UNITS AND DIMENSIONS

SYNOPSIS

1. Physics is a science of measurments
2. **PHYSICAL QUANTITY:** Any quantity which canbe measured directly (or) indirectly (or) in terms of which any laws of physics can be expressd is called physical quantity.
3. There are two types of physical quantities
   1) Fundamental quanties 2) Derived quanties
   1) **Fundamental Quantity :** Physical quantities which cannot be expressed in terms of any other physical quantites are called fundamental physical quantities.
   E.g. length, mass, time, temperature etc..
   2) **Derived Quantity** :Physical Quantities which are derived from fundamental quantities are called derived quantities.
   E.g. Area, density, force etc...

UNIT OF MEASUREMENT:

1. A fixed measurement chosen as a standard of measurement to measure a physical quantity is called a **Unit.**
2. To measure a physical quantity means to determine the number of times its standard unit is contained in that physical quantity.
3. A standard Unit is necessary for the sake of
   1. accuracy,
   2. convenience,
   3. uniformity and
   4. equal justice to all.
4. The standard unit chosen should have the following characteristics.
   1. Consistency (or) invariability
   2. Availability (or) reproducibility
   3. Imperishability (Permanency)
   4. Convenience and acceptability
5. The measure ment of a Physical Quantity is given by a numerical value and a unit. $\boxed{x = nu}$ where x is the measure of a physical quantity, n is numerical value and u is the unit.
6. The numerical value obtained on measuring a physical quantity is inversely proportional to the magnitude of the unit chosen.

$$\boxed{n \ \alpha \ \frac{1}{U}} \qquad \Rightarrow \boxed{n_1U_1 = n_2U_2}$$

Where n_1 and n_2 are the numerical values and U_1 and U_2 are the units of same physical quantity in different systems.

Fundemental unit : The unit used to measrue the fundamental quantity is called fundamental unit.
e.g., Metre for length, kilogram for mass etc..

Derived unit : The unit used to measure the derived quantity is called derived unit.
e.g., m^2 for area, gm cm^{-3} for density etc...

FUNDAMENTAL QUANTITIES AND THEIR S.I. UNITS:

1. There are seven basic quantities and two supplementary quantities in S. I. system. The names and units with symbols are given below:

S.No.	Physical Quantity	S.I.Unit	Symbol
1.	Length	metre	m
2.	Mass	kilogram	kg
3.	Time	second	s
4.	Thermo dynamic temperature	kelvin	K (or) θ
5.	Luminous intensity	candela	Cd
6.	Electric current	ampere	A
7.	Amount of substance (or) quantity of matter	mole	mol
	Suplementary quantities		
1.	Plane angle	radian	rad
2.	Solid angle	steradian	sr

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2. DEFINITIONS FOR S.I. UNITS:

1. **meter:** meter is 1 in 299, 792, 458th part of the distance travelled by light in vaccum in 1 second.
2. **kilogram:** kilogram is the mass of a platinum - irridium alloy cylinder proto type kept at Sevres, near Paris.
3. **second:** One second is the time taken by 9, 192, 631, 770 cycles of the radiation from the hyperfine transition in ceasium - 133 atom, when unperturbed by external fields.
4. **kelvin:** This is 1/273. 16 of the temperature at the triple point of water measured on thermodynamic scale.
5. **candela:** Candela is the luminous intensity in a direction normal to the surface of $\frac{1}{600000}m^2$ of a black body at the temperature of freezing platinum at a pressure of 101, 325 newton per square metre.
6. **ampere:** ampere is the current which when flowing in each of two parallel conductors of infinite length and negligible cross-section and placed one metre apart in vaccum causes each conductor to experience a force exactly $2x10^{-7}$ newton per metre length.

7. **mole:** mole is the amount of substance of a system that contains as many elementary entities as there are atoms in 0.012 kg of carbon - 12.

8. **radian:** radian is the angle subtended at the centre of a circle by an arc whose length is equal to the radius.

2π radian $= 360^0$: 1 radian $= \frac{360}{2\pi} = 57^0\,17'\,44''$

9. **steradian:** The solid angle subtended at the centre of the sphere of radius 1 metre by its surface of area 1 square metre. Solid angle= normal area/r^2. Total solid angle that can be formed at any point in space or at the centre of a sphere is 4π steradian.

3. Other conventional units of fundamental quantities :

Length :

micron $= 10^{-6}\,m$ to express the size of bacteria, animal cells etc.,

Angstrom unit $= 10^{-10}\,m$ to express the wavelength of light

X-ray unit $= 10^{-13}\,m$ for wavelength of x-rays

Fermi $= 10^{-15}\,m$ to express the size of nucleus

Light year $= 9.46 \times 10^{15}\,m$ to express astronomical distances

par sec $= 3.26$ light years $= 30.84 \times 10^{15}\,m$ to express astronomical distances

Bohr radius $= 0.5 \times 10^{-10}\,m$

Mass :

Quintal = 100 kg

Metric ton = 1000 kg

Atomic mass unit (a.m.u) = $= 1.67 \times 10^{-27}\,kg$

Chandra Shekar Limit = $= 1.4$ times mass of the sun

Time :

One day = 86400 seconds

Shake = $= 10^{-8}$ second

PREFIXES: (or) Abbreviations for multiples and sub-multiples of 10.

MACRO Prefixes	**MICRO Prefixes**
kilo $\rightarrow$ k $\rightarrow 10^3$	milli $\rightarrow$ m $\rightarrow 10^{-3}$
Mega $\rightarrow$ M $\rightarrow 10^6$	micro $\rightarrow \mu \rightarrow 10^{-6}$
Giga $\rightarrow$ G $\rightarrow 10^9$	nano $\rightarrow$ n $\rightarrow 10^{-9}$
Tera $\rightarrow$ T $\rightarrow 10^{12}$	pico $\rightarrow$ p $\rightarrow 10^{-12}$
Peta $\rightarrow$ P $\rightarrow 10^{15}$	femto $\rightarrow$ f $\rightarrow 10^{-15}$
Exa $\rightarrow$ E $\rightarrow 10^{18}$	atto $\rightarrow$ a $\rightarrow 10^{-18}$
Zetta $\rightarrow$ Z $\rightarrow 10^{21}$	zepto $\rightarrow$ z $\rightarrow 10^{-21}$
Yotta $\rightarrow$ Y $\rightarrow 10^{24}$	yocto $\rightarrow$ y $\rightarrow 10^{-24}$

Note: The following are not used in SI system.

deca $\rightarrow 10^1$	deci $\rightarrow 10^{-1}$
hecta $\rightarrow 10^2$	centi $\rightarrow 10^{-2}$

RULES FOR WRITING UNITS:

1. Symbols for a unit named after a scientist should have a capital letter. eg:N for newton, W for watt, A for ampere.
2. Full names of the units,even when they are named after a scientist should not be written with a capital letter. Eg: newton, watt, ampere, metre.
3. Units should be written either in full or in agreed symbols only.
4. Units do not take plural form.
   Eg: 10kg but not 10 kgs, 20W but not 20 Ws 2A but not 2As
5. No full stop or punctuation mark should be used within or at the end of symbols for units. Eg: 10W but not 10W.

DIMENSIONS OF PHYSICAL QUANTITY:

1.Dimensions: Dimensions of a physical quantity are the powers to which the fundamental units are to be raised to obtain one unit of that quantity

2.Dimensional Formula : An expression showing the powers to which the fundamental units are to be raised to obtain one unit of the derived quantity is called Dimensional formula of that quantity.

3. Dimensional Constants: The physical quantities which have dimensions and have a fixed value are called dimensional constants.

Eg: Gravitational Constant (G), Planck's Constant (h), Universal gas constant (R), Velocity of light in vacuum (c) etc.,

4. Dimensionless constants: Dimensionless quantities are those which do not have dimensions but have a fixed value.

(a): Dimensionless quantities without units.
Eg: Pure numbers, π, e, Sin θ, Cos θ, tan θ ......etc.,

(b) Dimensionless quantities with units.
Eg: Angular displacement - radian, Joule's constant- joule/calorie, etc.,

5. Dimensional variables: Dimensional variables are those physical quantities which have dimensions and do not have fixed value.

Eg: velocity, acceleration, force, work, power... etc.

6. Dimensionaless variables: Dimensionless variables are those physical quantities which do not have dimensions and do not have fixed value.,

Eg: Specific gravity, refractive index, Coefficient of friction, Poisson's Ratio etc.,

PHYSICAL QUANTITIES HAVING SAME DIMENSIONAL FORMULA:

1. Distance, Displacement, radius light year wavelength, radius of gyration (L)
2. Speed, Velocity, Velocity of light $\left(LT^{-1}\right)$
3. acceleration ,acceleration due to gravity, intensity of gravitational feild, centripetal acceleration $\left(LT^{-2}\right)$
4. Impulse, Change in momentum $\left(MLT^{-1}\right)$
5. Force, Weight, Tension, Thrust $\left(MLT^{-2}\right)$
6. Work, Energy, Moment of force or Torque, Moment of couple $\left(ML^2T^{-2}\right)$
7. Force constant, Surface Tension, Spring constant, Energy per unit area $\left(MT^{-2}\right)$
8. Angular momentum, Angular impulse, Plank's constant $\left(ML^2T^{-1}\right)$
9. Angular velocity, Frequency, Velocity gradient, Decay constant, rate of disintigration (T^{-1})
10. Stress, Pressure, Modulus of Elasticity, Energy density $\left(ML^{-1}T^{-2}\right)$
11. Latent heat, Gravitational potential $\left(L^2T^{-2}\right)$
12. Specific heat, Specific gas constant $\left(L^2T^{-2}\theta^{-1}\right)$
13. Thermal capacity, Entropy, Boltzman constant, Molar thermal capacity, $\left(ML^2T^{-2}\theta^{-1}\right)$
14. Wave number, Power of a lens, Rydberg constant $\left(L^{-1}\right)$
15. Time, RC, $\frac{L}{R}$, $\sqrt{LC}\,(T)$
16. Power, Rate of dissipation of energy, (ML^2T^{-3})
17. Intensity of sound, Intensity of radiation (MT^{-3})
18. Expansion coefficient, Temperature coefficient of resistance (K^{-1})
19. Electric potential, potential difference, electromotive force $(ML^2T^{-3}I^{-1})$
20. Intensity of magnetic field, Intensity of magnetization $\left(IL^{-1}\right)$

Principle of homogenity: It states only quantities of same diemensions can be added subtracted and equated. Hence in a Physical equation every term should have same dimensions.

USES OF DIMENSIONAL EQUATIONS:

I. **Use:** To check the correctness of the given equation. This use is based on the principle of homogenity.

II. **Use:** To convert one system of units into another system.

Eg: The numerical value of 10 joule in a new system of units in which the unit of mass is 10gm, unit of length 10cm. and unit of time 10sec. is ---- using since.

since $n_1[M_1^{\,a}L_1^{\,b}T_1^{\,c}] = n_2[M_2^{\,a}L_2^{\,b}T_2^{\,c}]$

$10[M^{\,1}L^{\,2}T^{-2}]_{S.I.} = n_2[M^{\,1}L^{\,2}T^{-2}]$ new system

$10[\text{kg x m}^2 \text{ x s}^{-2}]=n_2[10\text{gm}(10\text{cm.})^2(10\text{s})^{-2}]$

$10[1000\text{grm. x }100^2\text{cm}^2 \text{ x s}^{-2}]=n_2[10\text{grm x }10^2\text{cm}^2 \text{ x }10^{-2}\text{s}^{-2}]$

$\therefore n_2 = 10^7$

III. **Use:** To derive the equations showing the relation between different physical quantities.

Eg: When a spherical body falls through a viscous medium the upward viscous force acting on it depends upon
1.radius r of the body
2.coefficient of viscosity of the medium and
3.velocity v of the body.since $F \propto r^a\,\eta^b\,v^c$;
$F = k\,r^a\,\eta^b\,v^c$ $MLT^{-2} = k\,(L)^a\,(ML^{-1}T^{-1})^b\,(LT^{-1})^c$
$= M^bL^{a-b+c}\;T^{-b-c}$ (since K has no dimensions)
on comparision v = 1, a - b + c = 1,
-b -c = -2
hence a = 1, b = 1, c = 1
i.e., $F \propto r\;\eta\;v \Rightarrow F = Kr\eta V$

LIMITATIONS OF DIMENSIONAL SYSTEM:

1. Dimensionless quantities cannot be determined by this method. Constant of proportionality cannot be determined by this method. They can be found either by experiment (or) by theory.
2. This method is not applicable to trigonometric, logarthmic and exponential functions.
3. In the case of physical quantities which are dependent upon more than three physical quantities, this method will be difficult.
4. In some cases, the constant of proportionality also posseses dimensions. In such cases we cannot use this system.
5. If one side of equation contains addition or subtraction of physical quantities, we can not use this method.

THE FOLLOWING IS THE LIST OF SOME PHYSICAL QUANTITIES WITH THEIR FORMULAE AND DIMENSIONAL FORMULAE

Sl.No.	Physical Quantity	Explanation or Formulae	Dimensional Formulae	C.G.S. Unit	S.I.Unit
1.	Distance : (Length) Displacement ($\overline{S}$) Wave Length (λ) Radius of gyration (R) Circumference Perimeter Light year Par-sec	L $\overline{S}$ λ R C P L.Y Par-sec	$\left[M^0\ L^1\ T^0\right]$	Cm	m
2.	Mass	Measure of inertia	$\left[M^1\ L^0\ T^0\right]$	gm	Kg
3.	Period of oscillation, Time, Time constant	T = $\frac{total\ time}{No.of\ \ oscillations}$ T = Capacity x Resistance	$\left[M^0\ L^0\ T^1\right]$	s	s
4.	Frequency	Reciprocal of time $n=\frac{1}{T}$	$\left[M^0L^0T^{-1}\right]$	s^{-1} (hz)	hertz (Hz)
5.	Area	A = l x b (or) L^2	$\left[M^0L^2T^0\right]$	cm^2 (sq.cm)	m^2 (sq.m)
6.	Volume	V = L.b. h. (or) L^3	$\left[M^0L^3T^0\right]$	cm^3 (cubic cm)	m^3 (cubic metre)
7.	Density	$D=\frac{Mass}{Volume}=\frac{M}{L^3}$	$\left[M^1L^{-3}T^0\right]$	gm. cm^{-3}	kg.m^{-3}
8.	Linear density	$m=\frac{M}{L}$ (Mass per unit length)	$\left[M^1L^{-1}T^0\right]$	gm.cm^{-1}	kg.m^{-1}
9.	Speed (scalar) Velocity (Vector)	V = $\frac{L}{T}$	$\left[M^0L^1T^{-1}\right]$	cm s^{-1}	m.s^{-1}
10.	Acceleration	a = $\frac{dv}{dt}=\frac{Change\ in\ Velocity}{time}$	$\left[M^0L^1T^{-2}\right]$	cm s^{-2}	m.s^{-2}
11.	Linear Momentum	$\overline{P}=M\times\overline{V}$	$\left[M^1L^1T^{-1}\right]$	gm.cms^{-1}	kg.m.s^{-1}
12.	Impulse	$\overline{J}=F.t$	$\left[M^1L^1T^{-1}\right]$	dyne-s	N-s
13.	Force	F = M.a	$\left[M^1L^1T^{-2}\right]$	dyne. (gm cm s^{-2})	newton = (kg.m.s^{-2})
14.	Work Energy	W = F x S P.E= mgh KE = $\frac{1}{2}MV^2$ Strain energy = $\frac{1}{2}\times Stress\times Strain\times volume$	$\left[M^1L^2T^{-2}\right]$	erg=dyne.cm (gm.cm^2s^{-2})	joule =newton.m (kg.m^2s^{-2})

15.	Power	$P = \frac{Work}{time}$	$\left[M^1L^2T^{-3}\right]$	erg s^{-1}	$J.S^{-1}$. (or) Watt
16.	Pressure Stress	$\frac{Force}{Area}$			
	Modulus of Elasticity y, n, k	$y = \frac{Stress}{Strain}$	$\left[M^1L^{-1}T^{-2}\right]$	dyne - cm^{-2}	$N.m^{-2}$. (or) Pascal
17.	Strain	$\frac{e}{l}$	$\left[M^0L^0T^0\right]$	No Units	-------
18.	Strain energy density	E = $\frac{Work}{Volume}$	$M^1L^{-1}T^{-2}$	erg $.cm^{-3}$	$J.m^{-3}$
19.	Angular displacement	$\theta = \frac{l}{r}$	$M^0L^0T^0$	radian	radian
20.	Angular Velocity	$\omega = \frac{d\theta}{dt}$	$M^0L^0T^{-1}$	$rad.s^{-1}$	$rad.s^{-1}$
21.	Anuglar acceleration	$\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$	$M^0L^0T^{-2}$	rad s^{-2}	$rad.s^{-2}$
22.	Angular momentum	$\overline{L} = \overline{r} \times \overline{p} = rMVSin\theta$	$M^1L^2T^{-1}$	$gm.cm^2s^{-1}$	$kg.m^2s^{-1}$
23.	Planck's constant	$h = \frac{E}{v}$	$M^1L^2T^{-1}$	erg-s	J -S
24.	Angular impulse	Torque $\times$ time	$M^1L^2T^{-1}$	erg-s	J.s
25.	Torque	$\overline{\tau} = \overline{r} \times \overline{F} = r\,M\;\;a\;\;Sin\theta$	$M^1L^2T^{-2}$	dyne-Cm	N-m
26.	Acceleration due to gravity(g)= gravitational field strength	$g = \frac{F}{M}$	M^0LT^{-2}	$cm.s^{-2}$ = [$dyne.gm^{-1}$]	$m.s^{-2}$ [$N.kg^{-1}$]
27.	Universal gravitational Constant	$G = \frac{F.d^2}{M_1.M_2}$	$M^{-1}L^3T^{-2}$	$dyne.cm^2.gm^{-2}$ or [gm^{-1} cm^3 s^{-2}]	$N.m^2$ kg^{-2} or [$kg^{-1}.m^3.s^{-2}$]
28.	Moment of inertia	$I = MK^2$	$M^1L^2T^0$	$gm.cm^2$	$kg.m^2$
29.	Velocity gradient	$\frac{dv}{dx}$	$M^0L^0T^{-1}$	S^{-1}	S^{-1}
30.	Surface Tension, Spring Constant Force Constant	$S = \frac{F}{L}$ or $\frac{\Delta E}{\Delta A}$ (Surface energy) $K = \frac{F}{e}$	$M^1L^0T^{-2}$	$dyne.cm^{-1}$ = erg. cm^{-2}	$N.m^{-1}$ = $J.m^{-2}$

31.	Coefficient of Viscosity	$\eta = \frac{F}{A.\left(\frac{dv}{dx}\right)}$ = pressure x time	$M^1L^{-1}T^{-1}$	POISE	Pa-s
				dyne $s\ cm^{-2}$	$Ns\ m^{-2}$
32.	Gravitational Potential	$\frac{Work}{Mass}$	$M^0L^2T^{-2}$	erg.gm^{-1}	J.Kg^{-1}
33.	Heat energy	energy	$M^1L^2T^{-2}$	Calorie	Joule
34.	Temperature	θ (or) Kelvin	$M^0L^0T^0.\theta^1$	^{0}c	Kelvin(K)
35.	Thermal Capacity	$\frac{dQ}{d\theta} = Mass \times Sp.ht$	$M^1L^2T^{-2}.\theta^{-1}$	Cal/^{0}c	J. K^{-1}
36.	Specific heat Capacity	S (or) $C = \frac{Q}{M\,\theta}$	$M^0L^2T^{-2}.\theta^{-1}$	Cal / gm / ^{0}c	J kg^{-1} K^{-1}
37.	Latent heat (or)				
	Calorific value	$L = \frac{Q}{M}$	$M^0L^2T^{-2}$	Cal.gm^{-1}	J.kg^{-1}
38.	Water Equivalent	$W = MC$ grms	$M^1L^0T^0$	gm	kg.
39.	Coefficient of Thermal	α or β or γ			
	expansion	$\alpha = \frac{\Delta l}{l.\Delta\theta}$; $\beta = \frac{\Delta A}{A.\Delta\theta}$; $\gamma = \frac{\Delta V}{V.\Delta\theta}$	$\left[\theta^{-1}\right]$	^{0}c^{-1}	K^{-1}
40.	Universal gas constant	$R = \frac{PV}{nT}$	$M^1L^2T^{-2}\theta^{-1}mol^{-1}$	erg.mol^{-1}.^{0}c^{-1}	J.mol^{-1}.K^{-1}
	(for 1 Mole)				
41.	Gas constant (for 1 gram)	$r = \frac{R}{Mol.wt}$	$M^0L^2T^{-2}\theta^{-1}mol^{-1}$	erg.gm^{-1}.c^{-1}	J.kg^{-1}K^{-1}
42.	Boltzman constant				
	(for 1 Molecule)	$k = \frac{R}{AvagadroNo.}$	$M^1L^2T^{-2}\theta^{-1}$	erg.gm^{-1}.c^{-1}	J.K^{-1}
					molecule^{-1}
43.	Mechanical equivalent of	$J = \frac{W}{H}$	$M^0L^0T^0$	erg/Cal	-----
	heat			or J/cal	
44.	Coefficient of Thermal				
	Conductivity	$K = \frac{Q.d}{A\ \Delta\theta.t}$	$M^1L^1T^{-3}\theta^{-1}$	Cal s^{-1} cm^{-1} ^{0}c^{-1}	J.S^{-1} m^{-1} K^{-1}
					or w.m^{-1} K^{-1}
45.	Entropy	$\frac{dQ}{d\theta}$	$M^1L^2T^{-2}.\theta^{-1}$	erg ^{0}c^{-1}	J.K^{-1}
46.	Stefan's Constant	$\sigma = \frac{\Delta E}{\Delta A.\Delta T.\theta^4}$	$M^1L^0T^{-3}k^{-4}$	erg/scm^2/^{0}c^4	J/sm^2/K^4
(or)					
					W.m^{-2}.K^{-4}

47.	Thermal resistance	$R=\frac{d\theta}{\left(\frac{dQ}{dt}\right)}=\frac{temp\times time}{Heat}$ (or) $R=\frac{d}{K.A}$	$M^1L^{-2}T^3K$	----	KSJ^{-1}
48.	Temperature gradient	$\frac{Change\ in\ temp}{length}=\frac{d\theta}{dl}$	$\left[\theta\ L^{-1}\right]$	${}^0c.cm^{-1}$	$K.m^{-1}$
49.	Pressure gradient	$\frac{Change\ in\ pressure}{length}=\frac{dp}{dl}$	$M^1L^{-2}T^{-2}$	$dyne.cm^{-1}$	$pascal\ .m^{-1}$
50.	Solar constant	$\frac{Energy}{area\times time}=\frac{\Delta E}{A.T}$	$M^1L^0T^{-3}$	$erg.s^{-1}.cm^{-2}$	$J.S^{-1}.m^{-2}$ ($W.m^{-2}$)
51.	Enthalpy	heat .(ΔQ)	$M^1L^2T^{-2}$	Calorie	Joule
52.	Pole strength	$m=I.L$ (or) $\frac{Magnetic\ Momement}{Mag.Length}$	$M^0L.T^0A$	---	amp-metre (A.m)
53.	Magnetic Moment	$\overline{M}=2l.m.=$ $Current\times area\ pole$ $strength$ x length of the Magnet	$M^0L^2T^0A$	----	$A.m^2$
54.	Magnetic intensity (or) Magnetising field	$H=\frac{m}{4\pi d^2}$	$M^0L^{-1}T^0A$	Oersted	$A.m^{-1}$
55.	Intensity of Magnetisation	$I=\frac{\overline{M}}{V}=\frac{Magnetic\ Moment}{Volume}$	$M^0L^{-1}T^0A$	-----	$A.m^{-1}$
56.	Magnetic flux	$\phi=\overline{B}\times\overline{A}$ =(magnetic induction x area)	$M^1L^2T^{-2}A^{-1}$	Maxwell	Weber (wb)
57. (or)	Magnetic induction field strength	$\overline{B}=\frac{\phi}{A}=\frac{Magnetic\ flux}{area}=\frac{F}{il}$	$M^1L^0T^{-2}.A^{-1}$	gauss	tesla (or) web. m^{-2} $N.A^{-1}.m^{-1}$
58.	Magnetic permeability of free space	$\mu_0=\frac{4\pi.Fd^2}{m_1.m_2}$	$M^1L^1T^{-2}.A^{-2}$	e.m.u	$henry.m^{-1}$
59.	Magnetic susceptibility	$K=\frac{I}{H}$	$M^0L^0T^0$	No. Units	----
60.	Electric current	elementary quantity	$M^0L^0T^0A.$	stat amp.	ampere
61.	Charge (or) Electricity	$Q=I\times T$ Current x time	$M^0L^0T.A$	Stat coulomb	Coulomb
62.	Electric dipole moment	$P=Q\times d=Charge\times distance$	$M^0L^0T.A$	Stat.coul-cm	coulomb-met
63.	Electric field strength (or) Elec. Intensity	$E=\frac{F}{Q}=\frac{Force}{Charge}$	$M^1LT^{-3}A^{-1}$	dyne/stat.coul	Nc^{-1}

64.	Electrical flux (ϕ_E)	Electrical Intensity x area	$M^1L^3T^{-3}A^{-1}$	------	N.m^2 C^{-1}
65.	Electric potential (or) Potential difference	$V=\frac{Work}{Charge}$	$M^1L^2T^{-3}A^{-1}$	Stat Volt	Volt .(V)
66.	Electrical resistance	$R=\frac{Pot.diff}{Current}$	$M^1L^2T^{-3}A^{-2}$	Stat - Ohm	Ohm-(Ω)
67.	Electrical conductance	$C=\frac{1}{R}=\frac{1}{resistance}$	$M^{-1}L^{-2}T^3A^2$	-----	mho (or) Siemen (S)
68.	Specific resistance (or Resistivity ρ (or) s	$\rho=\frac{R.A}{l}$	$M^1L^3T^{-3}A^{-2}$		Ohm-m
69.	Electrical conductivity	$\sigma=\frac{1}{Resistivity}$	$M^{-1}L^{-3}T^3A^2$		Ohm^{-1}-m^{-1}((or) Siemen/ metre
70.	Current density (Current per unit area of cross section)	J = Electrical Intensity x Conductivity or $\left(\frac{Current}{area}\right)$	$M^0L^{-2}T^0A$		A.m^{-2}
71.	Capacitance	C= $\frac{Q}{V}=\frac{Charge}{Potential}$	$M^{-1}L^{-2}T^4A^2$		farad
72.	Self (or) Mutual Inductance	$L=\frac{dE}{\left(\frac{dI}{dt}\right)}=\frac{Voltage\times time}{Current}$	$M^1L^2T^{-2}A^{-2}$		henry (or) Weber/amp.
73.	Electrical permitivity of free space	$\varepsilon_0=\frac{q_1.q_2}{4\pi fd^2}$	$M^{-1}L^{-3}T^4A^2$		farad/m
74.	Surface density of Charge	$\frac{Charge}{area}$	$M^0L^{-2}T^1A^1$		C.m^{-2}
75.	Luminous flux	$\frac{Light\ energy}{time}$	$M^1L^2T^{-3}$		Lumen
76.	Intensity of illumination (or) Iluminance	$I=\frac{\Delta E}{\Delta t.\Delta A}=\left(\frac{Luminious\ flux}{area}\right)$	$M^1L^0T^{-3}$		Luman.m^{-2} (or) Lux.
77.	Focal Power	$P=\frac{1}{focal\ length}$	$M^0L^{-1}T^0$		Dioptre
78.	Wave number (Propagation constant)	$\bar{v}=\frac{1}{\lambda}$	$M^0L^{-1}T^0$	cm^{-1}	m^{-1}
79.	Rydberg constnat	$R=\frac{Z^2e^4m}{8\varepsilon_0^2ch^3}$	$M^0L^{-1}T^0$	cm^{-1}	m^{-1}

CONCEPTUAL QUESTIONS

1. If force F, LengthL and timeT are chosen as fundamental quantities,the dimensional formula for Mass is
1. FLT 2. $F^{-1}L^{-1}T^{-2}$ 3. $F^{-2}L^{-2}T^{-2}$ 4. $F^{1}L^{-1}T^{2}$
2. If Force F, Mass M and time T are chosen as fundamental quantities the dimensional formula for length is
1. FMT 2. $FM^{-1}T^{2}$ 3. $FL^{2}T^{-2}$ 4. $F^{-1}L^{-2}T^{-2}$
3. The velocity of an object varies with time as V = At^2+Bt+C . Taking the unit of time as1 sec and Velocity as ms^{-1}, the units of A, B, C respectively are:
1. ms^{-3},ms^{-2},ms^{-1} 2. ms^{-2},ms^{-1},ms^{-3}
3. ms^{-1},ms^{-2},ms^{-3} 4. ms^{-1},ms^{-1},ms^{-1}
4. The distance travelled by a body in time 't' is given by $x=a+bt+ct^2$ where x is distance, t is time a,b and c are constants. the dimesional formula for a, b and c respectively are :
1. $L,\ L^1T^{-1},\ L^1T^{-2}$ 2. $L^1T^{-1},\ L^1T^{-2},\ L$
3. $L^1T^{-2},\ L^1T^{-1},\ L$ 4. L, L, L
5. If the displacement S of a body in time 't' is given by $S=At^3+Bt^2+Ct+D$, the dimensions of A are
1. L^1T^3 2. T^{-3} 3. L^1T^{-3} 4. L^1
6. The S.I. Unit of pressure is
1. Newton 2. Nm^{-1} 3. pascal 4. poice
7. 1 Pascal = ____ C.G.S units (or) dyne Cm^{-2}
1. 10 2. $\frac{1}{10}$ 3. 100 4. 1000
8. The dimensional formula for strain energy density is
1. $M^1L^2T^{-3}$ 2. $M^1L^2T^3$ 3. $M^1L^{-1}T^{-2}$ 4. $M^1L^2T^{-2}$
9. The physical quantities which have the same dimensions as $[T^{-1}]$ are
1. Frequency and Angular velocity
2.Velocity gradient and radio active disintegration
3. Both 1 and 2
4. Wave number, Rydberg's constant
10. The physical quantity having the same dimensional formula as that of force is
1. weight 2. tension 3. thrust 4. 1, 2, 3
11. $N.m^{-1}$ is the SI unit of
1. Force constant 2. Spring constant
3. Surface tension 4. 1,2 and 3
12. The physical quantities having same dimensions of energy is
1. Torque 2. Moment of force
3. Moment of couple 4. 1,2, 3
13. The dimension of Mass iz zero in the following physical quantities.
1. Gravitational potential 2. latent heat
3. Specific heat capcity 4. 1, 2, 3
14. The SI unit of a physical quantity is $[J.\ m^{-2}]$. The dimensional formula for that quantity is
1. M^1L^{-2} 2. $M^1L^0T^{-2}$ 3. $M^1L^2T^{-1}$ 4. $M^1L^{-1}T^{-2}$
15. $[Jm^{-2}]$ is the unit of
1. Surface tension 2. Viscosity
3. Strain energy 4. Intensity of energy
16. $[Jm^{-3}]$ may be the unit of
1. Strain energy density
2. Modulus of Elasticity (y, k, n)
3. Both 1 & 2 4. Strain energy
17. The dimensional formula for potential energy is
1. $M^2L^2T^{-2}$ 2. $M^1L^{-2}T^{-2}$
3. $M^1L^2T^{-2}$ 4. $M^1L^2T^{-3}$
18. The dimensional formula for moment of couple is
1. $M^1L^2T^{-1}$ 2. $M^1L^2T^{-2}$
3. $M^{-1}L^2T^{-2}$ 4. $M^1L^1T^{-2}$
19. L, C, and R represent the physical quantities inductance, capacitance and resistance respectively. The combinations that have the dimensions of frequency are
1. $\frac{1}{CR}$ 2. $\frac{R}{L}$ 3. $\frac{1}{\sqrt{L.C}}$ 4. 1,2, & 3
20. The dimension of time in Electrical intensity in MKSA system is
1. -1 2. -2 3. -3 4.3
21. 1 a.m.u is equal to
1. 1.66 x 10^{-24} g 2. 1.66 x 10^{-27} g
3. 1.66 x 10^{24} g 4. 1.66 x 10^{27} g
22. 'POISE' is the
1. C.G.S. unit of Surface tension
2. C.G.S. unit of Viscosity
3. M.K.S. unit of Viscosity
4. M.K.S. unit of Surface energy
23. Thermodynamic temperature of the triple point of water is
1. 0^0C 2. 0 K 3. -273K 4.273.16K
24. If 'm' is the mass of a body, 'a' is amplitude of vibration, and 'ω' is the angular frequency, $\frac{1}{2}ma^2\omega^2$ has same dimensional formula as
1. Work 2. moment of force
3. energy 4. all the above
25. Pressure x Volume =
1. Work 2. Power
3. Modulus of Elasticity 4. Pressure.

26. The dimensional formula for pressure gradient is
1. $ML^{-1}T^{-2}$ 2. $M^1L^{-2}T^{-2}$
3. $M^1L^2T^{-2}$ 4. $M^1L^{-1}T^{-3}$

27. If C denotes the capacity and L denotes the inductance, the dimensions 'LC' are same as that of
1. $M^0L^0T^2$ 2. $M^1L^0T^2$
3. $M^1L^1T^{-2}$ 4. $M^0L^1T^2$

28. The dimensional formula for Areal velocity is
1. $M^0L^{-2}T^{-1}$ 2. $M^0L^{-2}T^1$
3. $M^0L^2T^{-1}$ 4. $M^0L^2T^1$

29. The dimensional formula for Magnetic Moment of a magent is
1. $M^0L^2T^0A^1$ 2. $M^0L^2T^0A^{-1}$
3. $M^0L^{-2}T^0A^{-1}$ 4. $M^0L^{-2}T^0A^{-1}$

30. SI Unit of a physical quantity whose dimensional formula is $M^{-1}L^{-2}T^4A^2$ is
1.ohm 2. volt 3. sieman 4. farad

31. $[M^1L^2T^{-3}A^{-2}]$ is the dimensional formula of :
1. Electric resistance 2. Capacity
3. Electric potential 4. Specific resistance

32. Magnetic flux and Magnetic induction field strength differ in the dimensions of
1. Mass 2. Length 3. time 4. 1,2, 3

33. Linear Momentum and Angular momentum have the same dimensions in
1. Mass and length 2. Length and time
3. Mass and time 4. Mass, length and time

34. Impulse and Angular velocity have the same dimensions in
1. Mass 2. Length 3. Time
4. Mass, length and time

35. If C is the capcity, V is the potential difference, the energy stored in a capcitor is given by $E=\frac{1}{2}CV^2$. The dimension of time in cv^2 is
1. -2 2. 2 3. 1 4. -1

36. If L is the inductance, 'i' is current in the circuit, $\frac{1}{2}Li^2$ has the dimensions of
1. Work 2. Power 3. Pressure 4. Force

37. The physical quantity having dimensions 2 in length is
1. Power 2. Acceleration
3. Force constant 4. Stress

38. In the following, the one which is not a physical quantity is
1. Power 2. Momentum
3. Latent heat 4. radian

39. Kilo watt hour is the unit of
1. Power 2. Energy
3. time 4. Electric current

40. The angle subtended at the centre of a circle by an arc whose length is equal to the diameter of the circle is
1. radian 2. 2 radian
3. π radian 4.p/2 radian

41. Which of the following is not a unit of time?
1. Mean solar day 2. Lunar Month
3. Leap year 4. Light year

42. The following is not used as the unit of work
1. erg 2. Joule
3. Electron volt 4. Volt

43. In the following, the one which has not been expressed properly is
1. $\frac{stress}{strain} = Nm^{-2}$
2. Surface tension = Nm^{-1}
3. Energy = $Kgms^{-1}$ 4. Pressure = Nm^{-2}

44. The derived unit is
1. Candela 2. mole 3. Kelvin 4. Tesla

45. $(Coulomb)^2 J^{-1}$ can be the unit of
1. Electric resistence 2. Electric energy 3. Electric capacity 4. Electric power

46. SI unit of Coefficient of viscosity is
1. Pascal s^{-1} 2. Pascal -s
3. N/m^2/unit velocity
4. N/m/unit velocity gradient

47. Siemen is the SI unit of
1. Electric resistance 2. Electric resistivity
3. Electric conductivity 4.Electric conductance

48. Read the following statements carefully and pick out the correct choice of answer.
A: Susceptibility is expressed as Am^{-1}.
B: Magnetic flux is expressed as JA^{-1}
1. A is correct but B is wrong
2. A is wrong but B is correct.
3. Both A and B are wrong
4. Both A and B are correct.

49. Read the following statements carefully and pick out the correct choice of answer.
A:Electromotive force is expressed in newtons.
B: Electric intensity is expressed in VC^{-1}
1. Both A and B are correct
2. Both A and B are wrong
3. A is correct but B is wrong
4. A is wrong but B is correct

50. The following does not give the unit of energy
1. watt second 2. Kilowatt hour
3. newton meter 4. pascal metre

51. 1 fermi is equal to
1. 10^{-15} m 2. 10^{-9} micron
3. $10^{-5}A^0$ 4. 1,2, 3

52. If n is the numeric, U is the name of the unit, then
1. $n \alpha U$ 2. $n \propto \frac{1}{U}$ 3. $n \alpha \frac{1}{U^2}$ 4. $n \alpha U^2$

53. "Impulse per unit area " has same dimensions as that of
1.coefficient of viscosity 2. surface tension
3. bulk modulus 4. gravitational potential

54. The following pair does not have same dimensions
1. Pressure, Modulus of Elasticity
2. Angular velocity, velocity gradient
3. Surface tension and force constant
4. Impulse and torque

55. If μ is the permeability and $\in$ is the permittivity then $\frac{1}{\sqrt{\mu \in}}$ is equal to
1. Speed of sound
2. Speed of light in vacuum
3. Speed of sound in medium
4. Speed of light in medium

56. The following is a unitless and dimensionless quantity
1. Angle 2. Solid angle
3. Mechanical equivalent of heat
4. Refractive index.

57. The unitless quantity is
1. Velocity gradient 2. Pressure gradiant
3. displacement gradient
4. force gradient

58. The one which is not a dimensionless quantity is
1. Moment of Momentum 2. Moment of force
3. Moment of inertia 4. 1, 2 & 3

59. If the unit of tension is divided by the unit of Surface tension the derived unit will be same as that of
1. mass 2. length 3. area 4. work

60. Attometer means
1. An instrument used to measure gradient
2. An insturment used to measure the altitude
3. 10^{18} metre 4. 10^{-18} metre

61. N m s^{-1} is the unit of
1. Pressure 2. Power
3. Potential 4. Pressure gradient

62. $\left[\frac{Permeability}{Permittivity}\right]$ will have the dimensions of :
1. $M^0L^0T^0A^0$ 2. $M^2L^2T^4A^2$
3. $M^2L^4T^{-6}A^{-4}$ 4. $M^{-2}L^{-4}T^6A^4$

63. One second is defined more accurately as
1. 1650763.73 periods of Krypton clock
2. 652189.63 periods of Krypton clolck
3. 1650763.73 periods of Caesium clock
4. 9,192,631,770 periods of Caesium clock

64. The number of micron in 1 metre is
1. 10 2.10^3 3. 10^6 4. 10^9

65. Stefan's constant has the unit as
1. J S^{-1} m^{-2} k^4 2. Kg s^{-3} k^4
3. w m^{-2} k^{-4} 4. N.m.s^{-2} k^{-4}

66. Which one of the following is not measured in the units of Energy
1. (Couple) x (angle turned through)
2. Moment of inertia x (angular velocity)^2
3. Force x distance 4. impulse x time

67. If the ratio of fundamental units in two systems is 1 :3, then the ratio of momenta in the two systems is
1. 1:3 2. 1:9 3. 1:27 4. 3:1

68. An example to define length in the form of time at a place is
1. Wrist watch
2. Linear expansion of iron rod
3. Frequency of ripples on the surface of water
4. Seconds pendulum

69. The one which is not the unit of length is
1. Angstrom unit 2. micron
3. Parsecond 4. Steradian

70. The physical quantity having the same dimensional formula as that of entropy is :
1. Latent heat 2. Thermal capcity
3. Heat 4. Specific heat

71. JS is the unit of
1. Energy 2. Angular Momentum
3. Momentum 4. Power

72. Which of the following cannot be expressed as dyne cm^{-2}?
1. Pressure 2. Longitudinal stress
3. Longitudinal strain
4. Young's Modulus of Elasticity

73. The ratio $\frac{L}{R}$ [L : inductance R : ressistance] has the dimensions of :
1. Velocity 2. Acceleration
3. time 4. Force

74. The physical quantity that has the same dimensions as $\sqrt{\frac{I}{MB}}$ is

1. mass 2. time 3. length 4. velocity

75. The dimension of length in electrical resistance is

1. 2 2. 1 3. -2 4. -1

76. The equation which is dimensionally correct among the following is

1. $V = u + at^2$ 2. $S = ut + at^3$

3. $S = ut + at^2$ 4. $t = S + av$

77. The unit of electrical parameter whose dimensional formula is $M L^2 T^{-1} Q^{-2}$ is

1. volt 2. siemen 3. ampere 4. ohm

78. If m is the mass of drop of a liquid of radius 'r' then $\frac{mg}{\pi r}$ has the same dimensions of :

1. Surface tension 2. tension

3. Young's Modulus 4. Coefficient of viscosity

79. The quantity $\frac{e^2}{2\varepsilon_o .hc}$ has the dimensions of

1. $M^1L^3T^{-2}$ 2. $M^1L^2T^{-1}$ 3. $M^0L^0T^0$ 4. $M^0L^0T^{-1}$

80. The unit of atmospheric pressure is :

1. metre 2. kg.wt 3. gm .cm^{-2} 4. bar

81. The ratio between pico and giga is

1. 10^{21} 2. 10^{-21} 3. 10^{14} 4. 10^8

82. 1 Micron = ----nanometer

1. 10^{-6} 2. 10^{-10} 3. 10^3 4. 10^{-3}

83. Which of the following has smallest value?

1. Peta 2. femto 3. Yotta 4. Yocto

84. henry is the unit of

1. Self inductance (or) Mutual inductance

2. e.m.f 3. capacity 4. Conductivity

85. E, m, J and g denote energy mass, angular momentum and gravitational constant respectively. Then the dimensions of $\frac{EJ^2}{m^5G^2}$ are same as that of

1. angle 2. length 3. mass 4. time

86. 1 Kilo watt hour is equal to ---- eV

1. 2.25 x 10^{25} 2. 3.6 x 10^{18}

3. 1.6 X 10^{10} 4. 2.25 X 10^{20}

KEY

1. 4	2. 2	3. 1	4. 1	5. 3
6. 3	7. 1	8. 3	9. 3	10. 4
11. 4	12. 4	13. 4	14. 2	15. 1
16. 3	17. 3	18. 2	19. 4	20. 3
21. 1	22. 2	23. 4	24. 4	25. 1
26. 2	27. 1	28. 3	29. 1	30. 4
31. 1	32. 2	33. 3	34. 3	35. 1
36. 1	37. 1	38. 4	39. 2	40. 2
41. 4	42. 4	43. 3	44. 4	45. 3
46. 2	47. 4	48. 2	49. 2	50. 4
51. 4	52. 2	53. 1	54. 4	55. 4
56. 4	57. 3	58. 4	59. 2	60. 4
61. 2	62. 3	63. 4	64. 3	65. 3
66. 4	67. 1	68. 4	69. 4	70. 2
71. 2	72. 3	73. 3	74. 2	75. 1
76. 3	77. 4	78. 1	79. 3	80. 4
81. 2	82. 3	83. 4	84. 1	85. 1
86. 1				

NUMERICAL QUESTIONS
LEVEL-1

1. The surface tension of a liquid in CGS system is 45 dyne cm^{-1}. Its value in SI system in is

1. 4.5 Nm^{-1} 2. 0.045 Nm^{-1}

3. 0.0045 Nm^{-1} 4. 0.45 Nm^{-1}

2. The value of universal gravitational cosntant G in CGS system is 6.67×10^{-8} dyne cm^2 gm^{-2} . Its value in SI system in is

1. 6.67x10^{-11} Nm^2 kg^{-2}

2. 6.67x10^{-5} Nm^2 kg^{-2}

3. 6.67x10^{-10} Nm^2 kg^{-2}

4. 6.67x10^{-9} Nm^2 kg^{-2}

3. If the unit of length is doubled and that of mass and time is halved, the unit of energy will be :

1. doubled 2. 4 times 3. 8 times 4. same

4. The dimensions of 'a' in Vanderwaal's equation $\left(p+\frac{a}{V^2}\right)(V-b) = RT$ is (V-volume, P-Pressure, R-Universal gas constant, T- Temperature)

1. $M^1L^{-1}T^{-2}$ 2. $M^1L^5T^{-2}$ 3. $M^0L^3T^0$ 4. $M^0L^6T^0$

5. The velocity of a freely falling body in a resisting medium at any time 't' is given by $V = \frac{A}{B\left[1-e^{Bt}\right]}$

The dimensions of 'A ' are

1. L 2. LT^{-2} 3. LT^{-1} 4. LT

6. The velocity of sound in air (V) pressure (P) and density of air (d) are related as $V \alpha p^x d^y$. The values of x and y respectively are

1. $1, \frac{1}{2}$ 2. $-\frac{1}{2}, -\frac{1}{2}$ 3. $\frac{1}{2}, \frac{1}{2}$ 4. $\frac{1}{2}, -\frac{1}{2}$

7. The mass (M) of a stone that can be moved by water current depends upon velocity 'V' of the stream, density of water d and acceleration due to gravity 'g' .The relation between the mass and velocity is

1. $M \alpha V^6$ 2. $M \alpha V^2$ 3. $M \alpha \frac{1}{d^2}$ 4. $M \alpha \sqrt{V}$

8. The period of oscillation of a simple pendulum is expected to depend upon the length of the pendulum (l), and acceleration due to gravity (g). The constant of proportionality is 2 π. Then T =

1. $\frac{2\pi l}{g}$ 2. $2\pi\sqrt{\frac{g}{l}}$ 3. $2\pi\sqrt{\frac{l}{g}}$ 4. $\frac{2\pi g}{l}$

9. The velocity of a body is expressed as V = $G^a M^b R^c$ where G is gravitational constant. M is mass, R is radius. The values of exponents a, b and c are :

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

3. $\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$ 4. 1, 1, $\frac{1}{2}$

10. The value of x in the formula $Y = \frac{2mgl^x}{5bt^3e}$ where m is the mass, 'g' is acceleration due to gravity, l is the length, 'b' is the breadth, 't' is the thickness and e is the extension and Y is Young's Modulus is

1. 3 2. 2 3. 1 4. 4

11. The frequency 'n' of transverse waves in a string of length l and mas per unit length m, under a tension T is given by n = $kl^aT^bm^c$ where k is dimensionless. Then the values of a, b, c, are

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

3. $-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$ 4. $-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}$

12. If the couple per unit twist C is related to the rigidity modulus 'n', radius of the wire 'r' and length of the wire 'l' according to the equation C = $Kn^xr^yl^z$. Where k is dimensionless constant, the values of x, y and z respectively are:

1. 1,1,1 2. 2,4,1 3. 1, -4, 2 4. 1, 4, -1

13. The value of density of mercury in CGS system is 13.56 gm cm^{-3} . Its value is SI system is

1. 135.6 kg. m^{-3} 2. 13.56 kg m^{-3}
3. 1.356 kg m^{-3} 4. 13560 kg m^{-3}

14. The viscosity of a liquid is 0.85 kg m^{-1}s^{-1}. Its value in CGS system is

1. 8.5 gm cm^{-1}s^{-1} 2. 85 gm cm^{-1}s^{-1}
3. 0.85 gm cm^{-1}s^{-1} 4. 0.085 gm cm^{-1}s^{-1}

15. Young's modulus of steel is 19 x 10^{10} Nm^{-2}. Its value in dyne cm^{-2} is

1. 19 x 10^{11} 2. 19 x 10^{17}
3. 19 x 10^{13} 4. 19 x 10^{21}

16. If minute is the unit of time, 10 ms^{-2} is the unit of acceleration and 100 kg is the unit of mass, the new unit of work in joule is

1. 10^5 2. 10^6 3. 6 x 10^6 4. 36x 10^6

17. If the unit of force is 1000N and unit of pressure is 40 pascal, the unit of length is

1. 50 cm 2. 0.05 m 3. 0.5 m 4. 5 m

18. The magnitude of force is 100 N. What will be its value if the units of mass and time are doubled and that of length is halved?

1. 25 N 2. 100 N 3. 200 N 4. 400 N

19. The value of g is 9.8 ms^{-2}. Its value in a new system in which the unit of length is kilometre and that of time 1 minute is

1. 35.3 Km minute^{-2} 2. 3.53 Km minute^{-2}
3. 353 Km minute^{-2} 4. 0.353 Km minute^{-2}

20. If force 'F', acceleration 'A' and time 'T' are taken as fundamental quantities then the dimensions of energy are :

1. A^2T 2. $F\ AT^2$ 3. F^2T 4. $FA^{-1}T^{-1}$

21. If kg, meter and minute are taken as the units of mass, length and time then the numerical value of force of 1000 dyne is

1. 300 units 2. 3600 units
3. 0.36 units 4. 36 units

22. If the unit of mass is $\frac{1}{2}$ kg and that of length is 2m and the unit of time is one second, the unit of pressure is

1. 2 pascal 2. 0.5 pascal
3. 0.25 pascal 4. 1.0 pascal

23. A motor pumps water at the rate of V m^3 per second, against a pressure P Nm^{-2}. The power of the motor in watt is

1. PV 2. $\frac{P}{V}$ 3. $\frac{V}{P}$ 4. $(V-P)$

24. If the fundamental units of length, mass and time are halved, the unit of momentum will be

1. doubled 2. halved
3. same 4. four times

25. If the fundamental units of length, mass and time are doubled, the unit of force will be

1. doubled 2. halved
3. same 4. four times

26. If pressure 'p' depends upon velocity 'v' and density 'd', the relationship between p, v and d is

1. $p\ \alpha\ vd$ 2. $p\ \alpha\ v^2d$

3. $p\ \alpha\ \frac{v^3}{d}$ 4. $p\ \alpha\ \frac{v^2}{d^2}$

27. If the units of length and force are increased by four times the unit of energy will be increased by
1. 16% 2.1600% 3. 15% 4. 400%

28. If the magnitude of mass is 1 kg that of time is 1 minute and that of acceleration due to gravity is 10 ms^{-2}, the magnitude of energy in joule
1. 3.6 x 10^5 2. 3.6 x 10^{-5}
3. 3.6 x 10^2 4. 10

29. The dimensions of 'k' in the relation V = $k\ avt$ (where V is the volume of a liquid passing through any point in time t, 'a' is area of cross section, v is the velocity of the liquid) is
1. $M^1L^2T^{-1}$ 2. $M^1L^1T^{-1}$ 3. $M^0L^0T^{-1}$ 4. $M^0L^0T^0$

30. IF (force)^x = $\frac{(Mass)^2(radius)^2}{(time\ period)^4}$ the value of x is
1. 1 2. 2 3. 3 4. 4

31. If the unit of length is quadrupled and that of force is doubled, the unit of power increases to --- times
1. 8 2. 4 3. 2 4. 16

32. If the unit of force is 5 N and that of length is 10m, the unit of energy in joule is
1. 0.5 2. 50 3. 2 4. 15

33. The period of oscillation 'T' of a loaded spring depends upon the mass of load 'M' and force costant K of the spring. If the constant of proportionality is 2π, the dimensional formula for 'T' is
1. T = $2\pi\frac{M}{K}$ 2. T = $2\pi\frac{K}{M}$
3. T = $2\pi\sqrt{\frac{K}{M}}$ 4. $T=2\pi\sqrt{\frac{M}{K}}$

34. The acceleration of a particle moving along the circumference of a circle depends upon the uniform speed 'v' and radius 'r'. If $a\ \alpha\ v^x r^y$ the values of x and y are
1. 2, 2 2.2, 1 3. 1, 1 4.2, -1

35. If the centrifugal force on a body moving on the circumference of a circle is related to the mass M, velocity V and radius of the circular orbit r as $F\alpha\ M^a V^b r^c$, the values of a, b and c respectively are
1. 1, 1, 2 2.1, 2, 1 3. 1, 2, 2 4.1, 2, -1

36. If the unit of force is 12 N, that of length is 3 m and that of time is 4 s, the unit of mass in new system is
1. 6.4 Kg 2. 64 kg 3. 640 Kg 4. 128 Kg

37. The final velocity of a particle falling freely under gravity is given by $V^2 - u^2 = 2gx$ where x is the distance covered. If v = 18 kmph. g = 1000cm s^{-2}, x = 120 cm then u = ----ms^{-1}
1. 2.4 2. 1.2 3. 1 4. 0.1

38. The Vander waal's equation for ideal gas is given by $\left(p+\frac{a}{V^2}\right)(V-b)=RT$ where P is pressure, V is volume a and b are constants, R is universal gas constant and T is absolute temperature. Then the dimensions of $\frac{a}{b}$ are same as that of
1. Force 2. Momentum
3. Energy 4. Power

39. 1 MeV = --- joule
1. 10^6 2. 1.6 x 10^{-13}
3. 1.6 x 10^{-19} 4. 3.6 x 10^6

40. Velocity of waves on water is given by $V = Kg^a\lambda^b$ where g is acceleration due to gravity, λ the wave length and K is a constant. The values of a and b are
1. $-\frac{1}{2}, -\frac{1}{2}$ 2. $\frac{1}{2}, 2$ 3. 2, 2 4. $\frac{1}{2},\frac{1}{2}$

41. The position of particle at any time 't' is given by
$S(t)=\frac{V_0}{\alpha}\left[1-e^{-\alpha.t}\right]$ where $\alpha > 0$ and V_0 is constant velocity. The dimensions of α are
1. T^1 2. T^{-1} 3. L^1T^{-1} 4. $L^{-1}T$

42. If J and E represent the angular momentum and rotational kinetic energy of a body, $\frac{J^2}{2E}$ represents the following physical qunatity.
1. Moment of couple 2. Moment of force
3. Moment of inertia 4. Force

KEY

1. 2	2. 1	3. 3	4. 2	5. 2
6. 4	7. 1	8. 3	9. 1	10. 1
11. 2	12. 4	13. 4	14. 1	15. 1
16. 4	17. 4	18. 1	19. 1	20. 2
21. 4	22. 3	23. 1	24. 2	25. 3
26. 2	27. 3	28. 1	29. 4	30. 2
31. 1	32. 2	33. 4	34. 4	35. 4
36. 2	37. 3	38. 3	39. 2	40. 4
41. 2	42. 3			

LEVEL- II

1. The equation which is dimensionally consistent in the following is Where S_n = distance travelled by a body in n^{th} second,
u = initial velocity a = acceleration
T = time period r = radius of the orbit
M = Mass of the sun
G=universal gravitational constant.
C = RMS velocity P = pressure.
d = density.
1. $S_n = u + a\left(n-\frac{1}{2}\right)$ 2. $T=\sqrt{\frac{4\pi^2 r^3}{GM}}$
3. C = $\sqrt{\frac{3p}{d}}$ 4. 1, 2, 3

2. If the units of velocity of light 'C', Gravitational constant 'G' and Planck's Constant 'h' are taken as fundamental units, the dimensional formula for Mass in the new system will be :

1. [C G h] 2. $\left[C^{\frac{1}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}\right]$

3. $\left[C^{\frac{1}{2}}G^{-\frac{1}{2}}h^{\frac{1}{2}}\right]$ 4. $[C^2G^2h^2]$

3. If the units of mass, time and length are 100 g, 20 cm and 1 minute respectively the equivalent energy for 1000 erg in the new system will be

1. 90 2. 900 3. 2 x 10^6 4. 300

4. Certain amount of energy is measured as 400 units. If the fundamental units of length, mass and time, each are doubled the magnitude of the same energy in the new system will be ---units.

1. 200 2.400 3. 800 4. 600

5. The viscous force F acting on a rain drop of radius 'a' falling through air of coefficient of viscosity 'η' with terminal velocity V is given by $F \alpha\ \eta^x a^y V^z$. Then the values of x, y and z are

1. -1, 2, 3 2.-1,-1,-1 3.1,2,3 4.1,1,1

6. The following equation is dimensionally correct.

1. pressure = Energy per unit area
2. pressure = Energy per unit volume
3. pressure = Force per unit volume
4. pressure = Momentum per unit volume per unit time

7. If 'Muscular strength' times 'Speed' is equal to power, then dimensional formula for ' Muscular strength' is

1. MLT 2. MLT^{-2} 3. ML^2T^{-2} 4. ML^0T^{-2}

8. The SI unit of a physical quantity having the dimensional formula of $ML^0T^{-2}A^{-1}$

1. tesla 2.weber 3.amp meter 4.amp m^2

9. The work done 'w' by a body varies with displacement 'x' as $w = Ax + \frac{B}{(c-x)^2}$. The dimensional formula for 'B' is.

1. ML^2T^{-2} 2. ML^4T^{-2} 3. MLT^{-2} 4. ML^2T^{-4}

10. $\mu = A + \frac{B}{\lambda} + \frac{C}{\lambda^2}$ is dimensionally correct. The dimensions of A, B and C respectively are (μ, A, B, C are constants)

1. No dimensions, L, L^2
2. L^2, No dimensions, L
3. L, L^2, No dimensions
4. L, L^2, No dimensions

11. In the equation $y = A\ Sin\left[kt - \frac{x}{\lambda}\right]$, the dimensional formula for k is

1. $M^0L^0T^{-1}$ 2. $M^0L^0T^0$ 3. M^0LT^0 4. ML^0T^0

12. If 'R' is Rydberg constant, h is Planck's constant, C is velocity of light, Rhc has the same dimensional formula as that of

1. Energy 2. Force
3. Angular momentum 4. Power

13. The units of force, velocity and energy are 100 dyne, 10 cm s^{-1} and 500 erg respectively. The units of mass, length and time are

1. 5 g, 5 cm, 5 s 2. 5 g, 5 cm, 0.5 s
3. 0.5 g, 5 cm, 5 s 4. 5 g, 0.5cm, 5 s

14. The height of Mercury barometer is 76 cm and density of Mercury is 13.6 g/cc. The corresponding height of water barometer is SI system is

1. 10.336 m 2.103.36 m
3. 5.5 m 4.1.0336 m

15. A certain physical quantity is calculated from the formula $x = \frac{\pi}{3}\left(a^2 - b^2\right)h$ where h, a and b, all are lengths. Then x is :

1. velocity 2.acceleration
3.area 4. volume

16. If the unit of length is 5 cm and unit of mass is 20g, then the density of a substance which is 8 g/cc in the new system is

1. 80 units 2. 40 units 3. 50 units 4.100 units

17. A certain amount of energy is measured as 500 units. If the fundamental units of length, Mass and time each are doubled then the magnitude of energy in new system will be

1. 1000 units 2. 250 units
3. 500 units 4. 2000 units

18. The value of g = 9.8 m s^{-2}. Its value in Km hr^{-2} is.

1. 278326 2. 15376 3. 227004 4.127008

19. The following pair does not have the same dimensions

1. Moment of inertia and Torque
2. Linear Momentum and impulse
3. Angular Momentum and Plank's constant
4. Work and internal energy

20. The pressure of a gas $p = \frac{RT}{V-b}.e^{\left(\frac{-aV}{RT}\right)}$. If V be the volume of gas, R be the universal gas constant and T be the absolute temperature. The dimensional formula of 'a' is same as that of

1. V 2. p 3. T 4. R

21. If the velocity 'V', the kinetic energy 'k' and time 'T' are taken as fundamental quantities the dimensional formula of surface tension is.

1. KV^2T^2 2. $KV^{-2}T^{-2}$
3. $K^2V^2T^{-2}$ 4. $K^2V^{-2}T^{-2}$

22. The power of a motor is 1600 watt. If the unit of mass is doubled and units of length and time are halved, the power of the motor in new system is

1. 400 units 2. 6400 units
3. 3200 units 4. 4800 units

23. If the unit of work is 100 joule, the unit of power is 1 kilo watt, the unit of time in second is

1. 10^{-1} 2. 10 3. 10^{-2} 4. 10^{-3}

24. If the fundamental units in the systems of measurement are in the ratio 2 : 3, then the units of surface tension in the system will be in the ratio of

1. 2 : 3 2. 3 : 2 3. 4 : 9 4. 9 : 4

25. The ratio of SI unit to the CGS unit of planck's constant is

1. 10^7:1 2. 10^4 :1 3. 10^6 :1 4. 1 :1

26. If P is pressure, ρ is the density then $\frac{P}{\rho}$ has the same dimensions of :

1. Force per unit Mass
2. Energy per unit Mass
3. Power per unit velocity
4. relative density

27. Hydrostatic pressure 'P' varies with displacement 'x' as $P = \frac{A}{B}\log\left(Bx^2 + c\right)$ where A, B and C are constants. The dimensional formula for 'A' is.

1. $M^1L^{-1}T^{-2}$ 2. MLT^{-2} 3. $ML^{-2}T^{-2}$ 4. $ML^{-3}T^{-2}$

28. The velocity 'V' of a particle varies with distance 'x' and time 't' as V = $A\sin Bx.\cos Ct$ when A, B, C are constants, then $\frac{AB}{C}$ will have the dimensions of

1.velocity 2. acceleration
3. pressure 4. strain

29. If the unit of velocity is equal to the velocity of light and acceleration is 10 ms^{-2}, the unit of time is

1. 3 x 10^7 s 2. 3 x 10^{-7} s
3. 3 x 10^{-5} s 4. 3 x 10^{-4} s

30. If the unit of force is 1 KN unit of length is 1 km and unit of time is 100 s in a new system, then the new unit of mass is

1. 1000 kg 2. 1 kg
3. 10,000 kg 4. 100 kg

31. If the unit of force is 4 N unit of length is 4 m and unit of mass is $\frac{1}{4}$ kg in a new system, then the new unit of velocity is

1. 8 ms^{-1} 2. 16 ms^{-1} 3. 4 ms^{-1} 4. 1 ms^{-1}

32. The thrust developed by a rocket motor is given by $F = mV + A\left(P_1 - P_2\right)$ where m is the mass, V is the velocity of gas A is area of cross section of the nozzle. P_1, P_2 are pressures of the exhaust gas and surrounding atmosphere. Then this equation is

1. dimensionally correct
2. dimensionally wrong
3. some times correct and some times wrong
4. algebrically correct

KEY

1. 4	2. 3	3. 1	4. 3	5. 4
6. 2	7. 2	8. 1	9. 2	10. 1
11. 1	12. 1	13. 2	14. 1	15. 4
16. 3	17. 2	18. 4	19. 1	20. 2
21. 2	22. 2	23. 1	24. 2	25. 1
26. 2	27. 4	28. 4	29. 1	30. 3
31. 1	32. 2			

HINTS

2. $M \,\alpha\, C^a.G^b.h^c$

$M^1L^0T^0 = K\left(L^1T^{-1}\right)^a.\left(M^{-1}L^3T^{-2}\right)^b.\left(M^1L^2T^{-1}\right)^c$

$\Rightarrow M^1L^0T^0 = M^{-b+c}.L^{a+3b+2c}.T^{-a-2b-c}$

$\therefore -b + c = 1$ --(1) $a + 3b + 2c = 0$ ---(2)

$-a - 2b - c = 0$ ------(3)

Solving above equations $a = \frac{1}{2}$ $b = -\frac{1}{2}$ $c = \frac{1}{2}$

$M \rightarrow \left[C^{\frac{1}{2}}G^{-\frac{1}{2}}.h^{\frac{1}{2}}\right]$

4. $M_2 = 2m_1,\ L_2 = 2L_1,\quad T_2 = 2T_1$

400 kg. $m^2s^{-2} = n_2 \times 2kg \times (2m)^2 \times (2s)^{-2}$

$= n_2 \times 2 \times 4 \times \frac{1}{4} kg.m^2s^{-2}$;

$n_2 = \frac{400}{2} = 200$

5. $F \alpha\ \eta^x.a^y.v^z$

$M^1L^1T^{-2} = k.\left(ML^{-1}T^{-1}\right).\left(L^1\right)^y.\left(L^1T^{-1}\right)^z$

$M^1L^1T^{-2} = M^x.L^{-x+y+z}.T^{-x-z}$

x =1 ; ....(1)

-x + y + z = -1 ....(2) $\Rightarrow$ -1+y+z = 1

-x -z = -2 ...(3) $\therefore$ y+z=2...............(4)

From 3 & 4 y + z = 2; -1 -z = -2; z = 1

From 2 -1+y + 1=1 y = 1

x = 1; y = 1 ; z = 1

7. Muscle x speed = power

$\rightarrow$ F x V = Power $\therefore$ Muscle $\Rightarrow$ Force.

9. W = $Ax + \frac{B}{(c-x)^2}$

Since x is displacement, C must be displacement.

$(c-x)^2 \Rightarrow L^2$

$\frac{B}{(c-x)^2} \Rightarrow W \Rightarrow M^1L^2T^{-2}$

$B \Rightarrow M^1L^2T^{-2}.L^2 = M^1L^4T^{-2}$

12. R.h.C. = L^{-1} $M^1L^2T^{-1}.L^1T^{-1}$

= $M^1L^2T^{-2}$ = Energy

13. F = $M^1L^1T^{-2}$ = 100 dynes ---------(1)

V = L^1T^{-1} = 10 $cm.s^{-1}$ ---------------(2)

E = $M^1L^2T^{-2}$ = 500 ergs---------------(3)

$\frac{E}{F} = L = 5cm$

$\frac{L}{V} = \frac{L}{L.T^{-1}} = T = \frac{5}{10} = 0.5$

$M = \frac{F}{LT^{-2}} = \frac{100}{5\times(0.5)^{-2}} = 5gm$

14. $h_1d_1 = h_2d_2$

$h_{Mercury} \times d_{Merc} = h_w.d_w$; $76\times13.6 = h_w \times 1$

$\Rightarrow h_w = 1033.6$ cm = 10.336 m

15. $x = \frac{\pi}{3}(a^2-b^2).h$ $a,b,h \rightarrow$ are Lengths.

$\therefore x \Rightarrow L^2.L = L^3 =$ Volume.

16. 8 gm cm^{-3} = $n_2\left[(20gm)\times(5cm)^{-3}\right]$

$n_2 = 8\times\frac{gm}{20gm}.\frac{Cm^{-3}}{(5cm)^{-3}} = 8\times\frac{1}{20}\times125 = 50$

17. $\frac{U_2}{U_1} = \frac{2M_1\times(2L_1)^2\times(2T_1)^{-2}}{M_1 \quad L_1^2 \quad T_1^{-2}} = 2$

$U_2 = 2U_1$ Since the unit is doubled. Magnitude will be halved.

$W_1 = \frac{500}{2} = 250$ Units.

18. 9.8 $m\ s^{-2} = n_2\ km.hr^{-2}$; $n_2 = 9.8\times\frac{m}{km}\times\left(\frac{s}{hr}\right)^{-2}$

$= 9.8\times\frac{1}{1000}\times\left(\frac{1}{3600}\right)^{-2} = \frac{9.8}{1000}\times3600\times3600$

$= 127008$

20. $P = \frac{RT}{v-b}.e^{\frac{-av}{RT}}$; $\frac{av}{RT} \Rightarrow$ Number

av = RT $\Rightarrow$ $a = \frac{RT}{V}$ $a = \frac{M^1L^2T^{-2}}{L^3}$

$a = M^1L^{-1}T^{-2} \Rightarrow P$ (Pressure)

21. Surface tension (S) α $V^ak^bT^c$ a = -2

$M^1T^{-2} = \left(L^1T^{-1}\right)^a.\left(M^1L^2T^{-2}\right)^b.T^c$ b = 1

$= M^b.L^{a+2b}.T^{-a-2b+c}$ c= -2

find a, b, c

22.

$P = \frac{ML^2}{T^3}$

$\frac{P_2}{P_1} = \frac{M_2}{M_1}\left(\frac{L_2}{L_1}\right)^2\left(\frac{T_1}{T_2}\right)^3$

$= 2\left(\frac{1}{2}\right)^2 2^3$

$p_2 = 4p_1$

since unit is increased by a factor 4 the number

23. Power = $\frac{Work}{time}$

time = $\frac{work}{power} = \frac{100}{1000} = \frac{1}{10} = 10^{-1}s$

24. $L_1 : L_2 = 2:3$; $M_1 : M_2 = 2:3$

$T_1 : T_2 = 2:3$ Surface tension = S = M^1T^{-2}

$\frac{S_2}{S_1} = \frac{M_2}{M_1}\times\left(\frac{T_2}{T_1}\right)^{-2} = \frac{3}{2}\times\left(\frac{3}{2}\right)^{-2} \Rightarrow \frac{3}{2}\times\frac{2^2}{3^2} = \frac{2}{3}$

$\Rightarrow S_1 : S_2 = 3:2$

25. $\frac{cgs}{S.I} \Rightarrow \frac{gm.\ cm^2s^{-1}}{kg.m^2s^{-1}} = \frac{1}{1000}\times\frac{1}{10^4} \Rightarrow 10^{-7}$

$\therefore S.I : c.g.s = 10^7 : 1$

27. $Bx^2 + c = Cons\tan t$ $l\times b = [L^3]$ $l\times b = [L^3]$

$BL^2 = 1$ $\therefore P = \frac{A}{B} \Rightarrow A = P.B$

$B = L^{-2}$; A $\Rightarrow M^1L^{-1}T^{-2}.L^{-2} = \left[M^1L^{-3}T^{-2}\right]$

28. V = $A\ Sin\ Bx.\ Cos\ CT$

$L^1T^{-1} = A \quad B = L^{-1}; \quad C = T^{-1}$

$\frac{AB}{C} = \frac{L^1T^{-1}.L^{-1}}{T^{-1}} = M^0L^0T^0$

29. $V = 3\times10^8 ms^{-1} \qquad a = 10m\ s^{-1};$

$a = \frac{V}{T} \Rightarrow T = \frac{V}{a} \Rightarrow \frac{3\times10^8}{10} = 3\times10^7$

30. $F = M^1L^1T^{-2}$

$\therefore M = \frac{F}{LT^{-2}} = \frac{K.N}{K.m.\times(100s)^{-2}} = \frac{1000\ kg.m.s^{-2}}{1000\ m.10^{-4}.s^{-2}}$

$= 10^4 kg$

31. F = ma; $\quad a = \frac{F}{M} = \frac{4\ N}{\frac{1}{4}kg} = 16\ m.s^{-2}$

$L^1T^{-2} = 16ms^{-2}\ ; \frac{L}{T^2} = 16 \Rightarrow T^2 = \frac{L}{16} = \frac{4}{16} = \frac{1}{4};$

$T = \frac{1}{2}s$ Velocity= $LT^{-1} = 4\times\left(\frac{1}{2}\right)^{-1} = 4\times2 = 8ms^{-1}$

LEVEL - III

1. Two physical quantities are represented by P and Q. The dimensions of their product is $M^2L^4T^{-4}I^{-1}$ and the dimensions of their ratio is I^{-1}. Then P and Q respectively are
1. Magnetic flux and Torque acting on a Magnet.
2. Torque and Magnetic flux.
3. Magnetic Moment and Polestrength
4. Magnetic Moment and Magnetic permeability.

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 static pressure, d is density of water, E is the total energy of the explosion. The values of a, b and c respectively are:

1. $\frac{5}{6}, \frac{-1}{2}, \frac{-1}{3}$ 2. $\frac{-5}{6}, \frac{1}{2}, \frac{1}{3}$

3. $\frac{5}{6}, \frac{1}{2}, \frac{1}{3}$ 4. $\frac{1}{2}, \frac{5}{6}, \frac{-1}{3}$

3. If the unit of power is 1 million erg per minute, the unit of force is 1000 dyne and that of time is $\frac{1}{10}$ s, the unit of mass in the new system is

1. 6 g   2. 60 g   3. 106 g   4. 1 g

4. In the formula $x = 3yz^2$, x and z have dimensions of capacitence and magnetic induction field strength respectively. The dimensions of y in MKSQ system are

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

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

5. The rate of flow of a liquid Q through a capillary tube depends upon the pressure gradient, *(P/l)*, radius of the capillary (r) and coefficient viscosity h and constant of proportionality is p/8. The equation for the rate of flow of the liquid Q is given by

1. $Q = \frac{\pi pr^2}{8\eta l}$ 2. $Q = \frac{\pi pr^4}{8\eta l}$

3. $Q = \frac{\pi}{8}.pr^2.\eta^2.l$ 4. $\frac{8\eta l}{\pi pr^4}$

6. The number of particles crossing unit area perpendicular to X-axis in unit time is given by N = $-D\frac{(n_2 - n_1)}{(x_2 - x_1)}$ 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, D is the diffusion constant. The dimensions of D are

1. LT^{-1} 2. L^2T^{-1} 3. LT   4. $L^{-1}T$

7. The frequency 'n' of a vibrating string depends upon its length 'l' linear density 'm' and tension 'T' in the string. The equation for the frequency of the string is (given the constnat of proportionality as 1/2)

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

3. $n = \frac{1}{2l}.\sqrt{T.m}$ 4. $n = \frac{l}{2}.\sqrt{\frac{T}{m}}$

8. If kinetic energy 'K', velocity 'v' and time 'T' are chosen as the fundamental units, the formula for surface tension S=

1. $\frac{v^2T^2}{AK}$ 2. $\frac{v^2}{AKT^2}$ 3. $\frac{AKT^2}{v^2}$ 4. $\frac{AK}{v^2T^2}$

9. The formula for the capacity of a condenser is given by $C = \frac{A}{d}$ when A is the area of each plate and d is the distance between the plates. Then the dimensions of missing quantity is

1. $\in_0 = M^{-1}L^{-3}T^4A^2$ 2. $\in_0 = M^1L^3T^{-4}A^{-2}$

3. $\in_0 = M^{-1}L^3T^4A^{-2}$ 4. $\in_0 = M^{-1}L^{-2}T^4A^2$

10. A small steel ball of radius r is allowed to fall under gravity through a column of viscous liquid of coefficient η. After some time the velocity of the ball attains a constant value known as terminal velocity, V_T. The terminal velocity depends on mass of the ball 'm', coefficient of viscosity 'η',

the radius of the ball 'r' and acceleration due to gravity g. The relationship between terminal velocity and other factors given is :

1. $V_T \alpha \dfrac{mg}{\eta r}$ 2. $V_T \alpha \dfrac{\eta r}{mg}$ 3. $V_T \alpha\ \eta rmg$ 4. $V_T \alpha \dfrac{mgr}{\eta}$

11. 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 $P^x.Q^y.C^z$ is dimensionless are :
1. x =1, y =1, z = -1 2. x=1, y=-1, z=1
3. x = -1, y =1, z =1 4. x=1, y=1, z=1

12. The unit of Mass is α kg. The unit of length is β metre and the unit of time is γ second. The magnitude of calorie in the new system is [1 calorie = 4.2 Joules]
1. $4.2\alpha^2\beta^2\gamma^2$ new units
2. 4.2 $\alpha^{-1}\beta^{-2}\gamma^2$ new units
3. $\alpha^{-1}\beta^{-2}\gamma^2$ new units
4. $\dfrac{1}{4.2}\alpha^{-1}\beta^{-2}\gamma^2$ new units

13. $\dfrac{8\pi\varepsilon_0\ kx}{Q^2}$ is a dimensionless quantity, ε_0 -permittivity of free space. K - energy; Q - charge. Then the dimensions of x are.
1. MLT^2 2. MLT^{-1} 3. M^0LT^0 4. $ML^{-1}T^{-1}$

14. If F is the force, μ is the permeability, H is the intensity of magnetic field and i is the electric current, then $\dfrac{F}{\mu Hi}$ has the dimensions of
1. mass 2. length 3. time 4. energy

15. If the period of vibration of a tuning fork depends upon the density 'd' Young's modulus of the material 'y' and the length of the spring 'L' then time period T is proportional to (I.I.T)
1. $Ld^{\frac{1}{2}}y^{\frac{1}{2}}$ 2. $Ld^{\frac{1}{2}}.y^{-\frac{1}{2}}$ 3. $L.d^{\frac{3}{2}}.y^{\frac{3}{2}}$ 4. $L.d^{\frac{-3}{2}}.y^{\frac{-3}{2}}$

16. A quantity x is defined by the equation $x = 3CB^2$. where C is capacitance in farad, B represents magnetic induction field strength in tesla. The dimensions of x are
1. ML^{-2} 2. $ML^{-2}T^{-2}$ 3. $M^1L^{-2}T^2I^2$ 4. $L^{-1}I^{-1}$

17. The electrical conductivity, σ is given by $\sigma = \dfrac{ne^2.T}{2m}$ where n is equal to number of free electrons per cubic meter. C is charge on electron T is relaxation time m and is mass of electron. The dimensional formula for σ is
1. $M^{-1}L^{-3}T^3A^2$ 2. $M^1L^{-3}T^3A^3$
3. $M^{-1}L^{-3}T^3A^{-2}$ 4. $M^{-1}L^{-2}T^3A^{-2}$

KEY

1. 1	2. 2	3. 1	4. 1	5. 2
6. 2	7. 1	8. 4	9. 1	10. 1
11. 2	12. 2	13. 3	14. 2	15. 2
16. 1	17. 1			

HINTS

1. $P \times Q = M^2L^4T^{-4}I^{-1}$ ------(1)

$\dfrac{P}{Q} = I^{-1}$ -------(2)

$1\times 2 \Rightarrow P^2 = M^2L^4T^{-4}I^{-2}$

$= P = ML^2T^{-2}I^{-1}$ (Magnatic flux)

$1 \div 2 \Rightarrow Q^2 = M^2L^4T^{-4} \quad Q = ML^2T^{-2}$ (Torque)

2. $T\ \alpha\ P^a.d^bE^c$

$M^0L^0T^{-1} = \left(M^1L^{-1}T^{-2}\right)^a.\left(M^1L^{-3}\right)^b.\left(M^1L^2T^{-2}\right)^c$

a + b + c = 0

-a - 3b - 2c = 0 - 2a - 2c = -1

Solving we get $a = \dfrac{-5}{6}$; $b = \dfrac{1}{2}$; $c = \dfrac{1}{3}$

3. $M\alpha\ p^a.F^b.T^c$

$M^1L^0T^0 = \left(M^1L^2T^{-3}\right)^a.\left(M^1L^1T^{-2}\right)^b.T^c$

$a + b = 1$ ---(1)

$2a + b = 0$ --(2)

$-3a - 2b + c = 0$ --(3)

By soving $a = -1$; $b = 2$; $c = 1$; $M \Rightarrow p^{-1}.F^2.T$

$$M = \frac{F^1.T}{P} \Rightarrow \frac{(1000)^2}{\frac{10^6}{60}} \times \frac{1}{10}$$

$$\Rightarrow 10^6 \times \frac{60}{10^6} \times 10^{-1} = 6\ g$$

4. $x = 3yz^2$

$$y = \frac{x}{3z^2} \Rightarrow \frac{Capacitance}{(Induction\ \ field\ \ Strength)^2}$$

$$\Rightarrow \frac{M^{-1}L^{-2}T^4I^2}{\left(M^1L^0T^{-2}I^{-1}\right)^2} \Rightarrow M^{-3}.L^{-2}.T^8.I^4$$

but $I = \dfrac{Q}{T} \quad \Rightarrow M^{-3}L^{-2}T^4.Q^4$

5. $Q\alpha\left(\frac{p}{l}\right)^a .r^b.\eta^c$

$$L^3T^{-1}=k.\left(\frac{M^1L^{-1}T^{-2}}{L}\right)^a.L^b.\left(M^1L^{-1}T^{-1}\right)^c$$

$$M^0L^3T^{-1}=M^{a+c}.L^{-2a+b-c}.T^{-2a-6}$$

$a+c=0$ ---(1) $\quad -2a+b-c=3$ ---(2)

$-2a-c=-1$ -------------(3)

from 1 & 3 adding a = 1;

from 1C = -1

from 2 ; -2(1) + b-(-1)=3 b=4

$$Q\ \alpha\left(\frac{p}{l}\right)^1.r^4.\eta^{-1}\Rightarrow Q=\frac{\pi}{8}.\frac{pr^4}{\eta l}$$

6. $D=\frac{N(x_2-x_1)}{n_2-n_1}=\frac{Number}{L^2T}\times\frac{L}{L^{-3}}=\left[L^2T^{-1}\right]$

7. $n\ \ \alpha\ L^a.m^b.T^c$

$$M^0L^1T^{-1}=k.L^a.\left(\frac{M}{L}\right)^b.T^c$$

Proceed $\left(Put\,k=\frac{1}{2}\right)$

10. V_T = (2/9) r^2g (r - d) / h = 2/9 r^2 g / h x m/V

= 2/9 r^2 g/h x m/(4/3pr^3);

V_T µ mg/hr

11. $P^xQ^yC^z=M^0L^0T^0$

$$(ML^{-1}T^{-2})^x\left(\frac{ML^2T^{-2}}{L^2T}\right)^Y(LT^{-1})^z=0$$

12. 1Cal = 4.2 J = 4.2 Kg, m^2 S^{-2}

$=n_2\times\alpha\ kg\left(\rho\ m\right)^2.\left(\gamma\ s\right)^{-2}$

$$n_2=4.2\times\frac{1}{\alpha}.\ \frac{1}{\beta^2}.\frac{1}{\gamma^{-2}}$$

$=4.2\ \alpha^{-1}\ \beta^{-2}\ \gamma^2$

13. $\frac{\delta\pi\ \varepsilon_0.kx}{Q^2}=M^0L^0T^0=1$

$$x=\frac{I^2T^2}{M^{-1}L^3T^4I^2.}\ M^1L^2T^{-2}$$

$$x=\left[M^0L^1T^0\right]$$

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

k = energy $M^1L^3T^{-2}$]

NEW MODEL QUESTIONS

(i) True or False Questions

1. Consider the following two statements A and B and identify the correct answer.
A) The size (u) of the unit of physical quantity and its numerical magnitude (n) are related to each other by the relation nu = constant
B) The choice of mass, length and time as fundamental quantities is not unique.
1) A is true but B is false
2) B is true but A is false
3) Both A and B are true
4) Both A and B are false

2. Consider the following two statements A and B and identify the correct answer.
A) The MKS system is a coherent system of units
B) In SI, joule is the unit for all forms of energy
1) A is true but B is false
2) B is true but A is false
3) Both A and B are true
4) Both A and B are false

3. Consider the following two statements A and B and identify the correct answer.
A) Two quantities which are to be added must have the same dimensions
B) Two quantities which are to be multiplied must hve the same dimensions.
1) A is true but B is false
2) B is true but A is false
3) Both A and B are true
4) Both A and B are false

4. Consider the following two statements A and B. Identify the correct answer.
A) The quantity $\frac{e^2}{\epsilon_0\ ch}$ is dimension less
B) $\frac{1}{\sqrt{\mu_0\ \epsilon_0}}$ has the dimensions of velocity and is numerically equal of velocity of light.
1) A is true but B is false 2) B is true but A is false
3) Both A and B are true 4) Both A and B are false

5. Choose the correct statements (s) from the given statements.
I. The proportionality constant in an equation can be obtained by dimensional analysis.
II. The equation can be derived by dimensional method.
III. The equation cannot be derived by dimensional method.
IV. The eqaution can be derived with dimensionl analysis.
1) Only III is correct 2) Only II and III are correct
3) Only II, III nd IV are correct
4) Only III and IV are correct

6. Choose the false statement from given statements.
I. Relative permittivity is dimensionless constant
II. Angular displacement has neither units nor dimensions
III. Refractive index is dimensionless variable
IV. Permeability of vaccum is dimensional constant
1) only I and II are correct
2) Only II is correct 3) Only III correct
4) Only IV is correct

(ii) Match the following

7. Study the following

List - I	***List - II***
a) Fundamental unit	I) rad
b) Derived unit	II) Kg-Wt
c) Practical unit	III) N
d) Supplementary unit	IV) Kg

The correct match is

	a	b	c	d
1.	I	IV	II	III
2.	IV	III	II	I
3.	II	III	IV	I
4.	I	II	III	IV

8. Column I gives three physicll quantities. Select the appropritate units for these from the choices given in column II. Some of the physical quantities may have more than one choice

Column-I	**Column - II**
a) Capacitance	d) Ohm second
b) Inductance	e) Coulomb^2 joule^{-1}
c) Magnetic induction	f) Coulomb volt^{-1}
	g) newton (ampere metre)$^{-1}$
	h) Volt second (ampere)$^{-1}$

	a	b	c
1.	e	d	g
2.	h	d	e
3.	e	g, h	g
4.	e,f	d, h	d,e

9. Match List I with List II and select the correct answer using the codes given below the lists.

List - I	***List - II***
a) Joule	e) Henry-amp/sec
b) Watt	f) Farad-Volt
c) Volt	g) Coulomb-volt
d) Coulomb	h) Oersted-cm
	i) Amp-gauss
	j) Amp^2-ohm

1) $a \to e; b \to j; c \to i; d \to h$
2) $a \to g; b \to j; c \to e; d \to f$
3) $a \to g; b \to j; c \to e; d \to i$
4) $a \to f; b \to j; c \to e; d \to g$

10. Match List I with List II and select the correct answer.

List - I	***List - II***
A) Spring constant	I) $M^1L^2T^{-2}$
B) Pascal	II) $M^0L^0T^{-1}$
C) Hertz	III) $M^1L^0T^{-2}$
D) Joule	IV) $M^1L^{-1}T^{-2}$

The correct match is

	A	B	C	D
1)	III	IV	II	I
2)	IV	III	I	II
3)	IV	III	II	I
4)	III	IV	I	II

11. Match List I with List II and select the correct answer using the codes given below the Lists.

List - I
List - II

A)	Distance between earth and stars	I) Micron
B)	Inter atomic distance in a solid	II) Angstrom
C)	Size of the nucleus	III) Light year
D)	Wave length of infrared laser	IV) Fermi
		V) Kilometer

	A	B	C	D
1)	V	IV	II	I
2)	III	II	IV	I
3)	V	II	IV	III
4)	III	IV	I	II

12. Match the physical quantities given in Column I with suitable dimensions expressed in Column II.

Column I	**Column II**
a) Angular momentum	e) $M^{-1}L^2T^{-1}$
b) Torque	f) MT^{-2}
c) Gravitational constant	g) ML^2T^{-2}
d) Tension	h) ML^2T^{-1}

The correct match is
1) $c \to f; d \to e$ 2) $a \to h; b \to g$ 3) $a \to g; c \to f$ 4) $b \to f; a \to e$

13. Match the physical quantities given in Column I with suitable dimensions expressed in Column II.

Column I	Column II
a) Angular momentum	g) ML^2T^{-2}
b) Latent heat	h) ML^2Q^{-2}
c) Torque	i) ML^2T^{-1}
d) Capacitane	j) $ML^3T^{-1}Q^{-2}$
e) Inductance	k) $M^{-1}L^{-2}T^2Q^2$
f) Resistivity	l) L^2T^{-2}

	a	b	c	d	e	f
1.	i	l	g	k	h	j
2.	l	i	k	g	j	h
3.	i	l	h	j	g	k
4.	h	j	g	k	i	l

14. Study the following.

List - I	*List - II*
a) Same negative dimensions of mass	I) pressure, Rydberg constant
b) same negative dimensions of length	II) Mangnetic induction field, potential
c) same dimensions	III) Capacity, of time universal gravitational constant
d) Same dimension of current	IV) Energy density, surface tension

	a	b	c	d
1	III	I	IV	II
2.	III	IV	I	II
3.	I	II	III	IV
4.	II	I	IV	III

15. The velocity $v\left(in\, ms^{-1}\right)$ of a particle is given in terms of time $t\left(in\, second\right)$ by the equation, $v = at + \frac{b}{\left(t+c\right)}$. The dimensions of a , b, c are

The correct match is

	a	b	c
1)	L	T	LT^2
2)	LT^2	LT	L
3)	LT^{-2}	L	T
4)	L^2	LT	T^2

(iii)ORDER ARRANGING TYPE QUESTIONS

16. The correct order in which the dimensions of length increases in the following physical quantities is

a) permittivity b) resistance
c) magnetic permeability d) stress
1) a, b, c, d 2) d, c, b, a
3) a, d, c, b 4) c, b, d, a

17. Set the following units of energies in increasing order.

a) Joule	**b) eV**	**c) k.w.h**	**d) erg**
1. a	b	c	d
2. b	d	a	c
3. d	c	b	a
4. b	a	c	b

18. The correct order in which the dimensions of "length " decreases in the following physical quantities is

a) Coefficient of viscocity
b) Thermal capacity c) Escape velocity
d) Density

1.	b	c	a	d
2.	a	b	c	d
3.	c	d	b	a
4.	a	d	c	b

19. The correct order in which the dimensions of "time" increases in the following physical quantities is

a) Stress
b) Period of revolution of satellite
c) Angular displacement
d) Coefficient of thermal conductivity

1.	a	b	c	d
2.	d	c	b	a
3.	a	d	c	b
4.	d	a	c	b

20. Arrange the following lengths in increasing order

I. 1 Angstrom II. 1 Micro
III. 1 Fermi IV. 1 light year
1. III, I, II, IV 2. I, II, III, IV
3. III, II, I, IV 4. II, III, I, IV

21. Arrange the following multiples in decreasing order

I. Milli II. Centi
III. Nano IV. Pico
1. IV, II, I, III 2. II, I, III,IV
3. I, III, II, IV 4. III, IV, I, II

22. Arrange the following physical quantities increasing order of their magnitudes

I. 10^6 dynes II. 1 N III. 3 Kg mS^{-2}
IV. $10^7\, gm\ cm\ S^{-2}$

1.	II	I	III	IV
2.	IV	I	III	II
3.	II	III	I	IV
4.	I	II	III	IV

23. Arrange the following physical quantities in the decreasing order of dimension of length

I. Density II. Pressure III. Power
IV. Impulse
1. I, II, III, IV 2. III, II, I, IV
3. IV, I,II, III 4. III, IV, II, I

24. Which of the following have same dimensional formula

i. Angular velocity ii. Velocity gradient
iii. Angular momentum iv. Frequency

1. i, ii, iv only 2. i, iv only
3. i, iii, v only 4. iii, iv, v only

25. A book with many printing errors contains four different expressions for the displacement 'y' of a particle executing simple harmonic motion. The wrong formula on dimensional basis

i. $y = A\sin\left(2\pi t / T\right)$

ii. $y = A\sin\left(Vt\right)$

iii. $y = A/T\sin\left(t/A\right)$

iv) $y = \frac{A}{\sqrt{2}}\left(\sin\omega t + \cos\omega t\right)$

1) ii only 2) ii and iii only
3) iii only 4) iii and iv only

(iv) ASSERTION AND REASON TYPE QUESTIONS:

Directions :Choose any of the following four options for the Questions given below.

A) If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B) If both Assertion and Reason are true, but Reason is correct explanation of the Assertion.

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

D) If Assertion is false, but the reason is true.

26. A: When we change the unit of measurement of a quantity, its numerical value changes.
R: Smaller the unit of measurement, smaller is its numerical value.
1) A 2) B 3) C 4) D

27. A: If $u_1\ and\ u_2$ are units and n_1, n_2 are their numerical values in two different systems then $n_1 > n_2 \Rightarrow u_1 < u_2$.
R: The numerical value of physical quantity is inversely proportional to unit
1) A 2) B 3) C 4) D

28. A: Plane angle is a dimensionless quantity.
R: All supplementary quantities need not be dimensionless.
1) A 2) B 3) C 4) D

29. A: Solid angle is a dimensionless quantity and it is a supplementary quantity.
R: All supplementary quantities need not be dimensional
1) A 2) B 3) C 4) D

30. A: Light year is a unit of time
R: Light year is the distance traveled by light in vaccum in one year.
1) A 2) B 3) C 4) D

31. A: Though Fermi is a unit of distance, it is not a fundamental unit.
R: All practical units needs not be fundamental units.
1) A 2) B 3) C 4) D

32. A: Surface tension and spring constant have the same dimensions.
R: Both are equivalent to force per unit length
1) A 2) B 3) C 4) D

33. A: Method of dimensions cannot be used for deriving formulate containing trigonometrical ratios.
R: This is because trigonometrical ratio's have no dimensions.
1) A 2) B 3) C 4) D

(v) MULTI CORRECT TYPE QUESTIONS

34. Which of the following is not a unit of time
a) par-sec b) light-year
c) micron d) sec
1) a and c are correct 2) a and b are correct
3) a,b and c are correct 4) all are correct

35. The SI unit of inductance, the henry can be written as
a) weber/ampere b) Volt second/ampere
c) joule(ampere)$^{-2}$ d) ohm-second
1) a & c are correct
2) a & b are correct
3) a, b, & c are correct 4) all are correct

36. Which of the following is dimensionless
a) Boltzmann's constant
b) Planck's constant c) Poisson;s ratio
d) Relative constant
1) a and b are correct 2) c and b are correct
3) c and d are correct 4) d and a are correct

37. Which of the following pairs have dimensions.
a) Torque and work
b) Angular momentum and work
c) Energy and Young's modulus
d) Light year and wavelength
1) a and b are correct 2) b and c are correct
3) c and d are correct 4) d and a correct

38. The pair of physical quantities that have same dimensions are
a) Reynold number and coefficient of friction
b) Latent heat and gravitational potential
c) Curie and frequency of light wave
d) Planck's constant and torque
1) b and c are correct 2) a and b are correct
3) a,b and c are correct
4) all are correct

39. If $e, \in_0, h\, and\, c$ respectively represents electric charge, permittivity of free space, Planck's constant and speed of light then $\frac{e^2}{\in_0 hc}$ has the dimensions of
a) angle b) relative density c) strain
d) current
1) a & b are correct 2) d & c are correct
3) a, b & c are correct
4) a, b , c & d are correct

40. If dimensions of length are expressed as where $G^x C^y h^z$ where G, C and h are universal gravitational constant and 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) $y = 1/2; z = 3/2$
1) a & c are correct 2) b & d are correct
3) a & b are correct 4) b & c are correct

41. Let $\in_0$ denote the permittivity of the vacuum and μ_0 is permeability of vacuum. If *M*=mass, *L*=length, *T*=time and *I* = electric current, then
a) $\in_0 = M^{-1}L^{-3}T^2 I$ b) $\in_0 = M^{-1}L^{-3}T^4 I^2$
c) $\mu_0 = MLT^{-2}I^{-2}$ d) $\mu_0 = ML^2T^{-1}I$
1) a & c are correct
2) b & c are correct
3) c & d are correct
4) d & a are correct

KEY

1) 3	2) 1	3) 1	4) 3	5) 1
6) 2	7) 2	8) 1	9) 2	10) 1
11) 2	12) 2	13) 1	14) 1	15) 3
16) 3	17) 2	18) 1	19) 4	20) 1
21) 2	22) 3	23) 4	24) 1	25) 3
26) 3	27) 2	28) 2	29) 2	30) 4
31) 1	32) 1	33) 1	34)3	35)4
36)3	37)4	38)1	39) 3	40) 4
41) 2				

PREVIOUS EAMCET QUESTIONS

1. According to Bernoulli's theorem $\frac{p}{d} + \frac{v^2}{2} + gh =$ constant. The dimensional formula of the constant is (P is pressure, d is density, h is height, v is velocity and g is accelaration due to gravity) **(2005 M)**
1) $M^0L^0T^0$ 2) M^0LT^0
3) $M^0L^2T^{-2}$ 4) $M^0L^2T^{-4}$

2. Names of units of some physical quantities are given in List - I and their dimensional formulae are given in List - II. Match the correct pair of the lists. **(2005 E)**

List - I	**List - II**
a) PaS	e) $\left[L^2T^{-2}K^{-1}\right]$
b) NmK^{-1}	f) $MLT^{-3}K^{-1}$
c) $J\,kg^{-1}\,k^{-1}$	g) $ML^{-1}T^{-1}$
d) $Wm^{-1}k^{-1}$	h) $\left[ML^2T^{-2}K^{-1}\right]$

	a	**b**	**c**	**d**
1.	h	g	e	f
2.	g	f	h	e
3.	g	e	h	f
4.	g	h	e	f

3. The position of a particle at time 't' is given by the equation $x(t) = \frac{V_0}{A}\left(1 - e^{AT}\right)$ where V_0 is a constant and A > 0. Dimensions of V_0 and A respectively are **(2004 E)**
1) M^0LT^0 and T^{-1} 2) M^0LT^{-1} and LT^{-2}
3) M^0LT^{-1} and T 4) M^0LT^{-1} and T^{-1}

4. The dimensional equation for magnetic flux is **(2003 M)**
1) $ML^2T^{-2}I^{-1}$ 2) $ML^2T^{-2}I^{-2}$
3) $ML^{-2}T^{-2}I^{-1}$ 4) $ML^{-2}T^{-2}I^{-2}$

5. In planetarymotion the areal velocity of position vector of a planet depends on angular velocity ω and the distance of the planet from sun (r). If so the correct relation for areal velocity is **(2003 E)**
1) $\frac{dA}{dt}\alpha\ \omega r$ 2) $\frac{dA}{dt}\alpha\ \omega^2 r$
3) $\frac{dA}{dt}\alpha\ \omega r^2$ 4) $\frac{dA}{dt}\alpha\sqrt{\omega r}$

6. The Vanderwaal's equation for a gas is $\left(P+\frac{a}{V^2}\right)(V-b)=nRT$ where P, V, R , T and n represent the pressure, volume, universal gas constant, absolute temperature, and number of moles of a gas respectively 'a' and 'b' are constants. The ratio b/a will have the following demensional formula **(2002E)**
1. $M^{-1}L^{-2}T^{2}$ 2. $M^{1}L^{-1}T^{-1}$ 3. $ML^{2}T^{2}$ 4. MLT^{-2}

7. The dimensional formula for coefficient of kinematic viscosity is : **(2002M)**
1. $M^{0}L^{-1}T^{-1}$ 2. $M^{0}L^{2}T^{-1}$
3. $ML^{2}T^{-1}$ 4. $ML^{-1}T^{-1}$

8. In C.G.S. system the magnitude of the force is 100 dyne. In another system where the fundamental physical quantities are kilogram, metre, and minute, the magnitude of force is **(2001E)**
1. 0.036 2.0.36 3. 3.6 4. 36

9. The dimensional formula for the product of two physical quantities P and Q is $ML^{2}T^{-2}$. The dimensional formula of $\frac{P}{Q}$ is MT^{-2}. Then P and Q respectively are: **(2001M)**
1. Force and velocity
2. Momentum and displacement
3. Force and displacement
4. Work and Velocity

10. The fundamental physical quantities that have same dimension in the dimensional formula of Torque and Angular Momentum are **(2000E)**
1. mass, time 2. time, length
3. mass, length 4.time, mole

11. If pressure P, Velocity V, and time T are taken as fundamental physical quantities the dimensional formula for force is **(2000E)**
1. $PV^{2}T^{2}$ 2. $P^{-1}V^{2}T^{-1}$ 3. PVT^{2} 4. $P^{-1}V.T^{2}$

12. The physical quantity which has the dimensional formula as that of $\frac{energy}{mass\times length}$ is **(2000M)**
1. Force 2. Power
3. Pressure 4. Acceleration

13. The dimensional formula for Magnetic induction is **(2000M)**
1. $MT^{-1}A^{-1}$ 2. $MT^{-2}A^{-1}$ 3. MLA^{-1} 4. $MT^{-2}A$

14. The dimnsional formula for latent heat is **(1999E)**
1. MLT^{-2} 2. $ML^{2}T^{-2}$ 3. $M^{0}L^{2}T^{-2}$ 4. MLT^{-1}

15. The S.I. unit of Moment of inertia is : **(1999E)**
1. kg/m^2 2. kg m^2 3. N/m^2 4. Nm^2

16. If m is the mass, Q is the charge and B is the magnetic induction, *m/BQ* has the same dimensions as : **(1999M)**
1. Frequency 2. Time
3. Velocity 4. Acceleration

17. Dimensions of 'ohm' are same as that of [h- Planck's constant e - charge] **(1998E)**
1. $\frac{h}{e}$ 2. $\frac{h^2}{e}$ 3. $\frac{h}{e^2}$ 4. $\frac{h^2}{e^2}$

18. Dimensions of impulse are : **(1998M)**
1. MLT^{-2} 2. $M^{2}LT^{-1}$ 3. MLT^{-1} 4. $ML^{2}T^{-1}$

19. Dimensional formula for capacitance is **(1997E)**
1. $M^{-1}L^{-2}T^{4}I^{2}$ 2. $M^{1}L^{2}T^{4}I^{-2}$
3. $M^{1}L^{2}T^{2}$ 4. MLT^{-1}

20. Velocity of a wave is directly proportional to modulus of Elasticity 'E' and density 'd' of a medium. The expression of 'V' using dimensional analysis is **(1997E)**
1. $V=\frac{E}{\sqrt{d}}$ 2. $V=\frac{\sqrt{E}}{d}$
3. $V=\sqrt{\frac{E}{d}}$ 4. $V=\sqrt{ED}$

21. modulus of Elasticity is dimensionally equivalent to **(1996E)**
1. Stress 2. Surface tension
3. Strain 4. Coefficient of viscosity

22. If the unit of length, Mass, time each be doubled the unit of work is increased to **(1996M)**
1. 5 times 2. 2 times 3. 3 times 4. 4 times

23. Dimensions of C x R (Capacity x Resistance) is **(1995E)**
1. frequency 2. energy
3. time period 4. current

24. The physical quantity that has no dimensions is: **(1995E)**
1. angular velocity 2. linear momentum
3. angular momentum 4. strain

25. $M^{1}L^{-1}T^{-2}$ represents **(1995M)**
1. Stress 2. Young's Modulus
3. Pressure 4. All the above

26. Dimensional formula for Angular momentum **(1995M)**

1. ML^2T^{-1} 2. $M^1L^3T^{-1}$ 3. $M^1L^1T^{-1}$ 4. ML^3T^{-2}

27. The unit of Luminous intensity is: **(1994E)**
1. Candela 2. Watt 3. Lumen 4. Ampere.

28. S.I. unit and C.G.S unit of a quantity vary by 10^3 times, it is : (1994E)
1. Boltzman constant 2.Gravitational constant
3. Plank's constant 4. Angular Momentum

29. $V \alpha\ g^x.h^y$ where V is velocity g is acceleration due to gravity and h is height. Then x and y are **(1994E)**

1. $\frac{1}{2}, \frac{1}{2}$ 2. $\frac{1}{2}, -\frac{1}{2}$ 3. $-\frac{1}{2}, \frac{1}{2}$ 4. $1, \frac{1}{2}$

30. The pair of physical quantities not having the same dimensional formula are. (1993E)
1. acceleration, gravitational field strength
2. Torque, angular momentum
3. Pressure, Modulus of Elasticity
4. All the above

31. If the time period 'T' of a drop under surface tension 's' is given by the formula T = $\sqrt{d^a r^b s^c}$ where d is the density, r is the radius of the drop. If a =1, c=-1 then the value of b is: **(1993E)**
1. 1 2. 2 3. 3 4. -1

32. A pair of physical qunatities having the same dimensional formula are **(1993M)**
1. Momentum and impulse
2. Momentum and energy
3. Energy and pressure 4. Force and power

33. The dimensional formula for universal gravitational constant is **(1992E)**
1. $M^1L^3T^{-2}$ 2. $M^0L^2T^{-2}$ 3. $M^1L^2T^{-2}$ 4. $M^{-1}L^3T^{-2}$

34. A pair of physical quantities having the same dimensional formula are **(1992M)**
1. Force and Work 2. Work and energy
3. Force and Torque 4. Work and Power

35. The pair of physical quantities having the same dimensional formula is **(1991E)**
1. Angular Momentum and torque
2. Torque and strain energy
3. Entropy and power
4. Power and Angular momentum

36. siemen is the S.I unit of ------(fill in the blanks) **(1991E)**
1. Electrical conductance
2. Electrical conductivity
3. Potential difference 4. Inductance

37. Planck's constant has the dimensions as that of **(1990E)**
1. Energy 2. Power
3. Linear momentum 4. Angular momentum

38. The SI unit of magnetic flux is **(1990E)**
1. maxwell 2. weber
3. tesla 4. gauss

39. The fundamental unit which has the same power in the dimensional formula of surface tension and coefficient of viscosity is **(1989E)**
1. mass 2. length 3. time 4. none

40. The physical quantity which has no dimensions is **(1989E)**
1. stress 2. strain
3. momentum 4. angular velocity

41. Electron volt is the unit of **(1988E)**
1. power 2. P.D 3. charge 4. energy

42. Dimensional formula of Torque is **(1987E)**
1. MLT^{-2} 2. ML^2T^{-2} 3. ML^2T^{-3} 4. MLT^{-3}

43. Dimensional analysis of the equation $(Velocity)^x = (Pressure\ difference)^{\frac{3}{2}}.(density)^{\frac{-3}{2}}$ gives the value of x as: **(1986E)**
1. 1 2. 2 3. 3 4. -3

44. For the equation F = $A^a v^b d^c$ where F is force, A is area, v is velocity and d is density, with the dimensional analysis gives the following values for the exponents. **(1985E)**
1. a=1, b = 2, c =1 2. a =2, b =1, c= 1
3. a =1, b =1, c= 2 4. a = 0, b =1 , c = 1

45. The dimensional formula for angular velocity is **(1984E)**
1. $M^{-1}L^1T^0$ 2. $M^0L^{-1}T^{-1}$ 3. $M^{-1}L^{-1}T^0$ 4. $M^0L^0T^{-1}$

46. The dimensional formula $M^{-1}L^3T^{-2}$ refers to **(1983E)**
1. Force 2. Power
3. Gravitational constant 4. Energy

KEY

1. 3	2. 4	3. 4	4. 1	5. 3	6. 1
	7. 2	8. 3	9. 3	10. 3	11.1
	12. 4	13. 2	14.3	15.2	16. 2
	17. 3	18. 3	19.1	20.3	21. 1
	22. 2	23. 3	24.4	25. 4	26. 1
	27. 1	28. 2	29. 1	30. 2	31. 3
	32. 1	33. 4	34. 2	35. 2	36. 1
	37. 4	38. 2	39. 1	40. 2	41. 4
	42. 2	43. 3	44. 1	45. 4	46. 3

QUESTIONS FROM OTHER COMPETETIVE EXAMINATIONS

1. Of the following quantities which one has the dimensions different from the remaining three? **(AIIMS 97)**
   1) energy density
   2) force per unit area
   3) product of charge per unit volume and voltage
   4) Angular momentum per unit mass

2. Let $[\in_0]$ denote the dimensional formula of the permittivity of the vacuum and (μ_0) that of the permeability of the vacuum. If M = mass, L = length, T = time and I = electric current **(IIT 98)**
   1) $[\in_0] = M^{-1}L^{-3}T^2I^2$ 2) $[\in_0] = M^{-1}L^{-3}T^4I^2$
   3) $[\mu_0] = M\,L\,T^{-2}I^{-2}$ 4) $[\mu_0] = ML^2\,T^{-1}I$

3. A force F is given by $F = at + bt^2$, where t is time. What are dimensions of a and b? **(AFMC 2000)**
   1) $MLT^{-3} and\ ML^2T^4$ 2) $MLT^{-3} and\ MLT^{-4}$
   3) $MLT^{-1} and\ MLT^0$ 4) $MLT^{-4} and\ MLT^1$

4. The dimensional formula of $\frac{1}{2}\in_0 E^2$ is $(\in_0$ is permittivity of free space and E is electric field) **(IIT SCREENING 2000)**
   1) ML^2T^{-2} 2) $M\,LT^{-2}$
   3) $M\,L^{-1}T^{-2}$ 4) $M\,L^{-2}T^{-1}$

5. Two soaps A and B are given. Dimensions of B are 50% more than each dimensions of A. Soap content of B as compared to A is **(AFMC 2001)**
   1) 1.5 2) 2.25 3) 3.375 4) 4

6. The dimensions of resistivity in terms of M, L, T and Q, where Q stands for the dimensions of charge is **(AIIMS 2001)**
   1) $ML^3T^{-1}Q^{-2}$ 2) $ML^3T^{-2}Q^{-1}$
   3) $ML^2T^{-1}Q^{-1}$ 4) $MLT^{-1}Q^{-1}$

7. A quantityX is given by X= $\in_0 L\frac{\Delta V}{\Delta t}$ where $\in_0$ is the permitttivity of free space, L is a length. ΔV is a potential difference and Δ t is a time interval. The dimensional formula for X is the same as that of **(IIT SCREENING 2001)**
   1) resistance 2) charge 3) voltage 4) current

8. The physical quantities not having same dimensions are
   1) torque and work
   2) momentum and Planck's constant
   3) stress and Young's modulus
   4) speed and $\left(\mu_0 \in_o\right)^{-1/2}$

9. The SI unit of magnetic pereability is **(AIEEE 2002)**
   1) Am^{-1} 2) Am^{-2} 3) Hm^{-2} 4) Hm^{-1}

10. Dimensions of $\frac{1}{\mu_0 \in_0}$, where symbols have their usual meaning are **(AIEEE 2003)**
    1) $L^{-1}T$ 2) L^2T^2 3) L^2T^{-2} 4) LT^{-1}

11. Which one of the following represents the correct dimensions of the coefficient of visocosity? **(AIEEE 2004)**
    1) $ML^{-1}T^2$ 2) MLT^{-1}
    3) $ML^{-1}T^{-1}$ 4) $ML^{-2}T^{-2}$

12. A body of mass m, accelerates uniformly from rest to V_1 in time t_1. The instantaneous power delivered to the body as a function of time "t" **(AIEEE 2004)**
    1) $\frac{mV_1t}{t_1}$ 2) $\frac{mV_1^2t}{t_1^2}$ 3) $\frac{mV_1t^2}{t_1}$ 4) $\frac{mV_1^2t}{t_1^2}$

13. What are the dimensions of $K = \frac{1}{4\pi \in_0}$? **(AIEEE 2004)**
    1) $C^2N^{-1}M^{-2}$ 2) NM^2C^{-2}
    3) NM^2C^2 4) unitless

14. In the relation $P = \frac{\alpha}{\beta}e^{-\alpha z/K\theta}$; P is pressure, K is Boltzmann's constant, Z is distance and θ is temperature. The dimensional formula of β will be **(AIEEE 2004)**
    1) $\left[M^0\,L^2\,T^0\right]$ 2) $\left[M^1\,L^2\,T^1\right]$
    3) $\left[ML^0\,T^{-1}\right]$ 4) $\left[M^0\,L^2\,T^{-1}\right]$

15. Which of the following quantities has the SI units Kg m^2 s^{-3} A^{-2}? **(IIT SCREENING 1993)**
    1) resistance 2) inductane
    3) capacitance 4) magnetic flux

16. Dimensional of $\frac{L}{RCV}$ are **(ROORKEE 94)**
1) A^{-1} 2) A^{-2} 3) A 4) A^2

17. If L has the dimensions of length, V that of potential and $\in_0$ is the permittivity of free space then quantity $\in_0 LV$ has the dimensions of **(MNR 1997)**
1) current 2) charge 3) resistance 4) voltage

18. If the time period (T) of vibration a liquid drop depends on surface tension (S). radius (r) of the drop and density (ρ) of the liquid, then the expressions of T is **(AMU 2001)**
1) $T = K\sqrt{\frac{\rho r^3}{S}}$ 2) $T = K\sqrt{\frac{\rho^{1/2} r^3}{S}}$
3) $T = K\sqrt{\frac{\rho r^3}{S^{1/2}}}z$ 4) none

19. Dyne - Second is the unit of **(IIT - 1975)**
1. Force 2. Momentum
3. Energy 4. Power

20. The dimensional formula for impulse is: **(CPMT - 78 NCERT-82)**
1. MLT^{-2} 2. MLT^{-1} 3. ML^2T^{-1} 4. M^2LT^{-1}

21. The dimensions of calorie are **(CPMT- 85)**
1. ML^2T^{-2} 2. MLT^{-2} 3. ML^2T^{-1} 4. ML^2T^{-1}

22. In an inductive circuit current I is flown. The work done is equal to $\frac{1}{2}LI^2$. The dimensions of LI^2 are **(CPMT 1985 , 82)**
1. ML^2T^{-2} 2. Not expressible in M, L,T
3. ML^{-1} 4. $M^2L^2T^2$

23. Specific heat in joule per kg per ^{0}c rise of temperature, its dimensions are: **(NCERT - 1983)**
1. $MLT^{-1}K^{-1}$ 2. $ML^2T^{-2}K^{-1}$
3. $M^0L^2T^{-2}K^{-1}$ 4. $ML^2T^{-2}K^{-1}$

24. The displacement in nth second of uniformly acelerated motion is given by $S_{n^{th}} = u+\frac{a}{2}(2n-1)$ This equation is dimensionally **(JIPMER - 2000)**
1. correct 2. not correct
3. can be made correct by multiplying the right hand side of equation by n.
4. can be made correct by dividing the left hand side of the equation by n.

25. Torr is the unit of physical quantity **(RAJ - PMT - 2000)**
1. density 2. pressure
3. torque 4. None

26. The unit of Young's Modulus is **(CPMT - 2000)**
1. N.m^{-1} 2. N.m 3. N.m^{-2} 4. N.m^2

27. Dimensions ($ML^{-1}T^{-1}$) are related to **(AIIMS - 1999)**
1. Work 2. Torque
3. Energy 4. Coefficient of viscosity

28. Force F = $at+bt^2$ where t is time. The dimensions of a and b are: **(AFMC - 2000)**
1. $[MLT^{-3}]$ and $[MLT^{-4}]$
2. MLT^{-3} and MLT^{-2} 3. MLT^{-1} and MLT^0
4. MLT^{-4} and MLT^{-1}

29. Given M is the mass suspended from a spring of force constant k the dimensional formula for $\left(\frac{M}{k}\right)^{\frac{1}{2}}$ is same as that for **(BHU - Med 1999)**
1. Wavelength 2. Velocity
3. Time period 4. Frequency

30. The S.I. unit of Mechanical equivalent of heat is: **(MPPMT - 1998)**
1. joule x calorie 2. joule/calorie
3. calorie x erg 4. erg/ calorie

31. The dimensions of $\frac{1}{2}\varepsilon_0.E^2$ (ε_0 - Electrical permittivity, E - Electrical field, is **(I.I.T. Screening Test - 2000)**
1. MLT^{-1} 2. ML^2T^{-2}
3. MLT^{-2} 4. No Answer

32. The numerical value of a measurement is **(BHU - 2000)**
1. directly proportional to unit
2. inversly proportional to unit
3. Both 4. None

KEY

1. 4	2) 2, 3	3) 2	4) 3	5) 3
6) 1	7) 4	8) 2	9) 4	10) 3
11) 3	12) 2	13) 2	14) 1	15)1
16) 1	17) 2	18) 1	19) 2	20) 2
21) 1	22) 1	23) 3	24) 1	25) 2
26) 3	27) 4	28) 1	29)3	30) 2
31) 4	32)2			