PHYSICS

BOOKS - DC PANDEY ENGLISH

UNIT AND DIMENSIONS

Example

1. Find the dimensional formula of the following question :

(a) Density (b) Velocity (c) Acceleration (d) Momentum (e) Force

(f) Work of energy (g) Power (h) Pressure

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2. Find the dimensional formula of the following question :

(a) Surface tension T

(b) Universal constant of gravitation , G

(c) Impulse ,J

(d) Torque τ

The equation involving these equations are :

$T = FilF = \frac{Gm_1m_2}{r^2}, J = F \times t$ and $\tau = F \times 1$

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3. The value of gravitation is $G = 6.67 \times 10^{-11}N - \frac{m^2}{k}g^2$ in SL units . Convert it into CGS system of units .

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4. Show that the expression of the time period T of a simple pendulum of length l given by $T = 2\pi\sqrt{\frac{l}{g}}$ is dimensionally currect

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5. The velocity v of the a particle depends upen the time t according to the equation $v = a + bt + \frac{c}{d+1}$ Write the dimension of a, b,c and d.

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6. The frequency (f) of a stretched string depends upen the tension F (dimensions of form) of the string and the mass per unit length mu of string .Derive the formula for frequency

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7. Find the dimensional formula of

(a) coefficient of viscosity η (b)charge q

(c) potention V (d) capacitance C and

(e) resistance R

Some of the equations containing these quantities are

$$F = -\eta A\left[\frac{\Delta v}{\Delta l}\right], q = It. U = VIt, q = CV \text{ and } V = IR$$

where A denotes the area, v the velocity , l is the length ,I the electric current, t the time and U the energy .

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8. Write the dimensions of a and b in the relation ,$P = \frac{b - x^2}{at}$,

where P

is power ,x is distance and t is time

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9. The contripetal force F acting on a particle moving uniformly in a circle may depend upon mass (m), velocity (v) and redio (r) of the circle . Derive the formula for F using the method of dimensions.

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10. If velocity , time and force were chosen as basic quantities , find the dimensions of mass and energy .

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11. Force acting on a particle is 5 N. If units of length and time are double and unit of mass is halved then find the numerical value of force in the new system of unit .

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12. Can pressure (p) ,density (p) and velocity (v) be taken as fundamental quantities ?

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Single Correct

1. the dimensional formula for planck's constant and angular momentum are

A. $[ML^3T^{-2}]$ and $[MLT^{-1}]$

B. $[ML^2T^{-1}]$ and $[ML^2T^{-1}]$

C. $[ML^2T^1]$ and $[ML^3T^{-2}]$

D. $[MLT^{-1}]$ and $[MLT^{-2}]$

Answer: B

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2. Dimension of velocity gradient is

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

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

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

D. $[ML^0T^{-1}]$

Answer: A

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3. Which of the following is the dimension of the coefficient of frintion ?

A. $[M^2L^2T]$

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

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

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

Answer: B

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4. Which of the following sets have different dimensions ?

A. Pressure ,Young's modulus, Stress

B. Enf potential difference.Electric potential

C. Heat, Work done .Energy

D. Dipole moment .Electric flux .Electric field

Answer: D

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5. The force F on a sphere of radius r moving in a medium with velocity v is given by $F = 6\pi\eta r v$. The dimensions of η are

A. $\left[ML^{-3}\right]$

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

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

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

Answer: D

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

A. $\left[MLT^{-4}\right]$ and $[MLT]$

B. $\left[MLT^{-1}\right]$ and $\left[MLT^{0}\right]$

C. $\left[MLT^{-3}\right]$ and $\left[MLT^{-4}\right]$

D. $\left[MLT^{-3}\right]$ and $\left[MLT^{0}\right]$

Answer: C

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

A. resistance

B. resistivity

C. electrical conductivity

D. electronmotive force

Answer: C

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8. The dimensional formula for planck's magnetic flux is

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

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

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

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

Answer: A

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9. Choose the wrong statement. Option 1 All quantities may be represented dimensionally in terms of the base quantities Option 2 A base quantity cannot be represented in terms of the rest of the base quantity Option 3 The dimension of a base quantity in other base quantities is always zero Option 4 The dimension of a derived quantities is never seen in any base quantity

A. All quantities may be represented dimensionally in terms of the base quantities

B. A base quantity cannot be represented in terms of the rest of the base quantity

C. The dimension of a base quantity in other base quantities is always zero

D. The dimension of a derived quantities is never seen in any base quantity

Answer: D

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10. If unit of length and time is double, dthe numerical valuure of $'g'$ (acceleration due to gravity) will be

A. doubled

B. halved

C. four time

D. same

Answer: B

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11. Using $mass(M), \text{length}(L), time(T)$ and current(A)as fundamental quantites the demension of permeability is

A. $\left[M^{-1}LT^{-2}A\right]$

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

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

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

Answer: C

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12. The equation of a wave is given by

$$y = a \sin \omega \left[\frac{x}{v} - k \right]$$

where ω is angular velocity and v is the linear velocity . The dimensions of k will be

A. $[T^2]$

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

C. $[T]$

D. $[LT]$

Answer: C

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13. 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

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14. If force F, length L and $time T$ are taken as fundemental unit , the dimensional formula mass will be

A. $[FL^{-1}T^2]$

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

C. $[FL^{-1}T^{-1}]$

D. $[FL^{-5}T^2]$

Answer: A

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15. The ratio of the dimensions of plank's constant and that of the moment of inertia is the dimension of

A. frequency

B. velocity

C. angular momention

D. time

Answer: A

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16. Given that $y = A\sin\left[\left(\frac{2\pi}{\lambda}(ct - x)\right)\right]$ where y and x are measured in metres ,Which of the following statements is true ?

A. The unit of λ is same as that of x and A

B. The unit of λ is same as that of x but not of A

C. The unit of c is same as that of $\frac{2\pi}{\lambda}$

D. The unit of $(a - x)$ is same as that of $\frac{2\pi}{\lambda}$

Answer: A

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17. Which of the following sets cannot enter into the list of fundamental quatities in any system of units?

A. length , mass and density

B. length , time and velocity

C. mass, time and velocity

D. length , time and mass

Answer: B

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

A. $(a)\left[M^{-3}L^{-1}T^{3}Q^{4}\right]$

B. $(b)\left[M^{-3}L^{-2}T^{4}Q^{4}\right]$

C. $(c)\left[M^{-2}L^{-2}T^{4}Q^{4}\right]$

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

Answer: B

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19. 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 diffrence and δt is a time interval . The dimensional formula for X is the seme as that of

A. resistance

B. charge

C. voltage

D. current

Answer: D

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

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

B. $\left[ML^2 T\right]$

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

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

Answer: A

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More Than One Correct

1. 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. Angure momentum and work

C. Energy and Young 's module

D. Light year and wevelength

Answer: A::B

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2. The pairs of physical quantities that have the same demensions is (are)

A. Reyaold number and coefficient of friction

B. Curie and frequency of a light wave

C. Latent beat and gravitational potential

D. Planck's constant and torque

Answer: A::B::C

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3. The SI unit of inductance, the henry can be written as

A. weber/ampers

B. volt -second /ampere

C. $\text{joule}/(\text{ampere})^2$

D. ohm - second

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

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4. Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of the vacuum, and $[\mu_0]$ that of the permeability of the vacuum. If `M = mass ,L = length, T = time and I = electric current,

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

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

C. $[\mu_0] = [MLT^{-2}I^{-2}]$

D. $[\mu_0] = [ML^2T^{-1}I]$

Answer: B::C

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5. L,C and R represent the physical quantities inductance, capacitance and resistance respectively. Which of the following combinations have dimensions of frequency?

A. $\frac{t}{RC}$

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

C. $\frac{1}{\sqrt{LC}}$

D. $\frac{c}{L}$

Answer: A::B::C

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Subjective

1. In the expression $y = a\sin(\omega t + \theta)$, y is the displacement and t is the time . Write the dimension of$a$,$\omega$and θ .

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2. Young 's modulus of steel is $2.0 \times 10^{11} Nm/(2)$. Express it is $\frac{\text{dyne}}{c} m^2$.

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3. The surface tension of water is 72 dyne/cm. convert it in SI unit.

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4. The relation between the energy E and the frequency v of a photon is repressed by the equation $E = hv$, where h is plank's constant Write down its dimensions.

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5. With the usual notations , check if the following equation $S_t = u + \frac{1}{2}a(2t - 1)$ is dimensionally correct or not.

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6. Give the MKS units for each of the following question .

(a) Young's modulus (b) Magnetic induction (c) power of a lena

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7. 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 static pressure d is the density of water and E is the total energy of explosion. Find the value of a,b and c.

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8. Show dimensionally that the expression , $T = \frac{MgL}{\pi r^2 l}$ is dimensionally correct , where T is Young 's modulus of the length of the wire ,Mg is the weight applied in the wire and L is the original length of the wire ,and l is the increase in the length of the wire .

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9. Dimensionsal methods provide three major advantages in verification , deviation , and changing the system of units . Any empirical formula that is derived based on this method has to be verified and propportionality constants found by experimental means . The presence or absence of certain factors - non dimensional constants or variables - cannot be identified by this method . So every dimensionally correct relation cannot be taken as perfectly correct.

The energy of an SHM is depend on mass m , frequency f , and amplitude A of oscillation . The relation is

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10. $\frac{a}{t^2} = Fv = \frac{\beta}{x^2}$ Find dimension formula for $[a]$ and $[\beta](heret = \text{time}, F = \text{force}, v = \text{velocity}, x = \text{distance})$

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11. For a moles of gas ,Van der Weals equation is $\left(p=\frac{a}{V^{-2}}\right)(V-b)=nRT$ltbr. Find the dimensions of a a and b, where $p=pressure$ of gas, $V=volume$ of gas and $T=temperatureofgas$.

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12. In the formula , $p=\frac{nRT}{V-b}e^{\frac{a}{RTV}}$ find the dimensions of a and b, where p = pressure , n= number of moles , T = temperture , V = volume and R = universal gas constant .

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13. Write the dimensions of the following in the terms of mass, time, length and charge

(a) Magnetic flux (b) Rigidity modulus.

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14. Let $x$and a stand for distance . Is $\int \frac{dx}{\sqrt{a^2 - x^2}} = \frac{1}{a}\sin^{-1}\left(\frac{a}{x}\right)$ dimensionally correct ?

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15. You may not know integration , but using dimensional analysis you can check on some results . In the integral $\int \frac{dx}{(2ax - x^2)^{1/2}} = a^n \sin^{-1}\left(\frac{x}{a} - 1\right)$, find the valiue of n .

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16. Taking $\text{force} F, \text{length} L$ and $\text{time} T$ to be the fundamental equations , find the dimensions of

(a) density (b) pressure (c) momentum and (d) energy

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Assertion And Reason

1. Assertion Velocity , volume and acceleration can be taken as fundemental quantities because

Reason: All the three are independent from each other .

A. If both Assertion and Reson are true and the Resion is correct explanation of the Assertion

B. If both Assertion and Reason are true but the correct explenation ofAssertion.

C. If Assertion is true , but the Reason is false .

D. If both Assertion and Reason are wrong.

Answer: D

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2. Assertion if two physical quantities have same dimension, then they can be certainly added or subtracted because

Reason if the dimension of both the quantities are same then both the physical quantities should be similar .

A. If both Assertion and Reson are true and the Resion is correct explanation of the Assertion

B. If both Assertion and Reason are true but the correct explenation ofAssertion.

C. If Assertion is true , but the Reason is false .

D. If both Assertion and Reason are wrong.

Answer: A

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