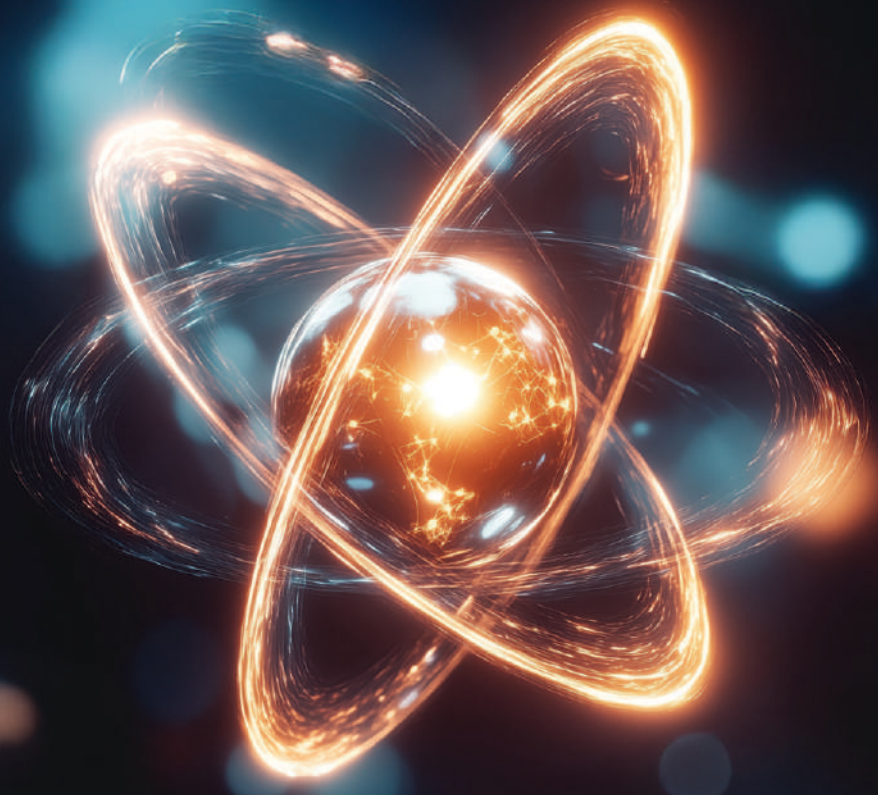
SPRINT

CRASH COURSE

FOR

JEE



Class XI

PHYSICS

CONTENTS

CHAPTER

1 Units, Measurements and Vectors

Fundamental Quantity	Derived Quantity
The physical quantities which do not depend on any other physical quantities for their measurements. E.g., Mass, Length, Time Temperature, current, luminous Intensity & mole	Those quantities which can be expressed in terms of fundamental/base quantities. E.g., velocity Acceleration, force etc.,

System of Units

(*a*) FPS System: Here length is measured in foot, mass in pounds and time in second.

(*b*) CGS System: In this system, L is measured in cm, M is measured in g and T is measured in sec.

(*c*) MKS System: In this system, L is measured in metre, M is measured in kg and T is measured in sec.

Principle of Homogeneity

According to this, the physical quantities having same dimension can be added or subtracted with each other and for a given equation, dimensions of both sides must be same.

For eg, in equation $F = A\sqrt{m} + \frac{B}{v} + C$,

all the three terms of R.H.S have same dimension as force on L.H.S.

Dimensions

The fundamental or base quantities along with their powers needed to express a physical quantity is called dimension.
E.g.: [F] = [MLT^{-2}] is dimension of force.

Usage of Dimensional Analysis

(i) To check the correctness of a given formula.

(ii) To establish relation between quantities dimensionally.

(iii) To convert the value of a quantity from one system of units to other system.

Limitations of Dimensional Analysis

(i) It does not predict the numerical value or number associated with a physical quantity in a relation

eg, $v = \frac{u}{3} + \frac{1}{5}\ at$ & $v = u + at$

Both are dimensionally valid.

(ii) It does not derive any relations involving trigonometric, logarithmic or exponential functions

E.g. $P = P_0 e^{-bt^2}$ cannot be derived dimensionally.

(iii) It does not give any information about dimensionally constants or nature of a quantity (vector/scalar) associated with a relation.

Significant Figure or Digits

1. **Rules to find out the number of significant figures:**

I Rule: All the non-zero digits are significant E.g. 1984 has 4 SF.

II Rule: All the zeros between two non-zero digits are significant. E.g. 10806 has 5 SF.

III Rule: All the zeros to the left of first non-zero digit are not significant. E.g.00108 has 3 SF.

IV Rule: If the number is less than 1, zeros on the right of the decimal point but to the left of the first non-zero digit are not significant. E.g. 0.002308 has 4 SF.

V Rule: The trailing zeros (zeros to the right of the last non-zero digit) in a number with a decimal point are significant. E.g. 01.080 has 4 SF.

VI Rule: The trailing zeros in a number without a decimal point are not significant e.g. 010100 has 3 SF. But if the number comes from some actual measurement then the trailing zeros become significant. E.g. m = 100 kg has 3 SF.

VII Rule: When the number is expressed in exponential form, the exponential term does not affect the number of S.F. For example in $x = 12.3 = 1.23 \times 10^1 = 0.123 \times 10^2 = 0.0123 \times 10^3 = 123 \times 10^{-1}$, each term has 3 SF only.

2. **Rules for arithmetical operations with significant figures:**

I Rule: In addition or subtraction the number of decimal places in the result should be equal to the number of decimal places of that term in the operation which contain lesser number of decimal places. E.g. 12.587 – 12.5 = 0.087 = 0.1 ($\because$ second term contain lesser i.e. one decimal place)

II Rule: In multiplication or division, the number of SF in the product or quotient is same as the smallest number of SF in any of the factors. E.g. 5.0 × 0.125 = 0.625 = 0.62.

Rounding Off

Rules for rounding off the numbers:

I Rule: If the digit to be rounded off is more than 5, then the preceding digit is increased by one. e.g. 6.87≈ 6.9

II Rule: If the digit to be rounded off is less than 5, than the preceding digit is unaffected and is left unchanged. e.g. 3.94 ≈ 3.9

III Rule: If the digit to be rounded off is 5 then the preceding digit is increased by one if it is odd and is left unchanged if it is even. e.g. 14.35 ≈ 14.4 and 14.45 ≈ 14.4

Representation of Errors

1. Mean absolute error is defined as

$$\overline{\Delta a} = \frac{|\Delta a_1| + |\Delta a_2| + \ldots + |\Delta a_n|}{n} = \sum_{i=1}^{n} \frac{|\Delta a_i|}{n}$$

Final result of measurement may be written as:

$$a = a_m \pm \overline{\Delta a}$$

2. **Relative Error or Fractional Error:** It is given by

$$\frac{\overline{\Delta a}}{a_m} = \frac{\text{Mean absolute Error}}{\text{Mean value of measurement}}$$

3. **Percentage Error** $= \frac{\overline{\Delta a}}{a_m} \times 100\%$

Combination of Errors

(i) **In Sum:** If $Z = A + B$, then $\Delta Z = \Delta A + \Delta B$.

Maximum fractional error in this case is

$$\frac{\Delta Z}{Z} = \frac{\Delta A}{A+B} + \frac{\Delta B}{A+B}$$

(ii) **In Difference:** If $Z = A - B$, then maximum absolute error is $\Delta Z = \Delta A + \Delta B$ and maximum fractional error in this case

$$\frac{\Delta Z}{Z} = \frac{\Delta A}{A-B} + \frac{\Delta B}{A-B}$$

(iii) **In Product:** If $Z = AB$, then the maximum fractional error,

$$\frac{\Delta Z}{Z} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$$

(iv) **In Division:** If $Z = A/B$, then maximum fractional error is

$$\frac{\Delta Z}{Z} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$$

(v) **In Power:** If $Z = A^n$ then $\frac{\Delta Z}{Z} = n\frac{\Delta A}{A}$

In more general form if $Z = \frac{A^x B^y}{C^q}$

then the maximum fractional error in Z is

$$\frac{\Delta Z}{Z} = x\frac{\Delta A}{A} + y\frac{\Delta B}{B} + q\frac{\Delta C}{C}$$

To Find Smaller Measurements

Vernier Calliper

(i) Least count: Suppose movable Jaw is slided till the zero of vernier scale coincides with any of the mark of the main scale.

Let, n V.S.D = $(n-1)$ MSD $\Rightarrow 1\text{VSD} = \left(\frac{n-1}{n}\right)$ M.S.D

$\therefore$ Vernier constant = 1 M.S.D – 1 V.S.D

$$= \left[1 - \frac{n-1}{n}\right]\text{MSD} = \frac{1}{n}\text{MSD}$$

(ii) Total reading = MSR + VSR

= MSR + $n \times$VC

where MSR = Main scale reading

VC = Vernier constant i.e. least count

$n = n^{\text{th}}$ division of vernier scale coinciding with main scale.

Screw Gauge

This instrument works on the principle of micro-meter screw. It is used to measure very small (mm) measurements. It is provided with linear scale and a circular scale.

(i) Pitch of the screw gauge

$$= \frac{\text{Distance moved in } n\text{-rotation of cir-scale}}{\text{No. of full-rotation}}$$

(ii) L.C $= \frac{\text{Pitch}}{\text{Total number of division on the circular scale}}$

(iii) Total Reading (T.R) = L.S.R + C.S.R

L.S.R = Linear scale Reading = N where

C.S.R = Circular Scale Reading = $n \times$ L.C

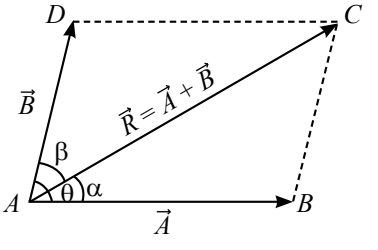
If n^{th} division of circular scale coincides with the linear scale line, then

$\therefore$ Total reading = $N + n \times$ (L.C)

VECTORS

Parallelogram Law of Vector Addition

If two vectors are represented by two adjacent sides of a parallelogram which are directed away from their common point then their sum (i.e. resultant vector) is given by the diagonal of the paralellogram passing away through that common point.

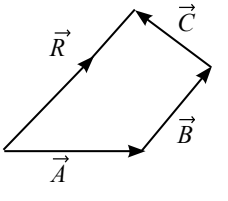


$$\overline{AB} + \overline{AD} = \overline{AC} = \overline{R} \text{ or } \vec{A} + \vec{B} = \vec{R} \Rightarrow R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$$\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta} \text{ and } \tan\beta = \frac{A\sin\theta}{B + A\cos\theta}$$

Addition of More than Two Vectors (Polygon Law)

If some vectors are represented by sides of a polygon in same order, then their resultant vector is represented by the closing side of polygon in the opposite order.



General Vector in x-y Plane

$$\vec{r} = x\hat{i} + y\hat{j} = r(\cos\theta\hat{i} + \sin\theta\hat{j})$$

JEE Main Corner

Units, System of Units

1. A unitless quantity
(*a*) Never has a non zero dimension
(*b*) Always has a non zero dimension
(*c*) May have a non zero dimension
(*d*) Does not exit

2. Parsec is a unit of
(*a*) Time (*b*) Angle
(*c*) Distance (*d*) Velocity

3. The SI unit of the universal gravitational constant G is
(*a*) N m kg^{-2} (*b*) N m^2 kg^{-2}
(*c*) N m^2 kg^{-1} (*d*) N m kg^{-1}

4. Surface tension has unit of
(*a*) Joule m^2 (*b*) Joule m^{-2}
(*c*) Joule m^{-1} (*d*) Joule m^3

5. The unit of magnetic moment is:
(*a*) Amp m^2 (*b*) Amp m^{-2}
(*c*) Amp m (*d*) Amp m^{-1}

6. The SI unit of Stefan's constant is
(*a*) $Ws^{-1}\ m^{-2}\ K^{-4}$ (*b*) J $s\ m^{-1}\ K^{-1}$
(*c*) J $s^{-1}\ m^{-2}\ K^{-1}$ (*d*) W $m^{-2}\ K^{-4}$

Dimensions of Physical Quantities

7. $[M\,L\,T^{-1}]$ are the dimensions of
(*a*) Power (*b*) Momentum
(*c*) Force (*d*) Couple

8. Which one of the following has the dimensions of $ML^{-1}T^{-2}$?
(*a*) Torque (*b*) Surface tension
(*c*) Viscosity (*d*) Stress

9. Which of the following is dimensional formula of intensity?
(*a*) MT^{-3} (*b*) $M^{-1}L^2T^{-2}$ (*c*) $ML^{½}T^{-1}$ (*d*) None

10. A dimensionless quantity:
(*a*) Never has a unit (*b*) Always has a unit
(*c*) May have a unit (*d*) Does not exit

11. The dimension of time in Electrical intensity is
(*a*) –1 (*b*) –2
(*c*) –3 (*d*) 3

12. The dimensional formula for areal velocity is
(*a*) M^0LT^{-1} (*b*) $M^0L^{-2}T^1$
(*c*) $M^0L^2T^{-1}$ (*d*) $M^0L^2T^1$

Dimensional Analysis and Its Application

13. The velocity of sound in a gas is given by $v = \sqrt{\gamma k_b \frac{T}{m}}$. Velocity v is measured in m/s, γ is a dimensionless constant, T is temperature in kelvin (K), and m is mass in kg. What are the units for the Boltzmann constant, k_b?
(*a*) $kgm^2s^{-2}K^{-1}$ (*b*) kgm^2s^2K
(*c*) $kgms^{-1}K^{-2}$ (*d*) $kgm^2s^{-2}K$

14. If $v = \sqrt{\frac{\gamma P}{\rho}}$, then the dimensions of γ are (P is pressure, ρ is density and v is speed of sound)
(*a*) $M^0L^0T^0$ (*b*) $M^0L^0T^{-1}$
(*c*) $M^1L^0T^0$ (*d*) $M^0L^1T^0$

15. If $F = \frac{A}{\sqrt{m}} + B$ where F = Force, m = Mass.
Then dimensions of $A \times B$ is,
(*a*) $M^{5/2}L^2T^{-4}$ (*b*) $M^{2/5}L^2T^{-1}$
(*c*) $M^2L^{2/5}T^{-1}$ (*d*) $M^{-1}L^{2/5}T^{-2}$

16. If a and b are two physical quantities having different dimensions then which of the following can denote a new physical quantity?
(*a*) $a + b$ (*b*) $a - b$ (*c*) a/b (*d*) $e^{a/b}$

Deducing Relation Among Various Physical Quantities

17. Force applied by water stream depends on density of water (ρ), velocity of the stream (v) and cross–sectional area of the stream (A). The expression of the force should be
(*a*) ρAv (*b*) ρAv^2 (*c*) $\rho^2 Av$ (*d*) $\rho A^2 v$

18. If the power, P delivered by a motor is dependent on force F, velocity v and density of material ρ. Then power may be proportional to
(*a*) $F^2v\rho^{-1}$ (*b*) $Fv^2\rho$
(*c*) $Fv\rho^0$ (*d*) None of these

19. The velocity of a freely falling body changes as $g^p h^q$ where g = acceleration due to gravity and h is height. The value of p and q are
(*a*) $1, \frac{1}{2}$ (*b*) $\frac{1}{2}, \frac{1}{2}$ (*c*) $\frac{1}{2}, 1$ (*d*) 1, 1

20. For a satellite orbiting around the Earth, its orbital velocity (v_0) is found to depend on mass of Earth M, radius of earth R and universal gravitational constant G. The orbital velocity is proportional to
(*a*) $G^{-1}M^1R^{-1}$ (*b*) $G^1M^1R^{-1}$
(*c*) $G^{1/2}M^{1/2}R^{-1/2}$ (*d*) None of these

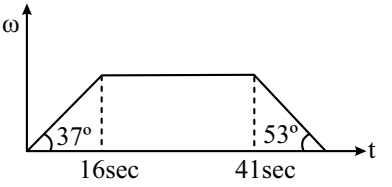
K represents kinetic energy, m represents mass, g represents acceleration due to gravity and A is unknown.

If $[A] = M^x L^y T^z$, then what is the value of $x + y + z$?

58. The radius of a sphere is measured to be 5.3 ± 0.1 cm. Calculate percentage error in volume. Round off to nearest integer.

59. Find the radius (in cm) of a rotating disc if the velocity of a point on rim is 5 times the velocity of a point located 5 m closer to the centre.

60. The angular velocity of a body moving in a circular path is shown in graph below. What is the average angular velocity (in rad/s) for the entire motion? Approximate the answer to nearest integer.



JEE Advanced Corner

Multiple Correct Type Questions

1. A student curiously picks up Resnick and Halliday and tries to understand the answers given at the end of the book using his new found knowledge of physics. He marks four answers. In which of the following quantity A has the same units as that of angular momentum ?

Useful formula, $\vec{L} = \vec{r} \times \vec{p}$, $\omega = \frac{2\pi}{T}$, $\vec{\tau} = \vec{r} \times \vec{F}$, E represent energy, l represents length c represents velocity of light, f represents frequency and t represents time.

(*a*) $\frac{1}{2}mv^2 = Af$ (*b*) $\Delta p = \frac{2A\omega}{v}\sqrt{1-\frac{v^2}{c^2}}$

(*c*) $\sin(kl) = k\sqrt{\frac{A^2}{2mE}}$ (*d*) $t = Al$

2. The quantity/quantities that does/do not have mass in its/their dimensions (when we take standard 7 quantities as fundamental) is/are

(*a*) Specific heat (*b*) Latent heat

(*c*) Luminous intensity (*d*) Mole

3. A chunk of unknown rock has mass 38.254 ± 0.003 grams and has a volume of 15.0 cm^3.

(*a*) The density of the rock is 2.55 g/cm^3.

(*b*) The absolute error in density is 0.02 g/cm^3.

(*c*) The relative error in density is 0.007.

(*d*) The number of significant figure 3 in density are 3.

4. Using a screw gauge the diameter of a wire is found to be 5.00 mm. The length of wire is measured by using a scale and is found to be 50.0 cm. If mass of wire is measured as 25 g, then mark the correct statement(s) (Take π = 3.14).

(*a*) The density has to be computed upto 2 significant digits.

(*b*) The least count of scale used to measure length of wire is 1 mm.

(*c*) The density of wire is 2.6 g/cm^3

(*d*) The least count of screw gauge is 0.01 mm

Comprehension Based Questions

Comprehension (Q. 5 to 7): According to Coulomb's law of electrostatics there is a force between two charged particles q_1 & q_2 separated by a distance r such that $F \propto q_1$, $F \propto q_2$ & $F \propto \frac{1}{r^2}$; combining all three we get $F \propto \frac{q_1 q_2}{r^2}$ or $F = \frac{kq_1 q_2}{r^2}$, where k is a constant which depends on the medium and is given by $1/4\pi\varepsilon_0\varepsilon_r$ where ε_0 is absolute permittivity & ε_r is relative permittivity.

But in case of protons of a nucleus there exists another force called nuclear force which is much higher in magnitude in comparison to electrostatic force and is given by $F = \frac{Ce^{-kr}}{r^2}$.

5. What are the dimensions of C ?

(*a*) $M^2L^3T^{-1}$ (*b*) ML^3T^{-3} (*c*) ML^3T^{-2} (*d*) ML^2T^{-3}

6. What are the dimensions of k?

(*a*) L (*b*) L^2 (*c*) L^{-3} (*d*) L^{-1}

7. What are the SI units of C?

(*a*) Nm^{-2} (*b*) Nm^2 (*c*) Nm^{-3} (*d*) Nm

Comprehension (Q. 8 to 10): Max Planck noted in 1899 the existence of a system of units based on the three fundamental constants G, c, and h. These constants are dimensionally independent in the sense that no combination is dimensionless and a length, a time, and a mass may be constructed from them. Specifically, with $\hbar \equiv \frac{h}{2\pi} = 1.05 \times 10^{-34}$ SI units in preference to h, the Planck scale is represented by ℓ_P, T_P, M_P.

8. Which of the following formula can represent length in terms of $\hbar$, c and G

(*a*) $\sqrt{\frac{\hbar G}{c^3}}$ (*b*) $\sqrt{\frac{\hbar c}{G}}$

(*c*) $\sqrt{\frac{Gc}{\hbar}}$ (*d*) $\sqrt{G\hbar c}$

9. Which among the following would be the order of numerical value of a unit of mass defined in terms of $\hbar$, c and G

(*a*) 10^{-8} kg (*b*) 10^{-10} kg

(*c*) 10^{-5} kg (*d*) 10^{-27} kg

10. The dimensional formula for acceleration in terms of these quantities would be

(*a*) $\hbar^{1/2}c^{3/2}G^{-1/2}$ (*b*) $\hbar^{3/2}c^{5/2}G^{1/2}$

(*c*) $\hbar^{-1/2}c^{7/2}G^{-1/2}$ (*d*) $\hbar^{5/2}c^{3/2}G^{1/2}$

Comprehension (Q. 11 to 13): The Van-der Waals equation is $\left(P+\frac{a}{V^2}\right)(V-b)=nRT,$ where P is pressure, V is volume, T is the temperature of the given sample of gas, R is called molar gas constant and a and b are called Van-der Waals constants

11. The dimensional formula for a is same as that for

(*a*) V^2 (*b*) P (*c*) PV^2 (*d*) RT

12. Which of the following does not possess the same dimensional formula as that for nRT?

(*a*) PV (*b*) Pb (*c*) a/V^2 (*d*) ab/V^2

13. The dimensional formula of nRT is same as that of

(*a*) Energy (*b*) Force

(*c*) Specific heat (*d*) Latent heat

Comprehension (Q. 14 to 16): Two forces $\vec{F}_1 = 2\hat{i}+2\hat{j}$ N and $\vec{F}_2 = 3\hat{j}+4\hat{k}$ N are acting on a particle.

14. The resultant force acting on particle is:

(*a*) $2\hat{i}+5\hat{j}+4\hat{k}$ (*b*) $2\hat{i}-5\hat{j}-4\hat{k}$

(*c*) $\hat{i}-3\hat{j}-2\hat{k}$ (*d*) $\hat{i}-\hat{j}-\hat{k}$

15. The angle between $\vec{F}_1$ and $\vec{F}_2$ is

(*a*) $\theta=\cos^{-1}\left(\frac{3}{2\sqrt{5}}\right)$ (*b*) $\theta=\cos^{-1}\left(\frac{3}{5\sqrt{2}}\right)$

(*c*) $\theta=\cos^{-1}\left(\frac{2}{3\sqrt{5}}\right)$ (*d*) $\theta=\cos^{-1}\left(\frac{\sqrt{3}}{5}\right)$

16. The component of force $\vec{F}_1$ along force $\vec{F}_2$ is

(*a*) $\frac{5}{6}$ (*b*) $\frac{5}{3}$ (*c*) $\frac{6}{5}$ (*d*) $\frac{5}{2}$

Match the Column Type Questions

17. Match the following:

	Physical quantity		Dimension		Unit
A.	Stefan's constant 'σ'	p.	$[M^1L^1T^{-2}A^{-2}]$	(i)	W/m^2
B.	Wien's constant 'b'	q.	$[M^1L^0T^{-3}K^{-4}]$	(ii)	K.m.
C.	Coefficient of viscosity 'η'	r.	$[M^1L^0T^{-3}]$	(iii)	tesla .m/A
D.	Emissive power of radiation (Intensity emitted)	s.	$[M^0L^1T^0K^1]$	(iv)	Wm^{-2}K^{-4}
E.	Mutual inductance 'M'	t.	$[M^1L^2T^{-2}A^{-2}]$	(v)	Poise
F.	Magnetic permeability 'μ_0'	u.	$[M^1L^{-1}T^{-1}]$	(vi)	Henry

(*a*) A-(p)-(iv); B-(s)-(iii); C-(q)-(v); D-(r)-(i); E-(u)-(vi); F-(t)-(ii)

(*b*) A-(q)-(iii); B-(s)-(ii); C-(r)-(i); D-(u)-(v); E-(p)-(vi); F-(t)-(iv)

(*c*) A-(p)-(iv); B-(s)-(ii); C-(r)-(i); D-(u)-(v); E-(t)-(vi); F-(q)-(iii)

(*d*) A-(q)-(iv); B-(s)-(ii); C-(u)-(v); D-(r)-(i); E-(t)-(vi); F-(p)-(iii)

18. Suppose two students are trying to make a new measurement system so that they can use it like a code measurement system and others do not understand it. Instead of taking 1 kg, 1 m and 1 s. as basic unit they took unit of mass as α kg, the unit of length as β m and unit of time as γ second. They called power in new system as SHAKTI, then match the two columns.

	Column-I		Column-II
A.	1N in new system	p.	$\alpha^{-1}\beta^{-2}\gamma^2$
B.	1J in new system	q.	$\alpha^{-1}\beta^{-1}\gamma^2$
C.	1 Pascal (SI unit of pressure) in new system	r.	$\alpha^{-1}\beta\gamma^2$
D.	α SHAKTI in watt	s.	$\alpha^2\beta^2\gamma^{-3}$

(*a*) A-(q); B-(p); C-(r); D-(s)

(*b*) A-(p); B-(q); C-(r); D-(s)

(*c*) A-(q); B-(p); C-(s); D-(r)

(*d*) A-(p); B-(r); C-(q); D-(s)

19. Match the following

	Column-I		Column-II
A.	Latent heat of fusion	p.	$M^0L^0T^0$
B.	Coefficient of friction	q.	ML^2
C.	Avogadro's constant	r.	ML^0T^{-3}
D.	Intensity of wave	s.	L^2T^{-2}
E.	Moment of inertia	t.	mol^{-1}

(*a*) A-(p); B-(s); C-(t); D-(q); E-(r)

(*b*) A-(s); B-(t); C-(p); D-(r); E-(q)

(*c*) A-(s); B-(p); C-(t); D-(r); E-(q)

(*d*) A-(s); B-(p); C-(t); D-(r); E-(q)

20. There are four vernier scales, whose specification are given in Column-I and the least count is given in Column-II. Match the Columns-I and II with correct specification and corresponding least count (s = value of main scale division, n = number of marks on vernier). Assume $(n-1)$ main scale divisions are equal to n vernier divisions.

	Column-I		Column-II
A.	s = 1 mm, n = 10	p.	0.05 mm
B.	s = 0.5 mm, n = 10	q.	0.01 mm
C.	s = 0.5 mm, n = 20	r.	0.1 mm
D.	s = 1 mm, n = 100	s.	0.025 mm

(*a*) A-(p); B-(s); C-(q); D-(r), (p)

(*b*) A-(r); B-(p); C-(s); D-(q)

(*c*) A-(p), (r); B-(q); C-(s); D-(r)

(*d*) A-(s); B-(p), (r); C-(q); D-(r), (s)

PYQ's (Past Year Questions)

Units, System of Units

1. Match List-I with List-II.

List-I		List-II	
A.	Heat capacity of body	I.	J kg^{-1}
B.	Specific heat capacity of body	II.	JK^{-1}
C.	Latent heat	III.	J kg^{-1} K^{-1}
D.	Thermal conductivity	IV.	Jm^{-1} $K^{-1}s^{-1}$

Choose the correct answer from the options given below:

[02 April, 2025 (Shift-II)]

(*a*) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)

(*b*) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

(*c*) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

(*d*) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

2. Match List-I with List-II. **[27 Aug, 2021 (Shift-II)]**

List-I		List-II	
A.	R_H (Rydberg constant)	I.	kg m^{-1} s^{-1}
B.	h(Planck's constant)	II.	kg m^2 s^{-1}
C.	μ_B (Magnetic field energy density)	III.	m^{-1}
D.	η (coefficient of viscocity)	IV.	kg m^{-1} s^{-2}

(*a*) A-II, B-III, C-IV, D-I (*b*) A-III, B-II, C-I, D-IV

(*c*) A-III, B-II, C-IV, D-I (*d*) A-IV, B-II, C-I, D-III

3. If E and H represents the intensity of electric field and magnetising field respectively, then the unit of E/H will be:

[27 Aug, 2021 (Shift-I)]

(*a*) Joule (*b*) Newton

(*c*) Ohm (*d*) Mho

Dimension, Finding Dimensional Formula

4. The dimension of $\sqrt{\frac{\mu_0}{\epsilon_0}}$ is equal to that of:

(μ_0 = Vacuum permeability and ϵ_0 = Vacuum permittivity)

[07 April, 2025 (Shift-II)]

(*a*) Voltage (*b*) Capacitance

(*c*) Inductance (*d*) Resistance

5. If ε_0 is the permittivity of free space and E is the electric field, then $\varepsilon_0 E^2$ has the dimensions: **[08 April, 2024 (Shift-II)]**

(*a*) $[M^0 L^{-2} TA]$ (*b*) $[ML^{-1} T^{-2}]$

(*c*) $[M^{-1} L^{-3} T^4 A^2]$ (*d*) $[ML^2 T^{-2}]$

6. Given below are two statements:

Statement (I): Dimensions of specific heat is $[L^2T^{-2}K^{-1}]$

Statement (II): Dimensions of gas constant is $[ML^2T^{-1}K^{-1}]$

[06 April, 2024 (Shift-II)]

(*a*) Statement (I) is incorrect but statement (II) is correct

(*b*) Both statement (I) and statement (II) are incorrect

(*c*) Statement (I) is correct but statement (II) is incorrect

(*d*) Both statement (I) and statement (II) are correct

7. Match List-I with List-II

	List-I		List-II
A.	Torque	I.	$[M^1L^1T^{-2}A^{-2}]$
B.	Magnetic field	II.	$[L^2A^1]$
C.	Magnetic moment	III.	$[M^1T^{-2}A^{-1}]$
D.	Permeability of free space	IV.	$[M^1L^2T^{-2}]$

Choose the correct answer from the options given below:

[06 April, 2024 (Shift-I)]

(*a*) A-I, B-III, C-II, D-IV (*b*) A-IV, B-III, C-II, D-I

(*c*) A-III, B-I, C-II, D-IV (*d*) A-IV, B-II, C-III, D-I

8. What is the dimensional formula of ab^{-1} in the equation $\left(P + \frac{a}{V^2}\right)(V - b) = RT$, where letters have their usual meaning. **[05 April, 2024 (Shift-II)]**

(*a*) $[M^0L^3T^{-2}]$ (*b*) $[ML^2T^{-2}]$

(*c*) $[M^{-1}L^5T^3]$ (*d*) $[M^6L^7T^4]$

9. If G be the gravitational constant and u be the energy density then which of the following quantity has the dimension as that of $\sqrt{uG}$: **[05 April, 2024 (Shift-I)]**

(*a*) Pressure gradient per unit mass

(*b*) Force per unit mass

(*c*) Gravitational potential

(*d*) Energy per unit mass

10. The dimensional formula of angular impulse is:

[1 Feb, 2024 (Shift-I)]

(*a*) $[M\,L^{-2}\,T^{-1}]$ (*b*) $[M\,L^2\,T^{-2}]$

(*c*) $[M\,L\,T^{-1}]$ (*d*) $[M\,L^2\,T^{-1}]$

Application of Dimensional Analysis

11. The electric flux is $\phi = \alpha\sigma + \beta\lambda$ where λ and σ are linear and surface charge density respectively, $\left(\frac{\alpha}{\beta}\right)$ represents.

[23 Jan, 2025 (Shift-I)]

(*a*) charge (*b*) displacement

(*c*) area (*d*) electric field

12. Consider two physical quantities A and B related to each other as $E = \frac{B - x^2}{At}$ where E, x and t have dimensions of energy, length and time respectively. The dimension of AB is **[31 Jan, 2024 (Shift-II)]**

(*a*) $L^{-2}M^{1}T^{0}$ (*b*) $L^{2}M^{-1}T^{1}$ (*c*) $L^{-2}M^{-1}T^{1}$ (*d*) $L^{0}M^{-1}T^{1}$

13. A force is represented by $F = ax^2 + bt^{1/2}$ Where x = distance and t = time. The dimensions of b^2/a are: **[31 Jan, 2024 (Shift-I)]**

(*a*) $[ML^3T^{-3}]$ (*b*) $[MLT^{-2}]$

(*c*) $[ML^{-1}T^{-1}]$ (*d*) $[ML^2T^{-3}]$

14. If mass is written as $m = k\,c^P\,G^{-1/2}\,h^{1/2}$ then the value of P will be: (Constants have their usual meaning with k a dimensionless constant) **[30 Jan, 2024 (Shift-II)]**

(*a*) 1/2 (*b*) 1/3 (*c*) 2 (*d*) –1/3

15. The equation of state of a real gas is given by $\left(P + \frac{a}{V^2}\right)(V - b) = RT$, where P, V and T are pressure. volume and temperature respectively and R is the universal gas constant. The dimensions of $\frac{a}{b^2}$ is similar to that of: **[27 Jan, 2024 (Shift-II)]**

(*a*) PV (*b*) P (*c*) RT (*d*) R

16. A temperature difference can generate e.m.f. in some materials. Let S be the e.m.f. produced per unit temperature difference between the ends of a wire, σ the electrical conductivity and κ the thermal conductivity of the material of the wire. Taking M, L, T, I and K as dimensions of mass, length, time, current and temperature, respectively, the dimensional formula of the quantity $Z = \frac{S^2\sigma}{\kappa}$ is: **[JEE Adv. 2025]**

(*a*) $[M^0 L^0 T^0 I^0 K^0]$ (*b*) $[M^0 L^0 T^0 I^0 K^{-1}]$

(*c*) $[M^1 L^2 T^{-2} I^{-1} K^{-1}]$ (*d*) $[M^1 L^2 T^{-4} I^{-1} K^{-1}]$

Errors in Measurement

17. A physical quantity C is related to four other quantities p, q, r and s as follows

$$C = \frac{pq^2}{r^3\sqrt{s}}$$

The percentage errors in the measurement of p,q,r and s are 1%, 2%, 3% and 2% respectively.

The percentage error in the measurement of C will be _____ %. **[03 April, 2025 (Shift-II)]**

18. In an expression $a \times 10^b$: **[08 April, 2024 (Shift-I)]**

(*a*) a is order of magnitude for $b \le 5$

(*b*) b is order of magnitude for $a \le 5$

(*c*) b is order of magnitude for $5 < a \le 10$

(*d*) b is order of magnitude for $a \ge 5$

19. To find the spring constant (k) of a spring experimentally, a student commits 2% positive error in the measurement of time and 1% negative error in measurement of mass. The percentage error in determining value of k is: **[06 April, 2024 (Shift-I)]**

(*a*) 3% (*b*) 1% (*c*) 4% (*d*) 5%

20. Time periods of oscillation of the same simple pendulum measured using four different measuring clocks were recorded as 4.62 s, 4.632 s, 4.6 s and 4.64 s. The arithmetic mean of these reading in correct significant figure is. **[05 April, 2024 (Shift-I)]**

(*a*) 4.623 s (*b*) 4.62 s (*c*) 4.6 s (*d*) 5 s

21. In an experiment to measure focal length (f) of convex lens, the least counts of the measuring scales for the position of object (u) and for the position of image (v) are Δu and Δv, respectively. The error in the measurement of the focal length of the convex lens will be: **[04 April, 2024 (Shift-I)]**

(*a*) $\frac{\Delta u}{u} + \frac{\Delta v}{v}$ (*b*) $f^2\left[\frac{\Delta u}{u^2} + \frac{\Delta v}{v^2}\right]$

(*c*) $2f\left[\frac{\Delta u}{u} + \frac{\Delta v}{v}\right]$ (*d*) $f\left[\frac{\Delta u}{u} + \frac{\Delta v}{n}\right]$

22. Match List-I with List-II.

	List-I (Number)		List-II (Significant figure)
(A)	1001	(I)	3
(B)	010.1	(II)	4
(C)	100.100	(III)	5
(D)	0.0010010	(IV)	6

Choose the correct answer from the options given below: **[1 Feb, 2024 (Shift-II)]**

(*a*) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

(*b*) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

(*c*) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

(*d*) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

23. The radius (r), length (l) and resistance (R) of a metal wire was measured in the laboratory as

$r = (0.35 \pm 0.05)$ cm, $R = (100 \pm 10)$ ohm, $l = (15 \pm 0.2)$ cm

The percentage error in resistivity of the material of the wire is: **[1 Feb, 2024 (Shift-I)]**

(*a*) 25.6% (*b*) 39.9% (*c*) 37.3% (*d*) 35.6%

24. The measured value of the length of a simple pendulum is 20 cm with 2 mm accuracy. The time for 50 oscillations was measured to be 40 seconds with 1 second resolution. From these measurements, the accuracy in the measurement of acceleration due to gravity is N%. The value of N is: **[31 Jan, 2024 (Shift-II)]**

(*a*) 4 (*b*) 8 (*c*) 6 (*d*) 5

25. If the percentage errors in measuring the length and the diameter of a wire are 0.1% each. The percentage error in measuring its resistance will be: **[31 Jan, 2024 (Shift-I)]**

(*a*) 0.2% (*b*) 0.3% (*c*) 0.1% (*d*) 0.144%

26. Length, breadth and thickness of a strip having a uniform cross section are measured to be 10.5 cm, 0.05 mm, and 6.0 μm, respectively. Which of the following option(s) give(s) the volume of the strip in cm^3 with correct significant figures: **[JEE Adv. 2025]**

(*a*) 3.2×10^{-5} (*b*) 32.0×10^{-6}

(*c*) 3.0×10^{-5} (*d*) 3×10^{-5}

Answer Key

JEE Main Corner

1. (*a*)	**2.** (*c*)	**3.** (*b*)	**4.** (*b*)	**5.** (*a*)	**6.** (*d*)	**7.** (*b*)	**8.** (*d*)	**9.** (*a*)	**10.** (*c*)
11. (*c*)	**12.** (*c*)	**13.** (*a*)	**14.** (*a*)	**15.** (*a*)	**16.** (*c*)	**17.** (*b*)	**18.** (*c*)	**19.** (*b*)	**20.** (*c*)
21. (*d*)	**22.** (*a*)	**23.** (*b*)	**24.** (*b*)	**25.** (*c*)	**26.** (*d*)	**27.** (*c*)	**28.** (*a*)	**29.** (*b*)	**30.** (*c*)
31. (*a*)	**32.** (*b*)	**33.** (*b*)	**34.** (*b*)	**35.** (*c*)	**36.** (*c*)	**37.** (*b*)	**38.** (*b*)	**39.** (*a*)	**40.** (*b*)
41. (*d*)	**42.** (*a*)	**43.** (*a*)	**44.** (*a*)	**45.** (*b*)	**46.** (*b*)	**47.** (*b*)	**48.** (*a*)	**49.** (*d*)	**50.** (*b*)
51. (*a*)	**52.** (*b*)	**53.** (*d*)	**54.** (*a*)	**55.** (*d*)	**56.** [3]	**57.** [3]	**58.** [6]	**59.** [625]	**60.** [9]

JEE Advanced Corner

1. (*a*,*b*,*c*)	**2.** (*a*,*b*,*c*,*d*)	**3.** (*a*,*b*,*c*,*d*)	**4.** (*a*,*b*,*c*,*d*)	**5.** (*c*)	**6.** (*d*)	**7.** (*b*)	**8.** (*a*)	**9.** (*a*)	**10.** (*c*)
11. (*c*)	**12.** (*c*)	**13.** (*a*)	**14.** (*a*)	**15.** (*b*)	**16.** (*c*)	**17.** (*d*)	**18.** (*a*)	**19.** (*c*)	**20.** (*b*)
21. (*d*)	**22.** [2.59]	**23.** [0.41]	**24.** [1.67]	**25.** [1]	**26.** [1]	**27.** [928]	**28.** (*b*)	**29.** (*b*)	**30.** (*c*)
31. (*c*)	**32.** (*b*)	**33.** (*a*)	**34.** (*a*)						

PYQ's (Past Year Questions)

1. (*d*)	**2.** (*c*)	**3.** (*c*)	**4.** (*d*)	**5.** (*b*)	**6.** (*c*)	**7.** (*b*)	**8.** (*b*)	**9.** (*b*)	**10.** (*d*)
11. (*b*)	**12.** (*b*)	**13.** (*a*)	**14.** (*a*)	**15.** (*b*)	**16.** (*b*)	**17.** [15]	**18.** (*b*)	**19.** (*d*)	**20.** (*c*)
21. (*b*)	**22.** (*c*)	**23.** (*b*)	**24.** (*c*)	**25.** (*b*)	**26.** (*d*)	**27.** (*b*)	**28.** (*b*)	**29.** (*b*)	**30.** (*d*)
31. (*c*)	**32.** (*a*)	**33.** (*b*)	**34.** (*c*)	**35.** (*d*)	**36.** (*d*)	**37.** (*c*)	**38.** (*c*)	**39.** [4]	**40.** [6]
41. (*a*)	**42.** [3]	**43.** [3]	**44.** (*d*)	**45.** (*c*)	**46.** (*d*)	**47.** (*a*)	**48.** [4]	**49.** [4]	

Explanation

JEE Main Corner

1. **(*a*)** Fact based

2. **(*c*)** Parsec is a unit of distance.
It is used in astronomical science.

3. **(*b*)** From law of gravitation,

$$F = \frac{GM_1M_2}{R^2}$$

Here M_1 and M_2 are masses
R = Distance between masses M_1 and M_2
F = Force

$$\Rightarrow G = \frac{FR^2}{M_1M_2} = \frac{\text{N m}^2}{\text{kg}^2}$$

So, Unit of G = N m^2 kg^{-2}

4. **(*b*)** Surface Tension (T) = Energy per unit area.

$$T = \frac{E}{A} = \frac{\text{J}}{\text{m}^2}$$

5. **(*a*)** $M = iA$ = Amp.m^2
Here i = current
A = cross-sectional Area

6. **(*d*)** Power radiated by a source
$P = \sigma AT^4$
where, σ = Stefan-Constant
A = area
T = temperature
Unit of $\sigma \rightarrow$ W/(m^2 – K^4) = Wm^{-2} K^{-4}

7. **(*b*)** Momentum, $P = mv$
Dimension of $[P] = [\text{MLT}^{-1}]$

8. **(*d*)** Find dimensions in all the options.
stress = Force/Area

$$= \frac{M^1L^1T^{-2}}{L^2}$$

stress = [M^{1}L^{-1}T^{-2}]

9. **(*a*)** $I = \frac{P}{A} = \frac{\text{ML}^2\text{T}^{-3}}{\text{L}^2} = \text{MT}^{-3}$

10. **(*c*)** Dimensionless quantity may have a unit
Ex. Angle: Unit $\rightarrow$ Radian
Dimension $\rightarrow$ M^{0}L^{0}T^0

11. **(*c*)** $E = \frac{F}{q}, q = [IT]$

12. **(*c*)** Areal velocity = $\frac{dA}{dt}$

13. **(*a*)** $k_B = \frac{v^2m}{T} = \frac{(\text{L}^2\text{T}^{-2})(\text{M})}{\text{K}}$

$\text{ML}^2\text{T}^{-2}\text{K}^{-1} = \text{kg m}^2\text{s}^{-2}\text{K}^{-1}$

14. **(*a*)** $\left[\sqrt{\frac{\gamma P}{\rho}}\right] = [v] \Rightarrow [\gamma \text{L}^2\text{T}^{-2}]$

$= [\text{L}^2\text{T}^{-2}] \left(\because \frac{P}{\rho} = L^2T^{-2}\right)$

$[\gamma] = [\text{M}^0\text{L}^0\text{T}^0]$

15. **(*a*)** $[\text{F}] = \frac{[\text{A}]}{\text{M}^{1/2}} \Rightarrow [\text{A}] = \text{M}^{3/2}\text{LT}^{-2}$

$[\text{B}] = [\text{F}] = \text{MLT}^{-2}$

So, $[\text{A} \times \text{B}] = \text{M}^{5/2}\text{L}^2\text{T}^{-4}$

16. **(*c*)** Only same physical quantities can be added or subtracted. Multiplication/ division will give a new quantity.
So, a/b denotes a new physical quantity.

17. **(*b*)** $\text{F} \propto \rho^a v^b A^c$

$\text{MLT}^{-2} = \text{M}^a\text{L}^{-3a}\text{L}^b\text{T}^{-b}\text{L}^{2c}$
$= \text{M}^a\text{L}^{-3a+b+2c}\text{T}^{-b}$
$\Rightarrow a = 1, b = 2, c = 1$
So, $F \propto \rho v^2 A$

18. **(c)** Acc. to given question

Power, $P = KF^a v^b \rho^c$

$ML^2T^{-3} = [MLT^{-2}]^a \times [LT^{-1}]^b \times [ML^{-3}]^c$

$= [M]^{a+c}\,[L]^{a+b-3c}\,[T]^{-2a-b}$

Comparing the coefficients

For M, $1 = a + c$

For L, $2 = a + b - 3c$

For T, $-3 = -2a - b$

Solving for a, b, c we get

$a = 1, \quad b = 1, \quad c = 0$

$\therefore P \propto Fv\rho^0$

19. **(b)** $v = Kg^p h^q$

$M^0LT^{-1} = [LT^{-2}]^p\,[L]^q$

$M^0LT^{-1} = L^{p+q}\,T^{-2p}$

Comparing the coefficients,

For L, $1 = p + q$

For T, $-1 = -2p \Rightarrow p = \dfrac{1}{2}$

Solving for q; we get $q = \dfrac{1}{2}$

20. **(c)** $V_0 \propto M^a R^b G^c$

$\Rightarrow \boxed{V_0 = KM^aR^bG^c}$

Substituting the dimensions for M, R and G

$[M]^a\,[L]^b\,[M^{-1}L^3T^{-2}]^c$

$M^0LT^{-1} = [M]^{a-c}\,[L]^{b+3c}\,[T]^{-2c}$

Comparing the powers, we get

$a - c = 0$ ...(*i*)

$b + 3c = 1$ ...(*ii*)

$-2c = -1 \Rightarrow c = \dfrac{1}{2}$

Solving for a, b we get $a = \dfrac{1}{2}, b = -\dfrac{1}{2}$

$\therefore \quad V_0 = KM^{1/2}R^{-1/2}G^{1/2}$

$= K\sqrt{\dfrac{GM}{R}}$

21. **(d)** Substitute dimensional formula of quantities

22. **(a)** Given $P = 10^6$ dyne/cm^2

$n_1u_1 = n_2u_2$

$n_1\left[M_1^1L_1^{-1}T_1^{-2}\right] = 10^6\left[M_2^1L_2^{-1}T_2^{-2}\right]$

$n_1 = 10^6\left[\dfrac{M_2}{M_1}\right]^1\left[\dfrac{L_2}{L_1}\right]^{-1}\left[\dfrac{T_2}{T_1}\right]^{-2}$

$= 10^6\left[\dfrac{1}{1000}\right]^1\left[\dfrac{1}{100}\right]^{-1}\left[\dfrac{1}{1}\right]^{-2}$

$= 10^6 \times \dfrac{10^2}{10^3} = 10^5$ N/m^2

23. **(b)** $\rho = 2$g/cm^3

$n_1u_1 = n_2u_2$

$n_1\left[M_1^1L_1^{-3}\right] = 2\left[M_2^1L_2^{-3}\right]$

$n_1 = 2\left[\dfrac{M_2}{M_1}\right]^1\left[\dfrac{L_2}{L_l}\right]^{-3}$

$= 2\left[\dfrac{10^{-3}}{1}\right]^1\left[\dfrac{10^{-2}}{1}\right]^{-3}$

$= 2 \times 10^{-3} \times 10^6 = 2 \times 10^3$ kg/m^3

24. **(b)** $n_2 = n_1\left(\dfrac{M_1}{M_2}\right)^a\left(\dfrac{L_1}{L_2}\right)^b\left(\dfrac{T_1}{T_2}\right)^c$

$= 20\left[\dfrac{1\text{ gm}}{1\text{ kg}}\right]^1\left[\dfrac{1\text{ cm}}{1\text{ m}}\right]^1\left[\dfrac{1\text{ sec}}{1\text{ sec}}\right]^{-2}$

{$\because$ As $F = MLT^{-2}$ $a = 1, b = 1, c = -2$}

$= 20 \times \dfrac{1}{1000} \times \dfrac{1}{100} \times 1 = 20 \times 10^{-5}$ N

25. **(c)** $10^3(N) = M^1L^1T^{-2}$

$10^3 = [M]^1\,[10^3]^1\,[100]^{-2}$

$M = \dfrac{10^3}{10^3 \times (100)^{-2}} = 10000\,\text{kg}$

26. **(d)** $P = \dfrac{F}{A}$

27. **(c)** 70.40s $\rightarrow$ four significant figures.

Time period $= \dfrac{70.40}{20} = 3.520$ sec.

(4 significant figures)

28. **(a)** $KE = \dfrac{1}{2}mv^2$

$\dfrac{\Delta K}{K} \times 100 = \dfrac{\Delta m}{m} + \dfrac{2\Delta v}{v} = 1\% + 2 \times 2\% = 5\%$

29. **(b)** For n times increase in number of observations, random error decreases by a factor of $1/n$.

30. **(c)** Fact based

31. **(a)** Since percentage increase in length = 2 %

Hence, percentage increase in area of square sheet $2 \times 2\% = 4\%$

32. **(b)** $A = l \times b$

$\Rightarrow \dfrac{\Delta A}{A} = \dfrac{\Delta l}{l} + \dfrac{\Delta b}{b}$

$\dfrac{\Delta A}{A} \times 100\%$

$= \dfrac{\pm 0.2}{20} \times 100\% + \dfrac{\pm 0.1}{10} \times 100\% = \pm 2\%$

33. **(b)** $\dfrac{dm}{dt} = \rho AV$

$\Rightarrow \dfrac{dm}{dt} \times 100\% = \dfrac{\Delta\rho}{\rho} \times 100\% +$

$\dfrac{\Delta A}{A} \times 100\% + \dfrac{\Delta v}{v} \times 100\%$

$= 0 \pm \dfrac{0.1}{10} \times 100\% + \dfrac{\pm 0.3}{30} \times 100\% = 2\%$

34. **(b)** $X = M^a L^b T^{-c}$

$\dfrac{\Delta X}{X} \times 100 = a\dfrac{\Delta M}{M} \times 100 + b\dfrac{\Delta L}{L} \times 100$

$+ c\dfrac{\Delta T}{T} \times 100$

35. **(c)** $y = \dfrac{a^2b}{c^3}$

$\dfrac{\Delta y}{y} \times 100 = \dfrac{2\Delta a}{a} \times 100 + \dfrac{\Delta b}{b} \times 100$

$+ \dfrac{3\Delta c}{c} \times 100$

36. **(c)** LC = 1 MSD – 1 VSD

LC = 0.1 cm $- \dfrac{m}{n} \Rightarrow 0.02$ cm $= \dfrac{1}{10} - \dfrac{n}{m}$

$\dfrac{m}{n} = \dfrac{1}{10} - \dfrac{2}{100} = \dfrac{0.8}{10}$

$n = 10$, $m = 0.8$ cm

37. **(b)** Mean value of $m = \dfrac{m_1 + m_2 + m_3 + m_4}{4}$;

$m \rightarrow$ measurement

$= \dfrac{1.22 + 1.23 + 1.19 + 1.20}{4} = 1.21$ mm

Absolute Deviations

1st Reading, $|\Delta m_1| = |\,\bar{m} - m_1\,| = 0.01$

2nd Reading, $|\Delta m_2| = |\,\bar{m} - m_2\,| = 0.02$

3rd Reading, $|\Delta m_3| = |\,\bar{m} - m_3\,| = 0.02$

4th Reading, $|\Delta m_4| = |\,\bar{m} - m_4\,| = 0.01$

$\therefore$ Mean $(\Delta\bar{m})$ Absolute value

$= \dfrac{|\,\Delta m_1\,| + |\,\Delta m_2\,| + \ldots + |\,\Delta m_4\,|}{4}$

$= 0.015 = 0.015$

$\therefore$ Reading with Error = $\bar{m} \pm \Delta\bar{m} = 1.21 \pm 0.015$

$\therefore$ % age Error

$= \dfrac{\pm 0.015}{1.21} \times 100\% = \pm 1.24\%$

38. **(b)** $\Delta\ell = 0.5$ mm

$N = 100$ divisions

zero correction = 2 divisions

Reading = Measured value – zero correction

$= (8 \times 0.5\,\text{mm}) + (83) \times \dfrac{0.5}{100}\text{mm} - 2 \times \dfrac{0.5}{100}.$

$= 4\text{ mm} + 0.415\text{ mm} - 0.01\text{ mm} = 4.405\text{ mm}$

39. **(a)** Measured Diameter = MSR + VSR × V.C

= 1.7 cm + 0.01 cm × 5 = 1.75 cm

Corrected Reading = Measured value – Zero error

$= 1.75 - (-0.05) = 1.80\text{ cm} = 180 \times 10^{-2}$ cm

$\therefore n = 180$

40. **(b)** $|P - Q| \le R \le |P + Q|$

If $P = 10$N & $Q = 6$N

$4 \le R \le 16$

41. **(d)** Initial and final positions coincide.

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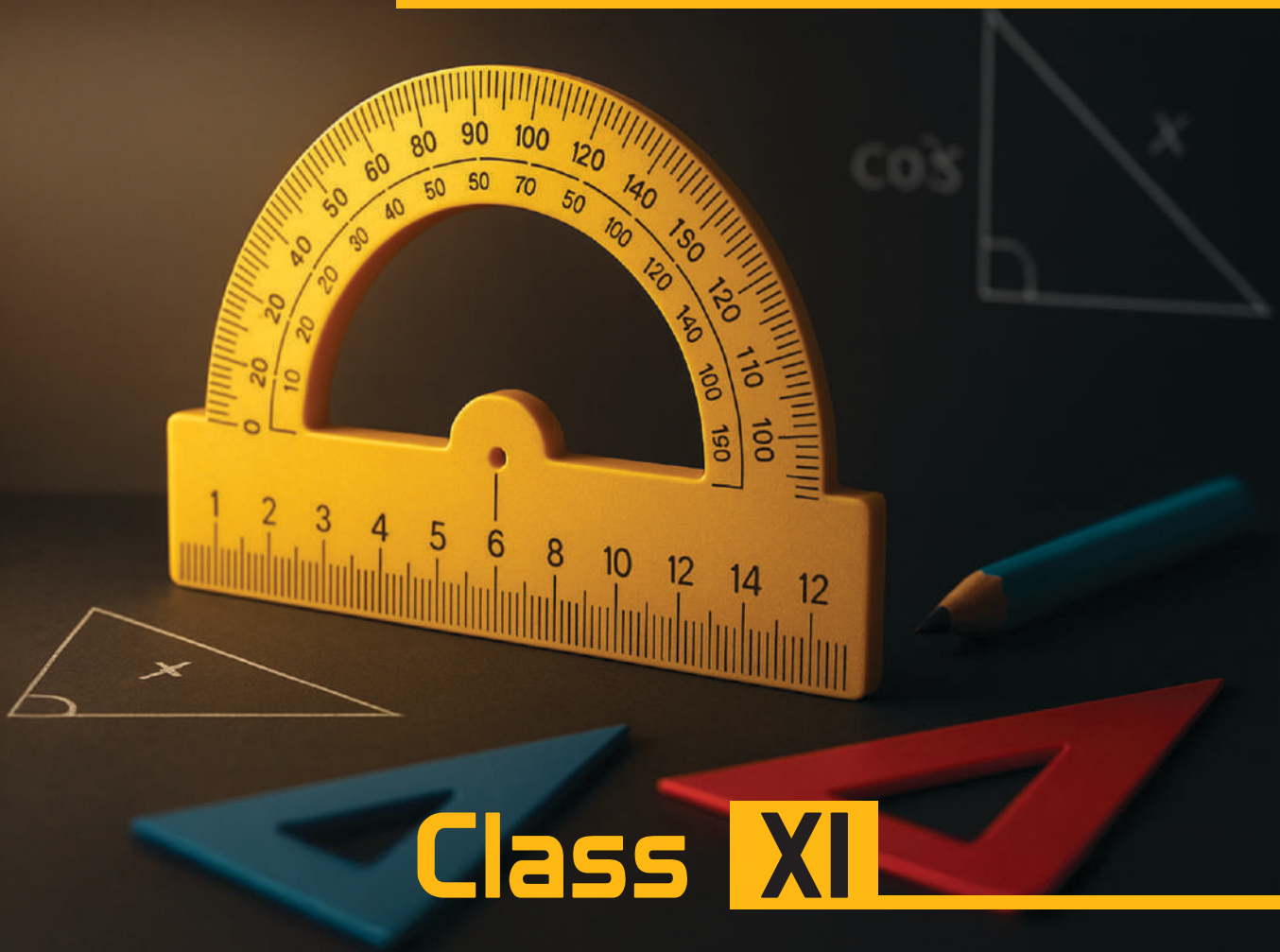

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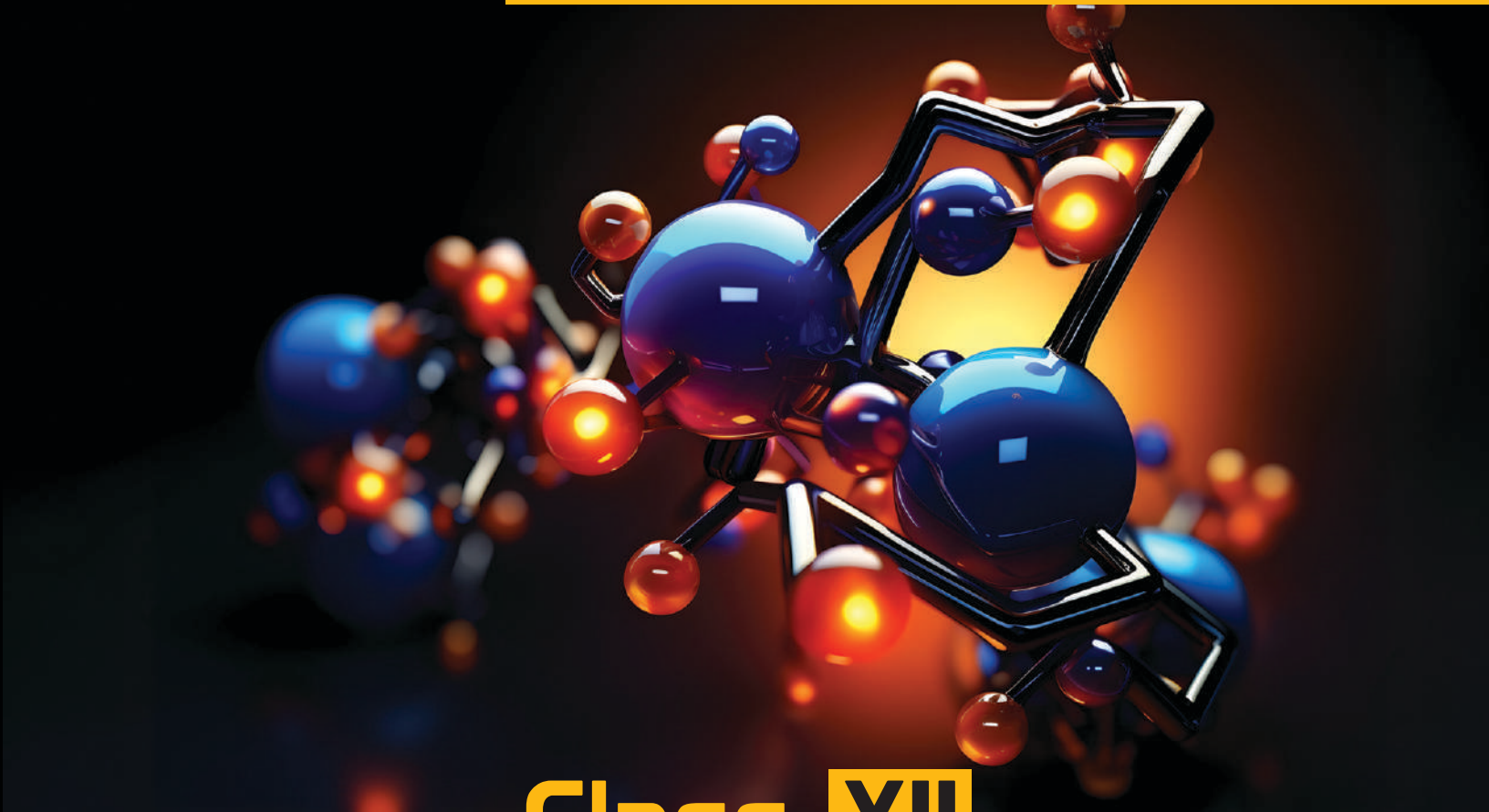

Class XII

CHEMISTRY

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