UNITS AND DIMENSIONS

2011

1. The Si unit of activity of radioactive sample is

a) Curie b) Rutherford c) Becquerel d) Mill curie

2. SI unit of power is

a) Joule b) Erg c) Newton d) Watt

3. The SI unit of thermal conductivity is

a) $Jsm^{-1}K^{-1}$ b) $W^{-1}m^{-1}K^{-1}$ c) $Wm^{-1}K^{-1}$ d) $Wm^{-2}K^{-1}$

4. The dimensions of $(\mu_0\varepsilon_0)^{-1/2}$ are

a) $[L^{-1}T]$ b) $[LT^{-1}]$ c) $[L^{-1/2}T^{1/2}]$ d) $[L^{1/2}T^{-1/2}]$

5. Surface tension has the same dimensions as that of

a) Coefficient of viscosity b) impulse

c) momentum d) spring constant e) frequency

6. The dimension of impulse is

a) $[MLT^{-1}]$ b) $[ML^2T^{-1}]$ c) $[ML^{-1}T^{-1}]$ d) $[MT^{-1}]$

7. If C be the capacitance and V be the electric potential, then the dimensional formula of CV^2 is

a) $[ML^2T^{-2}A^0]$ b) $[MLT^{-2}A^{-1}]$ c) $[M^0LT^{-2}A^0]$ d) $[ML^{-3}TA]$

2010

8. The unit of magnetic moment is

a) TJ^{-1} b) JT^{-1} c) Am^{-2} d) Am^{-1}

9. Unit of electrical conductivity is

a) Ohm b) siemen c) m/mho d) mho/m

10. Dimensions of capacitance is

a) $[M^{-1}L^{-2}T^4A^2]$ b) $[MLT^{-3}A^{-1}]$

c) $[ML^2T^{-3}A^{-1}]$ d) $[M^{-1}L^2T^3A^{-1}]$

11. A uniform wire of length L, diameter D and density ρ is stretched under a tension T. The correct relation between its fundamental frequency f, the length L and the diameter D is

a) $f \propto \frac{1}{LD}$ b) $f \propto \frac{1}{L\sqrt{D}}$ c) $f \propto \frac{1}{D^2}$ d) $f \propto \frac{1}{LD^2}$

12. The relation $p=\frac{\alpha}{\beta}e^{\frac{-\alpha Z}{k\theta}}$ where p is pressure, Z is distance, k is Boltzmann constant and θ is temperature. The dimensional formula of β will be

a) $[M^0L^2T^0]$ b) $[ML^2T]$ c) $[ML^0T^{-1}]$ d) $[M^0L^2T^{-1}]$

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

a) p b) R c) T d) V

14. Velocity v is given by $v=at^2+bt+c$, where t is time. What are the dimensions of a, b and c respectively?

a) $[LT^{-3}],[LT^{-2}]and[LT^{-1}]$ b) $[LT^{-1}],[LT^{-2}]and[LT^{-3}]$

c) $[LT^{-2}],[LT^{-3}]and[LT^{-1}]$ d) $[LT^{-1}],[LT^{-3}]and[LT^{-2}]$

15. If E, M, L and G denote energy, mass, angular momentum and gravitational constant respectively, then the quantity (E^2L^2/M^5G^2) has the dimensional of

a) angle b) length c) mass d) none of these

2009

16. Which one of the following quantities has not been expressed in proper units ?

a) Torque : Newton meter

b) Stress : Newton metre^{-2}

c) Modulus of elasticity: Newton metre^{-2}

d) Power : Newton metre second^{-1}

e) Surface tension : Newton metre^{-2}

17. The unit of specific conductivity is

a) $\Omega-cm^{-1}$ b) $\Omega-cm^{-2}$ c) $\Omega^{-1}-cm$ d) $\Omega^{-1}-cm^{-1}$

18. An object is moving through the liquid. The viscous damping force acting on it is proportional to the velocity. Then dimensional formula of constant of proportionality is

a) $[ML^{-1}T^{-1}]$ b) $[MLT^{-1}]$ c) $[M^0LT^{-1}]$ d) $[ML^0T^{-1}]$

2008

19. The unit of thermal conductance is

a) WK^{-1} b) JK^{-1} c) WK d) JK

20. Match the following columns

Column I	Column II
A) Capacitance	**i) volt $(\text{ampere})^{-1}$**
B) Magnetic induction	**ii) volt - sec $(\text{ampere})^{-1}$**
C) Inductance	**iii) newton $(\text{ampere})^{-1}$ $(\text{metre})^{-1}$**
D) Resistance	**iv) $\text{Coulomb}^2(\text{joule})^{-1}$**

A	B	C	D		A	B	C	D
a) ii	iii	iv	i		b) iv	iii	ii	i
c) iv	i	ii	iii		d) ii	iv	I	iii

21. If 'muscle times speed equals power', what is the ratio of the SI unit and the CGS unit of muscle?

a) 10^5 b) 10^3 c) 10^7 d) 10^{-5}

22. The unit of universal gas constant is

a) watt/K b) $dyne/{}^0C$ c) erg/K d) $newton/{}^0R$

23. Which two of the following five physical parameters have the same dimensions ?

1) energy density 2) refractive index 3) dielectric constant
4) young's modulus 5) magnetic field

a) 2 and 4 b) 3 and 5 c) 1 and 4 d) 1 and 5

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

a) resistance b) resistivity
c) electrical conductivity d) electromotive force

25. The speed of light c, gravitational constant G and Planck's constant h are taken as fundamental units in a system. The dimensions of time in this new system should be

a) $[G^{1/2}h^{1/2}c^{-5/2}]$ b) $[G^{1/2}h^{1/2}c^{1/2}]$ c) $[G^{1/2}h^{1/2}c^{-3/2}]$ d) $[G^{1/2}h^{1/2}c^{1/2}]$

26. Dimensions of resistance in an electrical circuit, in terms of dimensions of mass M, of length L, of time T and of current A, would be

a) $[ML^2T^{-3}A^{-1}]$ b) $[ML^2T^{-2}]$ c) $[ML^2T^{-1}A^{-1}]$ d) $[ML^2T^{-3}A^{-2}]$

27. Given that the displacement of an oscillating particle is given by $y = A\sin(Bx + Ct + D)$. The dimensional formula for (ABCD) is

a) $[M^0L^{-1}T^0]$ b) $[M^0L^0T^{-1}]$ c) $[M^0L^{-1}T^{-1}]$ d) $[M^0L^0T^0]$

28. If p represents radiation pressure, c represents speed of light and Q represents radiation energy striking a unit area per second then non-zero integers x, y and z such that $P^xQ^yc^z$ is dimensional, are

a) x = 1, y = 1, z = -1 b) x =1, y =-1, z = 1 c) x =-1, y = 1, z = 1 d) x = 1, y = 1, z = 1

29. If force F, work W and velocity v are taken as fundamental quantities, then the dimensional formula of time T is

a) [WFv] b) $[WFv^{-1}]$ c) $[W^{-1}F^{-1}v]$ d) $[WF^{-1}v^{-1}]$

30. If E = energy, G = gravitational constant, I= impulse and M = mass, then dimensions of $\frac{GIM^2}{E^2}$ are same as that of

a) time b) mass c) length d) force

2007

31. Parsec is the unit of

a) time b) distance c) frequency d) angular acceleration

32. The unit of permittivity of free space, ε_0, is

a) coulomb/newton-metre b) $newton-metre^2 / coulomb^2$

c) $coulomb^2 / newton-metre^2$ d) $coulomb^2 / (newton-metre)^2$

33. Given that $y = A\sin\left[\left(\frac{2\pi}{\lambda}(ct-x)\right)\right]$ where y and x are measured in meter. 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 (ct –x) is same as that of $\frac{2\pi}{\lambda}$

34. Light year is a unit of

a) time b) speed c) distance d) none of these

35. The magnitude of any physical quantity

a) depends on the method of measurement

b) does not depend on the method of measurement

c) is more in SI system than in CGS system

d) directly proportional to fundamental unit of mass, length and time

35. The unit of Stefan's constant is

a) $Wm^{-2}K^{-1}$ b) WmK^{-4} c) $Wm^{-2}K^{-4}$ d) $Nm^{-2}K^{-4}$

36. Which one of the following is not a derived unit?

a) Frequency b) Planck's constant c) Gravitational constant

d) Charge e) Electric current

37. What is SI unit of electric field intensity?

a) cm b) Vm^{-1} c) Am^{-1} d) NA

38. If the magnetic flux is represented in Weber, then the unit of magnetic induction will be

a) $\frac{Wb}{m^2}$ b) Wb x m c) $Wb \times m^2$ d) $\frac{Wb}{m}$

39. The ratio of the dimensions of Planck's constant and that of the moment of inertia is the dimension of

a) frequency b) velocity c) angular momentum d) time

40. The speed v of ripples on the surface of water depends on surface tension σ, density ρ and wavelength λ. The square of speed v is proportional to

a) $\frac{\sigma}{\rho\lambda}$ b) $\frac{\rho}{\sigma\lambda}$ c) $\frac{\lambda}{\sigma\rho}$ d) $\rho\lambda\sigma$

41. Using mass M, length L, time T and current A as fundamental quantities, the dimensions of permeability is

1) $[M^{-1}LT^{-2}A]$ b) $[ML^{-2}T^{-2}A^{-1}]$ c) $[MLT^{-2}A^{-2}]$ d) $[MLT^{-1}A^{-1}]$

42. The position of the particle moving along Y-axis is given as $y = At^2 - Bt^3$, where y is measured in meter and t in second. Then the dimensions of B is

a) $[LT^{-2}]$ b) $[LT^{-1}]$ c) $[LT^{-3}]$ d) $[MLT^{-2}]$

43. Which of the following units denotes the dimensions $[ML^2/Q^2]$, where Q denotes the electric charge ?

a) Wb/m^2 b) Henry (H) c) H/m^2 d) Weber (Wb)

44. The dimensions of $\frac{e^2}{4\pi\varepsilon_0 hc}$, where e, ε_0, h and c are electronic charge, electric permittivity, Planck's constant and velocity of light in vacuum respectively

a) $[M^0L^0T^0]$ b) $[ML^0T^0]$ c) $[M^0LT^0]$ d) $[M^0L^0T]$

45. The only mechanical quantity which has negative dimension of mass is

a) angular momentum b) torque

c) coefficient of thermal conductivity d) gravitational constant

2006

46. The magnetic force on a point charge is F = q(v x B) Here, q = electric charge, v = velocity of point charge, B = magnetic field. The dimensions of B is

a) $[MLT^{-1}A]$ b) $[M^2LT^{-2}A^{-1}]$

c) $[MT^{-2}A^{-1}]$ d) none of these

47. If σ = surface charge density, ε = electric permittivity the dimensions of $\frac{\sigma}{\varepsilon}$ are same as

a) electric force b) electric field intensity c) pressure d) electric charge

2005

48. Which one of the following is not a unit of Young's modulus?

a) Nm^{-1} b) Nm^{-2} c) $Dyne\,cm^{-2}$ d) Mega Pascal

49. Density of liquid in CGS system is $0.625 g\,cm^{-3}$. What is its magnitude in SI system?

a) 0.625 b) 0.0625 c) 0.00625 d) 625

2003

50. 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) $[M^2LT^{-3}]$ b) $[MT^{-2}]$ c) $[LT^{-3}]$ d) $[ML^3T^{-1}]$

KEY

1)C 2)d 3)c 4)b 5)d 6)a 7)a 8)b 9)d 10)a

11)a 12)a 13)a 14)a 15)d 16)e 17)d 18)c 19)a 20)b

21)a 22)c 23)c 24)c 25)a 26)d 27)b 28)b 29)d 30)a

31)b 32)c 33)a 34)c 35)b 36)e 37)b 38)a 39)a 40)a

41)c 42)c 43)b 44)a 45)d 46)a 47)b 48)a 49)d 50)b

HINTS

11. The fundamental frequency is $f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$

$\Rightarrow f = \frac{1}{2L}\sqrt{\frac{T}{\rho\pi\frac{D^2}{4}}} = \frac{1}{LD}\sqrt{\frac{T}{\pi\rho}}$

$\therefore f \propto \frac{1}{LD}$

12. In the given equation, $\frac{\alpha Z}{k\theta}$ should be dimensionless

$\therefore \alpha = \frac{k\theta}{Z}$

$\Rightarrow [\alpha] = \frac{[ML^2T^{-2}K^{-1}][K]}{[L]} = [MLT^{-2}]$

And $p = \frac{\alpha}{\beta}$

$\Rightarrow [\beta] = \left[\frac{\alpha}{p}\right] = \frac{[MLT^{-2}]}{[ML^{-1}T^{-2}]}$

$= [M^0L^2T^0]$

13. Given $p = \frac{RT}{V-b}e^{-\alpha V/RT}$

So, $\frac{\alpha V}{RT}$ is dimensionless

Hence, $[\alpha] = \left[\frac{RT}{V}\right] = \frac{[ML^2T^{-2}\theta^{-1}][\theta]}{[L^3]}$

$= [ML^{-1}T^{-2}]$

This is also the dimensionless formula of pressure.

14. Dimensions of velocity is $[v] = [L][T^{-1}]$

So, dimensions of $[at^2] = [LT^{-1}]$

$\Rightarrow [a][T^2] = [LT^{-1}]$

$\Rightarrow [a] = [LT^{-3}]$

Dimensions of $[bt] = [LT^{-1}] \Rightarrow [b][T] = [LT^{-1}]$

$\Rightarrow [b] = [LT^{-2}]$

Dimensions of $[c]=[LT^{-1}]$

15. The dimensions of $E=[ML^2T^{-2}]$

Dimensions of M = [M]

Dimensions of $L=[ML^2T^{-2}]$

Dimensions of $G=[M^{-1}L^3T^{-2}]$

$\therefore$ Dimensions of

$$\left[\frac{E^2L^2}{M^5G^2}\right]=\frac{[ML^2T^{-2}][ML^2T^{-1}]^2}{[M]^5[M^{-1}L^3T^{-2}]^2}=[ML^2T^{-2}]$$

18. We have $F\propto v\Rightarrow F=kv$

$$\Rightarrow[k]=\left[\frac{F}{v}\right]=\left[\frac{MLT^{-2}}{LT^{-1}}\right]$$

$$=[ML^0T^{-1}]$$

21. Muscle x speed = power

Or $$Muscle=\frac{power}{speed}=\frac{work}{time\times speed}$$

$$=\frac{[ML^2T^{-2}]}{[T][LT^{-1}]}=[MLT^{-2}]$$

= mass x acceleration = force

$$\therefore\frac{SI\ unit\ of\ \ force}{CGS\ unit\ of\ \ force}=\frac{kg\times m\times s^{-2}}{g\times cm\times s^{-2}}$$

$$=10^3\times10^2=10^5$$

25. Time $\propto c^xG^yh^z$

$$\Rightarrow T=kc^xG^yh^z$$

$$\Rightarrow[M^0L^0T]=[LT^{-1}]^x[M^{-1}L^3T^{-2}]^y[ML^2T^{-1}]^z$$

$$\Rightarrow[M^0L^0T]=[M^{-y+z}L^{x+3y+2z}T^{-x-2y-z}]$$

Comparing the powers of M, L and T, we get

- y + z = 0 ……(i)

x + 3y + 2z = 0 ……(ii)

-x – 2y – z = 1…….(iii)

On solving eqs (i), (ii) and (iii) we get

$$x=-\frac{5}{2},y=z=\frac{1}{2}$$

Hence, dimensions of time are $[G^{1/2}h^{1/2}c^{-5/2}]$

26. Resistance $R = \frac{potential\ difference}{current} = \frac{V}{I} = \frac{W}{qI}$

So, dimensions of R

$$= \frac{[\text{dimensions of work}]}{[\text{dimensions of charge}][\text{dimensions of current}]}$$

$$= \frac{[ML^2T^{-2}]}{[AT][A]} = [ML^2T^{-3}A^{-2}]$$

27. Given y = A sin (Bx + Ct +D)

As each term inside the bracket is dimensionless, so

A = y = [L]

$B = \frac{1}{x} = [L^{-1}]$

$C = \frac{1}{t} = [T^{-1}]$

And D is dimensionless

$\therefore [ABCD] = [L][L^{-1}][T^{-1}][1]$

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

28. $pressure = \frac{force}{area}$

$[p] = \frac{[F]}{[A]} = [ML^{-1}T^{-2}], [c] = [LT^{-1}]$

$[Q] = \frac{[E]}{[A][T]} = [MT^{-3}]$

As given, $p^xQ^yc^z = [M^0L^0T^0]$

$[ML^{-1}T^{-2}]^x[LT^{-1}]^z[ML^{-3}]^y = [M^0L^0T^0]$

$M^{x+y}L^{-x+z}T^{-2x-z-3y} = [M^0L^0T^0]$

$\therefore x + y = 0$

-x + z = 0

-2x – z- 3y = 0

Solving, we get x = 1, y = -1, z = 1

29. Let $T \propto F^a W^b v^c$

$[T] = [MLT^{-2}]^a [ML^2T^{-2}]^b [LT^{-1}]^c$

$[T^1] = [M^{a+b}][L^{a+2b+c}][T^{2a-2b-c}]$

Comparing the powers, we get

a + b = 0 ……(i)

a + 2b + c = 0 …..(ii)

-2a -2b – c = 1 …….(iii)

Solving eqs (ii), (iii) and (iv) we get

a = -1, b = 1, c = -1

Therefore, from eq (i)

$[T] = k[F^{-1}Wv^{-1}]$

Taking k = 1 in SI system, we have

$[T] = [WF^{-1}v^{-1}]$

30. Dimensions of $\frac{GIM^2}{E^2}$

$= \frac{[M^{-1}L^3T^{-1}][MLT^{-1}][M^2]}{[ML^2T^{-2}]^2}$

=[T] = dimensions of time

33. Here $\frac{2\pi}{\lambda}(ct - x)$ is dimensionless. Hence, $\frac{ct}{\lambda}$ is also dimensionless and unit of it is same as that of x. Therefore, unit of λ is same as that of x. Also unit of y is same as that of A, which is also the unit of x.

42. As $y = B[T^3]$

$\Rightarrow [L] = B[T^3]$

$\therefore B = [LT^{-3}]$

49. We know that, density $= \frac{mass}{volume}$

In CGS units $d = 0.625 g\, cm^{-3}$

In SI units $d = \frac{0.625 \times 10^{-3} kg}{10^{-6} m^3} = 625 kg\, m^{-3}$