1 Physical World and Measurement

Physics : Scope, Technology and under standing

- In physics we have study mechanial, thermal, electrical, magnetic and optical charcteristics of a body.
- To understand such a property, physics developed mechanics, thermodynamics, electormagnetism, optics and electrodynamics, such like branches.
- Range of physics is from zero to infinite.
- Range of length in physics is from 10^{-14}m (radius of nucleus) to 10^{26}m (length of Galaxy.) Hence ratio of measurement is in order of 10^{40}.
- Range of measurement of time is 10^{-22} s to 10^{18} s.
- Range of mass is from 10^{-30} kg (mass of an electron) to 10^{55} kg (mass of Galaxy).
- There are four type of fundamental forces in nature : (1) Gravitational force (2) Electro magnetic force (3) Weak nuclear force (4) Strong nuclear force.

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(1) Universe is made of ......

(A) Only radiation (B) Only matter (C) Vacuum (D) Matter and radiation

(2) Full name of AFM is ......

(A) Atomic force mirror (B) Atomic force microscope

(C) Atomic fire microscope (D) Automatic force microscope

(3) Full name of ESR is ......

(A) Electron spin resonance (B) Electron spin range

(C) Electric spin resonance (D) Electric space radar

(4) The range of physics is about ......

(A) Zero to infinite (B) range of nucleus (C) Earth to sun (D) near around the earth

(5) Physics considered vacuum as one ......

(A) Physical Quantity (B) Physical State (C) Physical unit (D) Infinite

(6) ...... is a branch of physics related to charge and magnetic field.

(A) Mechanics (B) Electrodynamics (C) Thermodynamics (D) Optics

(7) Electromagnetic force is ......

(A) only attractive (B) Attractive and repulsive

(C) Only repulsive (D) Short range force

(8) Strong nuclear force acting in the nucleus is between ......

(1) Proton-Proton (2) Proton-Neutron (3) Neutron-Neutron (4) Proton-Electron

(A) 1, 2, 3 (B) 1, 2, 4 (C) 1, 3, 4 (D) 4

(9) During the β-emission, nucleus emits ......

(A) neutron and electron (B) neutron and proton (C) neutrino and electron (D) neutrino and proton

(10) As space is isotropic, which law of conservation is obtained ?

(A) Law of conservation of energy (B) Law of conservation of charge

(C) Law of conservation of linear momentum (D) Law of conservation of angular momentum

(11) ...... is responsible for the conservation of linear momentum.

(A) Homogenity of a space (B) Isotropy of a space

(C) Homogenity of time (D) Isotropy of time

(12) If time is homogeneous, which law of conservation is obtained ?

(A) Law of conservation of energy (B) Law of conservation of charge

(C) Law of conservation of linear momentum (D) Law of conservation of angular momentum

(13) Full name of LHC is ......

(A) Large hedron collider (B) Large heater collider

(C) Large heater collision (D) Large hedron cobalt.

(14) If the resultant external ...... acting on the system is zero, total linear momentum of the system remains constant.

(A) Force (B) Torque (C) Charge (D) Mass

Ans : 1 (D), 2 (B), 3 (A), 4 (A), 5 (B), 6 (B), 7 (B), 8 (A), 9 (C), 10 (D), 11 (A), 12 (A), 13 (A), 14 (A)

Units and Unit systems :

SI unit system :

Fundamental physical quantity	**Name of Unit**	**Symbol**
Length (l)	metre	m
mass (m)	kilogram	kg
time (t)	second	s
Electric current (I)	Ampere	A
Thermodynamic temperature (T)	Kelvin	K
Lumnious Intensity (I)	Candella	cd
Quantity of matter (μ)	Mole	mol

Supplementry Units :

No.	**Supplementry physical quantity**	**SI Unit**	**Symbol**	**Formula**
1.	Plane angle (θ)	Radian	rad	$\theta = \dfrac{\text{arc}}{\text{radius}}$
2.	Solid angle (Ω)	Steradian	Sr	$\Omega = \dfrac{\text{area}}{(\text{radius})^2} = \dfrac{\Delta A}{r^2}$

(15) Number of fundamental units in SI system are ......

(A) 5 (B) 6 (C) 7 (D) 9

(16) Which is not a unit of energy ?

(A) joule (B) watt sec

(C) newton meter (D) kilogram-meter/sec^2

(17) Which one have derived unit ?

(A) Pressure (B) quanitity of matter

(C) mass (D) Thermodynamic temperature

(18) KWh is unit of which physical quantity ?

(A) Power (B) momentum (C) work (D) Electric potential

(19) Unit of modulus of rigidity is ......

(A) Nm (B) Nm^{-1} (C) Nm^{-2} (D) Nm^2

(20) Qurie is unit of which physical quantity ?

(A) Energy of γ - ray (B) radioactivity (C) Half life (D) Intensity of radiation

(21) SI unit of an angular momentum is ......

(A) kg ms^{-1} (B) kg m^2 s^{-1} (C) kg m^{-2} s^{-1} (D) kg m^2 s^{-2}

(22) Which one is supplementary unit ?

(A) second (B) Ampere (C) Candella (D) Steradian

(23) Which one is not a true unit of given physical quantity ?

(A) Power : N ms^{-1} (B) Torque : N m

(C) Pressure : N m^{-2} (D) Surface tension : N m^2

(24) Parsec is unit of ......

(A) Distance (B) velocity (C) time (D) plane angle

(25) Which one is unit of Intensity of an electric field ?

(A) Vm (B) NC (C) Vm^{-1} (D) As

(26) Which one is not a unit of time ?

(A) second (B) hour (C) year (D) lightyear

(27) Which one is not a physical quanitity ?

(A) Kelvin (B) Candella (C) Volt (D) All

(28) Which physical quantity having same unit in all the unit system ?

(A) Length (B) Time (C) mass (D) Work

(29) dyne g^{-1} is a unit of which physical quantity ?

(A) Velocity (B) mass (C) Force (D) Acceleration

(30) Which physical quantity from given below is dimensionless ?

(A) Angle (B) Stress (C) density (D) Latent heat

(31) Which relation given below is wrong ?

(A) 1J = 10^7 erg (B) 1 dyne = 10^5 N

(C) 1 fm = 10^{-15} m (D) 1 parsec = 3.08×10^{16} m

(32) The average distance between sun and earth is called ......

(A) 1 Parsec (B) 1 lightyear (C) 1 AU (D) 1Å

(33) SI unit of moment of inertia is ......

(A) kg m (B) kg m^{-2} (C) kg m^2 (D) kg cm^2

(34) Which unit is different than other unit ?

(A) Ws (B) KWh (C) Js (D) eV

(35) If the units for mass, length and time becomes double, then unit of angular momentum becomes ......

(A) Doubles (B) Three times (C) Four times (D) Eight times

(36) $\frac{1\text{ns}}{1\mu\text{s}}$ = ...

(A) 10^{-3} (B) 10^3 (C) 10^{-9} (D) 10^{-6}

(37) Ns is a unit of which physical quantity ?

(A) velocily (B) Angular momentum (C) Linear momentum (D) work

(38) The volume and area of surface are equal for a given cube. Then the surface area = ... unit.

(A) 36 (B) 216 (C) 144 (D) 1000

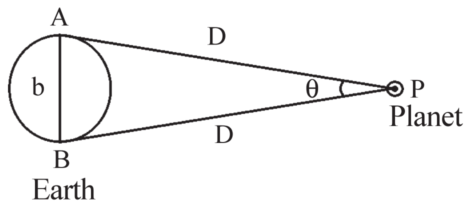
(39) Nm^{-2} is not a unit of physical quantity given below ?

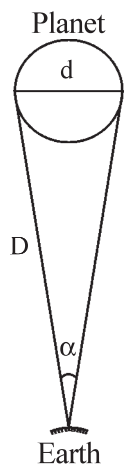
(A) Pressure (B) Stress (C) Bulk modulus (D) Strain

Ans. : 15 (C), 16 (D), 17 (A), 18 (C), 19 (C), 20 (B), 21 (B), 22 (D), 23 (D), 24 (A), 25 (C), 26 (D), 27 (D), 28 (B), 29 (D), 30 (A), 31(B), 32 (C), 33 (C), 34 (C), 35 (C), 36 (A), 37 (C), 38 (B), 39 (D)

Measurement :

Measurement for a long distance





Distance between Earth and planet, $D = \frac{b}{\theta}$ **Measurement of dimension of planet and Star** $\alpha = \frac{d}{D}$

Where, b = Distance between two positions for observation on the Earth.

α = angular diameter of planet.

θ = angle in radian

D = Distance between planet and the Earth d = diameter of the planet

- **Units for very small and very large distances**

Multiples

Value	Prefix	Symbol
10^{18}	Exa	E
10^{15}	Peta	P
10^{12}	Tera	T
10^{9}	Giga	G
10^{6}	Mega	M
10^{3}	Kilo	k
10^{2}	Hecto	h
10^{1}	Deca	da

Submultiples

Value	Prefix	Symbol
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

- **For very small distance**

1 fm = 10^{-15} m   fm = Fermi

1 $\mathring{A}$ = 10^{-10} m $\mathring{A}$ = Angstrom

1 nm = 10^{-9} m   nm = nanometer

- **For very large distance**

The average distance between the Sun and the Earth is called 1AU

1 Astronomical unit = 1 AU° = 1.496×10^{11} m

The distance corresponding to 1AU length where 1" angle lubtended, is called 1 parsec (1 pc).

1 Parsec = 3.08×10^{16} m

1 lightyear = 1 ly = 9.46×10^{15} m

- **Some units of mass :**

1 quintal = 100 kg

1 Metric ton = 1000 kg

1 atomic mass unit (amu) = 1.67×10^{-27} kg

- **Some units of time :**

1 year = 365.25 days = 3.156×10^{7} Sec.

1 LM (Lunar Month) = 27.3 days.

Time taken by moon to complete 1 revolution around the Earth is called 1 LM.

- For a given physical quantity nu = Constant

Where n = Quntitative value, u = unit

$\therefore$ $n_1u_1 = n_2u_2$

u_1 = unit of physical quantity in one system.

u_2 = unit of physical quantity in other system.

(40) 1° = ... rad

(A) $\frac{\pi}{180}$ (B) $\frac{180}{\pi}$ (C) $\frac{360}{n}$ (D) $\frac{n}{360}$

(41) If the unit of length and force increases to four times, the unit of energy ......

(A) Increases to 8 times (B) Increases to 16 times

(C) Decreases to 8 times (D) Decreases to 16 times

(42) If the unit of length and time are taken as km and hr, What is the value of g in km h^{-1}.

(A) 980 (B) 9800 (C) 1,27,008 (D) 12,700

(43) The angle between two observed direction for a planet observed from two diametrically opposite points A and B of the earth is 1.6°. If the diameter of the earth is 1.276×10^4 km, Find the distance between earth and planet.

(A) 4.57×10^5 km (B) 4.57×10^8 km (C) 3.84×10^8 m (D) 4.08×10^8 m

(44) Diameter of the sun is 1.393×10^9m. Angular diameter of the Sun is .... Distance between Sun and earth is 1.496×10^8 km and 1" = 4.85×10^{-6} rad.

(A) 1920" (B) 1920' (C) 192.0" (D) 1920 rad

(45) If the angle between two observed direction for moon is 54', When it is observed from the two diametrically opposite points simultaneously. If the radius of the earth is 6.4×10^6 m. Find the distance between earth and moon.

(A) 8.153×10^8 m (B) 4.076×10^8 m (C) 5.813×10^8 m (D) 3.581×10^8 m

Ans : 40 (A), 41 (B), 42 (C), 43 (A), 44 (A), 45 (A)

Errors in measurement :

Measurement of inaccuracy is called error.

- **Estimation of Error :**

(1) **Absolute error :**

Observations for any physical quantity are $a_1, a_2, ..., a_n$

$$\text{Mean } \bar{a} = \frac{a_1 + a_2 + ... + a_n}{n} = \frac{1}{n}\sum_{i=1}^{n} a_i$$

Absolute error in each observation

$\Delta a_1 = \bar{a} - a_1, \Delta a_2 = \bar{a} - a_2 ..... \Delta a_n = \bar{a} - a_n$

Average (Mean) Absolute error.

$$\Delta\bar{a} = \frac{|\Delta\bar{a}_1| + |\Delta\bar{a}_2| + ... + |\Delta\bar{a}_n|}{n} = \frac{1}{n}\sum_{i=1}^{n}|\Delta\bar{a}_i|$$

$\therefore$ Measurement of any physical quantity = $\bar{a} \pm \Delta\bar{a}$

(2) **Relative error.**

$$\delta a = \frac{\Delta\bar{a}}{\bar{a}}$$

(3) **Percentage error**

$$\delta a \times 100\ \% = \frac{\Delta\bar{a}}{\bar{a}} \times 100\ \%$$

Combination of errors :

No.	Formula	error
1.	Addition $Z = A + B$	$\Delta Z = \Delta A + \Delta B$
2.	Subtraction $Z = A - B$	$\Delta Z = \Delta A + \Delta B$
3.	Multiplication $Z = AB$	$\frac{\Delta Z}{Z} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$
4.	Division $Z = A/B$	$\frac{\Delta Z}{Z} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$
5.	Terms with power $Z = A^n$	$\frac{\Delta Z}{Z} = n\frac{\Delta A}{A}$

Significant digits :

"The number of digits whose value is accurately known in a measurement plus one additional digit about which we not certain are called significant figures (digits)"

Rules to decide significant digits

(1) All non - zero digits are significant.

(2) All zeros between two non - zero digits are significant.

(3) When the value is less than one, All zeros to the right of decimal and left of non - zero digit are never significant.

(4) All zeros on the right of non - zero digit are not significant.

(5) All zeroes after nonzero mumber in, number having decimal point are significant.

- As number of significant digits after decimal points are more, accuracy in measurement is more.

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(46) A body travels a distance (14.0 ± 0.2) m in (4.0 ± 0.3) s, its velocity is ...... ms^{-1}

(A) $(3.5 \pm 0.51)\ ms^{-1}$ (B) $(3.5 \pm 0.41)\ ms^{-1}$ (C) $(3.5 \pm 0.31)\ ms^{-1}$ (D) $(3.5 \pm 0.21)\ ms^{-1}$

(47) For parallel connection of Resistance $R_p = \frac{R_1 R_2}{R_1 + R_2}$ then $\frac{\Delta R_p}{R_p^2}$ = ...

(A) $\frac{\Delta R_1}{R_1} + \frac{\Delta R_2}{R_2}$ (B) $\frac{\Delta R_1}{R_1} - \frac{\Delta R_2}{R_2}$ (C) $\frac{\Delta R_1}{R_1^2} - \frac{\Delta R_2}{R_2^2}$ (D) $\frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2}$

(48) Two resistances $R_1 = (3 \pm 0.1)\ \Omega$ and $R_2 = (6 \pm 0.3)\ \Omega$ are connected in series, net resistance R = ... Ω

(A) 9 ± 0.2 (B) 3 ± 0.2 (C) 9 ± 0.4 (D) 9 ± 0.1

(49) The mass, lenght, breadth and thickness for a cube is (39.3 ± 0.1)g, (5.12 ± 0.01)cm (2.56 ± 0.01) cm, (0.37 ± 0.01) cm respectively then inaccuracy in measurement of density is ...... g cm^{-3}

(A) 0.29 (B) 0.41 (C) 0.19 (D) 0.035

(50) For a wire, mass = (0.3 ± 0.003) g radius = (0.5 ± 0.005) mm and length = (6 ± 0.06) cm, percentage error in density is ......

(A) 1 % (B) 2 % (C) 3 % (D) 4 %

(51) The periodic time of second pendulum is 2.0 s and mean absolute error in its measurement is 0.01s, then value of periodic time with error is ......

(A) 2.0 ± 0.10 s (B) 2.0 ± 0.05 s (C) 2.0 ± 0.02 s (D) 2.0 ± 0.01 s

(52) $V = (100 \pm 5)$ V, $I = (10 \pm 0.1)$ A, then percentage error in measurement of Resistance is ......

(A) 5.1 % (B) 4.9 % (C) 6 % (D) 3 %

(53) When current 'I' passes through a resistance 'R' in time 't', Heat energy produced is given by $H = I^2Rt$. Percentage error in I, R and t are 2 %, 3 % and 1 % respectively then percentage error in H = ...

(A) 6 % (B) 5 % (C) 7 % (D) 8 %

(54) A length of cube $l = (1.5 \pm 0.02)$ cm its volume V = ... cm^3

(A) 3.375 ± 0.04 (B) 3.375 ± 0.135 (C) 3.375 ± 0.4 (D) 3.375 ± 0.013

(55) Physical quantity $Z = \frac{A^{1/2}B^2}{CD^3}$. Percentage error in measurement of A, B, C, D are 2 %, 1 %, 3 % and $\frac{1}{3}$ % respectively. Find the percentage error in measurement of 'Z'.

(A) 8 % (B) 7 % (C) 6 % (D) 5 %

(56) How many significant digits in 0.0250 ?

(A) 1 (B) 2 (C) 3 (D) 4

(57) Significant digits in 5.4×10^3 is ......

(A) 1 (B) 2 (C) 3 (D) 4

(58) 1.875 + 2.41 = ... (by considering significant digits)

(A) 4.3 (B) 4.28 (C) 4.285 (D) 4.29

(59) Mass and radius of sphere are 5.13 g and 2.10 mm. Find its density by considering significant digits.

(A) 132 g cm^{-3} (B) 130 g cm^{-3} (C) 132.3 g cm^{-3} (D) 132.30 g cm^{-3}

(60) Multiplication of 15.235, 3.315 and 2 = ... (by considering significant digits)

(A) 101.0 (B) 101.00 (C) 101 (D) 100

(61) 1.97855 is round off to three digits then obtained number = ...

(A) 1.97 (B) 1.98 (C) 1.90 (D) 2.00

(62) Significant figures in 71.15, 3.008 and 0.1237×10^5 are ......

(A) 4, 2, 4 (B) 4, 4, 4 (C) 4, 3, 5 (D) 4, 4, 6

(63) Significant digits in 0.0007 are ......

(A) 1 (B) 2 (C) 3 (D) 4

(64) When 1.71 N is Subtracted from 3.75 N the result in significant figures is ......

(A) 2 N (B) 2.0 N (C) 2.04 N (D) 2.000 N

(65) Lenght of simple pendulum measured with scale of least count 1mm is 10 cm. Clock having dispersions is measures 90 s for 100 oscillations. The value of g = ... ms^{-2}. (take g = 9.8 ms^{-2})

(A) 9.8 ± 0.11 (B) 9.8 ± 0.21 (C) 9.8 ± 0.31 (D) 9.8 ± 0.41

(66) Thickness of plate measured with $l_1 = 40.2 \pm 0.1$ and $l_2 = 20.1 \pm 0.1$, maximum uncertainity in $l_1 + l_2$ = ...

(A) 0.1 (B) 0.2 (C) 0.3 (D) 0.4

(67) Thickness of plate measured by micrometer having least count 0.01mm is 1.03 mm. What is the percentage error in the measurement of thickness of plate ?

(A) 0.7 % (B) 0.97 % (C) 1 % (D) 1.2 %

(68) 9.15 + 3.8 = ... (by considering significant digits).

(A) 13 (B) 13.0 (C) 13.00 (D) 13.000

(69) Observations for the measurement in length are 2.01 m, 2.03 m, 2.09 m, 2.07 m and 2.01 m. Mean absolute error in the measurement is ......

(A) 0.028 m (B) 0.030 m (C) 0.152 m (D) 0.048 m

(70) $\phi = -\frac{GM}{r}$ (gravitational potential), then $\frac{\Delta\phi}{\phi}$ = ...

(A) $-\frac{\Delta r}{r}$ (B) $\frac{\Delta r}{r}$ (C) $2\frac{\Delta r}{r}$ (D) $\frac{r}{\Delta r}$

(71) If the percentage error in the measurement of volume of a sphere is 3 %, percentage error in the measurement of surface area is ......

(A) 2 % (B) 1 % (C) 3 % (D) 4 %

(72) Radius of a sphere is 1.51 cm. Area of sphere by considering significant figures is ......

(A) 28.6 cm^2 (B) 28.63 cm^2 (C) 28.638 cm^2 (D) 28.6381 cm^2

Ans : 46 (C), 47 (D), 48 (C), 49 (A), 50 (D), 51 (D), 52 (C), 53 (D), 54 (B), 55 (B), 56 (C), 57 (B), 58 (B), 59 (A), 60 (A), 61 (B), 62 (B), 63 (A), 64 (C), 65 (C), 66 (B), 67 (B), 68 (B), 69 (B), 70 (B), 71 (A), 72 (A)

Dimension and Dimensional Formula

- When any physical quantity is represented in terms of M, L, T, ..., the equation is known as dimensional formula and power of M, L, T.... is known as dimension.

- If the dimensional formula for a physical quantity is $M^a L^b T^c$, their values in two different unit system are n_1 and n_2 then,

$$n_2 = n_1\left[\frac{M_1}{M_2}\right]^a \left[\frac{L_1}{L_2}\right]^b \left[\frac{T_1}{T_2}\right]^c$$

Physical quantity : Formule, Units and dimensional formula.

No.	Physical Quantity	Formula	Unit	Dimensional Formula
1.	Speed	Distance / time	ms^{-1}	$M^{\circ} L^{1} T^{-1}$
2.	Acceleration	Change in volocity/time	ms^{-2}	$M^{\circ} L^{1} T^{-2}$
3.	Force	Mass × accleration	$N = kg\ ms^{-2}$	$M^{1} L^{1} T^{-2}$
4.	Density	Mass/volume	$kg\ m^{-3}$	$M^{1} L^{-3} T^{\circ}$
5.	Pressure	Force/area	$Nm^{-2} = Pa$	$M^{1} L^{-1} T^{-2}$
6.	Work	Force × displacement	Nm = J	$M^{1} L^{2} T^{-2}$
7.	Energy	-	J	$M^{1} L^{2} T^{-2}$
8.	Power	Work / time	Watt	$M^{1} L^{2} T^{-3}$
9.	Impulse of force	Force × Change in time	Ns	$M^{1} L^{1} T^{-1}$
10.	momentum	mass × velocity	$kg\ ms^{-1}$	$M^{1} L^{1} T^{-1}$
11.	Torque	Force × position vector	Nm	$M^{1} L^{2} T^{-2}$
12.	Temperature (T)	-	Kelvin	$M^{\circ} L^{\circ} T^{\circ} \theta^{-1}$
13.	Heat (Q)	-	J	$M^{1} L^{2} T^{-2}$
14.	Specific heat	$\frac{Q}{m\Delta T} = \frac{\text{Heat}}{\text{mass} \times \text{Temp. diffrence}}$	$J\ kg^{-1}\ K^{-1}$	$M^{\circ} L^{2} T^{-2} \theta^{-1}$
15.	Latent heat	$\frac{\text{Heat}}{\text{mass}}$	$J\ kg^{-1}$	$M^{\circ} L^{2} T^{-2}$
16.	Gas constant (R)	-	$J\ mol^{-1}\ K^{-1}$	$M^{1} L^{2} T^{-2} \theta^{-1}$
17.	Boltzmann constant (k_B)	$\frac{R}{N_A} = \frac{\text{gas constant}}{\text{Avagrado's No.}}$	$J\ K^{-1}$	$M^{1} L^{2} T^{-2} \theta^{-1}$
18.	Plank's constant (h)	Energy / frequency	Js	$M^{1} L^{2} T^{-1}$
19.	Charge (q)	Electric current × time	As = C	$M^{\circ} L^{\circ} T^{1} A^{1}$
20.	Surface Charge density (σ)	$\frac{\text{Charge}}{\text{area}}$	Cm^{-2}	$M^{\circ} L^{-2} T^{1} A^{1}$
21.	Electric current density (J)	Current per unit area	Am^{-2}	$M^{\circ} L^{-2} T^{\circ} A^{1}$
22.	Electric potential (V)	$\frac{\text{Work}}{\text{Charge}}$	JC^{-1}	$M^{1} L^{2} T^{-3} A^{-1}$
23.	Intensity of electric (E) field	Force/Charge	NC^{-1} or Vm^{-1}	$M^{1} L^{1} T^{-3} A^{-1}$
24.	Resistance (R)	$\frac{\text{Potential difference}}{\text{Electric current}}$	$\frac{V}{A} = \Omega$	$M^{1} L^{2} T^{-3} A^{-2}$
25.	Conductance $\left(\frac{1}{R}\right)$	$\frac{\text{Electric current}}{\text{Potrential difference}}$	Ω^{-1} = mho	$M^{-1} L^{-2} T^{3} A^{2}$
26.	Resistivity (ρ)	$\frac{RA}{l} = \frac{\text{Resistance} \times \text{Area}}{\text{length}}$	Ωm	$M^{1} L^{3} T^{-3} A^{-2}$

No.	Physical Quantity	Formula	Unit	Dimensional Formula
27.	Conductivity (σ)	$\frac{1}{\rho} = \frac{l}{RA}$	$\Omega^{-1}m^{-1}$	$M^{-1} L^{-3} T^3A^2$
28.	Permitivity of vacuum (ε_o)	$\varepsilon_o = \frac{q_1 q_2}{4\pi Fr^2}$	$N^{-1}C^2m^{-2}$	$M^{-1} L^{-3} T^4A^2$
29.	Capacitance (C)	$\frac{\text{Charge}}{\text{potential difference}}$	CV^{-1} or F	$M^{-1} L^{-2} T^4A^2$
30.	Intensity of magnetic field (B)	$B = \frac{F}{qv}$	$NA^{-1} m^{-1}$ or tesla	$M^1 L^0 T^{-2}A^{-1}$
31.	Magnetic flux (ϕ)	$N\vec{B}\cdot\vec{A}$	Vs or weber	$M^1 L^2T^{-2}A^{-1}$
32.	Self inductance (L)	$\frac{N\phi}{I}$	$Vs A^{-1}$ or henry	$M^1 L^2T^{-2}A^{-2}$
33.	Stress	Force / area	Nm^{-2}	$M^1 L^{-1}T^{-2}$
34.	Modulus of elasticity	Stress/Strain	Nm^{-2}	$M^1 L^{-1}T^{-2}$
35.	Moment of Inertia (I)	mass × (Perpendicular distance)^2	kg m^2	$M^1 L^2T^o$
36.	Surface Tension (T)	$\frac{\text{Force}}{\text{length}}$ or $\frac{\text{Energy}}{\text{area}}$	$Nm^{-1} = Jm^{-2}$	$M^1 L^0T^{-2}$
37.	Co-efficient of viscosity (η)	$\frac{F}{6\pi rv}$	Nsm^{-2}	$M^1 L^{-1}T^{-1}$

Physical quantity having same dimension :

No.	Dimensional Formula	Physical quantity
1.	$M^\circ L^\circ T^{-1}$	Frequency, Angular frequency, Angular Speed, Angular velocity velocity gradient, decay constant
2.	$M^1 L^2 T^{-2}$	Work, kinetic energy, potential energy Internal energy, Torque, Heat energy moment of force
3.	$M^1 L^{-1} T^{-2}$	Pressure, Stress, Bulk modulus, Young's modulus, modulus of rigidity energy density
4.	$M^1 L^1 T^{-1}$	Linear momentum, Impulse of Force.
5.	$M^\circ L^1 T^{-2}$	Acceleration, Acceleration due to gravity, Intensity of gravitational field
6.	$M^1 L^1 T^{-2}$	Force, Weight, Thrust
7.	$M^1 L^\circ T^{-2}$	Surface Tension, Surface energy (energy per unit area), spring constant.
8.	$M^\circ L^\circ T^\circ$	Strain, relative density, plane angle, solid angle, relative permitivity (Dielectric constant), relative permeability.
9.	$M^\circ L^2 T^{-2}$	Latent heat, Gravitational potential
10.	$M^1 L^2 T^{-2}\theta^{-1}$	Heat capacity, gas constant, Boltzmann's Constant, Antropy

(73) Dimensional formula of moment of force couple is ......

(A) $M^1 L^1 T^{-2}$ (B) $M^1 L^2 T^{-2}$ (C) $M^2 L^2 T^{-2}$ (D) $M^1 L^{-2} T^{-2}$

(74) Dimensional formula of energy density is ......

(A) $M^1 L^1 T^{-1}$ (B) $M^1 L^{-1} T^{-2}$ (C) $M^1 L^2 T^{-2}$ (D) $M^1 L^{-2} T^{-1}$

(75) If E, M, L G are Energy, mass, angular momentum and universal constant of gravitation respectively then dimension of $\frac{EL^2}{M^5G^2}$ is ......

(A) Plane angle (B) time (C) mass (D) Length

(76) Which pair (given below) having same dimensional formula ?

(A) Force and work (B) Torque and Power (C) Energy and Torque (D) Power and Energy

(77) If Speed of light (c), Acceleration due to gravity (g) and pressure (P) are taken as fundamental unit. Then the dimensions of Gravitational constant (G) in c, g, P is ....

(A) –1, 2, –1 (B) 1, 2, –1 (C) 2, 2, –1 (D) 0, 2, –1

(78) Dimensional formula of ab in $\left(P+\frac{a}{V^2}\right)$ (v–b) = μRT is .... Where V = volume, P = pressure, T = Temperature

(A) $M^1 L^3 T^{-2}$ (B) $M^1 L^5 T^{-2}$ (C) $M^1 L^{-8} T^2$ (D) $M^1 L^8 T^{-2}$

(79) Which one is dimensionally correct ?

(A) $v = v_0 + at^2$ (B) $F = \frac{W}{d}$ (C) $d = \frac{v^2}{2at}$ (D) $d = \frac{v^2 - v_0^2}{2a}$

v = final velocity, v_0 = initial velocity, a = acceleration, W = work, d = displacement

(80) If A, B and C are physical quantities having different dimension, then which one, given below is true ?

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

(81) Which pair given below having different dimension ?

(A) Torque and Work (B) Angular momentum, Plank's constant

(C) Impulse of force & linear momentum (D) Tension, Surface tension

(82) Amplitude of damped oscillation A(t) = $Ae^{\frac{-bt}{2m}}$. Dimensional formula of b = ... A = Initial Amplitude, m = mass, t = time.

(A) $M^1 L^\circ T^{-1}$ (B) $M^1 L^1 T^1$ (C) $M^1 L^1 T^{-1}$ (D) $M^1 L^1 T^\circ$

(83) The number of undecayed atoms at time ‘t’ in a element is given by $N = N_0\ e^{-\lambda t}$. Where N_0 = Initial undecayed atoms. Find the dimensional formula of λ.

(A) $M^{-1} L^{\circ} T^{\circ}$ (B) $M^{\circ} L^{\circ} T^{-1}$ (C) $M^{\circ} L^{-1} T^{\circ}$ (D) $M^{1} L^{\circ} T^{-1}$

(84) Dimensional formula of Power is ......

(A) $M^{1} L^{-2} T^{2}$ (B) $M^{1} L^{2} T^{-2}$ (C) $M^{1} L^{2} T^{-3}$ (D) $M^{\circ} L^{2} T^{-3}$

(85) Dimensional formula of Impulse of force is ......

(A) $M^{1} L^{1} T^{1}$ (B) $M^{1} L^{-1} T^{1}$ (C) $M^{1} L^{1} T^{-1}$ (D) $M^{1} L^{2} T^{-1}$

(86) $M^{\circ} L^{\circ} T^{-1}$ is dimensional formula of ......

(A) $\frac{R}{L}$ (B) $\frac{L}{R}$ (C) LR (D) $\frac{1}{LR}$

(87) Dimensional formula of Intensity of radiation is ......

(A) $M^{1} L^{-2} T^{-2}$ (B) $M^{\circ} L^{3} T^{-2}$ (C) $M^{1} L^{\circ} T^{-1}$ (D) $M^{1} L^{\circ} T^{-3}$

(88) Distance travelled by particle in time ‘t’ is ‘x’, $x = \frac{v_0}{k}\ [1 - e^{kt}]$, v_0= initial velocity, then dimensional formula of k = ...

(A) $M^{\circ} L^{-1} T^{1}$ (B) $M^{\circ} L^{1} T^{\circ}$ (C) $M^{\circ} L^{\circ} T^{-1}$ (D) $M^{\circ} L^{\circ} T^{1}$

(89) $\frac{dx}{dt} = ae^{-bt}$, a and b are constant, x is a displacement of a particle in time ‘t’. Dimension of $\frac{a}{b}$ is ......

(A) Distance (B) time (C) mass (D) velocity

(90) Pressure difference for inner and outer side of bubble formed in air is $P_i - P_o = \frac{4T}{R}$. Where R = Radius of bubble, T = Surface tension, dimension of surface Tension is ......

(A) $M^{1} L^{1} T^{-1}$ (B) $M^{1} L^{-1} T^{-1}$ (C) $M^{1} L^{\circ} T^{-2}$ (D) $M^{1} L^{\circ} T^{-1}$

(91) Young modulus for steel in MKS is 2×10^{11} Pa then in CGS its value is ...... dyne cm^{-2}.

(A) 2×10^{10} (B) 2×10^{12} (C) 2×10^{13} (D) 2×10^{6}

(92) In a new unit system units of force, distance and time are 100N, 10m and 10s respectively. What is the unit of mass in new system ?

(A) 10^{3} kg (B) 10^{4} kg (C) 10^{5} kg (D) 10^{6} kg

(93) u_1 and u_2 are units of some physical quantity, n_1 and n_2 are their quantitative values then ......

(A) $\frac{n_1}{n_2} = \frac{u_1}{u_2}$ (B) $\frac{n_1}{n_2} = \frac{u_2}{u_1}$ (C) $\frac{n_1}{u_2} = \frac{u_1}{n_2}$ (D) $\frac{n_1}{u_1} = \frac{n_2}{u_2}$

(94) Force acting on a body is 10N. If the unit of mass and distance become double and unit of time becomes half then magnitude of force in new unit system will be ...... N.

(A) 1.6 (B) 16 (C) 160 (D) 1600

(95) Energy of a particle is 10J. If the unit of mass becomes four times, unit of acceleration becomes double, unit of length becomes half, then energy of particle in new system is ......

(A) 4J (B) 40J (C) 400J (D) 4kJ

(96) Unit of power 100erg min^{-1}, unit of time is 1 h, unit of force is 60 dyne then unit of lenght is ...... cm.

(A) 1 (B) 10 (C) 100 (D) 1000

(97) Dimensional formula of force is $M^a L^b T^c$ then 3a + 5b – 2c = ...

(A) 10 (B) 1.2 (C) 4 (D) 12

(98) Dimensional formula of Electric power is $M^a L^b T^c A^d$ then, 5a + 2b + c – d = ...

(A) 4 (B) 6 (C) 8 (D) 10

(99) Dimensional formula of angular momentum is $M^a L^b T^c$ and dimensional formula of density is $M^x L^y T^z$ then ax + by – cz = ...

(A) –5 (B) 5 (C) 25 (D) –25

(100) When 10 N force is act on a particle momentum obtained is 1 SI, frequency of oscillation for a particle is ......

(A) 1 Hz (B) 10 Hz (C) 100 Hz (D) 1 KHz

(101) Momentum (p), Area (A), time (T) are taken as fundamental quantities, dimension of energy is ......

(A) $p^1 A^{-1} T^1$ (B) $p^2 A^1 T^1$ (C) $p^2 A^{\frac{-1}{2}} T^1$ (D) $p^1 A^{\frac{1}{2}} T^{-1}$

(102) A body is moving along the x-axis, equation of velocity is given by $v(t) = \frac{A+Bt^2}{1+Ct}$. Dimensional formula of A, B and C are ....

(A) $L^1 T^{-1}, L^1 T^{-3}, T^{-1}$ (B) $L^1 T^{-1}, L^1 T^{-2}, T^{-1}$

(C) $L^1 T^{-2}, L^1 T^{-1}, T^1$ (D) $L^1 T^{-1}, L^1 T^{-2}, L^1 T^{-1}$

(103) Momentum (p) is given by equation $p = \frac{mv}{\sqrt{1-\frac{v^2}{c^2}}}$. Dimension of c and p are ....

(A) $L^1 T^{-2}, M^1 L^1 T^{-2}$ (B) $M^1 L^1 T^{-1}, L^1 T^{-1}$

(C) $L^1 T^{-1}, M^1 L^1 T^{-1}$ (D) $M^1 L^1 T^{-2}, L^1 T^{-2}$

(104) Force is defined as $F = \frac{Dt+Et^2}{1+A\sin^2 \omega t}$, then units of A and D are ....

(A) unitless, Ns^{-1} (B) unitless, Ns (C) m, Ns^{-1} (D) m, Ns

(105) 100 g mass, 10 cm distance, 0.1s time are taken as units in new system. Unit of work = ... in new system.

(A) 0.01 J (B) 0.1 J (C) 1 J (D) 10 J

(106) Energy E = $G^x c^y h^z$. Where G = universal constand of gravitation, c = velocity of light and h = plank's constant then value of x, y, z are ....

(A) $\frac{1}{2}, \frac{-1}{2}, \frac{-5}{2}$ (B) $\frac{-1}{2}, \frac{3}{2}, \frac{1}{2}$ (C) $\frac{-1}{2}, \frac{5}{2}, \frac{1}{2}$ (D) $\frac{1}{2}, \frac{-1}{2}, \frac{-3}{2}$

(107) If energy (E), velocity (V), and time (T) are taken as fundamental physical quantities. Then, dimensional formula of surface tension is ......

(A) $E^1 V^{-2} T^{-2}$ (B) $E^1 V^{-1} T^{-2}$ (C) $E^1 V^{-2} T^{-1}$ (D) $E^{-2} V^{-1} T^{-3}$

(108) Dimensional formula of permitivity of vacuum is ......

(A) $M^{-1} L^{-3} T^4 A^2$ (B) $M^{-1} L^{-3} T^2 A^2$ (C) $M^{-1} L^{-3} T^4 A^{-2}$ (D) $M^{-1} L^{-3} T^{-2} A^{-2}$

(109) If the dimension of a physical quantity is $L^a M^b T^c$, then this physical quantity is ......

(A) Acceleration, If a = 1, b = 1, c = –2 (B) Pressure, If a = –1, b = 1, c = –2

(C) Force, If a = –1, b = 0, c = –2 (D) velocity, If a = 1, b = 0, c = 1

(110) Dimensional formula for the ratio of linear momentum and angular momentum is ......

(A) $M^\circ L^\circ T^\circ$ (B) $M^\circ L^{-1} T^\circ$ (C) $M^\circ L^1 T^\circ$ (D) $M^\circ L^1 T^{-1}$

(111) A physical quantity is given by $Z = M^x L^y T^z$. If percentage error in measurement of M, L and T are a, b and c respectively then maximum percentage error in the measurement of Z is ......

(A) $\frac{a}{x} + \frac{b}{y} + \frac{c}{z}$ (B) ax + by + cz (C) ax + by – cz (D) $\frac{a}{x} + \frac{b}{y} - \frac{c}{z}$

(112) 76 cm height of Hg = ... Nm^{-2}.

Density of Mercury (Hg), $\rho = 13.6$ g cm^{-3}.

(A) 1.013×10^5 (B) 1.01×10^{-5} (C) 76×10^{-2} (D) 7.6×10^5

Ans : 73 (B), 74 (B), 75 (A), 76 (C), 77 (D), 78 (D), 79 (B), 80 (D), 81 (D), 82 (A), 83 (B), 84 (C), 85 (C), 86 (B), 87 (D), 88 (C), 89 (A), 90 (C), 91 (B), 92 (A), 93 (B), 94 (C), 95 (B), 96 (C), 97 (D), 98 (B), 99 (A), 100 (B), 101 (D), 102 (A), 103 (C), 104 (A), 105 (B), 106 (C), 107 (A), 108 (A), 109 (B), 110 (B), 111 (B), 112 (A)

Questions depents on experimental skills :

Least-count of Vernier calliperse :

- L.C. = $\frac{\text{Value of one division on main scale (S)}}{\text{Total no. of divisions on vernier scale}}$
- Least count (L.C.) = Value of one division on main scale (1 MSD) - value of one division on vernier scale (1 VSD)
- Suppose 1 MSD = a unit

  If n^{th} division of vernier matches with m^{th} division of main scale.

  1 VSD = $\frac{m}{n} \times$ a unit

  $\therefore$ Least count (L.C.) = $a - \left(\frac{m}{n}\right)a = \left(1 - \frac{m}{n}\right)$ a unit

Least count of micrometer screw :

- Least count (L.C.) = $\dfrac{\text{Pitch (p)}}{\text{Total divisions on circular Scale}}$

  Where pitch (p)= distance of one division on main scale.

  = Distance travelled in complete one rotation of circular scale.

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(113) In vernier calliperse measurement of one division on main scale is 'x' cm. n^{th} division of vernier scale matches with $(n-1)^{th}$ division. Then minimum measurement of vernier calliperse is ...... cm.

(A) $\frac{x}{n-1}$ (B) $\left(\frac{n-1}{n}\right)x$ (C) $\frac{nx}{n-1}$ (D) $\frac{x}{n}$

(114) Micrometer screw with pitch 0.5 mm and 50 divisions on circular scale is used to measure diameter of a sphere. Then least count of micrometer screw is ......

(A) 0.1 cm (B) 0.01 cm (C) 0.001 cm (D) 0.05 cm

(115) 30^{th} division of vernier scale matches with 29^{th} division of main scale in spectrometer. If value of one division on main scale is 0.5° then minimum measurement (L.C.) = ...

(A) One minute (B) Half minute (C) 1° (D) 0.5°

(116) Diameter of a wire is measured with micrometer of least count 0.01 mm. Reading of main scale is 0 mm and reading of circular scale are 48 divisions then diameter of a wire is ....

(A) 0.48 cm (B) 0.048 cm (C) 0.24 cm (D) 0.0048 cm

Ans. : 113 (D), 114 (C), 115 (A), 116 (B)

Assertion - Reason type Question :

Instruction : Read assertion and reason carefully, select proper option from given below.

(a) Both assertion and reason are true and reason explains the assertion.

(b) Both assertion and reason are true but reason does not explain the assertion.

(c) Assertion is true but reason is false.

(d) Assertion is false and reason is true.

(117) **Assertion :** Light year and wavelength both represent distance.

Reason : Both having dimension of time.

(A) a (B) b (C) c (D) d

(118) **Assertion :** The distance of stars, which are farthar away than 100 light year can not measured with the method of parallex removal.

Reason : Angle of parallex removal can not be measured accurately.

(A) a (B) b (C) c (D) d

(119) **Assertion :** Dimension of Surface tension and Surface energy are equal.

Reason : Their SI units are equal.

(A) a (B) b (C) c (D) d

(120) **Assertion :** y = A sin (ωt – kx) and (ωt – kx) is dimensionless.

Reason : Dimension of k is $M^{\circ}L^{1}T^{\circ}$

(A) a (B) b (C) c (D) d

(121) **Assertion :** In all measurement, last significant digit is more in accurate.

Reason : d = 0.9 m, d = 0.90 m and d = 0.900 m the d = 0.900 m is more accurate.

(A) a (B) b (C) c (D) d

- **Match the columns :**

(122) Match the physical quantity in column-1 with SI unit in Column-2.

Column-1		Column-2	
(1)	Work	(a)	Jm^{-1}
(2)	Power	(b)	Ns
(3)	momentum	(c)	kwh
(4)	Force	(d)	Nms^{-1}

(A) 1 (c), 2 (d), 3 (b), 4 (a)
(B) 1 (b), 2 (c), 3 (a), 4 (d)
(C) 1 (d), 2 (b), 3 (c), 4 (a)
(D) 1 (c), 2 (d), 3 (a), 4 (b)

(123)

Column-1		Column-2	
(1)	Stefan's Constant	(a)	$JK^{-1}mol^{-1}$
(2)	Universal gas constant	(b)	Fm^{-1}
(3)	Electric permitivity	(c)	Hm^{-1}
(4)	magnetic permeability	(d)	$Wm^{-2}k^{-4}$

(A) 1 (d), 2 (b), 3 (c), 4 (a)
(B) 1 (a), 2 (d), 3 (b), 4 (c)
(C) 1 (d), 2 (a), 3 (b), 4 (c)
(D) 1 (a), 2 (d), 3 (c), 4 (b)

(124) Match the measurement in column-1 with significant digits in column-2.

Column-1		Column-2	
(1)	33.015	(a)	3
(2)	0.054	(b)	4
(3)	0.003530	(c)	2
(4)	1.75×10^{-4}	(d)	5

(A) 1 (b), 2 (a), 3 (d), 4 (c)
(B) 1 (d), 2 (c), 3 (b), 4 (a)
(C) 1 (d), 2 (a), 3 (c), 4 (a)
(D) 1 (b), 2 (c), 3 (d), 4 (a)

Ans. : 117 (B), 118 (A), 119 (C), 120 (C), 121 (B), 122 (A), 123 (C), 124 (B)

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