PHYSICS

BOOKS - SHREE BALAJI PHYSICS (HINGLISH)

UNIT AND DIMENSIONS

Example

1. Using dimensions find the value of 'g' in MKS system. The value in CGS system is 980.

Watch Video Solution

2. Convert a pressure of $76cm$ of mercury into Nm^{-2}. Density of mercury is $13.6gm/cc$.

Watch Video Solution

3. Find the dimensional method the value of Y in SI united when $Y = 20 \times 10^{11} \text{dyne} cm^{-2}$.

Watch Video Solution

4. If velocity of light, acceleration due to gravity and normal atmospheric pressure are taken as the fundamental units, what will be the units of mass, length and time? Given velocity of light $3 \times 10^8 ms^{-1}$, accelerating due to gravity $10 ms^{-2}$ and normal pressure $= 10^5 Nm^{-2}$.

Watch Video Solution

5. Check the accuracy of the equation

$$n = \frac{1}{2l}\sqrt{\frac{F}{m}}$$

where l is the length of the string, m its mass per unit length, F the stretching force and n the frequency of vibration.

Watch Video Solution

6. Check the accuracy of the relation $s = ut + \frac{1}{2}at^2$ where s is the distance travelled by the with uniform acceleration a in time t and having initial velocity u.

Watch Video Solution

7. Deduce the relation for the time period of a simple pendulum.

Watch Video Solution

8. Derive dimensionally the relation $s = ut + \frac{1}{2}ft^2$.

Watch Video Solution

9. If a composite physical quantity in terms of moment of inertia I, force F, velocity v, work W and length L is defined as,

$Q = \left(IFv^2 / WL^3\right)$,

find the dimensions of Q and identify it.

Watch Video Solution

10. If velocity, force and time are taken to be fundamental quantities find dimensional formula for (a) Mass, and (b) Energy.

Watch Video Solution

11. It is estimated that per minute each cm^2 of earth receives about 2 calorie of heat energy from the sun. This constant is called solar constant S. Express solar constant in SI units.

Watch Video Solution

12. $P = P_0 e^{-\left(\alpha t^2\right)}$

find dimensions of α, where P = pressure, t = time.

Watch Video Solution

13. The dimensins 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

Watch Video Solution

14. The position of a particle at time t, is given by the equation, $x(t) = \frac{v_0}{\alpha}(1 - e^{-\alpha t})$, where v_0 is a constant and $\alpha > 0$. The dimensions of v_0 & α are respectively.

Watch Video Solution

15. When a solid moves through a liquid, the liquid opposes the motion with a force F. The magnitude of F depends on the coefficient of viscosity η of the liquid, the radius r of the sphere and the speed v of the sphere. Assuming that F is proportional to different powers of these quantities, guess a formula for F using the method of dimension.

Watch Video Solution

16. If P is the pressure of a gas and ρ is its density , then find the dimension of velocity in terms of P and ρ .

Watch Video Solution

17. Young's modulus of steel is $19 \times 10^{10} \frac{N}{m^2}$. Expres it indyne/cm^2. Here dyne is the CGS unit of force.

Watch Video Solution

18. The dimensional formula for viscosity of fluids is,

$\eta = [M^{-1}L^{-1}T^{-1}]$

Find how many poise (CGS unit of viscosity) is equal to 1 poiseuille (SI unit of viscosity) ?

Watch Video Solution

Exercise

1. In two systems of units the relation between velocity acceleration and force is given by $v_2 = \frac{v_1 \varepsilon^2}{\tau}, a_2 = a_1 \varepsilon \tau, F_2 = \frac{F_1}{\varepsilon \tau}$, where ε and τ constants then find in this new system:

(a) $\frac{m_2}{m_1}$, (b) $\frac{L_2}{L_1}$

Watch Video Solution

2. In the formula $P = \frac{nRT}{V - b} e^{-\frac{a}{RTV}}$, find the dimensions of a and b where P = pressure, n = no. of moles, T = temperature, V = volume and R = universal gas constant.

Watch Video Solution

3. The loss of pressure when a fluid flows through a pipe is give by $P = k\rho^a l V^b d^c \mu$ where d and l are diameter and length of the pipe respectively, ρ, d and μ are the mass, density and coefficient of viscosity of the fluid, V is the mean velocity of flow through the pipe and k is a numerical constant. Find the values of a, b and c.

Watch Video Solution

4. $P = \frac{nx^y T}{V_0} e^{-\frac{Mgh}{nxT}}$, where n is number of moles, P is represents acceleration due to gravity and h is height. Find dimension of x and value of y.

Watch Video Solution

5. The units (U) of velocity acceleration and force in two systems are related as under:

(a) $U'_V = \frac{\alpha^2}{\beta} U_V$, (b) $U'_a = (\alpha\beta) U_a$

(c) $U'_F = \left[\frac{1}{\alpha\beta}\right] U_F$

All the primed symbols (U) belong to one system and unprimed ones (U) belong to the other systems. α and β are dimensionless constants. How momentum units of the two systems are related?

Watch Video Solution

6. Specific heat of hydrogen at constant pressure $C_p = 29 \text{joule kelvin}^{-1} mol^{-1}$.

(a) Find dimensions of C_p.

(b) Unit of length is changed to $50cm$, unit of time is changed to $2 \sec$, unit of temperature is changed to $2K$, keeping units of mass and amount of substance same. Find the value of specific heat of hydrogen in new system of units.

Watch Video Solution

Only One Alternative Is Correct

1. E, m, L, G denote energy mass, angular momentum & gravitation constant respectively. The dimensions of $\frac{EL^2}{m^5G^2}$ will be that of :

A. angle

B. length

C. mass

D. time

Answer: A

Watch Video Solution

2. The dimensional formula for which of the following pair is not the same ?

A. impulse and momentum

B. torque and work

C. stress and pressure

D. momentum and angular momentum

Answer: D

Watch Video Solution

3. If the speed of light c, acceleration due to gravity (g) and pressure (p) are taken as the fundamental quantities then the dimension of gravitational constant is

A. $[c^2 g^3 p^2]$

B. $[c^0 g^2 p^{-1}]$

C. $[c^2 g^2 p^{-2}]$

D. $[c^0 g p^{-3}]$

Answer: B

Watch Video Solution

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

A. $PQ - R$

B. PQ / R

C. $(P - Q) / R$

D. $(PR - Q^2) / QR$

Answer: C

Watch Video Solution

5. In a view unit system, 1 unit of time is equal to 10 second, 1 unit of mass is $5kg$ and 1 unit of length is $20m$. In the new system of units 1 unit of energy is equal to :

A. 20 joule

B. $\frac{1}{20}$ joule

C. 4 joule

D. 16 joule

Answer: A

Watch Video Solution

6. The dimensins 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. $[M^2LT^{-3}]$

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

C. $[LT^{-3}]$

D. $[ML^3T^{-1}]$

Answer: B

Watch Video Solution

7. The time dependence of a physical quantity P is given by $P = P_0 e^{-\alpha t^2}$, where α is a constant and t is time . Then constant α is//has

A. is dimensionless

B. has dimensions $[T^{-2}]$

C. has dimensions $[T^2]$

D. has dimensions of p

Answer: B

Watch Video Solution

8. If area (A) velocity (v) and density (ρ) are base units, then the dimensional formula of force can be represenited

A. $[Av\rho]$

B. $[Av^2\rho]$

C. $[Av\rho^2]$

D. $[A^2 v\rho]$

Answer: B

Watch Video Solution

9. Two forces P and Q act at a point and have resultant R. If Q is replaced by $\frac{(R^2 - P^2)}{Q}$ acting in the direction opposite to that of Q the resultant :

A. remains same

B. becomes half

C. becomes twice

D. none of these

Answer: A

Watch Video Solution

10. If instead of mass, length and time as fundamental quantities we choose velocity, acceleration and force as fundamental quantities and express their dimensional symbols as v, a and F respectively. Show that the dimensions of Young's modulus can be expressed as Fa^2v^{-4}

A. $[F\alpha^2v^{-4}]$

B. $[F^2v^{-1}\alpha]$

C. $[F\alpha^2v^{-1}]$

D. $[F\alpha v^{-2}]$

Answer: A

Watch Video Solution

11. Which of the following statements is correct about conversion of units, for example $1m = 100cm$?

A. Conversion of units have identical dimensions on each side of the equal sign but not the same units.

B. Conversion of units have identical dimensions on each side of the equal sign but not the same units.

C. If a larger unit is used then numerical value of physical quantity is large.

D. Due to conversion of units physical quantity to be measured will change.

Answer: A

Watch Video Solution

12. If the speed v of a particle of mass m as function of time t is given by $v = \omega A \sin\left[\left(\frac{\sqrt{k}}{m}\right)t\right]$, where A has dimension of length.

A. The argument of trigonometric function must be a dimensionless quantity.

B. Dimensional formula of ω is $\left[LT^{-1}\right]$

C. Dimensional formula of k is $[MLT^{-2}]$

D. Dimensional formula of $\sqrt{\frac{k}{m}}$ is $[T]$

Answer: A

Watch Video Solution

13. If P and Q have different non-zero dimensions, which of the following operations is possible ?

A. $P + Q$

B. PQ

C. $P - Q$

D. $1 - \frac{P}{Q}$

Answer: B

Watch Video Solution

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

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

B. $[M^{-3}L^{-2}T^4Q^4]$

C. $[M^{-2}L^{-2}T^4Q^4]$

D. $[M^{-3}L^{-2}T^4Q^1]$

Answer: B

Watch Video Solution

15. 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

16. Pressure depends on distance as, $P = \frac{\alpha}{\beta} \exp\left(\frac{-\alpha z}{k\theta}\right)$, where α, β are constants, z is distance, k is Boltzmann's constant and θ is temperature. The dimensions of β are :

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

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

C. $[M^0 L^2 T^0]$

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

Answer: C

Watch Video Solution

17. A wire of length $l = 6 \pm 0.06cm$ and radius $r = 0.5 \pm 0.005cm$ and mass $m = 0.3 \pm 0.003g$. Maximum percentage error in density is :

A. $4\,\%$

B. $2\,\%$

C. $1\,\%$

D. $6.8\,\%$

Answer: A

Watch Video Solution

18. Which of the following sets 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

Watch Video Solution

19. Which of the pair have same dimensions ?

A. Force and strain

B. Force and stress

C. Angular velocity and frequency

D. Energy and strain

Answer: C

Watch Video Solution

20. The physical quantities not having same dimensions are :

A. torque and work

B. momentum and Planck's constant

C. stress and Young's modulus

D. speed and $(\mu_0\varepsilon_0)^{-1/2}$

Answer: B

Watch Video Solution

21. The dimension of coefficient of viscosity is :

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

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

C. $[ML^0T^{-2}]$

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

Answer: A

Watch Video Solution

22. A particle is moving eastwards with velocity of $5m/s$. In $10\sec$ the velocity changes to $5m/s$ northwards. The average acceleration in this time is.

A. Zero

B. $\frac{1}{\sqrt{2}}ms^{-2}$ towards north-west

C. $\frac{1}{\sqrt{2}}ms^{-2}$ towards north-east

D. $\frac{1}{2}ms^{-2}$ towards north

Answer: B

Watch Video Solution

23. Out of the following the only pair that does not have identical dimensions is :

A. angular momentum and Planck's constant

B. moment of inertia and moment of a force

C. work and torque

D. impulse and momentum

Answer: B

Watch Video Solution

24. Which of the following units denotes the dimensions ML^2/Q^2, where Q denotes the electric charge ?

A. weber (Wb)

B. Wb/m^2

C. henry (H)

D. H/m^2

Answer: C

Watch Video Solution

25. The dimension of magnetic field in M, L, T and C (Coulomb) is given as :

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

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

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

D. $\left[MT^{-2}C^{-1}\right]$

Answer: C

Watch Video Solution

More Than One Alternatives Are Correct

1. Which of the following dimensions are correctly matched? $(\theta = \text{temperature})$

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

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

C. Stefan's constant $-[M^1T^{-3}\theta^{-4}]$

D. Planck's constant $-[M^1L^2T^{-2}]$

Answer: A::B::C

Watch Video Solution

2. The gas equation for n moles of a real gas is $\left(P+\frac{a}{V^2}\right)(V-b)=nRT$ where P is the pressure, V is the volume, T is the absolute temperature, R is the molar gas constant and a, b are arbitrary constants. Which of the following have the same dimensions as those of PV ?

A. nRT

B. a/V

C. Pb

D. ab/V^2

Answer: A::B::C::D

Watch Video Solution

3. The dimensions of the quantities in one (or more) of the following pairs are the same . Identify the pair(s)

A. Torque and work

B. Angular momentum and work

C. Energy and Young's modulus

D. Light-year and wavelength

Answer: A::C

Watch Video Solution

4. 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 :

A. $x = (1/2), y = (1/2)$

B. $x = (1/2), z = (1/2)$

C. $y = (-3/2), z = (1/2)$

D. $y = (1/2), z = (3/2)$

Answer: A::B

Watch Video Solution

5. The pairs of physical quantities that have the same dimensions in (are):

A. Reynolds number and coefficient of friction

B. Curie and frequency of a light wave

C. Latent heat and gravitational potential

D. Planck's constant and torque

Answer: A::D

Watch Video Solution

Passage 1

1. A student forgot Newton's formula for speed of sound but the knows there speed (v), pressure (p) and density (d) in the formula. He then start using dimensional analysis method to find the actual relation.

$v = kp^x d^y$

Where k is a dimensionless constant. On the basis of above passage answer the following questions:

The value of x is :

A. 1

B. $\frac{1}{2}$

C. $-\frac{1}{2}$

D. 2

Answer: B

Watch Video Solution

Passage 2

1. A student forgot Newton's formula for speed of sound but the knows there speed (v), pressure (p) and density (d) in the formula. He then start using dimensional analysis method to find the actual relation.

$v = kp^x d^y$

Where k is a dimensionless constant. On the basis of above passage answer the following questions:

The value of y is :

A. 1

B. $\frac{1}{2}$

C. $-\frac{1}{2}$

D. 2

Answer: C

Watch Video Solution

Passage 3

1. A student forgot Newton's formula for speed of sound but the knows there speed (v), pressure (p) and density (d) in the formula. He then start using dimensional analysis method to find the actual relation.

$v = kp^x d^y$

Where k is a dimensionless constant. On the basis of above passage answer the following questions:

If the density will increase the speed of sound will :

A. increase

B. decrease

C. unchanged

D. none of these

Answer: B

Watch Video Solution

Matching Type Problem

1. Match the column :

	Column-I (Quantity)		Column-II(Unit)
(a)	Energy density (Energy per unit volume)	(p)	dyne $/ cm^2$
(b)	Force constant of a spring	(r)	$kg - m / s$
(c)	Pressure	(r)	erg / cm^2
		(s)	pascal

Watch Video Solution

2. Suppose two students are trying to make a new measurement system so that they can use it like a code measurement system and others do not understands it. Instead of taking 1kg, 1m and 1 sec, as basic unit they took unit of mass as αkg, the unit of length as βm and unit of times as γ second. They called power in new system as ACME then match the two columns.

	Column-I		Column-II
(a)	1N in new system	(p)	$\alpha^{-1}\beta^{-2}\gamma^{2}$
(b)	1J in new system	(q)	$\alpha^{-1}\beta^{-1}\gamma^{2}$
(c)	1 pascal (SI unit of pressure) in new system	(r)	$\alpha^{-1}\beta\gamma^{2}$
(d)	αACME in watt	(s)	$\alpha^{2}\beta^{2}\gamma^{-3}$

Watch Video Solution

3. Match the physical quantities given in Column 1 with dimensions expressed in terms of mass (M), length (L), time (T), and charge (Q) given n column II.

	Column-I		Column-II
(a)	Angular momentum	(p)	$[ML^2T^{-2}]$
(b)	Torque	(q)	$[ML^2T^{-1}]$
(c)	Inductance	(r)	$[M^{-1}L^{-2}T^{2}Q^{2}]$
(d)	Latent heat	(s)	$[ML^2Q^{-2}]$
(e)	Capacitance	(t)	$[ML^3T^{-1}Q^{-2}]$
(f)	Resistivity	(u)	$[L^2T^{-2}]$

Watch Video Solution

4. Match the following:

Column-I

$(a)\quad F = A\sin(Bt) + \frac{1}{C\ln(Dx)}$ For above equation to be dimensionally cor

$(b)\quad \text{Pressure} = P + \frac{1}{2}\rho v^2 + gX$

$(c)\quad X = At + \frac{v}{B\ln(Cr)}$

(Where F = force, P = pressure, ρ = density, t = time, v = velocity, a = acceleration, X = displacement)

Watch Video Solution