d is the depression produced in the bar, m is the mass of the bar, g is the accelaration due to gravity, l is the length of the bar, b is its breadth and d is its depth and Y is the Young's modulus of the material of the bar.

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46. The equation given below is the Vandar Wall's equation for a gas $\left(P+\frac{a}{V^2}\right)(V-b)=RT$

where P is the pressure, V is the volume, R is the universal gas constant and T is the temperature. Find the dimensions of a/b.

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47. Rule out or accept the following formula for displacement y of particle undergoing periodic motion on the basis of dimentional arguments :

(i) $a\sin 2\pi t/T$

(ii) $a\cos vt$

(iii) $a\sin(\omega t-kx)$

where a= maximum displacement of the particle T= time period of motion, t= time interval, v= speed of particle, ω= Angular speed of particle, k= displacement constant.

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48. Find the dimensions of $a \times b$ in the given equations :

$$P = \frac{a}{bx} - \frac{t^2}{b}$$

where P is the power, x is the distance and t is the time.

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49. Centripetal force (F) on a body of mass (m) moving with uniform speed (v) in a circle of radius (r) depends upon m, v

and r. The formula for the centripetal force using theory of dimensons.

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50. Consider a simple pendulum having a bob attached to a string that oscillates under the action of a force of gracity. Suppose that the period of oscillation of the simple pendulum depends on its length (l), mass of the bob (m) and acc. Due to gravity (g). Derive the expression for its time period using method of dimensions.

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51. The period of revolution (T) of a planet around the sun depends upon (i) radius (r) of obit (ii) mass M of the sun and (iii) gravitational constant G. Prove that $T^2 \propto r^3$

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52. The surface tension 'S' of a liquid rising in a capillary tube is supposed to depend upon mass 'm' of the liquid, pressure 'p' of the liquid and radius 'r' of the capillary tube. Obtain an expression for 'S' using the method of dimensions.

Take dimensionless constant $K = 1/2$.

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53. If the value of universal gravitational constant is $6.67 \times 10^{11} Nm^2 kg^{-2}$, then find its value in CGS system.

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54. Express the value of following quantities in their SI units.

(i) Power of electric lamp $= 2 \times 10^9 \text{ergs}^{-1}$

(ii) Surface tension of water = 72 dyne cm^{-1}

(iii) Stefan's constant $= 5.67 \times 10^{-5} \text{ergs}^{-1} cm^{-2} K^{-4}$.

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55. If the units of force, energy and time are 20N, 100 J and 10s, find the units of mass and length.

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Practice Problems

1. Convert the angle of

(a) 5° (degree)

(b) 5' (min)

(c) 5'' (second) in radian.

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2. The density of water at $4^\circ C$ is:

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3. How many protons weight 5kg? The mass of a proton is $1.67 \times 10^{-27} kg$.

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4. Calculate the surface area of a cylinder of diameter 5 cm and height 20 cm.

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5. Express the average distance of earth from the sun in (i) light year (ii) per sec.

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6. A huge circular container is observed from two diametrically opposite position X and Y on the earth. The angle subtended by the two directions of observations is $1^\circ 26' 4''$. The diameter of earth is about $1.27 \times 10^7 m$. What is the distance of container from earth?

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7. What will be the diameter of an oil molecule if twenty drops of olive oil of radius 0.12mm are spread on the surface of water, so that they form a circular film of radius 25 cm.

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8. Calculate the linear magnification of a square of side 2mm, which when projected on a screen, gives an image of a square of side 2cm.

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9. How much is the empty space in 1 mole of Helium gas at STP if the radius of helium molecule is about $0.98\dot{A}$?

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10. Add $2.536 \times 10^2 cm$ to $1.415 \times 10^3 cm$ (with regard to significant figures).

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11. Which fo the following mass measurements is most accurate and why?

(i) 5.00 kg (ii) 5.004 kg (iii) 5.01 kg.

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12. Calculate the perimeter of a rectangle within error limits. The sides of the rectangle are $(7.5 \pm 0.2)cm$ and $(3.5 \pm 0.2)cm$.

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13. While determining the time period of oscillation of a simple pendulum, the readings from various measurements

are $1.73s, 1.62s, 1.52s, 1.45s$ and $1.83s$. Calculate the values of mean value of time period, absolute error, mean absolute error and relative error.

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14. A potential of $V = (10 \pm 0.1)$ volt is applied across a resistance of $(5 \pm 0.2)\Omega$. Find the volue of current within error limits.

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15. Calculate the percentage error in value of R is $V = (50 \pm 5)V$ and $I = (5 \pm 1)A$.

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16. What will be uncertainty in the density of a cube if uncertainty in mass and length is 2% and 3% respectively?

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17. While performing Searle's experiment, a weight of 50N is suspended from a wire. The extension produced is $0.121cm$ and is measured by a micrometer of least count $0.001cm$. The diameter of the wire is $0.700cm$, measured by a screw gauge of least count $0.001cm$. The length is 100 cm measured with the help of scale of least count 0.1 cm. Calculate the young's modulus of material of wire, given by $Y = \frac{FL}{Al}$ where F is weight, L is length of wire, A is area of wire and l is extension produced.

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18. Two resistances $R_1 = (15 \pm 0.5)\Omega$ and $(20 \pm 0.7)\Omega$ are connected in parallel. Calculate the total resistance of the combination and maximum percentage error.

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19. What will be focal length of a spherical mirror if distance of object from the mirror is $(30 \pm 0.5)cm$ and distance of image from the mirror is $(10 \pm 0.2)cm$?

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20. What will be the error in the measurement of kinetic energy, if the error in measuring momentum is 100%.

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21. How will you convert SI unit of enregy (Joule) to CGS unit of energy (erg)?

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22. It has been observed that velocity of ripple waves produced in water (ρ) , and surface tension (T) . Prove that $V^2 \propto T/\lambda\rho$.

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23. Find the units of mass and length if the unit of force is Mega Newton, unit of power is watt and unit of times is 1 microsecond.

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24. The depth x to which a bullet penetrates a human body depends on (i) coeffeicint of elasticity, η and (ii) KE (E_k) of the bullet, By the method of dimensions, show that $x \propto \left(\frac{E_k}{\eta}\right)^{1/3}$

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25. Calculate the value of 1 J/sec in a system having 10g, 10cm and 1 min. as fundamental units.

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26. Assume that the largest stone of mass 'm' that can be moved by a flowing river depends upon the velocity of flow v, the density d & the acceleration due to gravity g. I 'm' varies as the K^{th} power of the velocity of flow, then find the value of K.

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27. The frequency (V) of an oscillating drop may depends upon radius (r) of the drop density (ρ) of liquid and the surface tension (S) of the liquid. Deduce of formula dimensionally.

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28. Check the accuracy of relation $P = puv^{-3}$ P is linear momontum, p is density, u si velocity, v is frequency.

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29. Check the accuracy of the relation $\eta = \frac{\pi}{8}\frac{Pr^4}{lV}$

Here, P is pressure, V= rate of flow of liquid through a pipe,

η is coefficient of viscosity of liquid.

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30. Find the dimensions of resistance in terms of mass, length, time and current.

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31. Check by the method of dimensions, the formula $v = \frac{1}{\lambda}\sqrt{\frac{K}{d}}$, where v is velocity of longitudinal waves, λ is wavelength of wave, K is coefficient of volume elasticity and d is density of the medium.

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32. Assuming that the critical velocity of flow of a liquid through a narrow tube depends on the radius of the tube, density of the liquid and viscosity of the liquid, find an expression for critical velocity.

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33. The rotational K.E. of a body is given by $\frac{1}{2}I\omega^2$. Use this equation to obtain the dimensions of I.

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34. If force (F) velocity (V) and time (T) are taken as fundamental units, then the dimensions of mass are

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35. Test if following equation is equation is dimensionally correct $v = \frac{1}{2\pi}\sqrt{\frac{mgl}{1}}$ where, v = frequency, I =moment of inertia, m= mass, l= lengh, g= acc. Due to gravity.

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36. The distance covered by a particle in time t is given by $x = at + bt^2 + ct^3 + dt^4$.

Calculate the dimensions of $\frac{a}{b}$ and $\frac{c}{d}$.

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37. Find the value of p in the relation $\tau = \frac{YL^p}{\cos\theta}$ where Y is the young's modulus, τ is torque and L is the length.

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38. Find the dimensions of V in the equation $y = A\sin\omega\left(\frac{x}{V} - k\right)$

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39. A physical quantity X is defined by the formula $X = \frac{IFv^2}{WL^3}$

where I is moment of inertia, F is force, v is velocity, W is work and L is length, the dimensions of X are

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40. IF $\in_0$ is electric permittivity of free space and E is electric field, then show that $\in_0 E^2$ has the dimensions of pressure.

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Conceptual Questions

1. Length is one of the dundamental quantities. Justify this statement.

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2. Mention some ways to keep a track of time.

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3. How is one second measured?

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4. introduction || international system of units

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5. what are the characteristic of a standard unit?

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6. The distance between the sun and earth is one astronomical unit. Find the time taken by the sunlight to reach the earth.

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7. What is chandrashekhar limit?

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8. The difference in the lengths of a mean solar day and a sidereal day is about

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9. Why angular diameter of the sun and the moon in the sky same?

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10. How many radians are there in one second?

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11. What is one light year?

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12. Write in ascending order : light year, astronomical unit, par sec.

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13. How can we measure distance of star which is nearly 50 light years away from us? Can we measure the distance from a star 150 light away using the same method?

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14. How are large time intervals method?

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15. What is the smallest mass in our knowledge till date?

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16. Mention the uses of dimensional equations.

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17. In expression $A = \frac{BC^2}{2}$, the dimensions of A and C are $\left[ML^{-1}T^{-2}\right]$ and $\left[MLT^{-3}A^{-1}\right]$ respectively. Find the

dimensions of B and identify it.

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18. All constants are dimensionless. Comment.

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19. What are the dimensions of Reynolds number ?

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20. How can we reduce least count error of any instrument?

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21. How can we reduce the random errors in an experiment?

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22. Distinguish between accuracy and precision.

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23. In the given expression $X = \frac{abz^2}{h^3}$, which physical quantity should be measured more accurately to give the most accurate answer?

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24. How many significant digits are in 71450000?

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25. A physical quantity, U can be measured as $U = \frac{abz^2}{h^3}$.

Write the expression for finding the relative error in U.

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26. Which is more accurate 8.0 or 8.00?

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27. How many significant digits are there in 0.008?

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Tough And Tricky Problems

1. Calculate the dimensions of universal gravitational constant. If its value is SI units is 6.67×10^{11}, what will be its value is cgs system ?

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2. The dimensions of length are expressed as $G^x c^y h^z$, where G, c and h are the universal gravitational constant, speed of light and Planck's constant respectively, then :

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3. A varnier caliper is used to measure the diameter of a cylindrical rod. Zero of the varnier scale is found to lie between 4.15 cm and 4.20 cm of the main scale. Varnier scale has 50 divisions which are equivalent to 2.45 cm. The 36th division of varnier scale matches with one of the main scale divisions. What is the diameter of rod?

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4. The potential energy of a particle depends on its x-coordinates as $U = \frac{A\sqrt{x}}{x^2 + B}$, where A and B are dimensional constants. What will be the dimensional formula for A/B?

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5. Round off the following numbers up to 2 significant digits.

(a) 2462 (b) 76.14 (c)3.75 (d) 16.5.

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6. 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

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Ncert File Textbook Exercises

1. Fill in the blanks

(a) The volume of a cube of side 1 cm isk equal to..... m^3

(b) the surface area fo a solid cylinder of radius 2.0 cm and height 10.0 cm is equal to .... $(mm)^2$

(c) A vehical moving with a speed of $18kmh^{-1}$ covers ....m in 1s.

(d) The relative density of lead is 11.3. its density is .....g cm^{-3} or ..... kgm^{-3}

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2. Fill in the blanks by suitable conversion of units :

(a) $1kgm^2s^{-2} = gcm^2s^{-2}$ (b) 1m = ... Light year (c)

$3ms^{-2} = \ldots\ldots Kmh^{-2}$

(d) $G = 6.67 \times 10^{-11} Nm^2 kg^{-2} = \ldots\ldots cm^3 s^{-2} g^{-1}$

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3. A calorie is a unit of heat or energy and it equals about $4.2J, where 1J = 1kgm^2 s^{-2}$. Suppose we employ a system of units in which the unit of mass equals αkg, the unit of length equals is βm , the unit of time is γs. Show tthat a calorie has a magnitude $4.2\alpha^{-1}\beta^{-1}\gamma^2$ in terms of the new units.

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4. Explain this statement clearly :

"To call a dimensional quantity 'large' or 'small' is meaningless without specifying a standard for comparison". In view of this, reframe the following statement wherever necessary :

(a) atoms are very small objects

(b) a jet plane moves with great speed

(c) the mass of Jupiter is very large

(d) the air inside this room contains a large number of molecules

(e) a proton is much more massive than an electron

(f) the speed of sound is much smaller than the speed of light.

5. A new unit of length is chosen such that the speed of light in vaccum is unity. What is the distance between the sun and the earth in terms of the new unit if light takes 8 min and 20s to cover this distance?

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6. Which of the following is the most precise devise for measuring length ? (a) a Vernier callipers with 20 divisions on the sliding scals, coindiing with 19 main scale divions (b) a screw gauge of pitch 1mm and 100 divisions on the circular scale (c) an optical instrument that can measure length to within a wave length of light.

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7. A student measures the thickness of a human hair by looking at it through a microscope of magnification 100. He makes 20 observations and findsd that the average width of the hair in the field of view of the microscope is 3.5mm. What is his estimate on the thickness of hair?

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8. Answer the following :

(a) You are given a tread and a metre scale. How will you estimate the diameter of the thread ?

(b) A screw gauge has a pitch of 1.0 mm and 200 divisions on the circular scale. Do you think it is possible to increase the accuracy of the screw gauge arbitrarily by increasing the number of divisions on the circular scale ?

(c) The mean diameter of a thin brass rod is to be measured by vernier callipers. Why is a set of 100 measurements of the diameter expected to yield a more reliable estimate than a set of 5 measurement only ?

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9. The photograph fo a house occupies an area of $1.7cm^2$ on a 35 slide. The slide is projected on to a screen, and the area of the house on the screen is $1.55m^2$ What is the liner magnification of the projector screen arrangement?

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10. State the number of significant figures in the following

(a)$0.007m^2$ (b)$2.64 \times 10^{24}kg$ (c) $0.2370g/cm^{-3}$

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11. The length breadth and thickness of a metal sheet are 4.234 m 1.005 m and 2.01 cm respectively. Given the area and volume of the sheet to correct number of significant figure.

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12. The mass of a box measured by a grocer's balance is 2.300kg. Two gold pieces of masses 20.15 g and 20.17 g are

added to the box. What is (a) the total mass of the box, (b) the difference in the masses of the pieces to correct significant figures?

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13. A physical quantity P is related to four observables a, b, c and d as $P = a^3b^2/\sqrt{c}d$. The percentage errors in the measurements of a, b, c and d are 1%, 3% 4% and 2% respectively. What is the percentage error in the quantity P? If the value of P calculated using this formula turns out to be 3.763, to what value should you round off the result?

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14. A book with many printing errors contains four different forumlae for the displacement y of a particle undergoing a certain periodic motion : (i) $y = a\frac{\sin(2\pi t)}{T}$ (ii) $y = a\sin vt$ (iii)$y = \frac{a}{T}\frac{\sin(t)}{a}$ (iv)$y = \frac{a}{\sqrt{2}}\left[\frac{\sin(2\pi t)}{T} + \frac{\cos(2\pi t)}{T}\right]$ Here, a is maximum displacement of particle, v is speed of particle, T is time period of motion. Rule out the wrong forumlae on dimensinal grounds.

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15. 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?

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16. The unit of length convenint on the atomic scales is known as an angstrom and is denoted by $\text{Å}: 1\text{Å} = 10^{-10}m$. The size of a hydrogen atom is about 0.5Å What is the totall atomic volume in m^3 of a mole of hydrogen atoms?

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17. One mole of an ideal gas at NTP occupies 22.4 liters (molar volume). What is the ratio of molar volume to atomic

volume to atomic volume of a mole of hydrogen ? Take size of hydrogen molecule to be 1 Å. Why is this ratio so large?

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18. Explain this common observation clearly : If you look out of the window of a fast moving train, the nearby tress, houses etc. seem to move rapidly in a direction opposite to the train's motion, but the distant objects (hill tops, the Moon, the starts etc.) seem to be stationary. (In fact, since you are aware that you are moving, these distant objects seem to move with you).

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19. The principle of 'parallax' in Art. 1(c).4. is used in the determination of distacne of very distant stars. The baseline AB in the line joining the Earth's two locations six months apart in its orbit around the sun. That is, the baseline is about the diameter of the Earth 's orbit $\approx 3 \times 10^{11} m$. However, even the nearest stars are so distnat thet with such a long baseline, they show parallax only of the order of 1''(second) of arc or so . A parsec is a convenient unit of length on the astronomical scale. It is the distance of an objhect that will shown a parallax of 1'' (second) of arc fome oppsoite ends of a beasline equal to the distance from the Earth to the sun. How much is a parsec in terms of metres ?

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20. The nearest star to our solar system is 4.29 light years away. How mcuh is this distance in terms of par sec ? How mcuh parallax would this star show when viewed from two locations of the earth six months apart in its orbit around the sun?

Watch Video Solution

21. Precise measurements of physical quantities are a need of science. For example to ascertain the speed of an aircraft, one must have an accurate method to find its positions at closely separated instants of time. This was the actual motivation behind the discovery of radar in World War II. think of different examples in modern science where precise measurements of length, time, mass etc, arc needed. Also,

where ever you can, give a quantitative idea of the precision needed.

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22. Just as precise measurements are necessary in science, it is equally important to be able to make rough estimates of quantities using rudimentary ideas and common observations. Think of ways by which you can estimate the following (where an estimate is difficult to obtain. try to get upper bound on the quantity) :

(a) the total mass of rain-bearing clouds over India during the Monsoon

(b) the mass of an elephant

(c) the wind speed during a storm

(d) the number of strands of hair on your head

(e) the number of air molecules in your classroom.

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23. The sun is a hot plasma (ionised matter) with its linner core at a temperature excedding 10^7 K, and its outer surface at a temperature of about 6000K. At such high temps, no substance remains in a solid or liquid phase. In what range do you expect the mass density of the sun to be? In the range of densities of solids, liquieds or gases ? Check if your guess is correct from the following data : mass of sun $= 2.0 \times 10^{30} kg$, radius of the sun $= 7.0 \times 10^8 m$

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24. When planet Jupiter is at a distance of 824.7 million km from earth, its angular diameter is measured to be 35.72'' of arc. Calculate the diameter of Jupiter.

Watch Video Solution

Ncert File Additional Exercises

1. A man wlaking briskly in rain with speed v must slant his umbrella forward making an angle θ with the vertical . A student derives the following relation between θ and v :

$\tan \theta = v$

and checks that the relations has a correct limit : as $v \to 0, \theta \to 0$, as expected . (We are assuming there is no

string wing and that the rains falls vertically for a stationary man). Do you think this relation can be correct ? If not, guess at the correct relation .

Watch Video Solution

2. It is claimed that two cesium clocks, if allowed to run for 100 years, free from any disturbance, may differ by only about 0.02s. What does this imply for the accuracy of the standard cesium clock in measuring a time interval of 1s ?

Watch Video Solution

3. Estimate the averaage atomic mass density of a sodium atom, assuming its size ot be 2.5 Å. Compare it with density

of sodium in its crystalline phase $\left(970 kgm^{-3}\right)$. Are the two denities of the same order of magnitude ? If so, why ?

Watch Video Solution

4. The unit of length convenient on nuclear scale is a fermi, $1f = 10^{9} - 15)$m. Nuclear sizes obey rougholy the following empricial relation : $r = r_0 A^{1/3}$, where r is radius of the nucleus and r_0 is a constant equal to 1.2 f. show that the rule implies that nuclear mass density in nearly constant for different neclei. Estimate the mass density of sodium nucleus. Compare it with avarge mass density of sodium atom is Q. 27 $\left(4.67 \times 10^{3} kg/m^{3}\right)$.

Watch Video Solution

5. A LASER is source of very intense, monochromatic, and unidirectional beam of light. These properties of a laser light can be exploited to measure long distance. The distance of the moon from the Earth has been already determine very precisly at the moon's surface. How much is the radius of the lunar orbit around the Earth?

Watch Video Solution

6. A SONAR (sound navigation and ranging) uses ultrasonic waves to detect and locate object under water. In a submarine equaipped with as SONAR, the time delay between genration of a probe wave and the recption of its echo after refection from an enemy submarine is found to

be 77.0 s. What is the distance of the enemy submarine ? (speed of sound in water $= 1450 ms^{-1}$

Watch Video Solution

7. The farthest objects in out universe discovered by modern astronomeres are so distant that light emitted by them takes billions of year to reach the earth. These object (known as quasers) have may puzzling features, which have yet not been satisfactorily explained. What is the distance in km of a quasar form which light takes 3.0 billion years to reach us?

Watch Video Solution

8. It is a well known fact that during a total solar eclipes the disc of the moon almost completely covers the disc of the sun. From this fact and from the information you can gather from Solved Examples 3 and 4 on page 1//44, determine the approximate diameter of the moon.

Watch Video Solution

9. A great physicist of this century (P. A. M. Dirac) loved playing with numerical values of fundamental constant of nature. This led him to an instreasing observaion. Dirac found that form the basic constant of atomin physice (c,e, mass of electron mass of proton) and the gravitational constant G, he could arrive at a number with the dimension of time. Further, it was a very large number, its magnitude

being close to the present estimate on the age of the universe $(\approx 15 billion years)$. Form the table of fundamental constants in this book, try to see if you too can construct this number (or any other instresting number you can think of). if its coincidence with the age of the universe ware significant, what would this imply for the constancy of fundamental constants ?

Watch Video Solution

Ncert File Exemplar Problems Objective Questions

1. The number of significant figures in 0.06900 is

A. 5

B. 4

C. 2

D. 3

Answer: B

2. The sum of the numbers 436.32, 227.2 and 0.301 in appropriate significant figures is

A. 663.821

B. 664

C. 663.8

D. 663.82

Answer: B

Watch Video Solution

3. The mass and volume of a body are 4.237 g and $2.5cm^3$ respectively. The density of the material of the body in correct significant figures is

A. $1.6048gcm^{-3}$

B. $1.69gcm^{-3}$

C. $1.7gcm^{-3}$

D. $1.695gcm^{-3}$

Answer: C

Watch Video Solution

4. The numbers 2.745 and 2.735 on rounding off to 3 significant figures will give

A. 2.75 and 2.74

B. 2.74 and 2.78

C. 2.75 and 2.73

D. 2.74 and 2.74

Answer: D

Watch Video Solution

5. The length and breadth of a rectangular sheet are 16.2 cm and 10.1cm, respectively. The area of the sheet in

appropriate significant figures and error is

A. $164 \pm 3cm^2$

B. $163.62 \pm 2.6cm^2$

C. $163.6 \pm 2.6cm^2$

D. $163.62 \pm 3cm^2$

Answer: A

Watch Video Solution

6. Which of the following pairs of physical quantites does not have same dimensional formula ?

A. Work and torque

B. Angular momentum and Planck's cosntant

C. Tension and surface tension

D. Impulse and linear momentum

Answer: C

Watch Video Solution

7. Measure of two quantites along with the precision of respective measuring instrument is

$A = 2.5ms^{-1} \pm 0.5ms^{-1}$

$B = 0.10s \pm 0.01s$ The value of AB will be

A. $(0.25 \pm 0.08)m$

B. $(0.25 \pm 0.5)m$

C. $(0.25 \pm 0.05)m$

D. $(0.25 \pm 0.135)m$

Answer: A

Watch Video Solution

8. A person measures two quantities as $A = 1.0m \pm 0.2m, B = 2.0m \pm 0.2m$ We should report correct value for $\sqrt{AB}$ as

A. $1.4m \pm 0.4m$

B. $1.41m \pm 0.15m$

C. $1.4m \pm 0.3m$

D. $1.4m \pm 0.2m$

Answer: D

Watch Video Solution

9. which of the following measurements is most precise ?

A. $5.00mm$

B. $5.00cm$

C. $5.00m$

D. $5.00km$

Answer: A

Watch Video Solution

10. The mean length of an object is 5 cm. Which of the following measurements is most accurate?

A. $4.9cm$

B. $4.805cm$

C. $5.25cm$

D. $5.4cm$

Answer: A

Watch Video Solution

11. The Young's modulus of steel is $1.9 \times 10^{11} Nm^{-2}$. Calculate its value in dyne cm^{-2}.

A. 1.9×10^{10}

B. 1.9×10^{11}

C. 1.9×10^{12}

D. 1.9×10^{13}

Answer: C

Watch Video Solution

12. If momentum (p), area (A) and time$(t)$are taken to be fundamental quantities then energy has the dimensional formula

A. $\left(P^1 A^{-1} T^1\right)$

B. $\left(P^2 A^1 T^1\right)$

C. $\left(P^1 A^{-\frac{1}{2}} T^1\right)$

D. $\left(P^1 A^{\frac{1}{2}} T^{-1}\right)$

Answer: D

Watch Video Solution

13. On the basis of dimensions, decide which of the following relation for the displacement of a particle undergoing simple harmonic motion is not correct :

A. $y = a \sin 2\pi t/T$

B. $y = a \sin vt.$

C. $y = \frac{a}{T} \sin\left(\frac{t}{a}\right)$

D. $y = a\sqrt{2}\left(\frac{\sin(2\pi t)}{T} - \frac{\cos(2\pi t)}{T}\right)$

Answer: B::C

Watch Video Solution

14. If P,Q,R are physical quantities, having different dimensions, which of the following combinations can never be a meaningful quantity?

A. $(P-Q)/R$

B. $PQ-R$

C. PQ/R

D. $\left(PR-Q^2\right)/R$

Answer: A

Watch Video Solution

15. Photon is quantum of radiation with energy E =hv where v is frequency and h is Planck's constant. The dimensions of h are the same as that of

A. Linear implulse

B. Angular impulse

C. Linear momentum

D. Angular momentum Planck

Answer: B::D

Watch Video Solution

16. If Planck's constant (h) and speed of light in vacuum (c) are taken as two fundamental quantites, which on of the following can, in addition, be taken to express length, mass and time in terms of the three chosen fundamental quantities ?

A. Mass of electron (m_0)

B. Universal gravitational constant (G)

C. Charge of electron (e)

D. Mass of proton (m_p)

Answer: A::B::D

Watch Video Solution

17. Which of the following ratios express pressure?

A. Force/Area

B. Energy/Volume

C. Energy/Area

D. Force/Volume

Answer: A::B

Watch Video Solution

18. Which of the following are not a unit of time ?

A. Second

B. Parsec

C. Year

D. Light year

Answer: B::D

Watch Video Solution

Ncert File Exemplar Problems Subjective Questions

1. Why do we have different units for same physical quantity?

Watch Video Solution

2. The radius of atom is of the order of 1 Å and radius of nucleus is of the order of fermi. How many magnitudes higher is the volume of atom as compared to the volume of nucleus ?

Watch Video Solution

3. the device used for measuring the mass of atoms and molecules is

Watch Video Solution

4. Express unified atomic mass unit in kg.

Watch Video Solution

5. A function $f(\theta)$ is defined as : $f(\theta) = 1 - \theta + \frac{\theta^2}{2!} - \frac{\theta^3}{3!} + \frac{\theta^4}{4!} \ldots$. why is it necessary for θ to be a dimensionless quantity ?

Watch Video Solution

6. Why length, mass and time are chosen as base quantities in mechanics ?

Watch Video Solution

7. (a) The earth- moon distance is about 60 earth radius. What wil be the diameter of the earth (approximately in

degress) as seen from the moon ? (b) Moon is seen to be of $(1/2)^{\circ}$ diameter from the earth. What must be the relative size compared to the earth ? (c) From parallax measurement, the sun is found to be at a distance of about 400 times the earth. moon distance. Estimate the ratio of sun-earth diameters.

Watch Video Solution

8. Which of the following time measuring devices is most precise ? (a) A wall clock. (b) A stop watch. (c) A digital watch. (d) An atomic clock. Give reason for you answer.

Watch Video Solution

9. The distance of a galaxy is of the order of 10^{25}m. Calculate the order of magnitude of time taken by light to reach us from the galaxy.

Watch Video Solution

10. The vernier scale of a travelling microscope has 50 division which coincide with 49 main scale division. If each main scale division is 0.5 mm, calculate the minimum inaccuracy in the measurement of distance.

Watch Video Solution

11. During a total solar ecilpse the moon almost entirely covers the sphere of the sun. Write the relation between the distances and sizes of the sun and moon.

Watch Video Solution

12. If the unit of force is 100 N, unit of length is 10m and unit of time is 100 s, what is the unit of mass in this system of units ?

Watch Video Solution

13. Give an example of (a) a physical quantiy which has a unit but no dimensions. (b) a physical quantity which has

neither unit no dimensions. (c) a constant which has a unit.

(d) a constant which has no unit.

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14. Calculate the length of the arc of a circle of radius 31.0 cm which subtands and angle of $\frac{\pi}{6}$ at the centre.

Watch Video Solution

15. Calculate the solid angle subtended by the periphery of an area of $1cm^2$ at a point situated symmetrically at a distance of 5 cm from the area.

Watch Video Solution

16. The displacement of a progressive wave is represented by $y = A\sin(\omega t - kx)$, where x is distance and t is time. Write the dimensional formula of (i) ω and (ii) k.

Watch Video Solution

17. Time for 20 oscillations of a pendulum is measured as $t_1 = 39.6s, t_2 = 39.9s, t_3 = 39.5$. What is the precision in the measurements ? What is the accuracy of the measurement ?

Watch Video Solution

Higher Order Thinking Skills Advanced Level

1. If the velocity (V) , acceleration (A) , and force (F) are taken as fundamental quantities instead of mass (M) , length (L), and $time(T)$, the dimensions of young's modulus (Y) would be

Watch Video Solution

2. 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`.

Watch Video Solution

3. If energy E, velocity v and time T are taken as fundamental quanties, the dimensional formula for surface tension is

Watch Video Solution

4. In a new system of units, value of speed of light $(c = 3 \times 10^8 m/s)$, Universal gravitational constant $(G = 6.67 \times 10^{-11})$ and acceleration due to gravity $(g = 9.8 m/s^2)$ are found to be unity. What are the units of mass, length and time in this new system of units?

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Revision Exercises Very Short Answer Questions

1. What is a physical quantity ?

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2. Define unit vector.

Watch Video Solution

3. What are fundamental units and derived units?

Watch Video Solution

4. Mass of a body cannot be zero.

Watch Video Solution

5. What is length? What is its SI unit?

View Text Solution

6. Write the SI unit of luminous intensity and the amount of substance.

Watch Video Solution

7. Write the SI unit of thermodynamic temperature.

Watch Video Solution

8. How many electrons constitute current of one ampere ?

Watch Video Solution

9. Define Chandraskhar limit.

View Text Solution

10. How is one second measured?

View Text Solution

11. What are different systems of unita used for measuring all kinds of physical quantities?

Watch Video Solution

12. Why are units required?

Watch Video Solution

13. What is the smallest measured mass?

Watch Video Solution

14. Why are SI units required?

Watch Video Solution

15. Define one light year.

View Text Solution

16. Define a Astronomical Unit.

Watch Video Solution

17. What is parsec? (or) Define one parsec (parallactic second)

Watch Video Solution

18. How many astronomical units make up one light year?

Watch Video Solution

19. How many radians are there in one minute?

View Text Solution

20. What is angular diameter of the sun and the moon as seen from earth?

View Text Solution

21. A rectangle has an area equal to $7.654 cm^2$. If its breadth is 2.3 cm, then calculate the length in accordance with the rules of significant figures.

Watch Video Solution

22. What is electron microscope ?

Watch Video Solution

23. How many unified atomic mass units are there in one kg?

View Text Solution

24. RADIOACTIVE DATING

Watch Video Solution

25. What is an atomic clock? How does it work?

Watch Video Solution

26. What is the accuracy of a cesium clock?

Watch Video Solution

27. Express giga in terms of femto.

View Text Solution

28. Define error in a measurement of any physical quantity.

Watch Video Solution

29. Define random errors.

Watch Video Solution

30. What is a systematic error ? How can it be removed ?

Watch Video Solution

31. Instrumental error can be minimised by

Watch Video Solution

32. What is a systematic error ? How can it be removed ?

Watch Video Solution

33. What is least count error? How can we reduce it?

Watch Video Solution

34. Round off 1.00876 to four significant digits.

Watch Video Solution

35. Define gross errors. Give example.

Watch Video Solution

36. How can we define fractional and percentage error?

Watch Video Solution

37. How is absolute error different from mean absolute error?

Watch Video Solution

38. What do we mean by accuracy?

Watch Video Solution

39. What is meant by precision in measurement ?

Watch Video Solution

40. Which of the following physical quantity should be measured more accurately in the expression $X = \frac{h^2 y^3 z}{b}$ for most accurate results?

View Text Solution

41. The number of significant figures in 0.007 is

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42. Which of the two readings is more accurate - 7.0 or 7.00?

Watch Video Solution

43. How can we reduce least count of any instrument?

Watch Video Solution

44. Can we reduce the permissible error in a result using same instrument?

Watch Video Solution

45. What are dimensions of physical quantities ? How do we represent them?

Watch Video Solution

46. How is dimensional formula related to dimensional equation?

View Text Solution

47. What are the dimensions of Reynolds number ?

Watch Video Solution

48. Is it possible for a constant to have dimensions?

View Text Solution

49. What is the dimensional formula of electric permittivity of free space?

Watch Video Solution

Revision Exercises Additional Questions

1. The number of significant digita in 0.002 is

A. 1

B. 2

C. 3

D. 4

Answer: A

View Text Solution

2. In expression $m = 3zx^3$, the significant figures in factor 3 are

A. 0

B. 1

C. 2

D. ∞

Answer: D

View Text Solution

3. Which of the following has largest value

A. One astronomical unit

B. One parsec

C. One light year

D. one light minute

Answer: B

View Text Solution

4. Dimensional formula for Joule's mechanical equivalent is

A. $\left[M^{-1}L^{-3}T^{4}A^{2}\right]$

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

C. $\left[M^{-1}LTA^{-1}\right]$

D. $\left[M^{-1}L^{-1}T^{4}\right]$

Answer: B

View Text Solution

Revision Exercises Fill In The Blanks

1. Planck's constant has dimensions .....

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2. The coefficient of elasticity has dimensions of .....

View Text Solution

View Text Solution

3. Momentum per unit volume has same dimensions as the .....

View Text Solution

4. ..... Errors are those errors which occure irregularly and by .....

Watch Video Solution

5. 8.0505 grams of a substance occupies a volume of 2.3 cm^3. The density of the substance with regard to significant figures is .....

Watch Video Solution

6. the device used for measuring the mass of atoms and molecules is

Watch Video Solution

7. Accuracy of screw gauge can be increased by ..... The number of divisions on circular scale.

Watch Video Solution

8. The number of significant figures in 0.080 is .....

Watch Video Solution

Revision Exercises Short Answer Questions

1. what are the characteristic of a standard unit?

Watch Video Solution

2. Mention some advantages of SI system of units.

Watch Video Solution

3. Mention drawback of C.G.S. system of units?

Watch Video Solution

4. Derive a relation between one parsec and one light year.

Watch Video Solution

5. Calculate the number of light minutes in one metre?

Watch Video Solution

6. Why are length, mass and time chosen as fundamental quantites in mechanics ?

Watch Video Solution

7. How many light minutes are there in one AU?

Watch Video Solution

8. What convention are followed while writing the scientific names ?

Watch Video Solution

9. What is parallax method? How is it used to measure large distances?

Watch Video Solution

10. Convert 1° and 1' to radians.

Watch Video Solution

11. Why are length, mass and time chosen as fundamental quantites in mechanics ?

Watch Video Solution

12. How much longer then a microsecond is a millisecond ?

Watch Video Solution

13. How many femto metres are there in one A.U.?

Watch Video Solution

14. Give one example of the following :

(a) Physical quantity that is dimensionless but has a unit

(b) A constant having dimensions

Watch Video Solution

15. Explain three types of errors observed in measurement.

Watch Video Solution

16. Write mathematical expression for absolute error and mean absolute error.

Watch Video Solution

17. Two identical resistors of resiatance $(2 \pm 0.1)\Omega$ are connected in series. Calculate the effective resistance along with the percentage error.

Watch Video Solution

18. The diameters of two cylinders are $d_1 = (2.02 \pm 0.01)cm$ and $d_2 = (3.21 \pm 0.03)$. Find the difference between their diameters along with the error limits.

Watch Video Solution

19. Differentiate between precision and accuracy with an example.

Watch Video Solution

20. Solve the following with regard to significant figures.

(a) $781 + 0.5321$

(b) $9.0 - 0.521$

Watch Video Solution

21. Compute the following with regard to significant figures.

(a) 5.2×0.135

(b) $\dfrac{0.8851 \times 1.23}{1.985}$

Watch Video Solution

22. For physical quantity z, given by expression $z = \frac{gh^{1/2}I}{mx^3}$, write the expression for relative error in it.

Watch Video Solution

23. We can reduce random errors by

Watch Video Solution

24. What is meant by dimensional equation ? Give an example.

Watch Video Solution

25. Convert Newton into dyne.

Watch Video Solution

26. Consider the equation $T = 2\pi\sqrt{\frac{l}{g}}$ and check whether it is correct or not.

Watch Video Solution

Revision Exercises Long Answer Questions

1. Write a short note on standard international units. Mention their importance.

Watch Video Solution

2. Explain the concept of mass, length and time. Why mass, length and time are called fundamental quantites.

Watch Video Solution

3. What are the limitations of dimensional analysis?

Watch Video Solution

4. Write a short note on applications and uses of dimensional analysis.

Watch Video Solution

5. Define error in measurement. What are different types of possible errors which occur in experiments?

Watch Video Solution

6. Briefly explain the causes of systematic errors.

Watch Video Solution

Revision Exercises Numerical Problems

1. Express the given angles into radian.

(a) 1°

(b) $12\,\text{sec.}$

View Text Solution

2. A distant star is observed from two diametrically opposite points on earth. If both the points are at distance $1.27 \times 10^7 m$ and angle subtended by both the points at star is $0.80''$, calculate the distance between earth and the star.

Watch Video Solution

3. The diameter of the moon is 3474km and is 384,400 km away from the earth. Calculate the angular diameter of the moon in arc minutes.

Watch Video Solution

4. In an experiment, the time period measurements for an oscillating simple pendulum are 2.10s, 2.12s, 2.23s, 2.62s and 2.92s. Find the relative error and absolute error in the experiment.

Watch Video Solution

5. In Ohm's law experimental verification, the reading of voltage and resistance are $(120 \pm 5)V$ and $(2 \pm 0.1)\Omega$ respectively. What is the percentage error in the value of current obtained?

Watch Video Solution

6. Two identical resistors of resistance 100 ± 5 ohm are connected parallel. Calculate the eqivalent resistance of the combination.

Watch Video Solution

7. The diameter of two cylingers are found to be $d_1 = (2 \pm 0.01)cm$ and $d_2 = (3.1 \pm 0.03)cm$. Find the difference between both the diameters along with the error limits.

Watch Video Solution

8. Gravitational force between two objects with mass m_1 and m_2 kept r distance apart is given as $F_G = \frac{Gm_1m_2}{r^2}$, where G is gravitational constant. Express the relative error in F_G.

Watch Video Solution

9. Calculate the volume of cylinder with radius 1.123 cm and height 2.101 cm in appropriate significant figures.

Watch Video Solution

10. Check the dimensional consistency of the equation $\frac{mV^2}{r} = \frac{Gm_1m_2}{r^2}$.

Watch Video Solution

11. An oil drop of radius $0.10mm$ spreads on a circular film of diameter 20 cm. Calculate the molecules size of the oil drop on the film.

Watch Video Solution

12. Calculate the percentage error in the volume of a cube if error in the measurement of its each side is 12%.

Watch Video Solution

13. State the number of significant figures in the following measurements :

(a) 2.80×10^8

(b) 8.034

(c) $0.0009.$

Watch Video Solution

14. Round off the given numbers upto 3 significant digits.

(a) 18.65

(b) 429253

(c) 13.653.

Watch Video Solution

15. Obtain an expression for the centripetal force F acting on a particle of mass m moving with velocity v in a circle of radius r . Take dimensionless constant K = 1 .

Watch Video Solution

16. For a given expression of power, $P = \frac{a}{bx} - \frac{t^2}{b}$. Determine the dimensions of a and b. Here, x and t are distance and time respectively.

Watch Video Solution

17. For a planet of mass M, moving around the sun in an orbit of radius r, time period T depends on its radius (r),

mass M and universal gravitational constant G and can be written as : $T^2 = \frac{Kr^y}{MG}$. Find the value of y.

Watch Video Solution

Competition File Objective Type Questions Mcqs

1. What will be the value of 3.725 after rounding off to three significant digits?

A. 3.73

B. 3.72

C. 3.71

D. None of these

Answer: B

 Watch Video Solution

2. What will be the value of 3.735 after rounding off to three significant digits?

A. 3.73

B. 3.74

C. 3.72

D. None of these

Answer: B

 Watch Video Solution

3. A simple of material having mass 8.89g occupies a volume of $1.9cm^3$. What will be the density of material with correct significant digits?

A. $4.678g/cc$

B. $4.6g/cc$

C. $4.7g/cc$

D. $4.68g/cc$

Answer: C

Watch Video Solution

4. In a vernier caliper, 9 divisions of main scale match with 9+n divisions of vernier scale. What should be the value of n

so that count of the instrument remains at minimum possible value?

A. 1

B. 9

C. 2

D. None of these

Answer: A

Watch Video Solution

5. A physical quantity is measured and the result is expressed as nu where u is the unit used and n is the

numberical value. If the result is expressed in various units then

A. $n \propto 1/u$

B. $n \propto u$

C. $n \propto u^2$

D. $n \propto u^3$

Answer: A

Watch Video Solution

6. If the unit of length and force be increased four times, then the unit of energy is

A. 4 times

B. 8 times

C. 16 times

D. None of these

Answer: C

Watch Video Solution

7. What is the unit of 'a' in terms of fundamental units in Van der waal's equation

$\left(P + \frac{a}{V^2}\right)(V - b) = RT$?

A. ML^5T^{-2}, L^3

B. $ML^{-1}T^{-1}, L^3$

C. MLT, L^2

D. None of these

Answer: A

Watch Video Solution

8. Velocity of a particle at time t is expressed as follows :

$$v = \alpha t + \frac{\beta}{t + \gamma}$$

Dimensions of $\alpha, \beta \text{ and } \gamma$ are respectively.

A. L^3, T, LT^{-1}

B. LT^{-2}, L, T

C. L, T, LT^{-1}

D. None of these

Answer: B

Watch Video Solution

9. In the relation $p = \frac{a}{\beta} e^{\frac{aZ}{k\theta}}$, p is pressure Z is distance .k is Boltzman constant and θ is the temperature . The dimensional formula of β will be

A. $M^1L^2T^2$

B. $M^0L^2T^0$

C. $M^2L^0T^1$

D. None of these

Answer: B

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10. A quantity X is given by $\varepsilon_p L \frac{\delta V}{\delta t}$, where ε_p is the permitivity of free space ,L is a length , δV is a potential difference and δt is a time interval . The dimensional formula for X is the same as that of

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

B. $M^1 L^0 T^0 A$

C. $M^0 L^1 T^0 A$

D. None of these

Answer: A

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11. The dimensions of $\frac{1}{2}\varepsilon_0 E^2 (\varepsilon_0 =$ permittivity of free space, $E =$ electric field) is

A. $ML^{-1}T^{-2}$

B. $ML^{-1}T^{-1}$

C. MLT^{-2}

D. None of these

Answer: A

Watch Video Solution

12. Number of particles is given by $n = -D\frac{n_2 - n_1}{x_2 - x_1}$ crossing a unit area perpendicular to X-axis in unit time, where n_1 and n_2 are number of particles per unit volume

for the value of x meant to x_2 and x_1. Find dimensions of D called as diffusion constant

A. $\left[M^0L^2T^{-1}\right]$

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

C. $\left[MLT^{-1}\right]$

D. None of these

Answer: A

Watch Video Solution

13. Volume flow rate through a capillary tube is given by $V = \frac{K(r_2 - r_1)^4}{(x_2 - x_1)}$, where r_1 and r_2 are the inner and

outer radii and x_1 and x_2 are the positions crossed by the liquid. What will be the dimensional formula for K?

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

B. $[M^0L^0T^{-2}]$

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

D. None of these

Answer: C

Watch Video Solution

14. Marks on main scale of vernier caliper are made at 1mm separation. There are 25 equal divisions on vernier scale

and the same matches with 20 divisions on main scale. What is the least cound of given vernier caliper?

A. $0.1mm$

B. $0.25mm$

C. $0.15mm$

D. $0.2mm$

Answer: D

Watch Video Solution

15. A wire has a mass $0.3 \pm 0.003g$, radius $0.5 \pm 0.005mm$ and length $6 \pm 0.06cm$. 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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16. Edge length of a cube is $1.7 \times 10^{-2} m$. What will be the volume of cube with correct significant digits?

A. $4.913 \times 10^{-6} m^3$

B. $4.91 \times 10^{-6} m^3$

C. $4.9 \times 10^{-6} m^3$

D. $4.92 \times 10^{-6} m^3$

Answer: C

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17. Percentage error in mass and momentum are 3% and 2% respectively. Maximum possible percentage error in the kinetic energy is

A. 7%

B. 2%

C. 4%

D. 3%

Answer: A

Watch Video Solution

18. The least count of a stop watch is 0.2 s, The time of 20 oscillations of a pendulum is measured to be 25s. The percentage error in the time period is

A. 8%

B. 0.8%

C. 1.8%

D. 2%

Answer: B

Watch Video Solution

19. Acceleration due to gravity is to be measured using simple pendulum. If a and b are percentage errors in the measurement of length and time period respectively, then percentage error in the measurement of acceleration due to gravity is

A. $a - 2b$

B. $2a - b$

C. $a + 2b$

D. $b + 2a$

Answer: C

Watch Video Solution

20. Radius of a circle is 2.23m. Area of the circle is

A. $15.6m^2$

B. $15.6149m^2$

C. $15.615m^2$

D. $15.62m^2$

Answer: A

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Competition File Objective Type Questions Mcqs Aipmt Neet Other State Boards For Medical Entrance

1. Which of the following pairs does not have similar dimensions ?

A. Stress and pressure

B. Angle and strain

C. Tension and surface tension

D. Planck's constant and angular momentum

Answer: C

Watch Video Solution

2. The length and breadth of a metal sheet are 3.124m and 3.002m respectively. The area of this sheet upto correct significant figure is

A. $9.37m^2$

B. $9.\ 378m^2$

C. $9.3782m^2$

D. $9.378248m^2$

Answer: B

Watch Video Solution

3. The dimensions of the electric susceptibility are :

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

B. $\left[M^0L^{-2}T^0A^2\right]$

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

D. $\left[M^0L^{-1}T^0A^2\right]$

Answer: A

Watch Video Solution

4. Dimensional formula for coefficient of restitution

A. MLT^{-2}

B. $ML1T^{-2}$

C. $ML2T^{-1}$

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

Answer: D

Watch Video Solution

5. The quantity that has dimensions of time is :

A. $\frac{R}{L}$

B. $\frac{1}{RC}$

C. $\sqrt{LC}$

D. Light year

Answer: C

Watch Video Solution

6. If the energy (E) ,velocity (v) and force (F) be taken as fundamental quantities,then the dimension of mass will be

A. Fv^{-2}

B. Fv^{-1}

C. Ev^{-2}

D. Ev^2

Answer: C

Watch Video Solution

7. Pick out the wrong pair :

A. charge-coulomb

B. temperature-thermometer

C. pressure-barometer

D. sp. Gravity-hydrometer

Answer: A

Watch Video Solution

8. The instrument to measure time is :

A. barometer

B. chronometer

C. radiometer

D. None of these

Answer: B

Watch Video Solution

9. The main scale of a vernier callipers has n divisions/cm. n divisions of the vernier scale coincide with (n-1) divisions of main scale. The least count of the vernier callipers is,

A. $\frac{1}{n(n+1)}cm$

B. $\frac{1}{(n+1)(n-1)}cm$

C. $\frac{1}{n}cm$

D. $\frac{1}{n^2}cm$

Answer: D

Watch Video Solution

10. A cube has a side of length $1.2 \times 10^{-2} m$. Calculate its volume

A. $1.7 \times 10^{-6} m^3$

B. $1.73 \times 10^{-6} m^3$

C. $1.70 \times 10^{-6} m^3$

D. $1.732 \times 10^{-6} m^3$

Answer: A

Watch Video Solution

11. A student measued the diameter of a small steel ball using a screw gauge of least count $1.001 cm$. The main scale reading is $5 mm$ and zero of circular scale division coincides

with 25 divisions above the reference level. If screw gauge has a zero erroof $-0.004cm$, the correct diameter of the ball is

A. $0.053cm$

B. $0.525cm$

C. $0.521cm$

D. $0.529cm$

Answer: D

Watch Video Solution

12. Presure gradient has the ssame dimension as that of

A. velocity gradient

B. potential gradient

C. energy gradient

D. None of these

Answer: D

Watch Video Solution

13. The unit of permittivity of free space ε_0 is:

A. $\text{newton metre}^2/\text{coulomb}^2$

B. $\text{coulomb}^2/\text{newton metre}^2$

C. $\text{coulomb}^2/(\text{newton metre})^2$

D. coulomb/newton metre

Answer: B

Watch Video Solution

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. L, LT and T^2

B. LT^2, L and T

C. L^2, T and LT^2

D. LT^2, L and L

Answer: B

Watch Video Solution

15. The physical quantity having the dimensions $\left[M^{-1}L^{-3}T^{3}A^{2}\right]$ is

A. electromotive force

B. electrical conductivity

C. electrical resistivity

D. electrical resistance

Answer: B

Watch Video Solution

16. If the error in the measurement of radius of a sphere in 2% then the error in the determination of volume of the spahere will be

A. 6%

B. 8%

C. 12%

D. 4%

Answer: A

Watch Video Solution

17. Which two of the following five physical parameters have the same dimension?

(1) Energy density

(2) refractive index

(3) dielectric constant

(4) Young's modulus

(5) magnitic field

A. C and E

B. A and D

C. A and E

D. B and D

Answer: B

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18. Dimension of resistance in an elecatrical circuit, in terms of dimension of mass M, of length L, of time T, and of current I, would be

A. ML^2T^{-2}

B. $ML^2T^{-1}I^{-1}$

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

D. $ML^2T^{-3}I^{-1}$

Answer: C

Watch Video Solution

19. A force F is given by $F = at + bt^2$, where t is time . What are the dimensions of a and b?

A. MLT^{-1} and MLT^{0}

B. MLT^{-3} and $ML^{2}T^{4}$

C. MLT^{-4} and MLT^{1}

D. MLT^{-3} and MLT^{-4}

Answer: D

Watch Video Solution

20. 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. Acceleration if $a = 1, b = 1, c = -2$

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

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

Answer: D

Watch Video Solution

21. The dimensions of $\frac{1}{2} \in_0 E^2$, where $\in_0$ is permittivity of free space and E is electric field, is :-

A. ML^2T^{-1}

B. MLT^{-1}

C. ML^2T^{-2}

D. $ML^{-1}T^{-2}$

Answer: D

Watch Video Solution

22. The position of a particle at time t is given by the relation $x(t) = \frac{v_0}{A}\left(1 - e^{-At}\right)$, where v_0 is constant and $A > 0$. The dimensions of v_0 and A respectively

A. $\left[M^0 LT^{-1}\right]$ and $\left[T^{-1}\right]$

B. $\left[M^0 LT^0\right]$ and $\left[T^{-1}\right]$

C. $\left[M^0 LT^{-1}\right]$ and $\left[LT^{-2}\right]$

D. $\left[M^0 LT^{-1}\right]$ and $[T]$

Answer: A

Watch Video Solution

23. An object is moving through the liquid. The viscous damping force acting on it is proportional to the velocity. Then dimensions of constant of proportionality are

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

B. MLT^{-1}

C. $M^0L^{-1}T^{-1}$

D. ML^0T^{-1}

Answer: D

Watch Video Solution

24. If L, C and R denote the inductance, capacitance and resistance respectively, the dimensional formula for C^2LR

is

A. $ML^2T^{-1}I^0$

B. $M^0L^0T^3I^0$

C. $M^{-1}L^{-2}T^6I^2$

D. $M^0L^0T^2I^0$

Answer: B

Watch Video Solution

25. If velocity (V) , force (F), and energy (E) are taken as fundamental units , then find the dimensional formula for mass.

A. FTV^{-1}

B. $F^{-1}TV$

C. $F^{-1}T^{-1}V$

D. $FT^{-1}V^{-1}$

Answer: A

Watch Video Solution

26. Length cannot be measured by

A. fermi

B. debye

C. micron

D. Light year

Answer: B

Watch Video Solution

27. Using mass (M), length (L), time (T) and current (A) as fundamental quantities, the dimensions of permeability are :

A. $M^{-1}LT^{-2}A$

B. $ML^2T^{-2}A^{-1}$

C. $MLT^{-2}A^{-2}$

D. $MLT^{-1}A^{-1}$

Answer: C

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28. The dimensions of $\frac{a}{b}$ in the equation $P = \frac{a - t^2}{bx}$ where P is pressure, x is distance and t is time are

A. LT^{-3}

B. ML^3T^{-1}

C. M^2LT^{-3}

D. MT^{-2}

Answer: D

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29. The length, breadth and thickness of a block are given by l=12 cm , b=6cm and t=2.45 cm. The volume of the block according to the idea of significant figures should be

A. $1 \times 10^2 cm^3$

B. $2 \times 10^2 cm^3$

C. $1.763 \times 10^2 cm^3$

D. None of these

Answer: B

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30. The dimensional formula of light year is :

A. $[L^{-1}]$

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

C. $[L]$

D. $[T]$

Answer: C

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31. Using mass (M), length (L), time (T) and current (A) as fundamental quantities, the dimension of permittivity is:

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

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

C. $[M^{-1}L^{-3}T^{4}A^{2}]$

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

Answer: B

Watch Video Solution

32. The magnetic moment has dimensions of

A. $[LA]$

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

C. $\left[LT^{-1}A\right]$

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

Answer: B

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33. The dimensions of $\left[\mu_0 \in_0\right]^{\frac{1}{2}}$ are :

A. $\left[L^{\frac{1}{2}} T^{-\frac{1}{2}}\right]$

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

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

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

Answer: B

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34. In an experiment, the percentage of error occurred in the in the measurement of physical quantities A,B,C and D are $1\%, 2\%, 3\%$ and 4% respectively. Then the

maximum percentage of error in the measurement X, where $X = \frac{A^2 B^{1/2}}{C^{1/3} D^3}$, will be

A. $\frac{3}{13}\ \%$

B. $16\ \%$

C. $-10\ \%$

D. $10\ \%$

Answer: B

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35. 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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36. If energy E, velocity v and time T are taken as fundamental quanties, the dimensional formula for surface tension is

A. $\left[EV^{-2}T^{-1}\right]$

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

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

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

Answer: C

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37. A physical energy of the dimension of length that can be formula cut of c, G and $\frac{e^2}{4\pi\varepsilon_0}$ is [c is velocity of light G is universal constant of gravilation e is change

A. $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{\frac{1}{2}}$

B. $c^2\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{\frac{1}{2}}$

C. $\frac{1}{c^2}\left[\frac{e^2}{G4\pi\varepsilon_0}\right]^{\frac{1}{2}}$

D. $\frac{1}{c}G\frac{e^2}{4\pi\varepsilon_0}$

Answer: A

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Competition File Objective Type Questions Mcqs Jee Main Other State Boards For Engineering Entrance

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

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

C. α

D. $\frac{5}{2}\alpha$

Answer: A

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2. In a screw gauge, 5 complete rotations of the screw cause if to move a linear distance of $0.25cm$. There are 100 circular scale divisions. The thickness of a wire measured by this screw gauge gives a reading of 4 main scale divisions and 30 circular scale divisions. Assuming negligible zero error, the thickness of the wire is :

A. $0.4300cm$

B. $0.3150cm$

C. $0.0430cm$

D. $0.2150cm$

Answer: D

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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. 4.5%

B. 6%

C. 2.5%

D. 3.5%

Answer: A

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4. 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. $3.32mm$

B. $3.73mm$

C. $3.67mm$

D. $3.38mm$

Answer: D

Watch Video Solution

5. The pitch and the number of divisions, on the circular scale, for a given screw gauge are 0.5 mm and 100 respectively without any object, the zero of its circular scale

lies 3 divisions below the mean line.

The readings of the main scale and the circular scale, for a thin sheet, are 5.5 mm and 48 respectively, the thickness of this sheet is :

A. $5.740mm$

B. $5.950mm$

C. $5.725mm$

D. $5.755mm$

Answer: D

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6. 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. $6.5\ \%$

B. $7.5\ \%$

C. $6.0\ \%$

D. $8.5\ \%$

Answer: A

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7. in an experiment the angles are required to be using an instrument, 29 divisions of the main scale exactly coincide with the 30 divisions of the vernier scale. If the sallest division of the main scale is half- a degree $(=0.5^{\circ}$, then the least count of the instrument is :

A. 1 minute

B. half minute

C. one degree

D. half degree

Answer: A

Watch Video Solution

8. In a screw gauge, 5 complete rotations of the screw cause if to move a linear distance of $0.25cm$. There are 100 circular scale divisions. The thickness of a wire measured by this screw gauge gives a reading of 4 main scale divisions and 30 circular scale divisions. Assuming negligible zero error, the thickness of the wire is :

A. $0.4300cm$

B. $0.3150cm$

C. $0.0430cm$

D. $0.2150cm$

Answer: D

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9. 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. 59 degree

B. 58.59 degree

C. 58.77 degree

D. 58.65 degree

Answer: D

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10. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measurement of the current and the voltage difference are 3% each, then error in the value of resistance of the wire is

A. 3%

B. 6%

C. zero

D. 1%

Answer: B

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11. Let $[\in_0]$ denote the dimensional formula of the permittivity of vacuum. If M= mass, L=length, T=Time and A= electric current, then:

A. $[\varepsilon_0] = [M^{-1}L^{-3}T^4A^2]$

B. $[\varepsilon_0] = [M^{-1}L^2T^{-1}A^{-2}]$

C. $[\varepsilon_0] = [M^{-1}L^2T^{-1}A]$

D. $[\varepsilon_0] = [M^{-1}L^{-3}T^2A]$

Answer: A

Watch Video Solution

12. Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to:

A. $\sqrt{\frac{hc^5}{G}}$

B. $\sqrt{\frac{Gh}{c^3}}$

C. $\sqrt{\frac{c^3}{Gh}}$

D. $\sqrt{\frac{Gh}{c^5}}$

Answer: D

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13. 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. $3\,\%$

B. $1\,\%$

C. $5\,\%$

D. $2\,\%$

Answer: A

Watch Video Solution

14. 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 . $Ifthe \min i\mu m \div ision \in themeasur \in gclockis1$ s`, then the reported men time should be:

A. $92 \pm 2s$

B. $92 \pm 5.0s$

C. $92 \pm 1.8s$

D. $92 \pm 3s$

Answer: C

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15. A screw gauge with a pitch of $0.5mm$ and a circular scale with 50 divisions is used to measure the thicknes of a thin sheet of Aluminium. Before starting the measurement, it is found that wen the jaws of the screw gauge are brought in cintact, the 45^{th} division coincide with the main scale line and the zero of the main scale is barely visible. what is the thickness of the sheet if the main scale readind is $0.5mm$ and the $25th$ division coincide with the main scale line?

A. $0.75mm$

B. $0.80mm$

C. $0.70mm$

D. $0.50mm$

Answer: B

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

A. $\frac{ch}{2\pi\varepsilon_0^2}$

B. $\frac{e^2}{2\pi\varepsilon_0 G m_e^2}$

C. $\frac{m_0\varepsilon_0}{c^2}\frac{G}{he^2}$

D. $\frac{2\pi\sqrt{\mu_0\varepsilon_0}}{ce^2}\frac{h}{G}$

Answer: B

View Text Solution

17. In terms of resistance R and time T, the dimension of ratio $\frac{\mu}{\varepsilon}$ of the permeability μ and permittivity ε is :

A. RT^{-2}

B. R^2T^{-2}

C. R^2

D. R^2T^2

Answer: C

Watch Video Solution

18. 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

Watch Video Solution

19. 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

Watch Video Solution

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

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

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

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

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

Answer: C

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

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

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

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

Answer: C

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

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

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

D. $\frac{C}{BD} - \frac{AC^2}{C}$

Answer: B::D

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

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

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

Answer: A

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24. A physical quantity P is described by the relation $P = a^{\frac{1}{2}}b^{2}c^{3}d^{-4}$. If the relative errors in the measurement

of a,b,c and d respectively, are 2%, 1%, 3% asd 5%, then the relative error in P will be :

A. 8%

B. 12%

C. 32%

D. 25%

Answer: C

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25. A man grows into a giant such that his linear dimension increase by a factor of 9. Assuming that his density remains same, the stress in the leg will change by a factor of

A. 9

B. $\frac{1}{9}$

C. 81

D. $\frac{1}{81}$

Answer: A

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26. The area of a square is $5.29cm^2$ The area of 7 such squares taking into account the significant figures is:

A. $37.0cm^2$

B. $37cm^2$

C. $37.03cm^2$

D. $37.030 cm^2$

Answer: A

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Competition File Objective Type Questions Mcqs Jee Advanced For Iit Entrance

1. A vernier calipers has $1 mm$ marks on the main scale. It has 20 equal divisions on the Verier scale which match with 16 main scale divisions. For this Vernier calipers, the least count is

A. $0.02 mm$

B. $0.05 mm$

C. $0.1mm$

D. $0.2mm$

Answer: D

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2. Which of the following set have different dimensions?

A. Pressure, Young's modulus, stress

B. emf, potential difference, electric potential

C. heat, work done, energy

D. dipole moment, electric flux, electric field

Answer: D

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3. A quantity X is given by $\varepsilon_p L \frac{\delta V}{\delta t}$, where ε_p is the permitivity of free space ,L is a length , δV is a potential difference and δt is a time interval . The dimensional formula for X is the same as that of

A. resistance

B. charge

C. voltage

D. current

Answer: D

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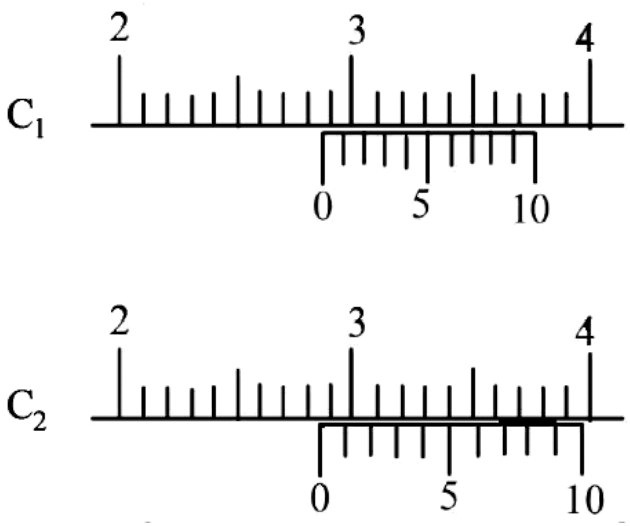
4. There are two Vernier calipers both of which have $1cm$ divided into 10 equal divisions on the main scale. The vernier scale of the calipers (c_1) has 10 equal divisions that correspond to 9 main scale divisions. The Vernier scale of the other calipers (C_2) has 10 equal divisions tgat correspond to 11 main scale divisions. the reading of the two calipers are shown in the figure. the measured values (in cm) by calipers C_1 and C_2 respectively, are



A. 2.87 and 2.86

B. $2.85 \text{ and } 2.82$

C. $2.87 \text{ and } 2.87$

D. $2.87 \text{ and } 2.83$

Answer: D

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5. In an experiment to determine the acceleration due to gravity g, the formula used for the time period of a periodic motion is $T = 2\pi\sqrt{\left(7\frac{R-r}{5g}\right.}$. The values of $R \text{ and } r$ are measured to be $(60 \pm 1)mm \text{ and } (10 \pm 1)mm$, repectively. In five successive measurment, the time period is found to be $0.52s, 0.56s, 0.57s, 0.54s \text{ and } 0.59s$. the least count of the watch used for the measurement of time

period is $0.01s$. Which of the following satement (s) is (are) true?

A. The error in the measurement of r is 10%

B. The error in the measurement of T is 3.57%

C. The error in the measurement of T is 2%

D. The error in the determined value of g is 11%

Answer: A

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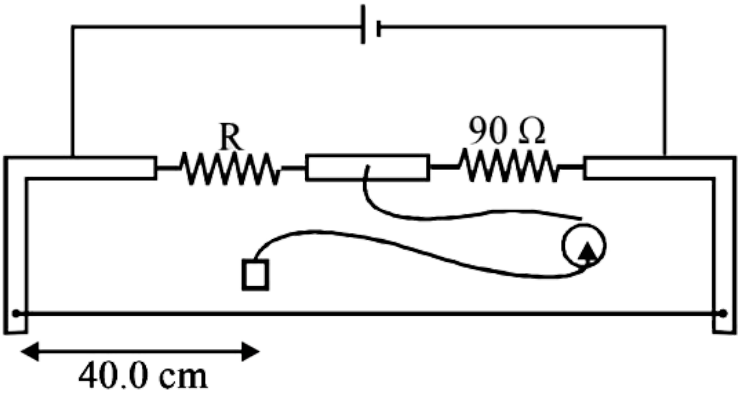
6. During an experiment with a metre bridge, the galvanometer shows a null point when the jockey is pressed at $40.0cm$ using a standard resistance of 90Ω, as shown in

the figure. The least count of the scale used in the metre bridge is 1mm. The unknown resistance is



A. $60 \pm 0.15\Omega$

B. $135 \pm 0.56\Omega$

C. $60 \pm 0.25\Omega$

D. $135 \pm 0.23\Omega$

Answer: C

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7. The diameter of a cylinder is measured using a Vernier callipers with no zero error. It is found that the zero of the Vernier scale lies between $5.10cm$ and $5.15cm$ of the main scale. The Vernier scale has 50 divisions equivalent to $2.45cm$. The 24^{th} division of the Vernier scale exactly coincides with one of the main scale divisions. the diameter of the cylinder is

A. $5.112cm$

B. $5.124cm$

C. $5.136cm$

D. $5.\ 148cm$

Answer: B

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8. Using the expression $2d \sin\theta = \lambda$, one calculates the values of d by measuring the corresponding angles θ in the range $0 \rightarrow 90 \circ$. The wavelength λ is exactly known and error in θ is constant for all values of θ. As θ increases from $0 \circ$

A. the absolute error in d remains constant

B. the absolute error in d increases

C. the fractional error in d remains constant

D. the fractional error in d decreases

Answer: D

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9. A person measures the depth of a well by measuring the time interval between dropping a stone and receiving the sound of impact with the bottom of the well. The error in his measurement of time is $e < aT = 0.01$ seconds and he measures the depth of the well to be $L = 20$ meters. Take the acceleration due to gravity $g = 10ms^{-2}$ and the velocity of sound is $300ms^{-1}$. Then the fractional error in the measurement, $\delta L / L$, is closest to

A. $0.2\,\%$

B. $3\,\%$

C. $5\,\%$

D. $1\,\%$

Answer: D

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10. 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$withanuncerta \int yof$+-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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11. Consider the ratio $r = \left(\frac{(1-a)}{(1+a)}\right)$ to be determined by measuring a dimensionless quantity a. If the error in the measurement of a is $\triangle a (\triangle a/a << 1)$, then what is the error $\triangle r$ in determining r?

A. $\frac{\triangle a}{(1+a)^2}$

B. $\frac{2 \triangle a}{(1+a)^2}$

C. $\frac{2 \triangle a}{(1-a)^2}$

D. $\frac{2a \triangle a}{(1-a)^2}$

Answer: B

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12. 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 $0.5mm$ and there are 50 divisions on the circular scale. The reading on the main scale is $2.5mm$ and that on 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%

Answer: C

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13. In the determination of Young's modulus $\left(Y = \frac{4MLg}{\pi / d^2}\right)$ 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 l = 0.25 mm in the length of the wire is observed. Quantities d and l are 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 measurement 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 l

Answer: A

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Competition File Objective Type Questions Mcqs With More Than One Correct Answer

1. Pairs of physical quantities having same dimensions are

A. Reynolds number and strain

B. Torque and force

C. Curie and frequency

D. Gravitational potential and latent heat

Answer: A::C::D

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2. A vernier caliper has 50 divisions which are equivalent to 2.45 cm. Main scale reading of vernier caliper is found to be 4.15 cm. Markings on main scale are at 0.05 cm. The 24th division of vernier scale matches with one of the main scale divisions.

A. Least count $= 0.001cm$

B. Least count $= 0.001mm$

C. Final reading $= 4.174cm$

D. Final reading $= 4.157cm$

Answer: A::C

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3. Two physical quantities P and Q have different dimensions. Which of the following mathematical operation is/are possible?

A. $\frac{P}{Q}$

B. PQ

C. $P+Q$

D. $P-Q$

Answer: A::B

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4. 10 vernier scale divisions VSD match with 9 main scale divisions MSD. Least count of the given vernier caliper is

A. $0.1mm$ if $1MSD = 1mm$

B. $0.05cm$ if $1MSD = 0.05cm$

C. $0.01mm$ if $1MSD = 1mm$

D. $0.005cm$ if $1MSD = 0.05cm$

Answer: A::D

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5. Select the correct options

A. Dimensionally correct equation must be correct

B. Dimensionally correct equation may be incorrect

C. Dimensionally correct equation may be correct

D. Dimensionally incorrect equation must be incorrect

Answer: B::C::D

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6. Accuracy of measurement is determined by

A. Absolute error

B. Relative error

C. Percentage error

D. None of these

Answer: B::C

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7. A dimensionless quantity

A. Must not have a unit

B. May have a unit

C. May not have a unit

D. Must have a unit

Answer: B::C

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8. United physical quantity

A. can have non-zero dimensions

B. cannot have non-zero dimensions

C. must have zero dimensions

D. does not exist

Answer: B::C

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9. The dimensions of $\left[ML^{-1}T^{-2}\right]$ may correspond to

A. impulse of a force

B. pressure

C. energy

D. energy per unit volume

Answer: B::D

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10. Which of the following sets of physical quantities can be used as fundamental quantities in a system of units?

A. length, velocity and acceleration

B. length, mass and acceleration

C. length, mass and time

D. mass, time and accleration

Answer: B::C::D

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11. A length - scale (l) depends on the permittivity (ε) of a dielctric material. Boltzmann constant (k_B), the absolute tempreture (T), the number per unit volume (n) of certain charged particles, and the charge (q) carried by each of the partcles. which of the following expression (s) for I is (are) 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. $l = \sqrt{\left(\frac{q^2}{\varepsilon n^{\frac{2}{3}} k_B T}\right)}$

D. $l = \sqrt{\left(\frac{q^2}{\varepsilon n^{\frac{1}{3}} k_B T}\right)}$

Answer: B::D

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

A. Error $\triangle T$ in measuring T, the time period, is 0.05s.

B. Error $\triangle T$ in measuring T, the time period, is 1s.

C. percentage error in the determination of g is 5%

D. percentage error in the determination of g is 2.5%

Answer: A::C

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13. 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)

C. (66,33)

D. (78,39)

Answer: C::D

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14. If in a hypothetical system if the angular momentum and mass are dimensionless. Then which of the following is true.

A. The dimension of force is L^{-3}

B. The dimension of energy is L^{-2}

C. The dimension of power is L^{-5}

D. The dimension of linear momentum is L^{-1}

Answer: A::B::D

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Competition File Objective Type Questions Mcqs Based On A Given Passage Comprehension

1. What is least count of the given vernier caliper?

There is one vernier caliper in which 1 main scale division (MSD) is 1mm. It is given that 10 divisions of vernier scale match with 9 divisions of main scale. Given vernier caliper is used to measure the edge of a cube. Main scale reading (MSR) was found to be 10 and first division of the vernier scale was found to be coinciding with some division of the main scale. Mass of the cube is 2.736g.

A. $0.1mm$

B. $0.1cm$

C. $0.01mm$

D. $1\mu m$

Answer: A

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2. What is the edge length of the cube?

There is one vernier caliper in which 1 main scale division (MSD) is 1mm. It is given that 10 divisions of vernier scale match with 9 divisions of main scale. Given vernier caliper is used to measure the edge of a cube. Main scale reading (MSR) was found to be 10 and first division of the vernier scale was found to be coinciding with some division of the main scale. Mass of the cube is 2.736g.

A. $1.01mm$

B. $1.01cm$

C. $10.1cm$

D. $1.001cm$

Answer: B

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3. The edge of a cube is measured using a vernier callipers. [9 divisions of the main scale is equal to 10 divisions of the vernier scale and 1 main scale dividsion is $1mm$]. The main scale division reading is 10 and $1st$ division of vernier scale was found to be coinciding with the main scale. The mass of the cube is $2.736g$. Calculate the density in g/cm^3 upto correct significant figures.

A. 1

B. 2

C. 3

D. 4

Answer: C

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4. 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 $10mm$ and first division of vernier scale coincides with the main scale. Mass of the cube is $2.736g$.

find the density of the cube in appropriate significant figures.

A. $1.03cm^3$

B. $1.0303cm^3$

C. $1.03mm^3$

D. $1.0303mm^3$

Answer: A

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5. 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 $10mm$ and first division of vernier scale coincides with the main scale. Mass of the cube is $2.736g$. find the density of the cube in appropriate significant figures.

A. $2.65g/cm^3$

B. $2.66g/cm^3$

C. $2.656g/cm^3$

D. $2.650g/cm^3$

Answer: B

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Competition File Assertion Reason Type Questions

1. Assertion : All equations which are physically correct must also be dimensionally correct.

Reason : All equations which are dimensionally correct must also be physically correct.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion.

B. If both assertion and reason are correct and reason is not the correct explanation of the assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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2. Assertion : Out of the two readings 15.25 and 15.256s, one is more precise.

Reason : Measurement with more decimal places are said to be more accurate.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion.

B. If both assertion and reason are correct and reason is not the correct explanation of the assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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3. A : When we change the unit of a measurement of a quantity, its numerical value changes.

R : The product of numerical value of the physical quantity and unit for a quantity remain constant.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion.

B. If both assertion and reason are correct and reason is not the correct explanation of the assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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4. Assertion : A physical quantity which has zero dimension may have unit of measurement.

Reason : Two physical entities having same dimensional formula may have different units of measurement.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion.

B. If both assertion and reason are correct and reason is not the correct explanation of the assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: B

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5. A : The maximum possible error in a reading is taken as least count of the measuring instrument.

R : Error in a measurement cannot be greater than least count of the measuring instrument.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion.

B. If both assertion and reason are correct and reason is not the correct explanation of the assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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6. Assertion : All physical quantities can be represented dimensionally in terms of the base quantities.

Reason : A base quantity cannot be represented dimensionally in terms of remaining base quantities.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion.

B. If both assertion and reason are correct and reason is not the correct explanation of the assertion.

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: B

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Competition File Matching Type Questions

1. Match the two lists

	List-I		List-II
P	Gravitational constant	1	$[ML^0T^{-2}]$
Q	Surface Tension	2	$[ML^2T^{-2}K^{-1}]$
R	Planck's constant	3	$[ML^2T^{-1}]$
S	Boltzmann's constant	4	$[M^{-1}L^3T^{-2}]$

A. P-1,Q-4,R-3,S-2

B. P-2,Q-3,R-1,S-4

C. P-4,Q-1,R-3,S-2

D. P-3,Q-4,R-2,S-1

Answer: C

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2. Match the two lists

List-I		List-II	
P	Boltzmann constant	1	$[ML^2T^{-1}]$
Q	Coefficient of viscosity	2	$[ML^{-1}T^{-1}]$
R	Planck constant	3	$[MLT^{-3}K^{-1}]$
S	Thermal conductivity	4	$[ML^2T^{-2}K^{-1}]$

A. P-3,Q-1,R-2,S-4

B. P-3,Q-2,R-1,S-4

C. P-4,Q-2,R-1,S-3

D. P-4,Q-1,R-2,S-3

Answer: C

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Competition File Matrix Match Type Questions

1. Match the two columns

	Column I		Column II
(A)	Stress	(p)	Joule
(B)	Coefficient of elasticity	(q)	ML^2T^{-2}
(C)	Work	(r)	N/m^2
(D)	Energy	(s)	$ML^{-1}T^{-2}$

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Competition File Integer Type Questions

1. What is the dimension of length in moment of inertia?

0,1,2,3,4,5,6,7,8,9.

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2. Consider the following equation $F = a\sqrt{x} + bt^2$**. If the dimensions of** a/b are $M^pL^qT^r$ **then calculate value of : - qr**

0,1,2,3,4,5,6,7,8,9.

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3. Assuming that the mass m of the largest stone that can be moved by a flowing river depends upon the velocity v,

of water, its density ρ and acceleration due to gravity g, then m is directly proportional to

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4. The energy of a system as a function of time t is given as $E(t) = A^2 \exp(-\alpha t)$, $\alpha = 0.2 s^{-1}$. The measurement of A has an error of $1.25\ \%$. If the error In the measurement of time is $1.50\ \%$, the percentage error in the value of $E(t)$ at t = 5 s` is

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5. During Searle's experiment, zero of the Vernier sacle lies between 3.20×10^{-2}, and $3.25 \times 10^{-2} m$ of the main

scale. The 20^{th} division of the Vernier scale exactly coincides with one of the main scale divisions. When an additional load of $2kg$ is applied to the wire, the zero of the vernier scale still lies between $3.20 \times 10^{-2},$ and $3.25 \times 10^{-2}m$ of the main scale but now the 45^{th} division of Vernier scale coincide with one of the main scale divisions. the length of the thin metallic wire is $2m$ and its cross-sectional ares is $8 \times 10^{-7}m^2$. the least count of the Vernier scale is $1.0 \times 10^{-5}m$. the maximum percentage error in the Young's modulus of the wire is

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6. To find the distance d over which a signal can be seen clearly in foggy conditions, a railways engineer uses dimensional analysis and assumes that the distance

depends on the mass density ρ of the fog, intensity $(\text{power}/\text{area})$ S of the light from the signal and its frequency f. The engineer finds that d is proportional to $S^{1/n}$. The value of n is.

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Chapter Practice Test

1. What are different systems of units used for measuring all kinds of physical quantities?

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2. How many astronomical units make up one light year?

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3. Define errors in a measurement of any physical quantity.

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4. Define precision and accuracy.

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5. How many significant digits are there in 7521.05890?

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6. Convert 1° and $1'$ to radians.

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7. Check the accuracy of the relation $T = 2\pi\sqrt{\frac{L}{g}}$ for a simple pendulum using dimensional analysis.

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8. What are random errors? How to minimise it?

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9. Convert Newton into dyne.

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10. A physical balance of least count 0.1 gram is used to measure the mass of an object. Write the results if mean value of the observed reading is 125.4g.

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11. The diameter of cylinders are $d_1 = (2.02 \pm 0.01)cm$ and $d_2 = (3.21 \pm 0.03)cm$ respectively. Find the difference between their dimensions along with the error limits.

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12. Explain three types of errors observed in measurement.

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13. Compute the following with regard to significant figures.

(a) 5.3×0.185

(b) $\frac{0.9251 \times 1.03}{1.285}$.

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14. How do we measure the standard international unit for mass, length and time? Also explain why they are also called fundamental units?

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15. Explain what is meant by dimensional analysis.

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