TOPIC WISE MULTIPLE CHOICE QUESTIONS

1.6 PRECISION AND ACCURACY

(1) A precise measurement is one which has

(a) less precision **(b)** maximum precision
(c) less absolute uncertainty **(d)** both 'a' and 'c'

(2) In printing we use colours which are in number

(a) 1 **(b)** 2
(c) 3 **(d)** 4

(3) The least count of meter rod is

(a) 0. 1 cm **(b)** 0.01 cm
(c) cannot be zero **(d)** can be zero

(4) The absolute uncertainty of screw gauge is

(a) 0.01 cm **(b)** 0.01 mm
(c) 0.001 mm **(d)** 0.1 cm

(5) Any measurement taken from an instrument will be more precise, if instrument has

(a) large absolute uncertainty **(b)** small least count
(c) both a and b **(d)** none of these

(6) The relation for fractional uncertainty can be given by

(a) $\frac{\text{absolute uncertainty}}{\text{measured value}}$ **(b)** $\frac{\text{measured value}}{\text{absolute uncertainty}}$
(c) $\frac{\text{least count}}{\text{absolute uncertainty}}$ **(d)** $\frac{\text{measured value}}{\text{least count}}$

1.7 ASSESSMENT OF TOTAL UNCERTAINTY IN THE FINAL RESULT

(7) There are four readings of a micrometer to measure the diameter of a wire in mm are 1.21, 1.23, 1.25, 1.23. The mean of deviations is: **MTN-2019 (G-II)**

(a) 0.02 mm **(b)** 0.01 mm
(c) 0.10 mm **(d)** 0.20 mm

(8) In addition and subtraction resultant uncertainty is obtained by

(a) adding absolute uncertainties **(b)** subtraction of absolute uncertainties
(c) addition of % age uncertainties **(d)** multiplication of % age uncertainties

(9) Velocity of object has 2% uncertainty and mass has 1% uncertainty. Total % age uncertainty in K.E is

(a) 3% **(b)** 4%
(c) 5% **(d)** 6%

(10) For total assessment of uncertainty in the final result obtained by multiplication and division **(LHR 2014)**

(a) add absolute uncertainty **(b)** add percentage uncertainty
(c) subtract absolute uncertainty **(d)** add fractional uncertainty

(11) Length of a side of a cube is 20mm. Its volume is

(a) $80mm^3$ **(b)** $8cm^3$
(c) $8m^3$ **(d)** $800m^3$

(12) The uncertainty in timing process can be determined by

(a) dividing the L.C of timing device by number of vibrations
(b) dividing the number of vibration by L.C of timing device
(c) multiplying the L.C of timing device with number of vibration
(d) adding the L.C of timing device by number of vibration

(13) The percentage uncertainty in measurement of mass and velocity are 2% and 3%. The maximum uncertainty in the measurement of kinetic energy is **(LHR 2013)**

(a) absolute uncertainties are added **(b)** fractional uncertainties are added
(c) % age uncertainties are added **(d)** errors are added

1.8 DIMENSIONS OF PHYSICAL QUANTITIES

(14) Dimension analysis helps in

(a) deriving the formula
(b) to convert one system of unit into another
(c) to confirm the correctness of any physical equation
(d) all of these

(15) The dimension of force is **(GRW 2014)**

(a) $\left[ML^{-2}T^{2}\right]$ **(b)** $\left[MLT^{-1}\right]$
(c) $\left[MLT^{-2}\right]$ **(d)** $\left[ML^{2}T^{-2}\right]$

(16) Physical quantity "pressure" is terms of base unit is: **LHR-2018 (G-I)**

(a) $kg^{-1}ms^{-2}$ **(b)** $kg^{2}ms^{-3}$
(c) $kg^{2}m^{-2}sec$ **(d)** $kg\ m^{-1}s^{-2}$

(17) Dimension of frequency is same that of

(a) time period **(b)** angular velocity
(c) angular acceleration **(d)** mass

(18) Which pair has same unit: **LHR-2019 (G-II)**

(a) work and power **(b)** momentum and impulse
(c) force and torque **(d)** torque and power

(19) Mass is highly concentrated form of: **RWP-2019 (G-I)**

(a) Inertia **(b)** Energy
(c) Plasma **(d)** Charge

(20) Pressure has dimension

(a) $\left[ML^{2}T^{-2}\right]$ **(b)** $\left[ML^{-2}T^{-2}\right]$
(c) $\left[ML^{-1}T^{-2}\right]$ **(d)** $\left[ML^{2}T^{2}\right]$

(21) Gravitational constant (G) has dimension

(a) $\left[ML^2T^{-2}\right]$ **(b)** $\left[ML^{-2}T^2\right]$

(c) $\left[ML^{-1}T^{-2}\right]$ **(d)** $\left[M^{-1}L^3T^{-2}\right]$

(22) The branch of physics which is concerned with ultimate particles of which matter is composed of **DGK-2016 (G-II)**

(a) Atomic physics **(b)** Nuclear physics

(c) Plasma physics **(d)** Particle physics

(23) In the light of Einstein's famous equation E = mc^2 the energy for mass of 2 kg is equal to **MTN-2018 (G-I)**

(a) 3×10^8 Joules **(b)** 9×10^{16} Joules

(c) 4×10^{16} Joules **(d)** 18×10^{16} Joules

(24) The dimension of power is

(a) $\left[ML^{-1}T^{-2}\right]$ **(b)** $\left[ML^2T^{-3}\right]$

(c) $\left[ML^2T^{-2}\right]$ **(d)** $\left[MLT^{-3}\right]$

(25) Ratio of dimension of power and work [power] : [work] **DGK-2016 (G-I)**

(a) 1: T **(b)** 1: T^2

(c) T: 1 **(d)** T^2: 1

(26) Relativistic mechanics was developed by: **BWP-2017 (G-II)**

(a) Newton **(b)** Faraday

(c) Kepler **(d)** Einstein

(27) The dimension of $\sqrt{\dfrac{F \times l}{m}}$ **is same that of dimension of**

(a) force **(b)** momentum

(c) velocity **(d)** acceleration

(28) Which of the given pairs not has same dimensions?

(a) work, torque **(b)** force, weight

(c) impulse, momentum **(d)** power, energy

(29) $\left[M^0L^0\ T^{-1}\right]$ **is dimension of**

(a) velocity **(b)** frequency

(c) force **(d)** acceleration

(30) The dimension of mc^2 is same as the dimension of

(a) force **(b)** momentum

(c) power **(d)** energy

(31) In an equation, if the quantities on both sides are same, the irrespective of the form of the formula then this is called.

(a) principle of dimension **(b)** principle of homogeneity of dimension

(c) principle of homogenous of equation **(d)** principle of dimensional equation

ANSWER KEYS

(Topic Wise Multiple Choice Questions)

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

SHORT QUESTIONS

(From Textbook Exercise)

1.4 Three students measured the length of a needle with scale on which minimum division is 1mm and recorded as (i) 0.2145m (ii) 0.21 m (iii) 0.214 m. Which record is correct and why?

Ans: In these records (iii) 0.214 m is more correct because the least count of scale is 1mm which can be written as 0.001m. So we can measure the length upto three decimal places.

1.7 Does a dimensional analysis give any information on constant of proportionally that may appear in algebraic expression? Explain.

Ans: Dimensional analysis does not give any information about the constant of proportionality k. This constant k can be determined experimentally.

Example

The relation for the time period of a simple pendulum is given as

$$T = \text{cosntant}\sqrt{\frac{l}{g}}$$

The numerical value of constant in the above relation cannot be measured by dimensional analysis, however, it can be found by experiments.

1.8 Write the dimensions of (i) Pressure (ii) Density

Ans: (i) Pressure (ii) Density

(i) As pressure $P = \frac{F}{A}$

$$\therefore [P] = \frac{[F]}{[A]}$$

$$But\ [F] = [MLT^{-2}] and [A] = [L^2]$$

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

(ii) As density is given by

$$\rho = m/V$$

$$[\rho] = \frac{[m]}{[V]}$$

$$But, [m] = [M]\ and [V] = [L^3]$$

$$\therefore [\rho] = \frac{[M]}{[L^3]} = [ML^{-3}]$$

1.9 The wavelength λ of a wave depends on the speed v of the wave and its frequency f knowing that $[\lambda]=[L]$, $[V]=[LT^{-1}]$ and $[f]=[T^{-1}]$ Decide which of the following is correct. $f = v\lambda$ or $f = \frac{v}{\lambda}$

Ans: **(i)** $f = v\lambda$

$[f]=[V][\lambda]$

Dimension of L.H.S = $[f] = [T^{-1}]$

Dimension of R.H.S = $[V][\lambda]=[LT^{-1}][L]=[L^2T^{-1}]$

Dimension of L.H.S ≠ Dimension of R.H.S

Thus, equation is dimensionally incorrect

Now,

(ii) $f = \frac{V}{\lambda}$

$$[f]=\frac{[V]}{[\lambda]}$$

Dimension of L.H.S = $[f]=[T^{-1}]$

Dimension of R.H.S = $\frac{[V]}{[\lambda]}=\frac{[LT^{-1}]}{[L]}=[T^{-1}]$

Dimension of L.H.S = Dimension of R.H.S

Thus equation is dimensionally correct

TOPIC WISE SHORT QUESTIONS

1.6 PRECISION AND ACCURACY

(1) How the accuracy of a measurement can be indicated?

Ans: The accuracy of a measurement can be indicated by taking fractional or percentage error. If it has less value, the measurements would be more accurate.

(2) Differentiate between precise and accuracy.

DGK-2016 (G-II), BWP-2017 (G-II), MTN-2015 (G-II), 2018 (G-I)

Ans:

Precise	Accuracy
(i) A precise measurement is the one which has less absolute uncertainty. **(ii)** Precision depend upon the absolute uncertainty or least count.	**(i)** An accurate measurement is the one which has less fractional or percentage uncertainty or error. **(ii)** Accuracy depend upon the fractional or percentage uncertainty.

(3) When a measurement is said to be precise? **DGK-2018 (G-I)**

Ans: A measurement is said to be precise when it has less precision. e.g. in order to get a precise measurement, the more precise instrument must be used, i.e. smaller the physical quantity, more precise instrument must be used.

(4) What is the limitation of measuring Instrument?

Ans. Every device capable to measure physical quantity like length, mass, time and temperature has some limit of precision.

1.7 ASSESSMENT OF TOTAL UNCERTAINTY IN THE FINAL RESULT

(5) Add the masses given in kg upto appropriate precision 2.189,0.089, 11.8 and 5.32 **BWP-2012, GRW-2016**

Ans: Total mass = 2.189 + 0.089 +11.8+5.32 = 19.390 kg

As least precision is 11.8 kg, having one decimal place. Therefore, the total mass must have one decimal place which is the appropriate precision.

Total mass = 19.4 kg

(6) What will be the percentage uncertainty in a radius of a small sphere measured as 2.25cm by a Vernier caliper with least count 0.01 cm? **BWP-2017 (G-I)**

Ans: If the radius of a small sphere is measured as 2.25 cm by a Vernier callipers with least count0.01 cm then

the radius r is recorded as $r = 2.25 \pm 0.01\text{cm}$

Absolute uncertainty = Least count = $\pm$ 0.01 cm

%age uncertainty in $r = \frac{0.01\text{cm}}{2.25\text{cm}} \times \frac{100}{100} = 0.4\%$

(7) Given that V = (5.2 $\pm$ 0.1) volt. Find its percentage uncertainty. **BWP-2019 (G-I)**

Ans: The percentage uncertainty of the voltage is measuring by this formula

Percentage uncertainty for $V = \frac{\text{least count}}{\text{measuring value}} \times 100\%$

V = 5.2 ± 0.1 V

The % age uncertainty for V = $\frac{0.1\text{V}}{5.2\text{V}} \times \frac{100}{100}$ = about 2 %

(8) How can we find uncertainty in a time period?

Ans: The uncertainty in a time period is found by dividing the least count of timing device by its number of vibrations.

i.e Uncertainty = $\frac{\text{Least count of timing device}}{\text{Number of vibrations}}$

1.8 DIMENSIONS OF PHYSICAL QUANTITIES

(9) Write any three uses of dimensional analysis?

Ans: The uses of dimensional analysis are

(i) It is used to find the relationship between different physical quantities.

(ii) It is used to convert one system of unit into another.

(iii) It is used to confirm the correctness of any physical equation.

(10) Find the dimension of gravitational constant. **MTN-2016 (G-II)**

Ans: $F = \dfrac{Gm_1m_2}{r^2}$

$G = \dfrac{Fr^2}{m_1m_2}$ ....(i)

As $F = ma$

$[F] = [MLT^{-2}]$

So, from equation (i)

$[G] = \dfrac{[MLT^{-2}][L^2]}{[M^2]}$

Therefore

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

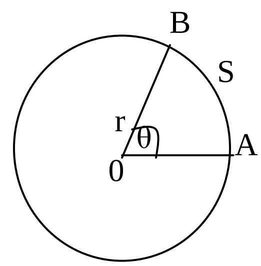
(11) What is dimension of angle? Derive it.

Ans: The angular displacement 'θ' can be related by the linear displacement's by the relation

$S = r\,\theta$ ....(i)

Where 'r' is the radius of circle.

From equation (i), the angle made at the centre of a circle can give the valve of angular displacement as



$\theta = \dfrac{S}{r} = \dfrac{\text{Length of arc AB}}{\text{Radius of circle}}$

$\therefore \quad [\theta] = \left[\dfrac{L}{L}\right] \qquad \begin{cases} \because S = L \\ \because r = L \end{cases}$

$[\theta] = 1$

Hence θ is dimensionless

(12) Write any two drawbacks of dimensional analysis?

Ans: **(i)** The dimensional analysis is unable to find the values of various constants.

(ii) It cannot be applied to physical quantities involving trigonometric and logarithmic functions.

(iii) It cannot differentiate between terms having same dimensions. For example, work and Torque, stress and pressure.

(13) What is meant by dimensions of physical quantities?

Ans: Each base quantity is considered as dimension denoted by specific symbol written with in the square brackets. Its stands for the qualitative nature of the physical quantity.

Dimension of length is 'L' expressed as [L]

Dimension of mass is 'M' expressed as [M]

and Dimension of time is 'T', expressed as [T]

(14) What is meant by dimensional analysis?

Ans: Method to check the correctness of a given formula or an equation and to derive it using the dimensions of involved physical quantities is called dimensional analysis.

(15) Calculate the dimensions of pressure and work?

Ans: Dimensions of Pressure $[P] = \frac{[F]}{[A]}$

$$= \frac{[ma]}{[A]}$$

$$= \left[\frac{MLT^{-2}}{L^2}\right]$$

$$[P] = \left[ML^{-1}T^{-2}\right]$$

Dimension of work $[W] = [F][d]$

$$[W] = \left[MLT^{-2}\right][L]$$

$$[W] = \left[ML^2T^{-2}\right]$$

(16) Show that energy-mass equation $E = mc^2$ is dimensionally correct?

MTN-2016 (G-I), SWL-2016, 2017, DGK-2018 (G-II)

Ans: $E = m c^2$

Dimension of L.H.S = $[E] = [F \times d] = [MLT^{-2}] [L] = [ML^2 T^{-2}]$

Dimension of R.H.S = $[m c^2] = [M] [LT^{-1}]^2 = [M] [L^2 T^{-2}] = [M L^2 T^{-2}]$

Therefore, the relation $E = mc^2$ is dimensionally correct.

(17) Write the dimension of (i) Velocity (ii) Density

Ans: Dimension of velocity $= \frac{\text{Dimension of displacement}}{\text{Dimension of time}}$

$$[v] = \frac{[L]}{[T]} = [L][T^{-1}] = [LT^{-1}]$$

$$\text{Dimension of density} = \frac{\text{Dimension of mass}}{\text{Dimension of volume}} = \frac{[M]}{[L^3]} = \left[ML^{-3}T^0\right]$$

(18) Show that the equation $v_f = v_i + at$ is dimensionally correct LHR-2013, 2018 (G-I), LHR-2013

Ans: First equation of motion is given by

$v_f = v_i + at$

where initial velocity = v_i = (velocity at t = 0)

Final velocity = v_f = (velocity at time t)

Acceleration = a

As, $v_f = v_i + at$

Dimension of L.H.S. of the equation = $[v_f] = [LT^{-1}]$

Dimensions of R.H.S. of the equation = $[v_i] + [a] \times [t]$

$= [LT^{-1}] + [LT^{-2}] \times [T]$

$= [LT^{-1}] + [LT^{-1}]$

$= 2\left[LT^{-1}\right]$ where 2 has no dimension

Hence,

Dimensions of L.H.S. = Dimensions of R.H.S

Or $[LT^{-1}] = [LT^{-1}]$

Thus we find that dimensions of all the three terms are the same which proves the correctness of the equation $v_f = v_i + at$

(19) Find the dimensions of coefficient of viscosity i.e. $F = 6\pi\eta r v$

BWP-2015, SWL-2013, 2016 (G-I),MTN-2012

Ans: 6π is a number having no dimensions. It is not accounted in dimensional analysis. Then

$$\eta = \frac{F}{rv}$$

or Substituting the dimensions of F, r and v in R.H.S.

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

Thus, the SI unit of coefficient of viscosity is kg m^{-1} s^{-1}.

(20) Check the correctness of relation $V = \sqrt{\frac{f \times \ell}{m}}$ **DGK-2016 (G-II)**

Ans: Dimensions of L.H.S of the equation= $[v] = [LT^{-1}]$

Dimensions of R.H.S of the equation = $([F] \times [l] \times [m^{-1}])^{\frac{1}{2}}$

$$= ([MLT^{-2}][L][M^{-1}])^{\frac{1}{2}} = [LT^{-1}]$$

Since the dimensions of both sides of the equation are the same, hence equation is dimensionally correct.

(21) State the principle of homogeneity of dimensions.

Ans: In order to check the correctness of an equation, we are to show that the dimensions of the quantities on both sides of the equation are the same, irrespectively of the form of formula. This is called the principle of homogeneity of dimensions.