PRACHAND NEET

ONE SHOT

Physics

UNIT & MEASUREMENTS



By - Aayudh Yashlaha Sir

Topics *to be covered*

1. Part 1 – Ganji Chudail ka Swyamvar
2. Part 2 – Introduction
3. Part 3 – Rules of Dimensions
4. Part 4 – PUPPY DIMENSIONS AND PATTERNS
5. Part 5 – Errors, SF, Accuracy, Precision, Rounding Off
6. Part 6 – Interconversions
7. Part 7 – Vernier Caliper
8. Part 8 – Theory & AR Based Question
9. Part 9 – PUPPY POINTS



PRACHAND SERIES

TELEGRAM CHANNEL

@PW_YAKEENDROPPER

S#03



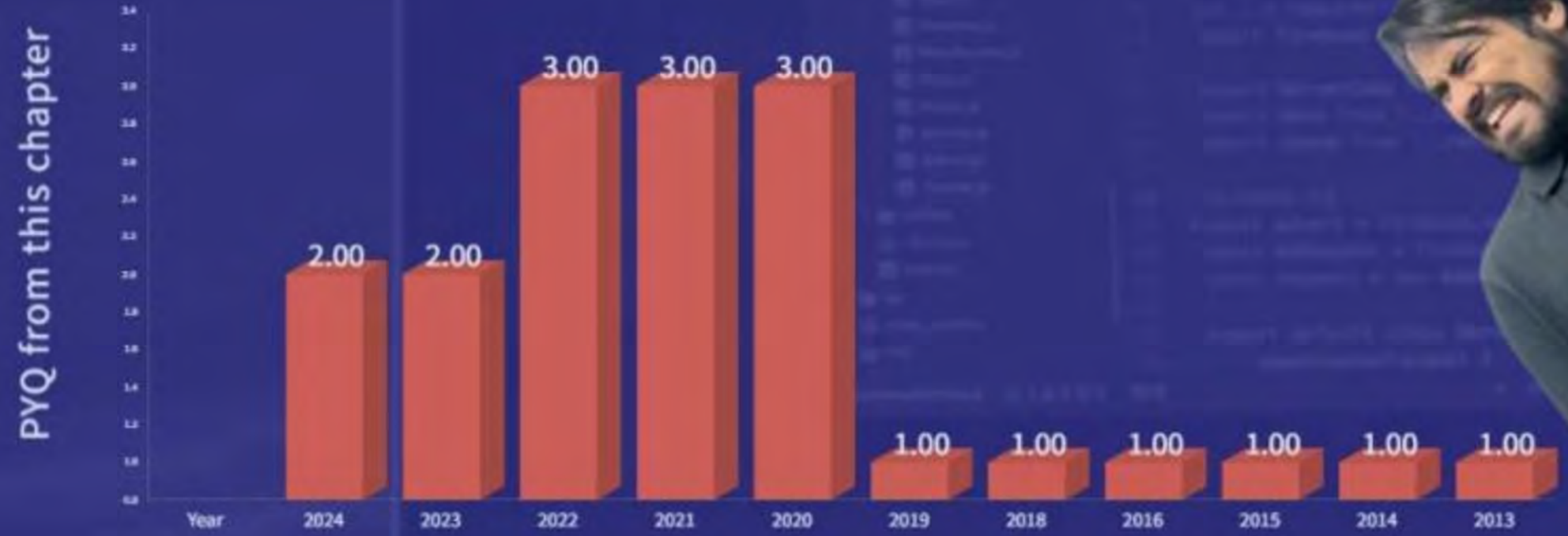
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NEET SYLLABUS

- Units of measurements
- System of Units - S I Units, fundamental and derived units
- Least count
- Significant figures
- Errors in measurements
- Dimensions of Physics quantities
- Dimensional analysis and its applications.
- Vernier calipers-its use to measure the internal and external diameter and depth of a vessel.
- Screw gauge-its use to determine thickness/diameter of thin sheet/wire

NEET SYLLABUS

Brofessor Analysis





Part 1 – Ganji Chudail ka Swyamvar



Canditate 1 – Munjya – (Suitable Size, well – defined, must not change with time)





Canditate 2 – Dark Lord

Changes Random ×





Part 2 – Introduction

Units

The reference standard used to measure the physical quantities is called the unit.

PROPERTIES OF UNITS

- The unit should be of some suitable size
- The unit must be well-defined
- The unit should be easily reproducible, i.e., it should not change with place
- The unit must not change with time
- The unit should not change with physical conditions like temperature, pressure, etc.
- The unit must be easily comparable experimentally with similar physical quantities.

DIMENSION ANALYSES

$$\text{velocity} = \frac{\text{Length}}{\text{Time}} = \frac{L}{T} = [LT^{-1}]$$

A method of analysis in which physical quantities are expressed in terms of their fundamental dimensions

The dimensions of a physical quantity are the power to which the units of base quantities are raised to represent a derived unit of that quantity.

Note

- A dimensionless quantity ~~can~~ may have unit (Angle and Solid Angle)
- A unitless quantity cannot have any dimensions

$$a = \frac{\text{length}}{\text{time}^2} = \frac{L}{T^2} = [LT^{-2}]$$

TYPES OF UNIT

- **Fundamental Units** ✓✓ (MLTCALTx)
  - Mass (kilogram) M → ❤ kilogram (mass) (Only fundamental unit to have prefix)
  - Length (meter) L
  - Time (second) T
  - Current (ampere) C
  - Amount of substance (mole) A
  - Luminous intensity (candela) L
  - Temperature (kelvin) T or K or θ

★ Condition for Fundamental (Ganji Planet)
Koi bhi Fundamental unit bachi units se nahi ban sakti Eg → (Length, time, velocity) ✗
$v = \frac{\text{length}}{\text{time}}$ ✗
Eg → (Mass, time, velocity) ✓✓

- **Derived Units** ✓✓
- **Supplementary Units**

Dimensionless units known as supplementary

- Angle (radian)
- Solid angle (steradian)

] Dimensionless but units ✓

QUESTION-01

(Ganji Planet)

Difficulty : ~~Easy~~ Hard

Which of the following sets cannot enter into the list of fundamental quantities in any system of units?

(HCV OBJECTIVE I)

1. length, mass and velocity ✓
2. ~~length, time and velocity~~ $v = \frac{l}{t}$
3. mass, time and velocity
4. length, time and mass

Difficulty : Easy

QUESTION-02

The units that are used for the fundamental physical quantities are called

[NCERT Based]

1. systems of unit ×
2. base units ✓
3. derived units
4. All of these

❤ Fundamental → Base Unit

❤ System of Units → Base / Fundamental & Derived

Difficulty : Easy

QUESTION-03

The system of units is a complete set of

[NCERT Based]

1. base units only
2. derived units only
3. both base units and derived units
4. CGS system

Difficulty : Easy

QUESTION-04

In International System of units, there are seven base quantities whose units are defined. Which physical quantity has a prefix with its unit? [NCERT Based]

1. Mass (kilo gram) ❤
2. Thermodynamic temperature
3. Luminous intensity
4. Amount of substance

Difficulty : Easy

QUESTION-05

Which one of the following physical quantities is not a fundamental quantity?

[NCERT Based]

1. Luminous intensity
2. Thermodynamic temperature
3. Electric current
4. Work

NU

Measure = N U

N → Number, U → Unit

$$[\text{length} = \underset{n=5}{5}\ \underset{u=km}{km}] = [\underset{n=5000}{5000}\ \underset{u=meter}{m}]$$

Interconversion

$N_1U_1 = N_2U_2$

→ Last part

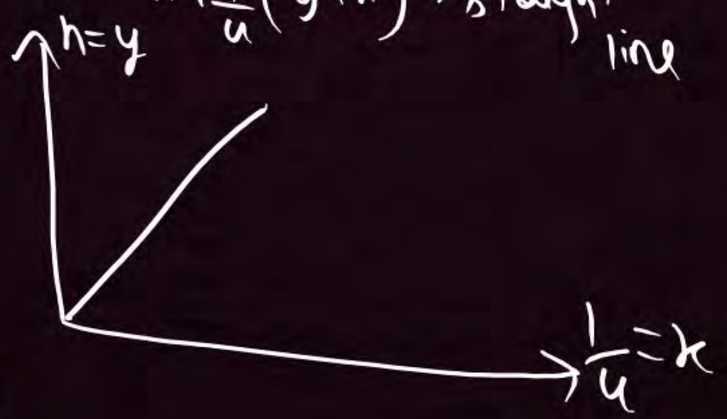
❤ $NU \Rightarrow$ constant ✓

Graphs nu = constant.

$\left(n \propto \frac{1}{u}\right)$ → Hyperbola



$n \propto \frac{1}{u}$ $(y \propto x)$ → straight line





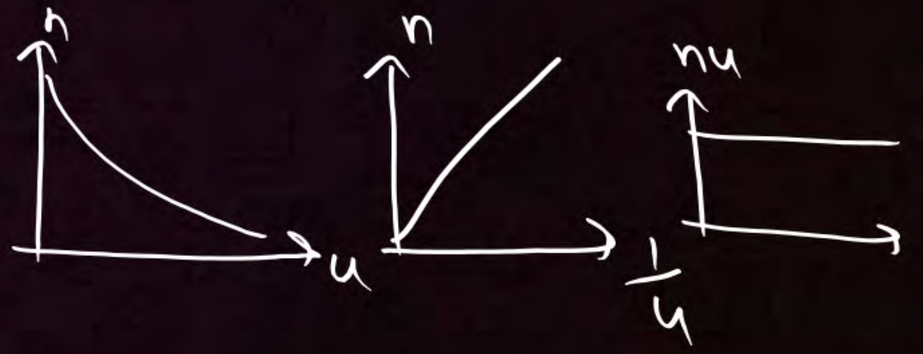
Difficulty : Medium

QUESTION-06

A physical quantity is used, and the result is expressed as nu where u is the unit used, and n is the numerical value. If the result is expressed in various units, then

(HCV OBJECTIVE I)

1. $n \propto$ size of u
2. $n \propto u^2$
3. $n \propto \sqrt{u}$
4. $n \propto \frac{1}{u}$



Difficulty : Medium

QUESTION-07

A dimensionless quantity

(HCV OBJECTIVE I)

1. never has a unit,
2. always has a unit,
3. may have a unit,
4. does not exist.

QUESTION-08

Telegram

Difficulty : Medium

HW.

A unitless quantity

(HCV OBJECTIVE I)

1. never has a non zero dimension,
2. always has a non zero dimension,
3. may have a non zero dimension,
4. does not exist.

❤ Non zero dimension
⇒ dimensionless

QUESTION-09

Difficulty : Hard

Theory

Choose the incorrect statement(s):

(HCV OBJECTIVE II)

1. All quantities may be represented dimensionally in terms of the base quantities.
2. A base quantity cannot be represented dimensionally in terms of the rest of the base quantities.
3. The dimension of a base quantity in other base quantities is always zero.
4. The dimension of a derived quantity is never zero in any base quantity.

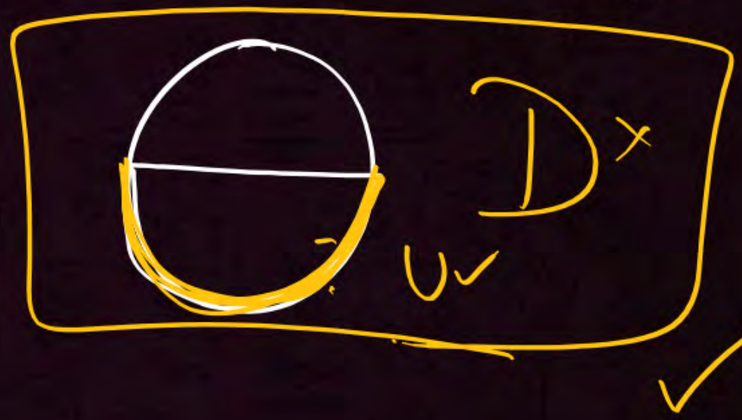
velocity $= [M^0 L T^{-1}]$

Difficulty : Medium

QUESTION-10

Plane angle and solid angle have: [2022]

1. Both units and dimension
2. Units but no dimensions
3. Dimensions but no units
4. No units and no dimensions



System of units

System	Length	Mass	Time
F.P.S.	foot	pound	second
C.G.S.	centimetre	gram	second
M.K.S.	metre	kilogram	second

P.L.S Bmeter Barudgram Second

❤ FPS, CGS, MKS
↳ Same unit (second) - Time

Difficulty : Easy

QUESTION-11

Which of the following physical quantities has same unit in all the three systems of units?

[NCERT Based]

1. Mass
2. Length
3. Time
4. None of these

QUESTION-12

Soln $x = M^a L^b T^c$

$\left(M^a = \frac{x}{L^b T^c}\right)$ | if $a = 0$, $x = L^b T^c$

Difficulty : ~~Hard~~ Yodha

Suppose a quantity x can be dimensionally represented in terms of M, L and T, that is, $[x] = M^a L^b T^c$. The quantity mass *(HCV OBJECTIVE I)*

1. can always be dimensionally represented in terms of L, T and x, ✗ ($a = 0$)
2. can never be dimensoinally represented in terms of L, T and x, ✗
3. may be represented in terms of L, T and x if $a = 0$ ✗
4. may be represented in terms of L, T and x if $a \neq 0$ ✓

PUPPY POINTS-1 Units & Dimensions

Introduction

7 Fundamental

MLT CALT

Mass kg → ☆ (prefix)

Length m

Time sec → ☆ (same in all system)

Current Ampere

Amount of substance mole

Luminous Intensity candela

Temperature Kelvin

2 Supplimentary

[Angle radian
Solid Angle steradian]

↳ Dimensionless (Unit ✓)

Unit → Suitable size, well defined, reproducible experimental, not change with T, P, time.

NU = constant



Part 3 – Rules of Dimensions

RULE 1 – Only same dimensions can be added subtracted or equated

RULE 2 – Any dimensions can be multiplied or divided

RULE 3 – Value inside mathematical function like exponent, logarithm, sin, cos ,etc. must be dimnensionless

$a^{(y)}$ $\log(y)$ $\sin(y)\cos(y)$

PUPPY 1 – (+, - ,=) ko (=) bana do

PUPPY 2 – sin(y), log(y), $a^{(y)}$, (y) ko 1 bana do

$P \pm Q \pm R$

Difficulty : Easy

QUESTION-14

If P, Q, R are physical quantities, having different dimensions, which of the following combinations can never be a meaningful quantity? [NCERT Based]

(Finding Bawaseer)

Bawaseer

1. $\frac{P-Q}{R}$
2. $PQ - R$
3. $\frac{PQ}{R}$
4. $\frac{PR - Q^2}{R}$

3.1 Direct add/ subtract

Difficulty : Easy

QUESTION-15

If $x = at + bt^2$, where x is the distance travelled by the body in kilometres while t is the time in seconds, then the units of b is: [1989]

1. km/s
2. kms
3. km/s^2
4. kms^2

$x = at + bt^2$

$km = a\,sec + b\,sec^2$

$km = a\,sec = b\,sec^2$

$km = b\,sec^2$

$b = \frac{km}{sec^2}$

QUESTION-16

Difficulty : Medium

☆ Pressure = $P = ML^{-1}T^{-2}$
Volume = $V = L^3$
$V^2 = L^6$

An equation is given here $\left(P + \frac{a}{V^2}\right) = b\frac{\theta}{v}$ where P = Pressure, V = Volume and θ = Absolute temperature. If a and b are constants, the dimensions of a will be:

[1996]

$\left(P + \frac{a}{V^2}\right)$

$P = \frac{a}{V^2}$

$a = PV^2$

$a = [ML^{-1}T^{-2}]\ L^6$

$= ML^5T^{-2}$

Maths mahna

$x^a x^b = x^{a+b}$

$L^{-1} L^6 = L^{-1+6} = L^5$

1. $[ML^{-5}T^{-1}]$
2. $[ML^5T^1]$
3. $[ML^5T^{-2}]$ ✓
4. $[M^{-1}L^5T^2]$

QUESTION-17

$$\left[\begin{array}{l} P = ML^{-1}T^{-2} \\ V = L^3 \\ V^3 = L^9 \end{array}\right]$$ Hint

Difficulty : ~~Medium~~ Hard

The equation of state of a gas is given by $\left(p + \frac{a}{V^3}\right)(V - b^2) = cT$ where P, V, T are pressure, volume and temperature respectively, and a, b, c are constants. The dimensions of a and b are respectively

[NCERT Based]

1. $[ML^8T^{-2}]$ and $[L^{3/2}]$
2. $[ML^5T^{-2}]$ and $[L^3]$
3. $[ML^5T^{-2}]$ and $[L^6]$
4. $[ML^6T^{-2}]$ and $[L^{3/2}]$

$\left(P + \frac{a}{V^3}\right)$ | $V - b^2$

$P = \frac{a}{V^3}$ | $V = b^2$

$a = PV^3$ | $L^3 = b^2$

$a = [ML^{-1}T^{-2}][L^9]$ | $b = L^{3/2}$

$a = ML^8T^{-2}$

Maths Mama

$x^a x^b = x^{a+b}$

$L^{-1}L^9 = L^{-1+9} = L^8$

3.2 Upon me + or −

$$a = b + \frac{c}{t+d}$$

Concept

(I) How to solve:

$(t+d) \longrightarrow t = d$ ✓

(II) Equation me dono me se ek rakh do

$$a = b + \frac{c}{t}$$

L

↓

$$x = bt + \frac{c}{d+T^3}$$

(I) $d + T^3$

$d = T^3$

(II) $x = bt + \frac{c}{T^3}$ ✓

$[v = LT^{-1}]$ Hint

Difficulty : Hard

QUESTION-18

The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constants. The dimensions of a, b and c are respectively: [2006]

1. $[LT^{-2}]$, $[L]$ and $[T]$
2. $[L]$, $[T]$ and $[LT^2]$
3. $[L^2T^2]$, $[LT]$ and $[L]$
4. $[L]$, $[LT]$ and $[T^2]$

(I) $v = at + \frac{b}{t+c}$

$t + c$

$c = T$

(II) $v = at = \frac{b}{T}$

$\frac{L}{T} = aT$

$\frac{L}{T^2} = a$

$\frac{L}{T} = b$

$b = L$

3.3 Exponents

$e^{(\ )}$ $\quad$ $a^{(\ )}$

$e^{\omega t}$

Concept

e^{y} ⟶ then $y \rightarrow$ dimensionless

$[y = 1]$ ✓

ϕ $e^{\omega T}$

$\omega T = 1$

$\omega = \frac{1}{T} = [T^{-1}]$ ✓

Difficulty : Medium

QUESTION-19

The time dependence of a physical quantity p is given by $p = p_0 \exp(-\alpha t^2)$, where α is constant and t is the time. The constant α: [1993]

1. Is dimensionless
2. Has dimensions $[T^{-2}]$
3. Has dimensions $[T^2]$
4. Has dimensions of p

$P = P_0 e^{(-\alpha t^2)}$

Concept $e^{(y)}$ $(y=1)$

$\alpha t^2 = 1$

$\alpha = \frac{1}{T^2}$

$\alpha = [T^{-2}]$

3.3 sin cos log

Concept

$\sin y$, $\cos y$, $\log y$

$y \longrightarrow$ Dimensionless

$[y = 1]$ ✓

Time Length

$\sin(\omega t - kx)$

$\omega t - kx = 1$

$\omega t = kx = 1$

$\omega t = 1 \qquad kx = 1$

$\omega = \frac{1}{T} \qquad k = \frac{1}{x} = \frac{1}{L}$

$(\omega = T^{-1} \qquad k = L^{-1})$ ✓

Difficulty : Medium

QUESTION-20

Which of the following relations for the displacement of a particle undergoing simple harmonic motion is not correct dimensionally, a is in meters, T and t are in seconds, ω is in sec^{-1}

[NCERT Based]

1. $y = a \sin \frac{2\pi t}{T}$

2. $y = a \cos \omega t$

3. $y = \frac{a}{T} \sin\left(\frac{t}{a}\right)$

4. $y = a\sqrt{2}\left(\sin \frac{2\pi t}{T} + \cos \frac{2\pi t}{T}\right)$

Difficulty : Medium

QUESTION-21

The displacement of a progressive wave is represented by $y = A\sin(\omega t - kx)$ where x is distance and t is time. The dimensions of $\frac{\omega}{k}$ are same as those of

[NCERT Based]

1. velocity
2. wave number
3. wavelength
4. frequency

$\sin(\omega t - kx)$: ωt → 1, kx → 1

$\omega t = 1 \Rightarrow \omega = \frac{1}{t}$ (sec^{-1})

$kx = 1 \Rightarrow k = \frac{1}{x}$ ($\frac{1}{\text{m}}$)

$\frac{\omega}{k} = \frac{\left(\frac{1}{\text{sec}}\right)}{\left(\frac{1}{\text{m}}\right)} = \frac{\text{m}\times 1}{\text{sec}}$

$\frac{\omega}{k} = \frac{\omega}{\frac{1}{x}} = \frac{x}{t}$

Maths Mama

$\left(\frac{a/b}{c}\right) = \frac{ad}{bc}$

3.4 Merits of dimensions

To check the consistency of a dimensional equation (Check)

To derive the relation between physical quantities in physical phenomena ($v = LT^{-1}$)

To change units from one system to another (Interconversion)

3.5 Limitations of dimensions

It doesn't give information about the dimensional constant. $y = x$, $y = 3x$ ✗

The formula containing trigonometric function, exponential functions, logarithmic function, etc. cannot be derived. $x = A\sin\omega t$

It gives no information about whether a physical quantity is a scalar or vector.

- A dimensionally correct equation may or may not be correct
- A dimensionally incorrect equation is always incorrect

Difficulty : Medium

QUESTION-22

Choose the incorrect statement(s):

(HCV OBJECTIVE II)

1. A dimensionally correct equation may be correct.
2. A dimensionally correct equation may be incorrect.
3. A dimensionally incorrect equation may be correct.
4. A dimensionally incorrect equation may be incorrect.

QUESTION-23

Difficulty : Hard

HW

Which one of the following statements is incorrect? [NCERT Based]

1. Direct and indirect methods are used for the measurement of physical quantities.
2. Scientific notation and the prefixes are used to simplify numerical computation.
3. A dimensionally correct equation need not be a correct equation.
4. The SI units is based on six base units

PUPPY POINTS-1 Units & Dimensions

Introduction

7 Fundamental

MLT CALT

Mass kg → ☆ (prefix)

Length m

Time sec → ☆ (same in all system)

Current Ampere

Amount of substance mole

Luminous Intensity candela

Temperature Kelvin

2 Supplimentary

[Angle radian
Solid Angle steradian]

↳ Dimensionless (Unit ✓)

Unit → Suitable size, well defined, reproducible experimental, not change with T, P, time.

NU = constant



Rules

+, −, = → =

$\sin(y), \log(y), e^{(y)} \rightarrow [y = 1]$

Dimensionally correct may/may not be correct ✓

Dimensionally incorrect must be incorrect ✓

-1

Part 4 – PUPPY DIMENSIONS AND PATTERNS

PUPPY PATTERN 1 – Dimensionless

PUPPY PATTERN 2 – Mechanics Core

PUPPY PATTERN 3 – Rotational Dimensions

PUPPY PATTERN 4 – Pattern in Electro-Magnetism

PUPPY PATTERN 5 – Same Dimension

PUPPY PATTERN 5 – Thermal

PUPPY PATTERN 1 – Dimensionless

- Angle
- Solid angle

→ Unit ✓

- Trigonometric ratios
- Exponential
- Logarithmic

Maths ✗

- Relative density
- Relative permittivity
- Relative permeability
- Dielectric constant
- Magnetic Susceptibility
- Coefficient of friction → μ
- Poisson's Ratio → x
- Strain → $\frac{\Delta l}{l}$ x
- Refractive Index → μ x

No unit

Relative velocity ✓ Dimension

Difficulty : Easy

QUESTION-24

Which of the following is a dimensional constant? [1995]

1. Relative density
2. Gravitational constant
3. Refractive index
4. Poisson's ratio.

DIMENSIONLESS

- Angle
- Solid angle
- Trigonometric ratios
- Exponential
- Logarithmic
- Relative density
- Relative permittivity
- Relative permeability
- Dielectric constant
- Magnetic Susceptibility
- Coefficient of friction
- Poisson's Ratio
- Strain
- Refractive Index

PUPPY PATTERN 2 – Mechanics Core

- Mass = M
- Length = L
- Time = T
- Velocity = speed = LT^{-1}
- Acceleration (m/s^2) = LT^{-2}
- Force = $ma = MLT^{-2}$
- Pressure = Energy/Volume = Force/Area = Y = B = G = $[ML^{-1}T^{-2}]$
- Energy = Work = Torque = $F \cdot x = [ML^2T^{-2}]$
- Power = $\frac{\text{Energy}}{\text{time}} = \frac{ML^2T^{-2}}{T} = [ML^2T^{-3}]$
- Intensity = $\frac{\text{Power}}{\text{Area}} = \frac{ML^2T^{-3}}{L^2} = MT^{-3}$

- G =
- h =
- η =

$P_r = \frac{\text{Force}}{\text{Area}} = \text{Stress} = Y = B = G = \frac{\text{Energy}}{\text{Volume}} = \text{Energy Density} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0}$

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

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$ ✓
4. $E = [M^1L^2T^{-2}]$ ✓
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$ ✓
7. $P = [M^1L^2T^{-3}]$

$G = [M^{-1}L^3T^{-2}] \rightarrow$ 10 times ✓

η (viscocity) $= [M^1L^{-1}T^{-1}]$ ✓

h (Plank) = Energy$t = [ML^2T^{-1}]$ ✓

M, L, T

$v = LT^{-1}$

$a = LT^{-2}$

- $F = MLT^{-2}$
- $E = \text{Work} = \text{torque} = ML^2T^{-2}$.
- $P_r = ML^{-1}T^{-2} \longrightarrow = P_r = \frac{F}{A} = \frac{E}{V} = \text{Stress} = Y = \beta = G = \mathcal{E} \cdot D \cdot = \left(\varepsilon_0 E^2 = \frac{B^2}{\mu_0}\right)$ ✓

(Force ka L lag gya)

$\text{Power} = E/t$

$\text{Intensity} = P/\text{Area}$ (MT^{-3})

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

$\eta = ML^{-1}T^{-1}$

$h = ML^2T^{-1}$

//

Difficulty : Easy

QUESTION-25

The dimensions $ML^{-1}T^{-2}$ may not correspond to

(1) Force per unit Area $= \frac{F}{A}$

(2) linear momentum ×

(3) pressure ✓

(4) energy per unit volume. ✓

(HCV OBJECTIVE II)

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$
7. $P = [M^1L^2T^{-3}]$

Difficulty : Medium

QUESTION-26

If the dimensions of a physical quantity are given by $M^aL^bT^c$, then the physical quantity will be [2009]

1. velocity if $a = 1, b = 0, c = -1$
2. acceleration if $a = 1, b = 1, c = -2$
3. force if $a = 0, b = -1, c = -2$
4. pressure if $a = 1, b = -1, c = -2$

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$

Difficulty : Easy

QUESTION-28

The dimensions of universal gravitational constant are [2004, 1992]

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

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

1. $\eta = [M^1 L^{-1} T^{-1}]$
2. $G = [M^{-1} L^3 T^{-2}]$
3. $F = [M^1 L^1 T^{-2}]$
4. $E = [M^1 L^2 T^{-2}]$
5. $h = [M^1 L^2 T^{-1}]$
6. $Pr = [M^1 L^{-1} T^{-2}]$

Difficulty : Easy

QUESTION-29

HW

Which of the following has the dimensions of pressure? [1994, 1990]

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

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$

Difficulty : Easy

QUESTION-30

According to Newton, the viscous force acting between liquid layers of area A and velocity gradient $\Delta v/\Delta Z$ is given by $F = -\eta A \frac{\Delta v}{\Delta Z}$, where η is constant called coefficient of viscosity. The dimensional formula of η is [1990]

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

$\eta = M^1 L^{-1} T^{-1}$

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$

Difficulty : Easy

QUESTION-31

Turpentine oil is flowing through a tube of length l and radius r. The pressure difference between the two ends of the tube is P. The viscosity of oil is given by $\eta = \frac{P(r^2 - x^2)}{4vl}$ where v is the velocity of oil at a distance x from the axis of the tube. The dimensions of η are [1993]

1. $[M^0 L^0 T^0]$
2. $[MLT^{-1}]$
3. $[ML^2 T^{-2}]$
4. $[ML^{-1} T^{-1}]$

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$

Difficulty : Easy

QUESTION-32

If E and G respectively denote energy and gravitational constant, then $\frac{E}{G}$ has the dimensions of:

[2021]

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

$$\frac{E}{G} = \frac{ML^2T^{-2}}{M^{-1}L^3T^{-2}}$$

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

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$

PUPPY POINTS-1 Units & Dimensions

Introduction

7 Fundamental

MLT	CALT	
Mass	kg	☆ (prefix)
Length	m	
Time	sec	☆ (same in all system)
Current	Ampere	
Amount of substance	mole	
Luminous Intensity	candela	
Temperature	Kelvin	

2 Supplimentary

- Angle — radian
- Solid Angle — steradian

↳ Dimensionless (Unit ✓)

Unit → Suitable size, well defined, reproducible experimental, not change with T, P, time.

NU = constant



Rules

$+, -, = \rightarrow =$

$\sin(y), \log(y), e^{(y)} \rightarrow [y = 1]$

Dimensionally correct may/may not be correct

Dimensionally incorrect must be incorrect

PP-1 Dimensionless

- Angle
- Solid Angle

→ Unit

- Trigonometric
- Exponents
- Logarithm
- Relative density
- Relative permittivity
- Relative permeability
- Dielectric
- Susceptibity
- Strain
- Coefficient of friction
- Poisson's Ratio
- Refractive Index

Unitless

PP-2 Mechanics

Mass-[M] Length[L] Time[T]

speed/velocity $\rightarrow LT^{-1}$

acceleration $\rightarrow LT^{-2}$

Force = ma $\rightarrow [MLT^{-2}]$

Energy = Work = Torque = $F \cdot x = [ML^2T^{-2}]$

Power = $\frac{E}{t} = [ML^2T^{-3}]$

Intensity = $\frac{P}{A} = [MT^{-3}]$

Momentum = Ft = Impulse = $mv = [MLT^{-1}]$

Pressure = $\frac{F}{A} = \frac{E}{V}$ = Stress = Y/B/G = $\varepsilon_0 E^2 = \frac{B^2}{\mu_0} = [ML^{-1}T^{-2}]$

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

$h = E \times t = [ML^2T^{-1}]$

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

PUPPY PATTERN 3 – Rotational Dimensions

- Torque = Energy = $[ML^2T^{-2}]$
- Frequency = $f = \frac{1}{T} = [T^{-1}]$
- Wavelength = $\lambda = [L]$
- Wavenumber = $\frac{1}{\lambda} = [L^{-1}]$
- Angular frequency = $\omega = [T^{-1}]$
- Angular wave number = $k = [L^{-1}]$
- Angular displacement = displacement/radius $= \frac{L}{L} = [\,] \rightarrow$ Dimensionless
- Angular velocity = velocity/Radius $= \frac{LT^{-1}}{L} = [T^{-1}]$
- Angular acceleration = acceleration/Radius $= \frac{LT^{-2}}{L} = [T^{-2}]$
- Angular momentum =
- Moment of Inertia = $ML^2 = [ML^2]$

Atomic Structure : Bohr model

Angular momentum $= \frac{nh}{2\pi}$

❤ $= [ML^2T^{-1}]$

$mvr = \frac{nh}{2\pi}$

$F = MLT^{-2}$

$E = ML^2T^{-2}$ ⟶ Work – Torque

$P_r = ML^{-1}T^{-2}$ — $\frac{F}{A}$ = Stress = $\frac{E}{V}$ = Y = B = G = Energy Density $= \left(\varepsilon_0 E^2 = \frac{B^2}{\mu_0}\right)$

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

$h = ML^2T^{-1}$ = Angular Momentum = mvr

$\eta = ML^{-1}T^{-1}$

Difficulty : Easy

QUESTION-27

The ratio of the dimensions of Planck's constant and that of moment of inertia is the dimensions of [2005]

$\left(\frac{h}{I}\right) = \left(\frac{ML^2T^{-1}}{ML^2}\right)$ = frequency = angular f =

1. time
2. frequency
3. angular momentum
4. velocity.

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$

Difficulty : Easy

QUESTION-33

hw

The dimensional formula of torque is

[1989]

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

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$

Difficulty : Easy

QUESTION-34

The dimensional formula of angular momentum is [1998]

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

1. $\eta = [M^1L^{-1}T^{-1}]$
2. $G = [M^{-1}L^3T^{-2}]$
3. $F = [M^1L^1T^{-2}]$
4. $E = [M^1L^2T^{-2}]$
5. $h = [M^1L^2T^{-1}]$
6. $Pr = [M^1L^{-1}T^{-2}]$

Current = A or I

PUPPY PATTERN 4 – Pattern in Electro-Magnetism

(Only for 12th & Droppers)

- Charge = [A T]
- ε_0 = Permittivity = $[M^{-1} A^{2} L^{-3} T^{4}]$
- μ_0 = Permeability = $[M^{1} A^{-2} L^{1} T^{-2}]$
- $1/\sqrt{\varepsilon_0\mu_0}$ = speed → Speed = $\frac{1}{\sqrt{\varepsilon_0\mu_0}}$
- k(Coulomb's) = $1/\varepsilon_0$
- R = Resistor = $[M A^{-2} L^{2} T^{-3}]$
- C = T/R
- L = RT
- $\vec{E}$ (Electric Field) = F/q
- $\vec{B}$ (Magnetic Field) = F/qv

- Electric Flux = $\vec{E}$ Area
- Magnetic Flux = $\vec{B}$ Area

$\varepsilon_0\mu_0 = L^{-2}T^{2}$ $\sqrt{\frac{1}{\varepsilon_0\mu_0}} = \sqrt{\frac{L^2}{T^2}} = \frac{L}{T}$ = velocity ✗

$$\text{time} = RC = \frac{L}{R} = \sqrt{LC}$$

(Ganja Flux = Ganja Area)

1. $L = [M^1L^2T^{-2}A^{-2}]$
2. $R = [M^1L^2T^{-3}A^{-2}]$
3. $C = [M^{-1}L^{-2}T^4A^2]$
4. $E = [M^1L^1T^{-3}A^{-1}]$
5. $B = [M^1 \ldots\ldots T^{-2}A^{-1}]$
6. $\varepsilon = [M^{-1}A^2L^{-3}T^4]$
7. $\mu = [M^1A^{-2}L^1T^{-2}]$

M, L, T

velocity $= LT^{-1}$

$a = LT^{-2}$

❤ $F = MLT^{-2}$

❤ $E = ML^2T^{-2}$ = Work = torque

❤ $Pr = \frac{F}{A} = \frac{E}{V} = E \cdot D$ = stress = $Y = B = G = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = [ML^{-1}T^{-2}]$

$P_0 = E/t =$

$I = P_0/\text{Area} =$

$G = M^{-1}L^3T^{-2}$ ❤

h = Angular Momentum $= ML^2T^{-1}$ ❤

$\eta = M^1L^{-1}T^{-1}$ ❤

Charge $= AT$

❤ ε – permitivity – $M^{-1}A^2L^3T^4$

❤ μ – permeability – $M^1A^{-2}L^1T^{-2}$

❤ R – Resistor – $M^1A^{-2}L^2T^{-3}$

❤ Speed $= \frac{1}{\sqrt{\mu\varepsilon}}$ | Time $= RC = \frac{L}{R} = \sqrt{LC}$

❤ $\varepsilon_0 E^2 = \frac{B^2}{\mu_0}$ = Energy Density $= [ML^{-1}T^{-2}]$

k (Coulomb) $= 1/\varepsilon_0$

$\vec{E} = F/q$

$\vec{B} = F/qv$

Flux $B = B \cdot \text{Area}$

Flux $E = \vec{E} \cdot \text{Area}$

$C = R/T$

$L = RT$

Difficulty : Easy

QUESTION-35

Dimensions of resistance in an electrical circuit, in terms of dimension of mass M, of length L, of time T and of current I, would be [2007]

1. $[ML^2 T^{-2}]$
2. $[ML^2 T^{-1} I^{-1}]$
3. $[ML^2 T^{-3} I^{-2}]$
4. $[ML^2 T^{-3} I^{-1}]$

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

1. $L = [M^1 L^2 T^{-2} A^{-2}]$
2. $R = [M^1 L^2 T^{-3} A^{-2}]$
3. $C = [M^{-1} L^{-2} T^4 A^2]$
4. $E = [M^1 L^1 T^{-3} A^{-1}]$
5. $B = [M^1 \ldots\ldots T^{-2} A^{-1}]$
6. $\varepsilon = [M^{-1} A^2 L^{-3} T^4]$
7. $\mu = [M^1 A^{-2} L^1 T^{-2}]$

Difficulty : Medium

QUESTION-36

The dimensional formula of magnetic flux is [1999]

1. $[M^0 L^{-2} T^{-2} A^{-2}]$
2. $[ML^0 T^{-2} A^{-2}]$
3. $[ML^2 T^{-2} A^{-1}]$ ✓
4. $[ML^2 T^{-1} A^3]$

$= B \cdot Area$

$= \frac{F \cdot Area}{qv}$

$= \left(\frac{MLT^{-2}}{AT} \times L^2\right)$

1. $L = [M^1L^2T^{-2}A^{-2}]$
2. $R = [M^1L^2T^{-3}A^{-2}]$
3. $C = [M^{-1}L^{-2}T^4A^2]$
4. $E = [M^1L^1T^{-3}A^{-1}]$
5. $B = [M^1 \ldots\ldots T^{-2}A^{-1}]$
6. $\varepsilon = [M^{-1}A^2L^{-3}T^4]$
7. $\mu = [M^1A^{-2}L^1T^{-2}]$

Difficulty : Easy

QUESTION-37

The dimensional formula of permeability of free space μ_0 is [1991]

$[M^1 A^{-2} L^1 T^{-2}]$

1. $[MLT^{-2} A^{-2}]$
2. $[M^0 L^1 T]$
3. $[M^0 L^2 T^{-1} A^2]$
4. none of these.

1. $L = [M^1L^2T^{-2}A^{-2}]$
2. $R = [M^1L^2T^{-3}A^{-2}]$
3. $C = [M^{-1}L^{-2}T^4A^2]$
4. $E = [M^1L^1T^{-3}A^{-1}]$
5. $B = [M^1 \ldots\ldots T^{-2}A^{-1}]$
6. $\varepsilon = [M^{-1}A^2L^{-3}T^4]$
7. $\mu = [M^1A^{-2}L^1T^{-2}]$

Difficulty : Easy

QUESTION-38

The dimension $[MLT^{-2}A^{-2}]$ belong to the: [2022]

1. electric permittivity
2. magnetic flux
3. self inductance
4. magnetic permeability

$[M\ A^{-2}\ L\ T^{-2}]$

μ

1. $L = [M^1L^2T^{-2}A^{-2}]$
2. $R = [M^1L^2T^{-3}A^{-2}]$
3. $C = [M^{-1}L^{-2}T^4A^2]$
4. $E = [M^1L^1T^{-3}A^{-1}]$
5. $B = [M^1 \ldots\ldots T^{-2}A^{-1}]$
6. $\varepsilon = [M^{-1}A^2L^{-3}T^4]$
7. $\mu = [M^1A^{-2}L^1T^{-2}]$

PUPPY PATTERN 5 – Same Dimension

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{1}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0}$ = P = $\frac{F}{A}$ = Stress = E

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{1}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque = $[ML^2T^{-2}]$
4. Force x time = Impulse = Momentum = $mv = [MLT^{-1}]$
5. Energy x time = h = Angular Momentum = mvr = $[ML^2T^{-1}]$
6. Energy Density = $\left(\frac{\text{Energy}}{\text{Volume}}\right) = \varepsilon_0 E^2 = \frac{B^2}{\mu_0}$ = Pressure = $\frac{\text{Force}}{\text{Area}}$ = Stress = Coefficient of Elasticity (Y, B, η)

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

Difficulty : Medium

QUESTION-39

Dimensions of stress are: [2020]

Pressure

$ML^{-1}T^{-2}$

1. $[ML^2 T^{-2}]$
2. $[ML^0 T^{-2}]$
3. $[ML^{-1} T^{-2}]$
4. $[ML^0 T^{-2}]$

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-40

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

$\frac{1}{\sqrt{\mu\varepsilon}}$ → Speed = LT^{-1}

[Mains 2012, 2011]

1. $[L^{1/2}\,T^{-1/2}]$
2. $[L^{-1}\,T]$
3. $[LT^{-1}]$ ✓
4. $[L^{1/2}\,T^{1/2}]$

1. Time = RC = $\frac{L}{R}$ = $\sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V}$ = $\varepsilon_0 E^2$ = $\frac{B^2}{\mu_0}$ = P = $\frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-41

Dimensions of stress are

[NEET 2020]

1. $[ML T^{-2}]$
2. $[ML^2 T^{-2}]$
3. $[ML^0 T^{-2}]$
4. $[ML^{-1} T^{-2}]$

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-42

$R = \frac{F}{A} = E \cdot D = Y = B = G = \frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = [M L^{-1} T^{-2}]$ = stress

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

(1) energy density

(2) refractive index → unitless

(3) dielectric constant → unitless

(4) Young's modulus 5. magnetic field → $B = \frac{F}{vq}$

[2008]

1. 1 and 4 (1, 4 same; 2, 3 same)
2. 1 and 5
3. 2 and 4
4. 3 and 5

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-43

The dimensions of Planck's constant equals to that of [2001]

$h = \text{Energy} \times t = L = mvr = [ML^2T^{-1}]$

1. energy
2. momentum
3. angular momentum
4. power.

PUPPY

1. Time = $RC = \frac{L}{R} = \sqrt{LC}$
2. Speed of light = $c = = \frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-44

Which pair do not have equal dimensions? [2000]

1. Energy and torque
2. Force and impulse
3. Angular momentum and Planck's constant
4. Elastic modulus and pressure

1. Time = RC = $\frac{L}{R}$ = $\sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V}$ = $\varepsilon_0 E^2$ = $\frac{B^2}{\mu_0}$ = P = $\frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-45

The dimensions of impulse are equal to that of [1996]

1. pressure
2. linear momentum
3. force
4. angular momentum

1. Time = RC = $\frac{L}{R}$ = $\sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V}$ = $\varepsilon_0 E^2$ = $\frac{B^2}{\mu_0}$ = P = $\frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-46

Hw

Which of the following dimensions will be the same as that of time? [1996]

1. L/R
2. C/L
3. LC
4. R/L

1. Time = RC = $\frac{L}{R}$ = $\sqrt{LC}$
2. Speed of light = c = = $\frac{1}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V}$ = $\varepsilon_0 E^2$ = $\frac{B^2}{\mu_0}$ = P = $\frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-47

Hw

The dimension of $\frac{1}{2}\varepsilon_0 \vec{E}^2$, where ε_0 is permittivity of free space and E is electric field, is

[2010]

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

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-48

The dimensions of RC is

[1995]

$RC = \frac{L}{R} = \sqrt{LC} = t_{time}$

1. square of time
2. square of inverse time
3. time ✓
4. inverse time.

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-49

Of the following quantities, which one has dimensions different from the remaining three? [1998]

HW

1. Energy per unit volume
2. Force per unit area
3. Product of voltage and charge per unit volume
4. Angular momentum.

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-50

HW

The pair of quantities having same dimensions is

[NEET 2013]

1. Impulse and Surface Tension
2. Angular momentum and Work
3. Work and Torque
4. Young's modulus and Energy

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-51

If C and R denote capacitance and resistance, the dimensional formula of CR is

[1998]

1. $[M^0 L^0 T^1]$
2. $[M^0 L^0 T^0]$
3. $[M^0 L^0 T^{-1}]$
4. not expressible in terms of MLT.

1. Time = RC = $\frac{L}{R} = \sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = E

Difficulty : Medium

QUESTION-52

Which of the following pairs of physical quantities does not have same dimensional formula?

[NCERT Exemplar]

1. Work and torque.
2. Angular momentum and Planck's constant.
3. Tension and surface tension.
4. Impulse and linear momentum

1. Time = RC = $\frac{L}{R}$ = $\sqrt{LC}$
2. Speed of light = c = = $\frac{L}{\sqrt{\mu\varepsilon}}$
3. Energy = Work = Torque
4. Force x time = Impulse = Momentum
5. Energy x time = h = L = mvr
6. E.D. = $\frac{E}{V}$ = $\varepsilon_0 E^2$ = $\frac{B^2}{\mu_0}$ = P = $\frac{F}{A}$ = Stress = E

Pattern - 6 - Thermal

- Thermal Conductivity $= \frac{\text{Force}}{\text{time temperature}} = [MLT^{-3}\theta^{-1}]$

✓ Thermal Resistance $= \frac{\ell}{kA} = \frac{1}{\text{Conductivity} \times \text{length}} = [M^{-1}L^{-2}T^{3}\theta^{1}]$

$\frac{MLT^{-2}}{T\theta}$

$(MLT^{-3}\theta^{-1})$

PUPPY POINTS-1 Units & Dimensions

Introduction

7 Fundamental
MLTCALT
Mass kg → ☆ (prefix)
Length m
Time sec → ☆ (same in all system)
Current Ampere
Amount of substance mole
Luminous Intensity candela
Temperature Kelvin

2 Supplimentary
Angle radian
Solid Angle steradian
↳ Dimensionless (Unit ✓)

Unit → Suitable size, well defined, reproducible experimental, not change with T, P, time.

NU = constant



Rules

+, −, = → =

sin(y), log(y), $e^{(y)}$ → [y = 1]

Dimensionally correct may/may not be correct

Dimensionally incorrect must be incorrect

PP-1 Dimensionless

Angle, Solid Angle → Unit

Trigonometric
Exponents
Logarithm
Relative density
Relative permittivity
Relative permeability
Dielectric
Susceptibility
Strain
Coefficient of friction
Poisson's Ratio
Refractive Index

Unitless

PP-2 Mechanics

Mass-[M] Length[L] Time[T]

speed/velocity → LT^{-1}

acceleration → LT^{-2}

Force = ma → $[MLT^{-2}]$

Energy = Work = Torque = F.x = $[ML^2T^{-2}]$

Power = $\frac{E}{t}$ = $[ML^2T^{-3}]$

Intensity = $\frac{P}{A}$ = $[MT^{-3}]$

Momentum = Fxt = Impulse = mv = $[MLT^{-1}]$

Pressure = $\frac{F}{A}$ = $\frac{E}{V}$ = Stress = Y/B/G = $\varepsilon_0 E^2$ = $\frac{B^2}{\mu_0}$ = $[ML^{-1}T^{-2}]$

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

$h = E \times t = [ML^2T^{-1}]$

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

PP-3 Rotational

torque = ML^2T^{-2}

Frequency = $1/T$ = $[T^{-1}]$

Wavelength = L

wave number = $1/L$ = $[L^{-1}]$

Angular frequency ω = $[T^{-1}]$

Angular wave number k = $[L^{-1}]$

Angular displacement = θ/R = $[L^1]$

Angular velocity = V/R = $[T^{-1}]$

Angular acceleration = a/R = $[T^{-2}]$

Angular momentum = $\frac{mvx}{}$ = h = $[ML^2T^{-1}]$

Moment of Inertia → ML^2 = $[ML^2]$

PP-4

Charge = [AT]

$RC = L/R = \sqrt{LC}$ = time = [T]

$\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ = C = speed = $[LT^{-1}]$

Voltage = $\frac{Work}{q}$ = $\frac{ML^2T^{-2}}{AT}$

k (Coulomb's) = $1/\varepsilon$

Resistor = R = V/I = $[M^1A^{-2}L^2T^{-3}]$

Capacitor = RC → time

Inductor = L/R → time

permittivity = ε = $[M^{-1}A^2L^{-3}T^4]$

permeability = μ = $[M^1A^{-2}L^1T^{-2}]$

Electric field = F/q

Magnetic field = F/qv

PP-5 Patterns

Time = RC = L/R = $\sqrt{LC}$

Speed = $\frac{1}{\sqrt{\mu\varepsilon}}$

Energy = work = torque = ML^2T^{-2}

Fxt = Impulse = Momentum = mv = $[MLT^{-1}]$

Energy x t = h = L = mvr = ML^2T^{-1}

$\frac{E}{V} = \varepsilon E^2 = \frac{B^2}{\mu_0} = P = \frac{F}{A}$ = Stress = Y B G = $[ML^{-1}T^{-2}]$

Thermal conductivity $[MLT^{-3}\theta^{-1}]$

Thermal Resistance = $[M^{-1}L^{-2}T^3\theta]$

Hawa Hawai - Questions

→ Full Randomness

↳ Syllabus k Formula

↳ Nerd – Yodha

QUESTION-55

Ganji Planet

Difficulty : Hard

If momentum (p), area (A) and time (t) are taken to be fundamental quantities, then energy has the dimensional formula

[NCERT Exemplar]

1. $[p^1 A^{-1} t^{-1}]$
2. $[p^2 A^1 t^1]$
3. $[p^1 A^{1/2} t^1]$
4. $[p^1 A^{1/2} t^{-1}]$

$E = P^x A^y T^z$ ✗

Time = T

$A = L^2$ $\quad L = \sqrt{A}$

$P = mv$ $\quad m = \frac{P}{v} = \frac{P}{LT^{-1}}$

$E = ML^2T^{-2}$

$= \frac{P}{LT^{-1}} A T^{-2}$

$= P \frac{A}{\sqrt{A}} T^{-1}$

$= (P^1 A^{1/2} T^{-1})$

QUESTION-55

Energy $\propto \frac{\text{Momentum}^2}{\text{Mass}}$ → Hint

Difficulty : ~~Hard~~

YODHA

If momentum (p), area (A) and time (t) are taken to be fundamental quantities, then energy has the dimensional formula [NCERT Exemplar]

1. $[p^1 A^{-1} t^{-1}]$
2. $[p^2 A^1 t^1]$
3. $[p^1 A^{1/2} t^1]$
4. $[p^1 A^{1/2} t^{-1}]$

$E = \frac{p^2}{2m}$

$p = mv$

$p = m\frac{L}{T}$

$m = \frac{pT}{L}$

$E = \frac{p^2 L}{pT}$

$E = p L T^{-1}$

$A = L^2 \rightarrow L = A^{1/2}$

$E = p A^{1/2} T^{-1}$

QUESTION-56

Ganji Planet

Difficulty : Hard

If force [F], acceleration [A] and time [T] are chosen as the fundamental physical quantities. Find the dimensions of energy. [2021]

$\mathcal{E} = F \cdot L \rightarrow$ Energy/Work = Force · displacement

$A = \frac{L}{T^2}$

$L = AT^2$

$\mathcal{E} = FAT^2$

1. $[F][A][T^2]$
2. $[F][A][T^{-1}]$
3. $[F][A^{-1}][T]$
4. $[F][A][T]$

Difficulty : ~~Hard~~ Yodha

QUESTION-57

L

A physical quantity of the dimensions of length that can be formed out of c, G and $\frac{e^2}{4\pi\varepsilon_0}$ is [c is velocity of light, G is universal constant of gravitation and e is charge]:

[2017-Delhi]

$C = LT^{-1}$ — (1)

$G = M^{-1}L^3T^{-2}$ — (2)

$\frac{q^2}{\varepsilon_0} = \frac{A^2T^2}{M^{-1}A^3L^{-3}T^4T^{-2}}$

$\frac{e^2}{4\pi\varepsilon_0} = ML^3T^{-2}$ — (3)

1. $c^2\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$

2. $\frac{1}{c^2}\left[\frac{e^2}{G4\pi\varepsilon_0}\right]^{1/2}$

3. $\frac{1}{c^2}G\frac{e^2}{4\pi\varepsilon_0}$

4. $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$

Difficulty : ~~Hard~~ Yodha

QUESTION-57

A physical quantity of the dimensions of length that can be formed out of c, G and $\frac{e^2}{4\pi\varepsilon_0}$ is [c is velocity of light, G is universal constant of gravitation and e is charge]:

[2017-Delhi]

1. $c^2\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$
2. $\frac{1}{c^2}\left[\frac{e^2}{G4\pi\varepsilon_0}\right]^{1/2}$
3. $\frac{1}{c^2}G\frac{e^2}{4\pi\varepsilon_0}$
4. $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$

$L = C^x G^y \left(\frac{e^2}{4\pi\varepsilon_0}\right)^z$

$L = [LT^{-1}]^x [M^{-1}L^3T^{-2}]^y \left[\frac{A^2T^2}{M^{-1}A^2L^{-3}T^4}\right]^z$

(I) $C \to LT^{-1}$, $G \to M^{-1}L^3T^{-2}$, $\frac{e^2}{4\pi\varepsilon_0} = ML^3T^{-2}$ $\Rightarrow L$

(II) $G\frac{e^2}{4\pi\varepsilon_0} = M^{-1}L^3T^{-2} \times ML^3T^{-2} = L^6T^{-4}$

(III) $\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2} = L^3T^{-2}$

(IV) $\frac{1}{C^2}\left(G\frac{e^2}{4\pi\varepsilon_0}\right)^{1/2} = \frac{L^3T^{-2}}{L^2T^{-2}} = L$

Difficulty : Yodha

QUESTION-58

HW

Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length? [2016-II]

(1) $\times\sqrt{\frac{hc}{G}}$

(2) $\times\sqrt{\frac{Gc}{h^{3/2}}}$

(3) $\frac{\sqrt{hG}}{c^{3/2}}$

(4) $\sqrt{\frac{hG}{c^{5/2}}}$

(I)

$h = ML^2T^{-1}$

$c = LT^{-1}$

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

$hG = (ML^2T^{-1})(M^{-1}L^3T^{-2})$

Difficulty : Hard

QUESTION-59

hw//

energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be: [2015]

Surface Tension $= \frac{F}{L} = \frac{\text{Energy}}{\text{Area}}$

1. $[EV^{-1}T^{-2}]$
2. $[EV^{-2}T^{-2}]$
3. $[E^{-2}V^{-1}T^{-3}]$
4. $[EV^{-2}T^{-1}]$

Difficulty : ~~Hard~~ Yodha

nw

QUESTION-60

If dimension of critical velocity of liquid flowing through a tube are expressed as $v_0 \propto [\eta^x \rho^y r^z]$ where η, ρ and r are the coefficient of viscosity of liquid, density of liquid and radius of the tube respectively, then the values of x, y and z are given by:

[2015 - Re]

1. 1, 1, 1
2. 1, –1, –1
3. – 1, – 1, 1
4. – 1, – 1, – 1

Difficulty : Hard

QUESTION-61

If Force (F), Velocity (V) and Time (T) are taken as fundamental units, then the dimensions of mass are: [2014]

1. $[FV\ T^{-1}]$
2. $[F\ V^{-1}\ T^{-2}]$
3. $[F\ V^{-1}\ T^{-1}]$
4. $[F\ V^{-1}\ T]$

Difficulty : ~~Hard~~ Yodha.

QUESTION-63

P represents radiation pressure, c represents speed of light and S represents radiation energy striking per unit area per sec. The non-zero integers x, y, z such that $P^x S^y c^z$ is dimensionless are: [1992]

1. $x = 1, y = 1, z = 1$
2. $x = -1, y = 1, z = 1$
3. $x = 1, y = -1, z = 1$
4. $x = 1, y - 1, z = -1$

Difficulty : Hard

QUESTION-64

The frequency of vibration f of a mass m suspended from a spring of spring constant k is given by a relation $f = am^x k^y$; where a is a dimensionless constant. The values of x and y are: [1990]

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

PUPPY POINTS-1 Units & Dimensions

Introduction

7 Fundamental
MLTCALT
Mass kg → ☆ (prefix)
Length m
Time sec → ☆ (same in all system)
Current Ampere
Amount of substance mole
Luminous Intensity candela
Temperature Kelvin

2 Supplimentary
[Angle radian
Solid Angle steradian]
↳ Dimensionless (Unit ✓)

Unit → Suitable size, well defined, reproducible experimental, not change with T, P, time.

NU = constant



Rules

+, −, = → =

sin(y), log(y), $e^{(y)}$ → [y = 1]

Dimensionally correct may/may not be correct

Dimensionally incorrect must be incorrect

PP-1 Dimensionless

[Angle, Solid Angle] → Unit

[Trigonometric
Exponents
Logarithm
Relative density
Relative permittivity
Relative permeability
Dielectric
Susceptibility
Strain
Coefficient of friction
Poisson's Ratio
Refractive Index]

Unitless

PP-2 Mechanics

Mass-[M] Length[L] Time[T]

speed/velocity → LT^{-1}

acceleration → LT^{-2}

Force = ma → $[MLT^{-2}]$

Energy = Work = Torque = F.x = $[ML^2T^{-2}]$

Power = $\frac{E}{t}$ = $[ML^2T^{-3}]$

Intensity = $\frac{P}{A}$ = $[MT^{-3}]$

Momentum = Ft = Impulse = mv = $[MLT^{-1}]$

Pressure = $\frac{F}{A} = \frac{E}{V}$ = Stress = Y/B/G = $\varepsilon_0 E^2 = \frac{B^2}{\mu_0}$ = $[ML^{-1}T^{-2}]$

$G_1 = [M^{-1}L^3T^{-2}]$

$h = E \times t = [ML^2T^{-1}]$

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

PP-3 Rotational

torque = ML^2T^{-2}

Frequency = $1/T = [T^{-1}]$

Wavelength = L

wave number = $1/L = [L^{-1}]$

Angular frequency $\omega = [T^{-1}]$

Angular wave number $k = [L^{-1}]$

Angular displacement = $\theta/R = [L^1]$

Angular velocity = $V/R = [T^{-1}]$

Angular acceleration = $a/R = [T^{-2}]$

Angular momentum = $\underline{mvx} = h = [ML^2T^{-1}]$

Moment of Inertia → $ML^2 = [ML^2]$

PP-4

Charge = [AT]

$RC = L/R = \sqrt{LC}$ = time = [T]

$\frac{1}{\sqrt{\mu_0 \varepsilon_0}} = C$ = speed = $[LT^{-1}]$

Voltage = $\frac{Work}{q} = \frac{ML^2T^{-2}}{AT}$

k (Columb's) = $1/\varepsilon$

Resistor = R = V/I = $[M^1A^{-2}L^2T^{-3}]$

Capacitor = RC → time

Inductor = L/R → time

permittivity = $\varepsilon = [M^{-1}A^2L^{-3}T^4]$

permeability = $\mu = [M^1A^{-2}L^1T^{-2}]$

Electric field = F/q

Magnetic field = F/qv

PP-5 Patterns

time = RC = L/R = $\sqrt{LC}$

Speed = $\frac{1}{\sqrt{\mu\varepsilon}}$

Energy = work = torque = ML^2T^{-2}

Ft = Impulse = Momentum = mv = $[MLT^{-1}]$

Energy × t = h = L = mvr = ML^2T^{-1}

$\frac{E}{V} = \varepsilon E^2 = \frac{B^2}{\mu_0}$ = P = $\frac{F}{A}$ = Stress = Y B G = $[ML^{-1}T^{-2}]$

Thermal conductivity $[MLT^{-3}\theta^{-1}]$

Thermal Resistance = $[M^{-1}L^{-2}T^3\theta]$

Part 5 – Errors, SF, Accuracy, Precision, Rounding Off

Impossible.

1. Bina Pade NEET me acha Score lana (Except 2024)
2. Ganji Chudail k baal a jana //
3. Kutte ki puch sidhi ho Jana
4. Live class me shaadi.com khelna
5. Ek din me 30 ghante padhna
6. True Value of Physical Quantity measure ✓

$\Rightarrow$ [$L = 6\,cm$ (Measured)
$L = 6.0001\,cm$ (True value)]

$$\text{Error (+ve)} = |\text{True Value} - \text{Measured Value}|$$

$$= |6.001 - 6|$$

$$\text{Error} = 0.001$$

5.1 ERROR

❤️ Measured Value → Experiment or Instrument or Pratical
❤️ True value → Formula or Theoritical

The difference between the measured value of the physical quantity using a measuring device and the true value of the physical quantity obtained using a theoretical formula is termed as error in measurement of that physical quantity.

5.2 CLASSIFICATION OF ERROR

RS – PIT

1) Systemic Error: Errors in which can calculated value differentiates from true value in consistent way.

2) Random Errors: Errors which occur at random with respect to sign and size are called Random errors. ❤️ **Unpredictable** (NE=NE)

These occur due to unpredictable fluctuations in experimental conditions like temperature, voltage supply, mechanical vibrations, personal errors etc.

These errors can be removed by increasing sample of observations.

5.2 CLASSIFICATION OF ERROR (RS -PIT)

Systemic



Instrumental Error



Zero Error ✓

Technical Error



Personal Error



Difficulty : Easy

QUESTION-65

The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are: [2023]

1. Random errors
2. Instrumental errors
3. Personal errors
4. Least count errors

❤ How to reduce Random Error

$\Longrightarrow$ Increase Number of observation

$$N\mathcal{E} = N\mathcal{E}$$

Number × Error → Constant.

Difficulty : Easy

QUESTION-66

N ε N ε=?

Random error in 10 observations is 4. Find error in 200 observations.

$N\varepsilon = N\varepsilon$

$10 \times 4 = 200 \times \varepsilon$

$\varepsilon = \frac{10 \times 4}{200} = \frac{1}{5} = 0.2$

1. 2
2. 5
3. 0.2
4. 0.5

5.3 Measuring errors

ABSOLUTE ERROR

$|\text{Measured value} - \underline{\text{True Value}}| = \Delta a$ (+ve)

(a)

- Unit of Δa is same as a

RELATIVE ERROR $\left(\frac{\Delta a}{a}\right)$

- Unitless

PERCENTAGE ERROR $\left(\frac{\Delta a}{a} \times 100\%\right)$

- Unitless

$l = (50 \pm 0.02)\,m$

$\Delta a = 0.02\,m$

$l = (50 \pm 0.02\%)\,m$

$\frac{\Delta a}{a} \times 100\% = 0.02$

QUESTION-67

Difficulty : Hard

Lengthly

The intervals measured by a clock given the following readings: 1.25 s, 1.24 s, 1.27 s, 1.21 s and 1.28 s. What is the percentage relative error in the observations? [2020-Covid]

(1) 4%

(2) 1.6%

(3) 16%

(4) 2%

(I) $a_1 = 1.25 \quad a_2 = 1.24 \quad a_3 = 1.27 \quad a_4 = 1.21 \quad a_5 = 1.28$

(II) $a = \frac{a_1 + a_2 + a_3 + a_4 + a_5}{5} = \frac{6.25}{5} = 1.25$

$$\begin{array}{r} 1.25 \\ 1.24 \\ 1.27 \\ 1.21 \\ +\ 1.28 \\ \hline 6.25 \end{array}$$

(III) Error

$a_1 - a = 0$

$a_2 - a = 0.01$

$a_3 - a = 0.02$

$a_4 - a = 0.04$

$a_5 - a = 0.03$

(IV) $\Delta a_{avg} = \frac{0 + 0.01 + 0.02 + 0.04 + 0.03}{5}$

$= \frac{0.10}{5} = 0.02$

(V) $\frac{\Delta a}{a} \times 100\%$

$= \frac{0.02 \times 100}{1.25}$

$= \frac{2 \times 100}{125} 4 = \frac{8}{5}$

$= 1.6\%$

PUPPY POINTS - 2 - Errors & Instruments.

RS-PIT

Random - NE=NE

Systemic - Personal
Instrumental
Technique

☆ Zero is a type of Instrumental

5.4 RULES OF ERROR CALCULATION

RULE 1 – In addition/subtraction absolute errors are added

RULE 2 – In multiplication/division relative and percentage errors are added

RULE 3 – in exponents, Sir s niche utar do in relative and percentage errors

5.4 Addition/Subtraction

❤️ RULE 1 – In addition/subtraction absolute errors are added

Q $a = b + c$

I $b = 100 \pm 2$ $\quad \Delta b = 2$

$c = 80 \pm 1.$ $\quad \Delta c = 1$

II
$$a = b + c$$
$$= 100 + 80$$
$$= 180$$

III $\Delta a = \Delta b + \Delta c$

$\Delta a = 2 + 1 = 3$

IV $a = 180 \pm 3$

5.4 Addition/Subtraction

❤️ RULE 1 – In addition/subtraction absolute errors are added

Q $a = b - c$

I $b = 100 \pm 2$ $\quad \Delta b = 2$

$c = 80 \pm 1$ $\quad \Delta c = 1$

II $a = 100 - 80 = 20$

III $\Delta a = \Delta b + \Delta c$

$\Delta a = 2 + 1 = 3$

IV $a = 20 \pm 3$ ✓

5.4 Multiplication/Division

❤️ RULE 2 – In multiplication/division relative and percentage errors are added

Q $a = bc$ (I) $b = 100 \pm 2\%$ $c = 10 \pm 1\%$

(II) $a = bc$
$= 100 \times 10$
$= 1000$

(III) $\%\Delta a = \%\Delta b + \%\Delta c$
$= 2 + 1$
$= 3\%$

(IV) $a = (1000 \pm 3\%)$ ✓

Q $a = b/c$

(A) $10 \pm 2\%$

(B) $10 \pm 1\%$

(C) $10 \pm 3\%$ ✓

(D) $10 \pm 21\%$

$a = b/c$
$= \frac{100}{10} = 10$

$\%\Delta a = \%\Delta b + \%\Delta c$
$= 2\% + 1\%$
$= 3\%$

5.5 Exponents in error

❤️ RULE 3 – in exponents, Sir s niche utar do in relative and percentage errors

$$a = b^{7}$$

$$\frac{\Delta a}{a} = 7\,\frac{\Delta b}{b}$$

$$\%\Delta a = 7\,\%\Delta b$$

$$a = \frac{b^{3}\,c^{4}}{d^{2}\,x^{3/5}}$$

$$\%\Delta a = 3\,\%\Delta b + 4\,\%\Delta c + 2\,\%\Delta d + \frac{3}{5}\,\%\Delta x$$

Difficulty : Easy

QUESTION-68

If $Z = \frac{A^4 B^{1/3}}{CD^{3/2}}$ and ΔA, ΔB, ΔC and ΔD are their absolute errors in A, B, C and D respectively. The relative error in Z is

[NCERT Based]

1. $\frac{\Delta Z}{Z} = 4\frac{\Delta A}{A} + \frac{1}{3}\frac{\Delta B}{B} + \frac{\Delta C}{C} + \frac{3}{2}\frac{\Delta D}{D}$
2. $\frac{\Delta Z}{Z} = 4\frac{\Delta A}{A} + \frac{1}{3}\frac{\Delta B}{B} - \frac{\Delta C}{C} - \frac{3}{2}\frac{\Delta D}{D}$
3. $\frac{\Delta Z}{Z} = 4\frac{\Delta A}{A} + \frac{1}{3}\frac{\Delta B}{B} + \frac{\Delta C}{C} - \frac{3}{2}\frac{\Delta D}{D}$
4. $\frac{\Delta Z}{Z} = 4\frac{\Delta A}{A} + \frac{1}{3}\frac{\Delta B}{B} - \frac{\Delta C}{C} + \frac{3}{2}\frac{\Delta D}{D}$

Difficulty : Hard

QUESTION-70

The percentage error in the measurement of g is:

(Given that $g = \frac{4\pi^2 L}{T^2}$, L = (10 ± 0.1) cm, T = (100 ± 1) s) [2022 Re]

1. 7%
2. 2%
3. 5%
4. 3%

$g = \frac{L}{T^2}$

$L = 10 \pm 0.1$ $\quad T = 100 \pm 1$

$\%\Delta L = \frac{\Delta L}{L} \times 100\% = \frac{0.1}{10} \times 100 = 1\%$

$\Delta\%T = \frac{\Delta T}{T} \times 100\% = \frac{1}{100} \times 100\% = 1\%$

$\Delta\%g = \Delta\% L + 2\Delta\%T$

$= 1\% + 2 \times 1\%$

$= 1 + 2$

$= 3\%$

Difficulty : Easy

QUESTION-71

In an experiment, the percentage of error occurred in the measurement of physical quantities A, B, C and D are 1%, 2%, 3% and 4% respectively. Then the maximum percentage of error in the measurement of X, where $X = \frac{A^2B^{1/2}}{C^{1/3}D^3}$ will be

$$\Delta\%X = 2\Delta\%A + \frac{1}{2}\Delta\%B + \frac{1}{3}\Delta\%C + 3\Delta\%D$$

[2019]

$$= 2\times 1\% + \frac{1}{2}\times 2\% + \frac{1}{3}\times 3\% + 3\times 4\%$$

$$= 2 + 1 + 1 + 12$$

$$= 16\%$$

1. $\left(\frac{3}{13}\right)\%$
2. 16%
3. -10%
4. 10%

Difficulty : Easy

QUESTION-72

HW

In an experiment four quantities a, b, c and d are measured with percentage error 1%, 2%, 3% and 4% respectively. Quantity P is calculated as follows $P = \frac{a^3 b^2}{cd}$. % error in P is: [2013]

1. 4%
2. 14%
3. 10%
4. 7%

Difficulty : Hard

QUESTION-73

HW

A student measures the distance traversed in free fall of a body, initially at rest in a given time. He used this data to estimate g, the acceleration due to gravity. If the maximum percentage errors in measurement of the distance d and the time t are e_1 and e_2 respectively, the percentage error in the estimation of g is: ($g = 2d/t^2$)

$g = \frac{d}{t^2}$ → e_1, → e_2

[2010 Mains]

1. $e_2 - e_1$
2. $e_1 + 2e_2$ ✓
3. $e_1 + e_2$
4. $e_1 - 2e_2$

Difficulty : Hard

QUESTION-74

If the error in the measurement of radius of a sphere is 2%, then the error in the determination of volume of the sphere will be: [2008]

1. 2%
2. 4%
3. 6%
4. 8%

$$\text{Volume} = \frac{4}{3}\pi r^3$$

$$\left[\Delta\%V = 3\Delta\%r\right]$$

$$= 3 \times 2\%$$

Difficulty : Medium

QUESTION-75

The error in measurement of radius of a sphere is 0.1% then error in its volume is: [1999]

1. 0.3%
2. 0.4%
3. 0.5%
4. 0.6%

Difficulty : Medium

QUESTION-77

Percentage errors in the measurement of mass and speed are 2% and 3% respectively. The error in the estimate of kinetic energy obtained by measuring mass and speed will be($K = \frac{1}{2} mv^2$) [1995]

1. 8%
2. 12%
3. 2%
4. 10%

QUESTION-69

Difficulty : Yodha



Volume $= \pi r^2 l$

A metal wire has mass $(0.4 \pm 0.002)\ g$, radius (0.3 ± 0.001) mm and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be : [2023]

1. 1.4%
2. 1.2%
3. 1.3%
4. 1.6%

(1) $m = 0.4 \pm 0.002$

$\Delta\%m = \frac{0.002}{0.4} \times 100 = \frac{1}{2}\%$

$r = 0.3 \pm 0.001$

$\Delta\%r = \frac{0.001}{0.3} \times 100\% = \frac{1}{3}\%$

$l = 5 \pm 0.02$

$\Delta\%l = \frac{0.02}{5} \times 100\% = \frac{2}{5}\%$

$\rho = \frac{\text{mass}}{\text{Volume}} = \frac{\text{mass}}{\pi r^2 l}$

$\Delta\%\rho = \Delta\%m + 2\,\Delta\%r + \Delta\%l$

$= \frac{1}{2} + 2 \times \frac{1}{3} + \frac{2}{5} = \frac{15+20+12}{30} = \frac{47}{30} = \frac{156}{100}$

$= 1.56\%$

Difficulty : ~~Yodha~~ Hard

QUESTION-76

HW

The density of a cube is measured by measuring its mass and length of its sides. If the maximum error in the measurement of mass and lengths are 3% and 2% respectively, the maximum error in the measurement of density would be:

[1996]

1. 12%
2. 14%
3. 7%
4. 9%

PUPPY POINTS - 2 - Errors & Instruments.

RS-PIT

Random - NE=NE

Systemic - Personal
Instrumental
Technique

☆ Zero is a type Instrumental

Rules Error

+/- use absolute error +

×/÷ use relative error +

$C=a\pm b$ $\Delta C=\Delta a+\Delta b$

$C=ab$ $\frac{\Delta C}{C}=\frac{\Delta a}{a}+\frac{\Delta b}{b}$

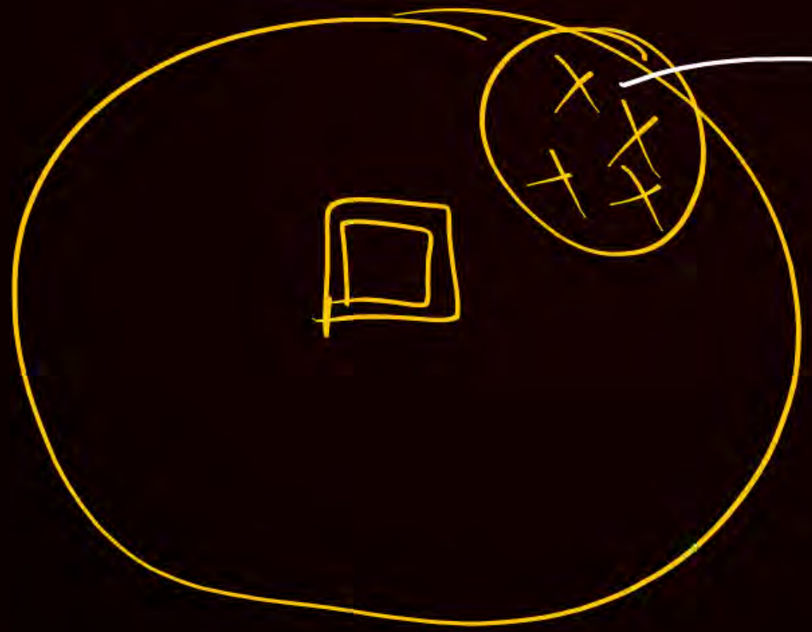
Always added (error)

$a=b^n$ $\frac{\Delta a}{a}=n\frac{\Delta b}{b}$



Accurate ✓ ~~Precise~~

(Average is correct)



Precise ✓ ~~Accurate~~

(Measured Values are nearby)



Accurate ✓

Precise ✓

5.6 ACCURACY AND PRECISION

Precision and accuracy are two ways that scientists think about error.

(average)

Accuracy refers to how close a measurement is to the true or accepted value.

Precision refers to how close measurements of the same item are to each other.

Precision is independent of accuracy.

Point ke jitnee baad jaoge, utna precise answer paoge

1-34 < 1-3412 < 1-3412112022



A ✗
P ✗



A ✓
P ✗



P ✓
A ✗



A ✓
P ✓

5.7 Rounding OFF

	Rule	Example
i	If the digit to be dropped is smaller than 5, then the preceding digit should be left unchanged.	(i) 7.32 is rounded off to 7.3 (ii) 8.94 is rounded off to 8.9
ii	If the digit to be dropped is greater than 5, then the preceding digit should be increased by 1	(i) 17.26 is rounded off to 17.3 (ii) 18.89 is rounded off to 11.9
iii	If the digit to be dropped is 5 followed by digits other than zero, then the preceding digit should be raised by 1	(i) 7.352, on being rounded off to first decimal becomes 7.4. (ii) 18.159 on being rounded off to first decimal, become 18.2
iv	If the digit to be dropped is 5 or 5 followed by zeros, then the preceding digit is not changed if it is even	(i) 3.45 is rounded off to 3.4 (ii) 8.250 is rounded off to 8.2
v	If the digit to be dropped is 5 or 5 followed by zeros, then the preceding digit is raised by 1 if it is odd	(i) 3.35 is rounded off to 3.4 (ii) 8.350 is rounded off to 8.4

dadu baap beta

2.3453 2

Round Off Upto 4 S.F. (Significant Figures)

① Baap dekhega bete ko (less than 5 - -)
chod ke bhaag jyaga = 2.345

2.345(7) 2.34553

② Baap dekhega bete ko (more than 5 - -)
naam rashan. kr diya (+1) = 2.346

③ 2.3455
exact 5
2.3485

baap odd +1 2.346

baap even ✗ 2.348

Difficulty : Easy

QUESTION-78

The numbers 2.745 and 2.735 on rounding off to 3 significant figures will give

[NCERT Exemplar]

1. 2.75 and 2.74
2. 2.74 and 2.73
3. 2.75 and 2.73
4. 2.74 and 2.74

2.745 → even → 2.74

2.735 → odd → 2.74

5.8 Rules for counting Significant Figure

(i) All the non-zero digits are significant. In 2.738 , the number of significant figures is 4.

(ii) All the zeroes between two non-zero digits are significant, no matter where the decimal point is, if at all. As examples, 209 and 3.002 have 3 and 4 significant figures respectively.

(iii) If the measurement of number is less than 1, the zero (es) on the right of decimal point and to the left of the first non-zero digit are non-significant. In 0.00807 , first three underlined zeroes are non-significant and the number of significant figures is only 3.

(iv) The terminal or trailing zero (es) in a number without a decimal point are not significant. Thus, $12.3 = 1230$ cm $= 12300$ mm has only 3 significant figures.

(v) The trailing zero (es) in number with a decimal point are significant. Thus, 3.800 kg has 4 significant figures.

(vi) A choice of change of units does not change the number of significant digits or figures in a measurement.

PUPPY SF → Chudail ka Hamla

SF

00230050000

00230050000

5 SF ✓

00232000000010

10 SF

Decimal

00232310.062366

11 SF

00230100

6 SF

0000100

3 SF

Difficulty : Easy

QUESTION-79

Which of the following statements is incorrect regarding significant figures?

[NCERT Based]

1. All the non-zero digits are significant.
2. All the zeros between two non-zero digits are significant.
3. The trailing zero(s) in a number without a decimal point are not significant.
4. The power of 10 is counted while counting the number of significant figures.

Difficulty : Easy

QUESTION-80

The number of significant figures in 0.06900 is

[NCERT Exemplar]

1. 5
2. 4
3. 2
4. 3

Difficulty : Easy

QUESTION-81

The respective number of significant figures for the numbers 6.320, 6.032, 0.0006032 are

[NCERT Based]

1. 3,4,8
2. 4,4,8
3. 4,4,4
4. 4,3, 4

5.9 Addition/Subtraction of SF

(i) When adding/subtracting, the answer should have the same number of decimal places as the limiting term. The limiting term is the number with the least decimal places.

SF after decimal

$$\begin{array}{r} 2.003 \\ +\ 823.5 \\ \hline 825.503 \end{array}$$

(4 SF) (1 SF)

825.5

(1 SF)

Q) 1.0001 + 21.222

(4 SF) (3 SF) ✓

(A) 22.2221 ✗

(B) 22.222 ✓

9

1.27923 (5 SF)

$+\ 1.11$ (2 SF)

2.38923

Round off

2.39

(A) 2.38923 ✗

(B) 2.38 ✗

(C) 2.39 ✓

Difficulty : Easy

QUESTION-82

The sum of the numbers 436.32, 227.2 and 0.301 in appropriate significant figures is

[NCERT Exemplar]

1. 663.821
2. 664
3. 663.8
4. 663.82

Difficulty : Easy

QUESTION-83

The diameter of a spherical bob, when measured with vernier callipers yielded the following values: 3.33 cm, 3.32 cm, 3.34 cm, 3.33 cm and 3.32 cm. The mean diameter to appropriate significant figures is: [2023-Manipur]

1. 3.328 cm
2. 3.3 cm
3. 3.33 cm
4. 3.32 cm

Difficulty : Medium

QUESTION-84

Taking into account of the significant figures, what is the value of $9.99\ \text{m} - 0.0099\ \text{m}$? [2020]

(1) 9.98 m

(2) 9.980 m

(3) 9.9 m

(4) 9.9801 m

5.9 Multiplication/Division of SF

(i) When multiplying/dividing, the answer should have the same number of significant figures as the limiting term. The limiting term is the number with the least number of significant figures.

→ Pure SF

$1.21 \times 1.1 = 1.331$

3 SF

2 SF

1.3 ✓

Q) $1.0 \times 1.0 \times 1.0$

(A) 1

(B) 1.0

(C) 1.00

(D) 1.000

Difficulty : Easy

QUESTION-85

The mass and volume of a body are 4.237 g and 2.5 cm^3 respectively. The density of the material of the body in correct significant figures is

[NCERT Exemplar]

$\rho = \frac{m}{V} = \frac{4.237}{2.5}$

4 S.F

2 S.F

1. 1.6948 g cm^{-3}
2. 1.69 g cm^{-3}
3. 1.7 g cm^{-3}
4. 1.695 g cm^{-3}

Difficulty : Easy

QUESTION-86

The area of a rectangular field (in m^2) of length 55.3 m and breadth 25 m after rounding off the value for correct significant digits is: [2020]

1. 14×10^2
2. 138×10^1
3. 1382
4. 1382.5

Area = 55.3 × 25

3 S.F

2 S.F

PUPPY POINTS - 2 - Errors & Instruments.

RS-PIT

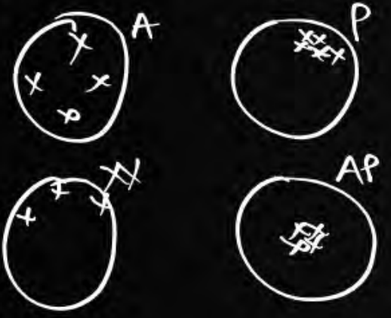
Random - NE=NE

Systemic - Personal
Instrumental
Technique

☆ Zero is a type of Instrumental

Accuracy → Average near true

Precision → Nearby values



Round off

odd S → +1

even S → same

Significant Figures

✗ 0 1000^ → 1

✓ 0.00 1000 0 ↘ 4

Absolute Error = Δa

Relative $\Delta a/a$

Percentage $\Delta a/a \times 100$?

Rules Error

+/− use absolute error

×/÷ use relative error

$C = a \pm b$ $\Delta C = \Delta a + \Delta b$

$C = ab$ $\frac{\Delta C}{C} = \frac{\Delta a}{a} + \frac{\Delta b}{b}$

Always added (error)

$a = b^n$ $\frac{\Delta a}{a} = n\frac{\Delta b}{b}$

Rules for S.F.

+/− Only after decimal

÷/× Full S.F.

Jo choto wo sahi

Part 6 – Interconversions

$$N_1U_1 = N_2U_2$$

Level 1

kilo = 1000

hecto = 100

deca = 10

deci = $\frac{1}{10}$

Centi = $\frac{1}{100}$

Milli = $\frac{1}{1000}$

$2\,km = x\,mm$

$N\ U \quad = N\ U$

$2 \times 1000 \times m = x \times \frac{1}{1000} m$

$x = 2000000$

Level-2

tera	10^{12}
giga	10^{9}
mega	10^{6}
kilo	10^{3}
milli	10^{-3}
micro(μ)	10^{-6}
nano	10^{-9}
pico	10^{-12}
femto/fermi	10^{-15}

Q

$8\ TL = x\ dL$

8 Tera Litre = x deci Liter.

$8 \times 10^{12}\ K = x\ \frac{1}{10}\ K$

$x = 8 \times 10^{13}$

Interconversions

Most important

Level 1

1 kilo = 1000

1 hecto = 100

1 deca = 10

Base unit

1 deci = 1/10

1 centi = 1/100

1 milli = 1/1000

Level 2

1 Tera = 10^{12}

1 Giga = 10^{9}

1 Mega = 10^{6}

1 kilo = 10^{3}

Base unit

1 milli = 10^{-3}

1 micro = 10^{-6}

1 nano = 10^{-9}

1 pico = 10^{-12}

1 fermi = 10^{-15}

Level - 3

- 1 Angstrom (Å) = 10^{-10} m
- 1 in = 2.54 cm
- 1 amu = 1.66×10^{-27} kg
- 1 hr = 3600 seconds
- 1 day = 86400 seconds
- 1 gm/ml = 10^{3} kg/m^3
- 1 N = 10^{5} dyne (CGS)
- 1 bar = 10^{5} Pa
- 1 J = 10^{7} erg (CGS)
- 1 cal = 4.18 J
- 1 hp = 746 kW
- 1 e = 1.6×10^{-19} C

Pure SYLLABUS k Interconversions LELO

Unit of Length:

1 A.U. (Astronomical Unit) = 1.49×10^{11} m (average distance between Earth and Sun)

1 ly (light year) = 9.461×10^{15} m (distance travelled by light in vacuum in one year)

1 Pc (parsec/parallectic second) = 3.08×10^{16} m (distance at which are of length 1 AU subtense an angle of 1 second at point)

1 a_0 (Bohr Radius) = 0.529 Å

1 meter = 100 cm = 1000 mm

1 meter = 3.28feet (ft)

1 ft = 12 inch (in)

1 micron (micrometer m) = 10^{-6} m

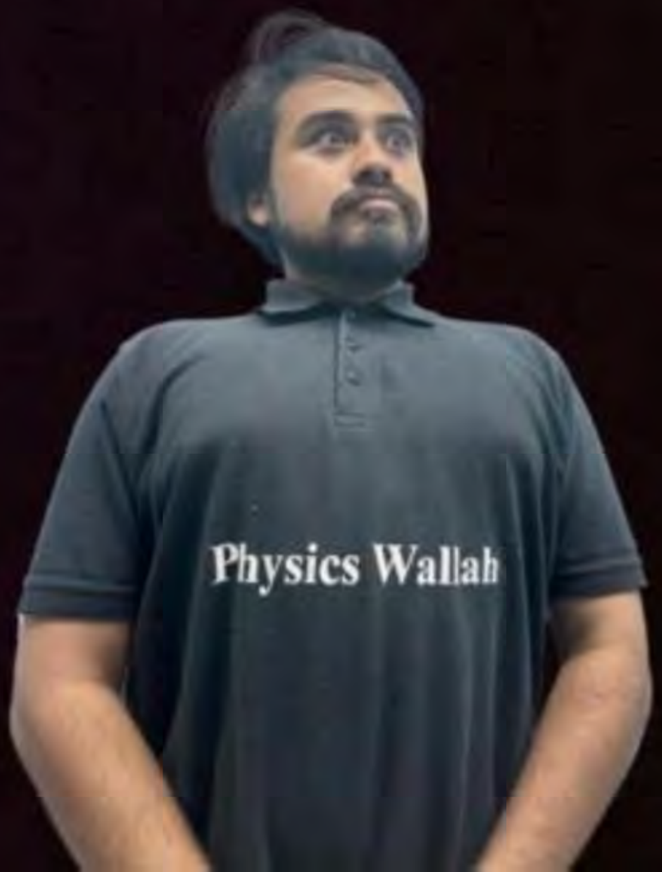
1 Angstrom (Å) = 10^{-10} m

1 kilometer (km) = 1000 m

1yard (yd) = 3 ft

1 in = 2.54 cm

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



Unit of Radioactivity

1 Bq (Bacquerel) = 1 dps (disintegration per second)

1 Ci (Curie) = 3.7×10^{10} dps

1 Rd (Rutherford) = 10^6 dps

Unit of Mass:

1 kg = 1000 gm

1 kg = 2.2 pounds (lb)

1 quintal = 100 kg

1 ton = 907.2 kg

1 amu = 1.66×10^{-27} kg

1 amu = 931 MeV/c^2 = 1.5×10^{-10} J/c^2

Unit of time

1 hr = 60 min = 3600 seconds

1 min = 60 seconds

1 day = 24 hours = 86400 seconds

1 year = 52 weeks = 365 days (365.24)

Unit of density

1 gm/ml = 10 kg/m^3

Unit of speed

10 m/s = 36 km/hr

Unit of acceleration

g = 9.8 m/s = 32 ft/s^2

Unit of Force

1 N = 10^5 dyne (CGS)

1 kg-wt = 1 kg-F = 9.8 N

Unit of Pressure

1 Pa = 1 N/m

1 bar = 10^5 Pa

1 atm = 1.013 bar

1 atm = 760 torr = 760 mm of Hg

1 atm = 10.3 m of water

1 torr = 1 mm of Hg

1 cm of Hg = 1 mm of Hg

Unit of Work Energy

$1\ J = 10^7$ erg (CGS)

1 cal = 4.18 J

$1\ eV = 1.6 \times 10^{-19}$ J

$1\ kWhr = 3.6 \times 10^6$ J

Unit of Power

1 hp = 746 kW

1 kW = 1000 W

1 W = 1 J/s

Unit of electric Charge

$1\ C = 3 \times 10^9$ esu

1 esu = 1 stat coulomb

$1\ e = 1.6 \times 10^{-19}$ C

Unit of Magnetic Field

1 T (Tesla) = 10^4 G (Gauss)

1 T (Tesla) = 1 Wb/m^2 (Weber per m)

Unit of Magnetic Flux

1 Wb (Weber) = 10^8 maxwell

Unit of Intensity of Magnetic Field

1 oersted = 79.55 A/m

Unit of Viscosity

1 Poiseuille = 1 N-s/m = 1 Pa-s

1 Poiseuille = 1 decapoise = 10 poise

Unit of Temperature

1 K (Kelvin) = 1° C

K = °C + 273

°F = 9/5 °C + 32

Unit of Angle

1 rad = 57.30°

1° is = 60' = 3600"

1 is = 60"

1 rev = 360° = 2π rad

π rad = 180°

Angle

$1^c = 57.3^\circ$

$1^\circ = \frac{1}{57.3}^c = 0.017$

$60' = 0.017^c$

$1' = \frac{0.017}{60}^c = 2.9 \times 10^{-4}$

$60'' = 2.9 \times 10^{-4}$

$1'' = \frac{2.9 \times 10^{-4}}{60} = 4.8 \times 10^{-6}$

PYQ

NCERT

Angle Conversion

$1^c = 57.3^\circ$

$1^\circ = 1.7 \times 10^{-2}$

$1' = 2.9 \times 10^{-4}$

$1'' = 4.8 \times 10^{-6}$

$1^c = 57.3^\circ$

$1^\circ = 1.7 \times 10^{-2}$

$1' = 2.9 \times 10^{-4}$

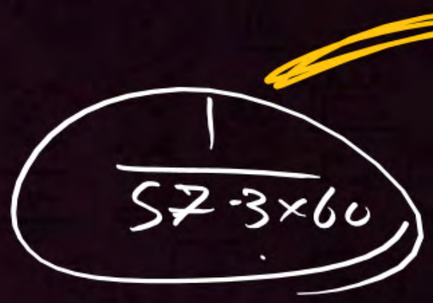
$1'' = 4.8 \times 10^{-6}$

Difficulty : Hard

QUESTION-88

The angle of 1' (minute of arc) in radian is nearly equal to, [2020-Covid]

1. 4.85×10^{-4} rad
2. 4.80×10^{-6} rad
3. 1.75×10^{-2} rad
4. 2.91×10^{-4} rad



$1\,N \rightarrow 10^5$ dyne (CGS)

$F = MLT^{-2}$

$NU = NU$

$1\,\frac{kg\,m}{sec^2} = x\,\frac{gm\,cm}{sec^2}$

$1000\,gm\,m = x\,gm\,\frac{1}{100}\,cm$

$x = 1000\,00 = 10^5$

$1\,J \rightarrow 10^7$ erg (CGS)

$E = ML^2T^{-2}$

$1\,\frac{kg\,mm}{sec\,sec} = x\,\frac{gm\,cm\,cm}{sec\,sec}$

$1 \times 1000\,gm\,m\,m = x\,gm\,\frac{1}{100}\,m\,\frac{1}{100}\,m$

$1000\,00\,00 = x$

$x = 10^7$

Difficulty : Hard

QUESTION-87

Young's modulus of steel is 1.9×10^{11} N m^{-2}. When expressed in cgs units of dynes cm^{-2} it will be equal to

($1\ N = 10^5$ dyne, $1\ m^2 = 10^4\ cm^2$)

[NCERT Exemplar]

1. 1.9×10^{10}
2. 1.9×10^{11}
3. 1.9×10^{12}
4. 1.9×10^{13}

$(NU = N\,U)$

$$\left(1.9\times10^{11}\ \frac{N}{m\ m}\right) = x\ \frac{dyne}{cm\ cm}$$

$$\frac{1.9\times10^{11}\times10^{5}\ dyne}{m\ m} = x\ \frac{dyne}{100\ 100}$$

$$1.9\times10^{12} = x$$

Difficulty : Hard

QUESTION-89

Ganji Planet

The density of a material in CGS system of units is $4\ g/cm^3$. In a system of units in which unit of length is 10 cm and unit of mass is 100 g, the value of density of material will be: [2011 Mains]

$gm = 10\,cm \qquad gg = 100\,g$

1. 0.4
2. 40
3. 400
4. 0.04

$$NU = NU$$

$$\left(\frac{4\ gm}{cm\ cm\ cm}\right) = x\ \frac{gg}{gm\ gm\ gm} = x\left(\frac{100\,g}{10\,cm\ 10\,cm\ 10\,cm}\right)$$

$$40 = x$$

Difficulty : Hard

QUESTION-90

HW

The value of universal gravitational constant $G = 6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$ The value of G in units of $g^{-1}\ cm^3\ s^{-2}$ is

[NCERT Based]

$G = 6.67 \times 10^{-11} \frac{N\ m^2}{kg\ kg} = 6.67 \times 10^{-11} \frac{10^5\ dyne\ 100\,100\ cm^2}{1000\ 1000\ g\,m^2}$

1. 6.67×10^{-8}
2. 6.67×10^{-7}
3. 6.67×10^{-9}
4. 6.67×10^{-10}

Difficulty : Hard

QUESTION-91

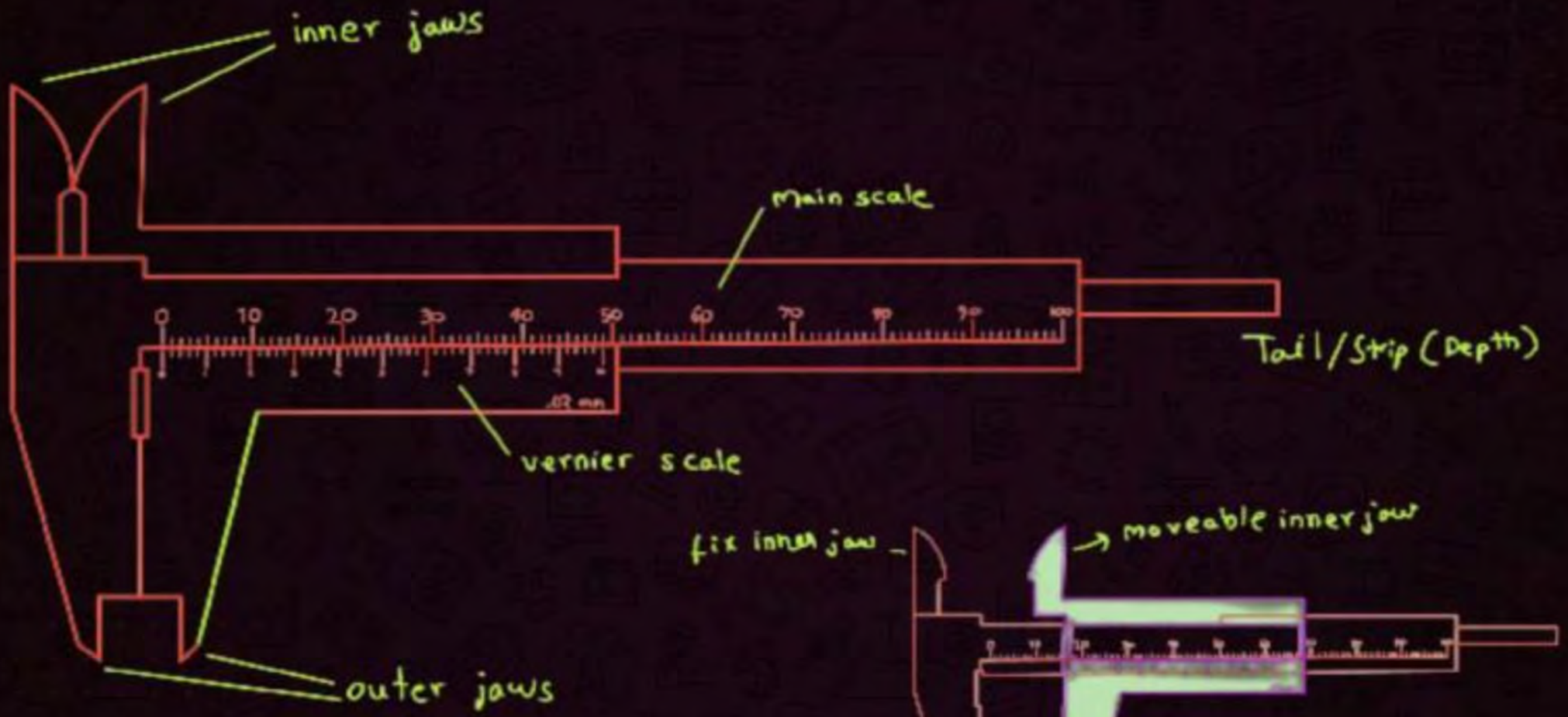
If the value of atmospheric pressure is 10^6 dyne cm^{-2}, its value in SI units is

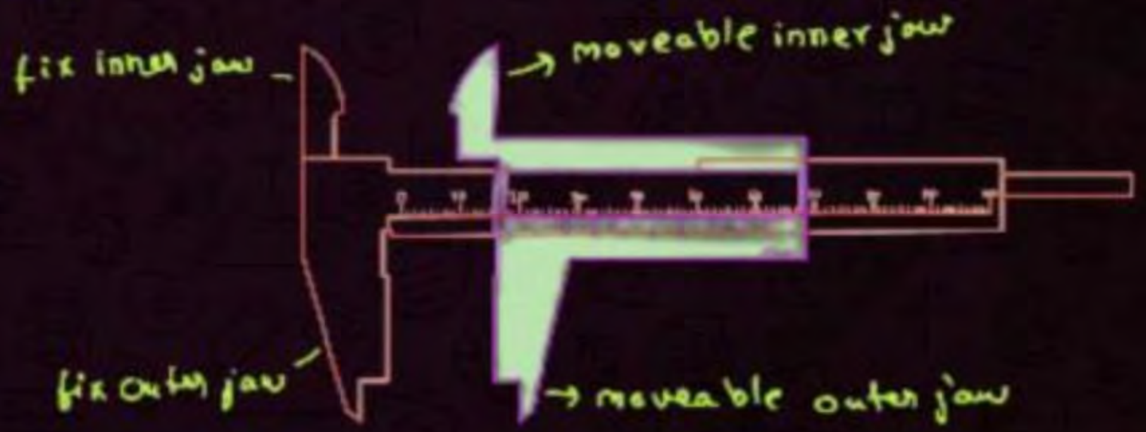
[NCERT Based]

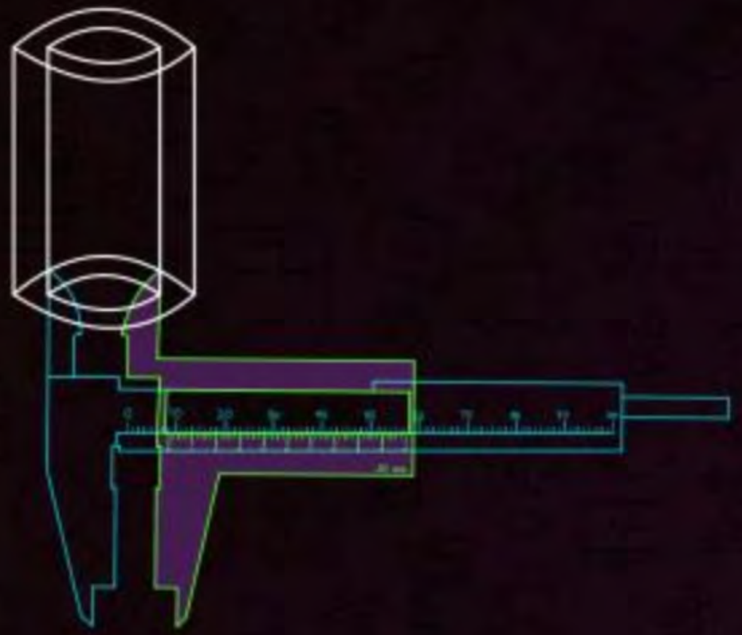
1. $10^4\ N\ m^{-2}$
2. $10^6\ N\ m^{-2}$
3. $10^5 N\ m^{-2}$
4. $10^3\ N\ m^{-2}$

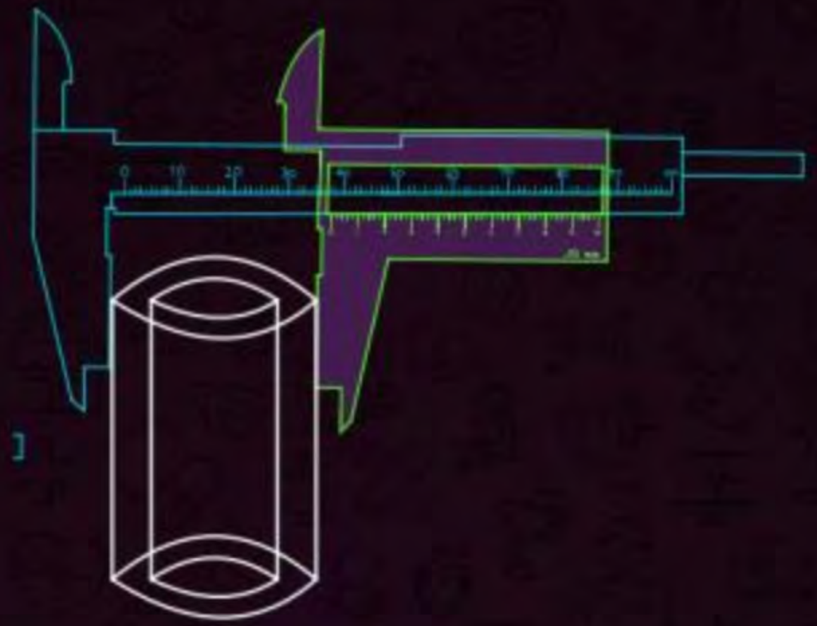
Part 7 – Vernier Caliper

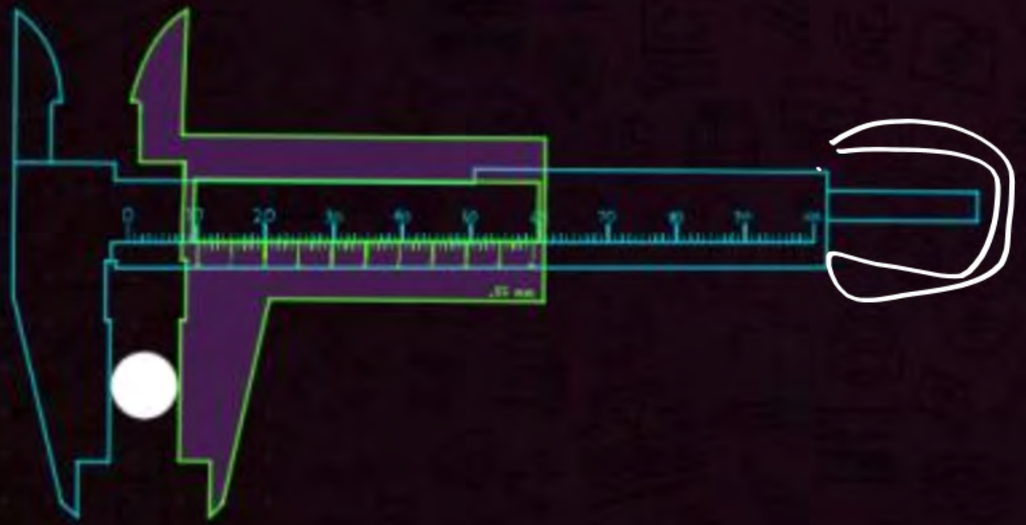
Vernier Caliper











Concept →



Least Count :→ Minimum Value that you can measure

$L.C = 10 - 9 = 1$ mm

MSD → Main Scale Division



VSD → Vernier Scale Division

Vernier Caliper LC

PUPPY – 1

Difficulty : Easy

1. Smallest Main Scale division is 1mm and smallest vernier scale division is 0.9mm. Find least count of vernier calliper.

MSD = 1mm, VSD = 0.9mm

$LC = MSD - VSD$

$= 0.1mm$

2. Smallest Main Scale division is 1mm and smallest vernier scale division is 1.3mm. Find least count of vernier calliper.

$L.C. = 1.3 - 1 = 0.3\ mm$

3. Smallest Main Scale division is 1mm and smallest vernier scale division is 0.99mm. Find least count of vernier calliper.

$L.C. = MSD - VSD$

$1 - 0.99 = 0.01\ mm$

4. Smallest Main Scale division is 2mm and smallest vernier scale division is 1.2mm. Find least count of vernier calliper.

LC

(A) 0.1mm (D) None

(B) 0.8

(C) 0.9

Language

Q1) 10 division of Vernier Scale is equal to 9 division of Main Scale, M.S.D = 1mm



$10\ VSD = 9\ MSD$

$VSD = \frac{9}{10} \times 1 = 0.9\ mm$

$L.C. = MSD - VSD$

$= 1 - 0.9 = 0.1\ mm$ //

PUPPY Method

$N \cdot V.S.D = N - x\ M.S.D$

$L.C = \frac{x}{N}\ M.S.D$

Language

Q1) 10 division of Vernier Scale is equal to 9 division of Main Scale, M.S.D = 1mm



$N = 10$

$x = 1$

$$LC = \frac{x}{N} MSD = \frac{1}{10} \times 1mm = 0.1mm$$

PUPPY Method

$N \cdot V.S.D = N - x$ M.S.D → kitna kam hua

$$L.C = \frac{x}{N} MSD$$

9] 50 div of VS ⟶ 49 div of M.S. (1 MSD = 1mm)

50 VSD = 49 MSD

$VSD = \frac{49}{50} \times 1mm = 0.98mm$

LC = MSD − VSD

= 1mm − 0.98mm

= 0.02mm

PUPPY

$LC = \left(\frac{\text{kitne se kam hua}}{N} \times MSD\right)$

$LC = \frac{1}{50} \times 1 = 0.02mm$

Vernier Caliper LC

PUPPY-2

Difficulty : Easy

10 divisions of vernier scale equals to 9 divisions of Main scale. Main scale division is 1mm. Find ~~vernier scale division as well as~~ least count of instrument. LC = 0.1mm

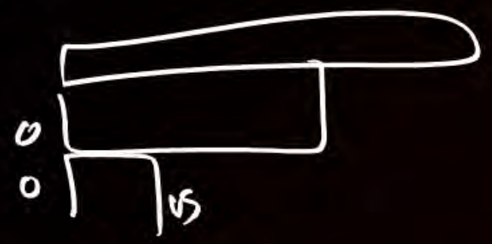
20 divisions of vernier scale equals to 16 divisions of Main scale. Main scale division is 1mm. Find ~~vernier scale division as well as~~ least count of instrument. L.C. = 0.2mm

50 divisions of vernier scale equals to 49 divisions of Main scale. Main scale division is 4mm. Find ~~vernier scale division as well as~~ least count of instrument. LC = 0.08 mm

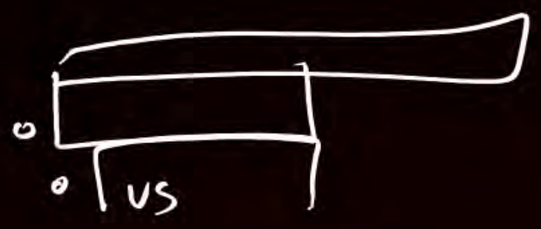
50 divisions of vernier scale equals to 49 divisions of Main scale. Main scale division is 1 mm. Find ~~vernier scale division as well as~~ least count of instrument. LC = 0.02 mm

$$LC = \frac{x}{N} \text{ MSD}$$

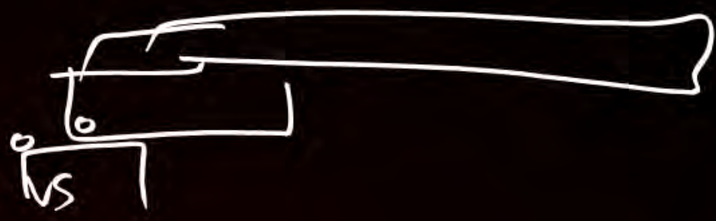
Zero Error



No Zero Error



+ve Zero Error



−ve Zero Error //

$$l = M.S.R + L.C. \times V.S.R$$

given

given

Difficulty : Medium

QUESTION-92

10 divisions of vernier scale equals to 9 divisions of Main scale. Main scale division is 1mm. If reading of main scale is 11 mm and vernier scale is 3. Find the measurement.

MSR

VSR

L.C = 0.1mm

$$\ell = MSR + LC \times VSR$$

$$= 11\,mm + 0.1 \times 3\,mm$$

$$= 11.3\,mm$$

Difficulty : Medium

QUESTION-93

10 divisions of vernier scale equals to 9 divisions of Main scale. Main scale division is 1mm. If reading of main scale is 1.8 cm and vernier scale is 2. Find the measurement.

L.C. = 0.1mm

MSR = 18 mm

(A) 18mm
(B) 2mm
(C) 18.2mm ✓
(D) 18.21mm

$l = MSR + L.C. \times VSR$

$= 18\,mm + 0.1 \times 2$

$= 18 + 0.2$

$= 18.2$

Difficulty : Medium

QUESTION-94

10 divisions of vernier scale equals to 9 divisions of Main scale. Main scale division is 1mm. If reading of main scale is 23 mm and vernier scale is 8. Find the measurement.

23.8

Difficulty : Hard

QUESTION-95

hw

20 divisions of vernier scale equals to 16 divisions of Main scale. Main scale division is 1mm. If reading of main scale is 11.6 cm and vernier scale is 3. Find the diameter of wire measured.

116 mm
MSR

VSR

$\rightarrow L.C. = \frac{4}{20} \times 1 = 0.2\text{mm}$

$l = MSR + L.C. \times VSR$

$= 116 + 0.6$

$= 116.6\text{ mm}$

$= 11.66\text{ cm}$

Difficulty : Hard

QUESTION-96

HW

50 divisions of vernier scale equals to 49 divisions of Main scale. Main scale division is 4mm. If reading of main scale is 11 cm and vernier scale is 3. Find the radius of wire measured.

$$L.C. = \frac{x}{N}(MSD)$$

$$= \frac{1}{50} \times 4 = 0.08$$

110.24 mm

QUESTION-97

Challenge #1

Difficulty : Yodha

The diameter of a cylinder is measured using a vernier caliper with no zero error. It is found that the zero of vernier scale lies between 5.10 cm and 5.15 cm of the main scale. The vernier scale has 50 divisions equivalent to 2.45 cm. The 24th division of vernier scale exactly coincides with one of the main scale division. The diameter of cylinder is

1. 5.112 cm
2. 5.124 cm
3. 5.136 cm
4. 5.148 cm

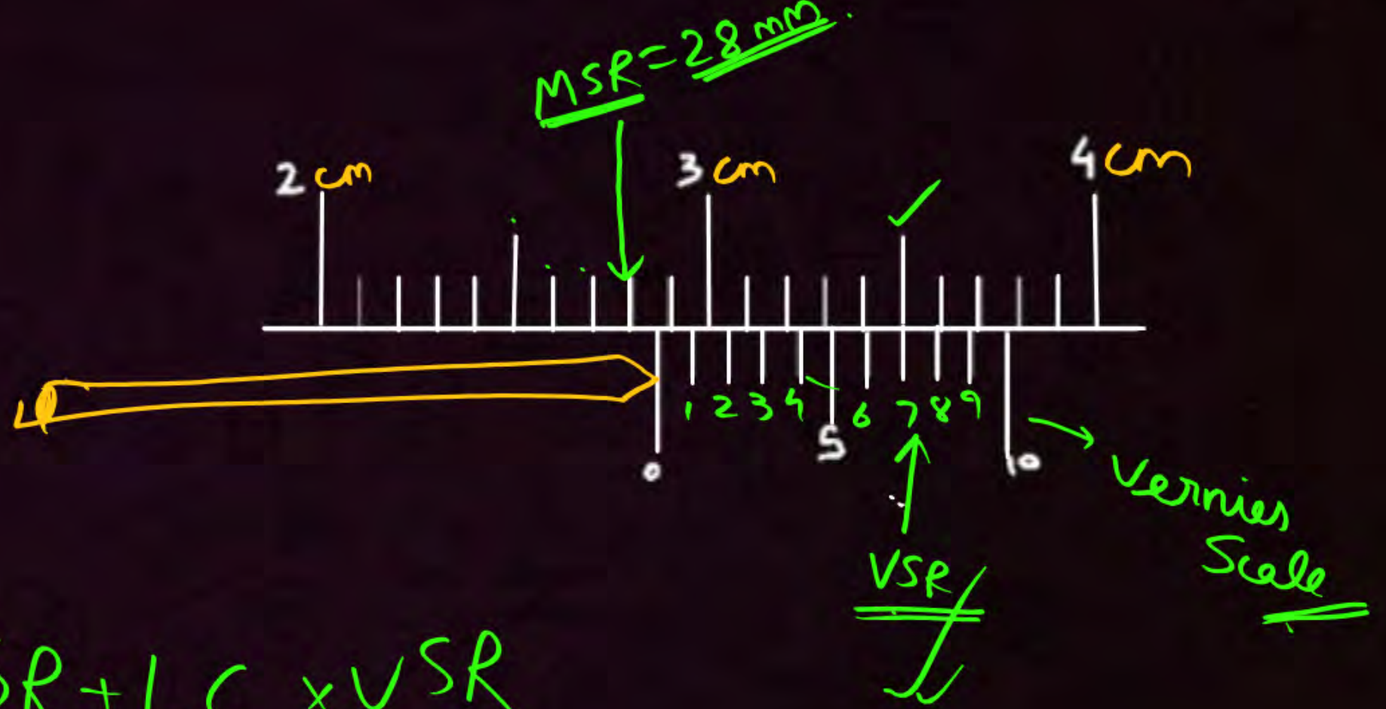
Difficulty : Yodha

QUESTION-98

Find the length (10 VSD = 9 MSD)

L.C = 0.1 mm

1. 2.85 cm
2. 2.86 cm
3. 2.87 cm ✓
4. 2.88 cm



$$l = MSR + LC \times VSR$$
$$= 28 + 0.1 \times 7$$
$$= 28.7 \text{ mm}$$
$$= 2.87 \text{ cm}$$

QUESTION-99

n MSD $= 1$ cm

1 MSD $= \frac{1}{n}$ cm (I)

Difficulty : ~~LEVEL~~ Yodha

The main scale of a vernier calipers has n divisions/cm. n divisions of the vernier scale coincide with $(n-1)$ divisions of main scale. The least count of the vernier calipers is

[Odisha NEET 2019]

1. $\frac{1}{(n+1)(n-1)}$ cm
2. $\frac{1}{n}$ cm
3. $\frac{1}{n^2}$ cm
4. $\frac{1}{n(n+1)}$

L.C. $= \frac{x}{N} \times$ (MSD)

$= \frac{1}{N} \times \frac{1}{N} = \frac{1}{N^2}$

QUESTION-99

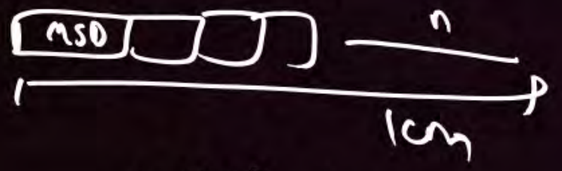
Difficulty : HARD Yodha

The main scale of a vernier calipers has n divisions/cm. n divisions of the vernier scale coincide with $(n-1)$ divisions of main scale. The least count of the vernier calipers is

[Odisha NEET 2019]

1. $\frac{1}{(n+1)(n-1)}$ cm
2. $\frac{1}{n}$ cm
3. $\frac{1}{n^2}$ cm
4. $\frac{1}{n(n+1)}$

(I) n div /cm



n MSD = 1 cm

MSD = $\frac{1}{n}$ cm

(II) n VSD = $(n-1)$ MSD

VSD = $\frac{n-1}{n}$ MSD

L.C = MSD − VSD = MSD − $\frac{n-1}{n}$ MSD

(II) PUPPY

L.C. = $\frac{x}{N} \times$ MSD

= $\frac{1}{N} \times \frac{1}{N} = \frac{1}{N^2}$

PUPPY POINTS-2 - Errors & Instruments.

RS-PIT

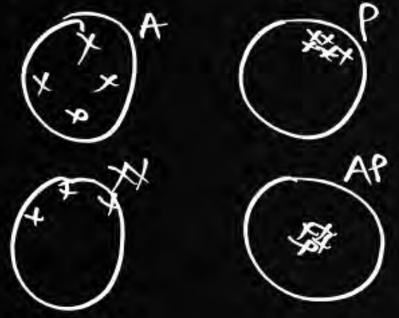
Random - NE=NE

Systemic - Personal
Instrumental
Technique

★ Zero is a type of Instrumental

Accuracy → Average near true

Precision → Nearby values



Round off

odd 5 → +1

even 5 → same

Significant Figures

$\overset{\times}{0}1000^{\wedge} \rightarrow 1$

$0^{\times}.00100^{\vee} \rightarrow 4$

Absolute Error = Δa

Relative $\Delta a/a$

Percentage $\Delta a/a \times 100\%$

Rules Error

+/− use absolute error

×/÷ use relative error

$C = a \pm b \quad \Delta C = \Delta a + \Delta b$

$C = ab \quad \frac{\Delta C}{C} = \frac{\Delta a}{a} + \frac{\Delta b}{b}$

Always added (error)

$a = b^{n} \quad \frac{\Delta a}{a} = n\frac{\Delta b}{b}$

Rules for S.F.

+/− Only after decimal

÷/× Full S.F.

Jo choto wo saki

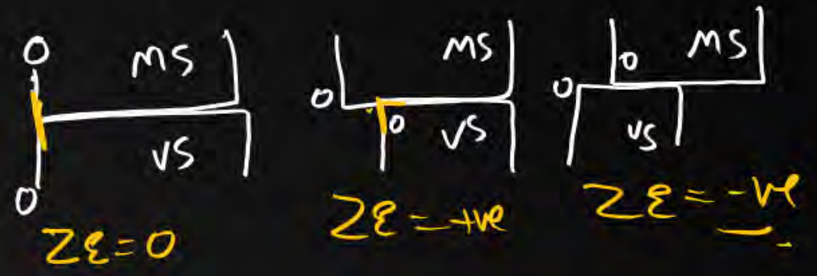
Vernier Caliper

LC = MSD − VSD → N div on vernier scale = N − x division on main scale,

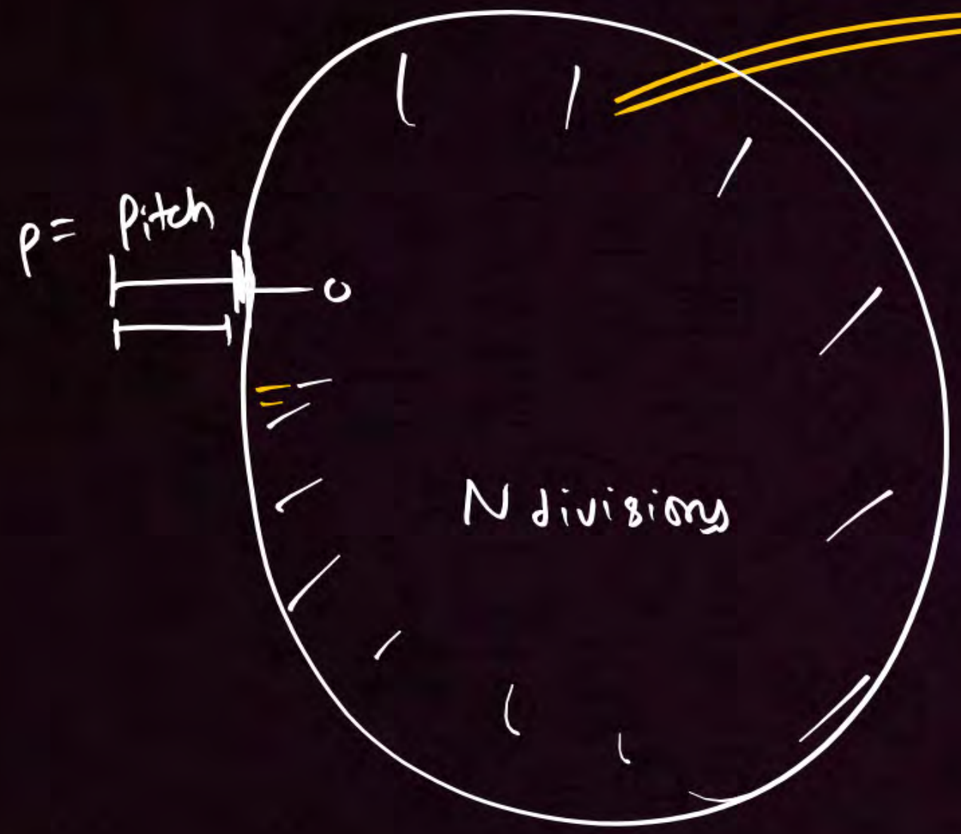
$L.C. = \left(\frac{x}{N}\right) MSD$

$\ell = MSR + LC \times VSR$

$\ell = \ell' - \text{Zero Error}$



Part 8 – Screw Gauge

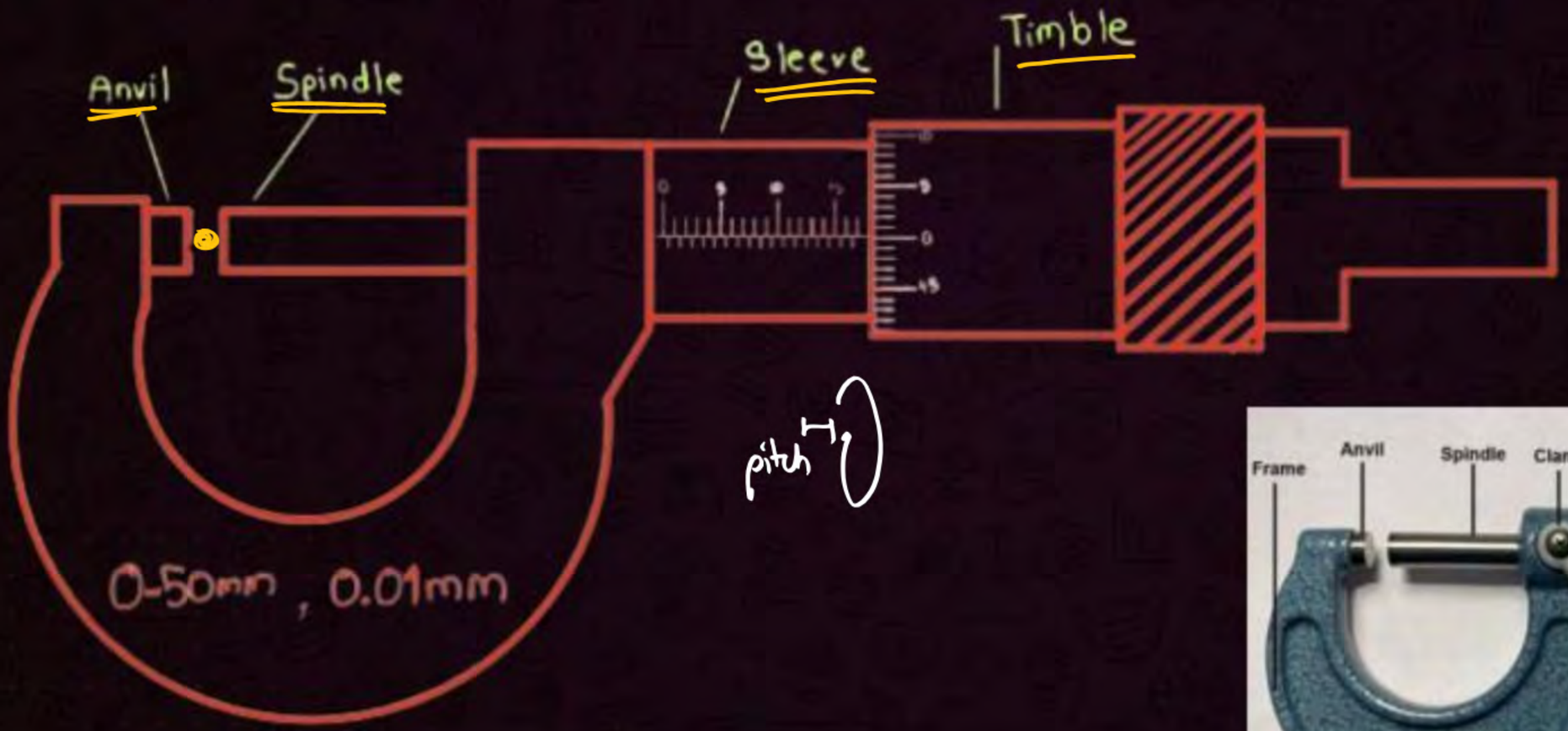


$1p = N$ division

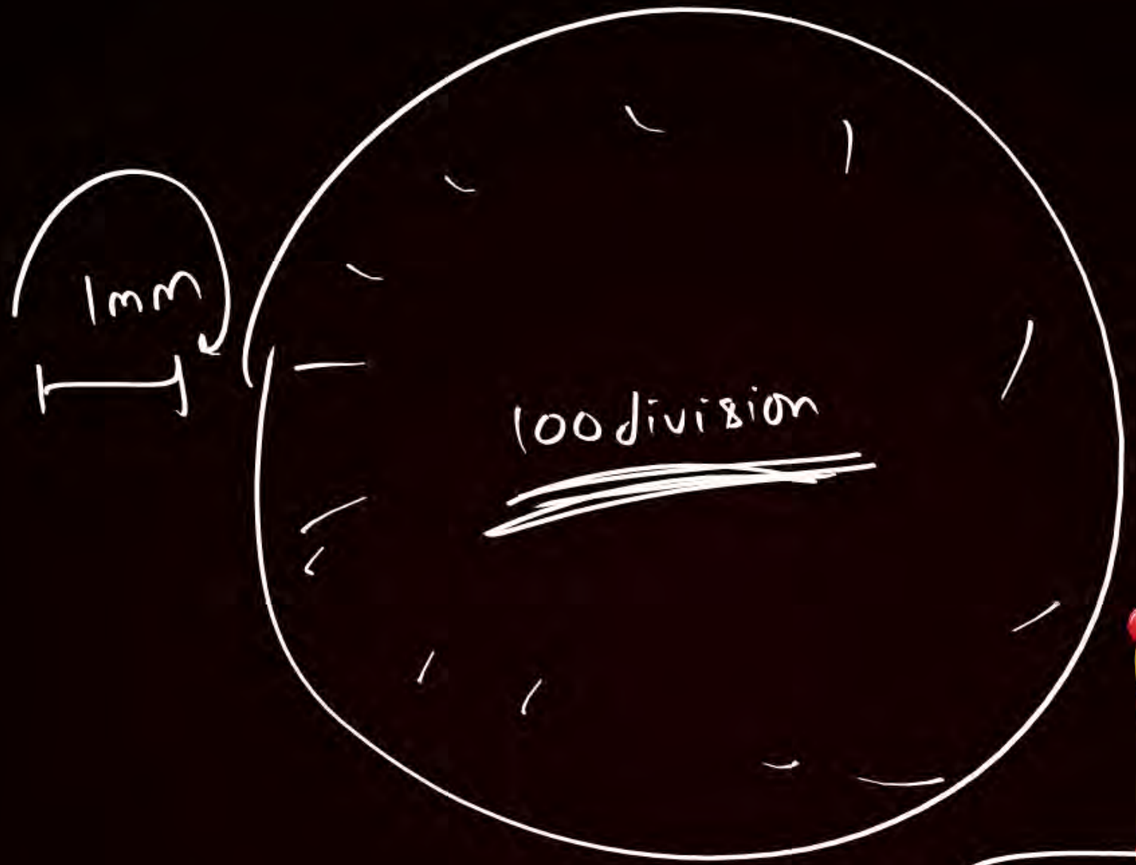
$L.C. = 1\,\text{div} = \frac{P}{N}$

$$L.C. = \frac{\text{Pitch}}{\text{Circular Scale Division}}$$

Micrometer Screw Gauge





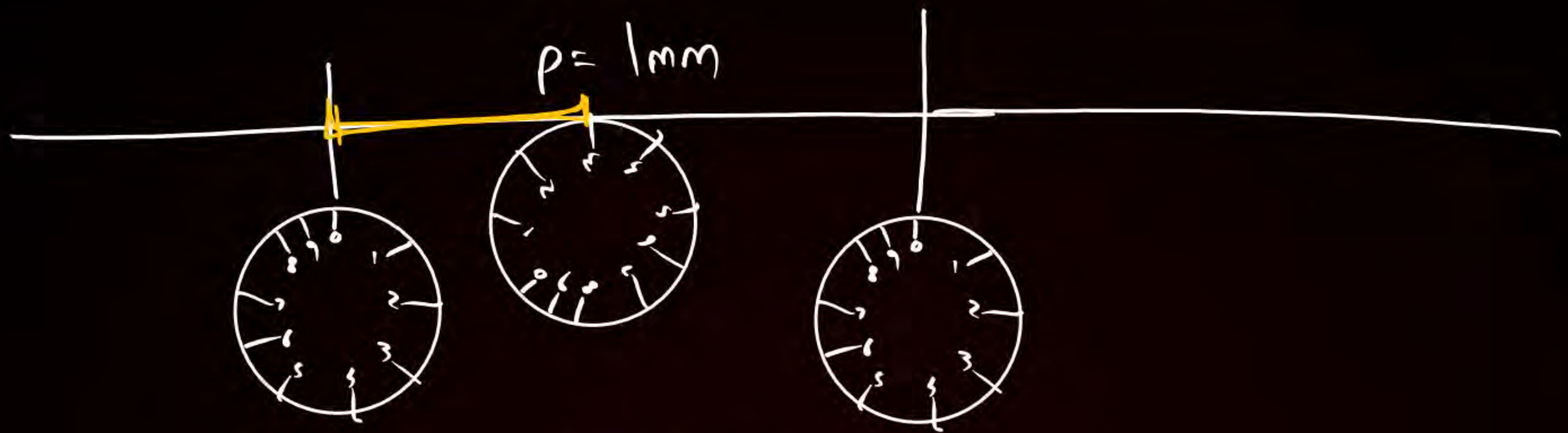


1mm = 100 div

div = $\frac{1}{100}$ = 0·01mm = L·C

L·C = $\frac{\text{pitch}}{\text{C·S·D}}$

l = MSR + L·C × C·S·R



10 div ⇒ 1mm

3 div → $\frac{1}{10} \times 3$

Difficulty : Easy

Micrometer LC

(PUPPY-3)

1. Pitch is 1mm and number of circular divisions are 100. Find Least count of micrometer

$L.C. = \frac{P}{CSD} = \frac{1}{100} = 0.01 mm$

2. Pitch is 5mm and number of circular divisions are 80. Find least count of screw gauge

$LC = \frac{P}{CSD} = \frac{5}{80} = \frac{1}{16} = 0.0625 mm$

3. Least count of main scale is 2mm and number of divisions on Trimble are 50. What is the least count of the instrument.

$LC = 0.04 mm$

4. A micrometer can measure upto 0.01 mm and it has 20 division on the head scale. What is the pitch of the instrument.

$P = C.S.D \times L.C$

$0.2 mm$

LC

CSD

Difficulty : Medium

QUESTION-100

P CSD

The pitch of a screw gauge is 1 mm and there are 100 divisions on the circular scale. In measuring the diameter of a sphere there are six divisions on the linear scale and forty divisions on circular scale coincides with the reference line. The diameter of the sphere is

[NCERT Based]

1. 2.1 mm
2. 4.2 mm
3. 6.4 mm
4. 8.2 mm

$L.C. = \frac{1}{100} = 0.01$ mm

MSR = 6mm

CSR = 40

$\ell = MSR + L.C. \times C.SR$

$= 6 + 0.01 \times 40$

$= 6.4$ mm

Difficulty : Medium

QUESTION-101

A sheet is put between stud and spindle of micrometer. Reading on main scale is 10mm and reading on circular scale containing 50 divisions is 3. What is the thickness of the sheet.(pitch is 1 mm)

CSD

CSR

$10 + \frac{3}{50}$

10.06 mm

Difficulty : Medium

QUESTION-102

hw

A micrometer with least count of 0.01 mm is used to measure radius of a spherical metal ball. Reading on sleeve is 4mm and 20 on head scale. Find the reading.

Difficulty : Medium

QUESTION-103

If zero error is 0.25mm and least count is 0.01mm. Find the true measurement if reading of main scale is 5mm and head scale is 20 divisions.

Difficulty : ~~Hard~~ Yodha

QUESTION-104

A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm (LC). The main scale reading is 5 mm (MSR) and zero of circular scale division coincides with 25 divisions (CSR) above the reference level. If screw gauge has a zero error of −0.004 cm, the correct diameter of the ball is [NEET 2018]

1. 0.521 cm
2. 0.525 cm ✗
3. 0.053 cm
4. 0.529 cm ✓

$l = MSR + LC \times CSR$

$= 5\,mm + 0.01\,mm \times 25$

$l = 5.25\,mm$

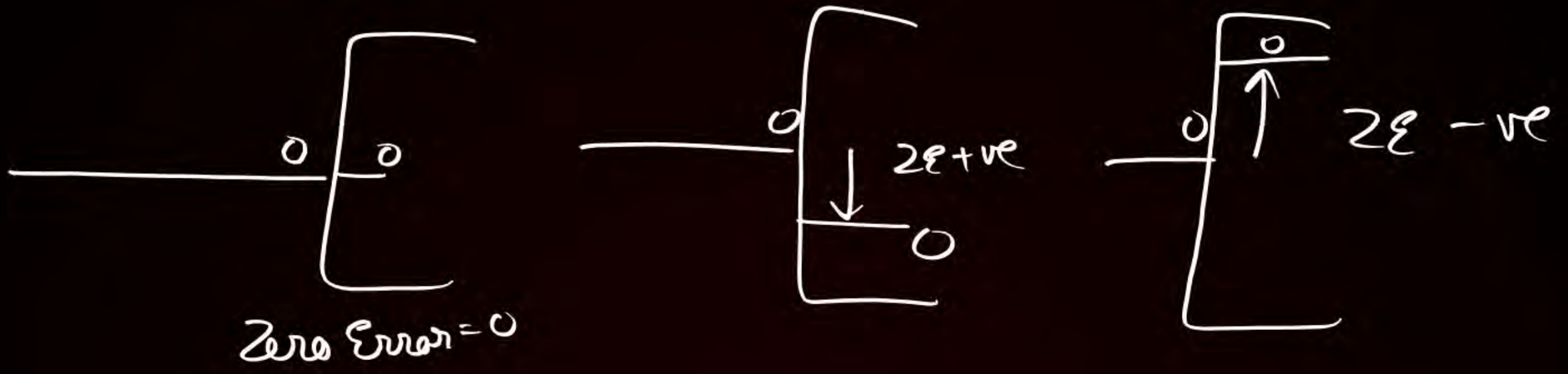
$l = l' - \text{Zero Error}$

$= 5.25 - (-0.04\,mm)$

$= 5.25 + 0.04\,mm$

$= 5.29\,mm$

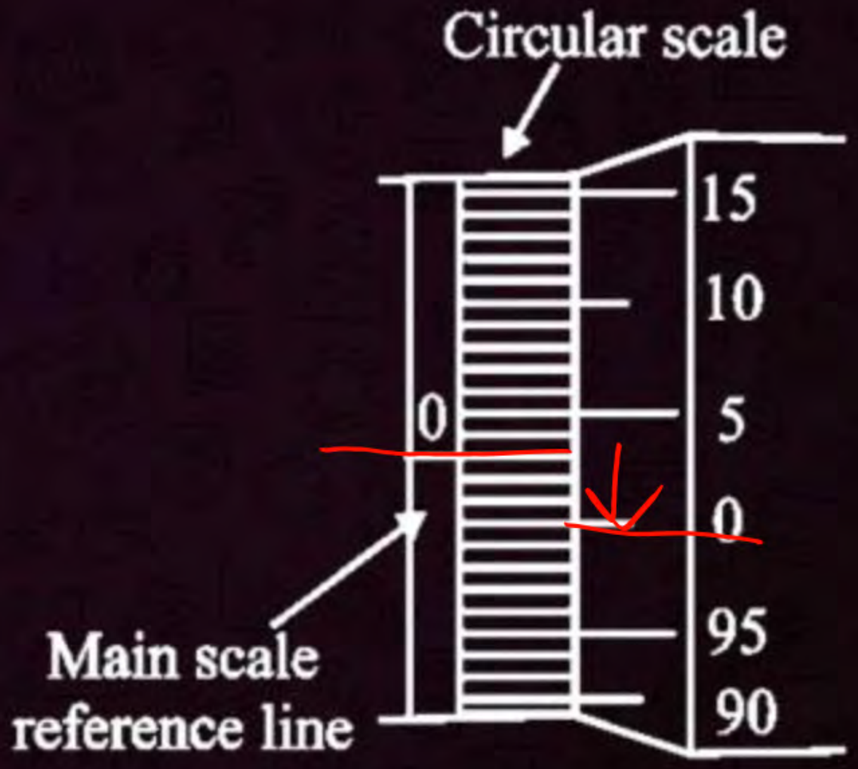
$= 0.529\,cm$ //


Zero Error = 0
2ε + ve
2ε - ve

Difficulty : Medium

QUESTION-105

In the given figure zero error will be? [NEET 2018]



1. Nil
2. Positive
3. Negative
4. None of these

Difficulty : Hard

QUESTION-106

Challenge #2

A screw gauge gives the following readings when used to measure the diameter of a wire Main scale reading: 0 mm Circular scale reading: 52 divisions.

Given that 1 mm on main scale corresponds to 100 divisions on the circular scale. The diameter of the wire from the above data is:

[2021]

1. 0.026 cm
2. 0.26 cm
3. 0.052 cm
4. 0.52 cm

Difficulty : Medium

QUESTION-107

A screw gauge has least count of 0.01 mm and there are 50 divisions in its circular scale.

The pitch of the screw gauge is: [2020]

1. 0.25 mm
2. 0.5 mm
3. 1.0 mm
4. 0.01 mm

Difficulty : Hard

QUESTION-108

A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm. The main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of –0.004 cm, the correct diameter of the ball is [2018]

1. 0.053 cm
2. 0.525 cm
3. 0.521 cm
4. 0.529 cm

PUPPY POINTS-2 - Errors & Instruments.

RS-PIT

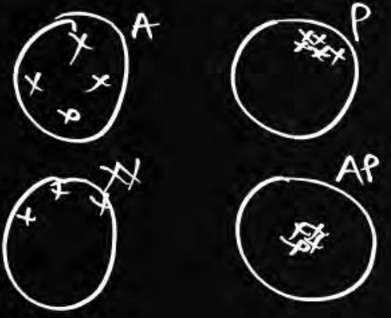
Random - NE=NE

Systemic - Personal
Instrumental
Technique

☆ Zero is a type of Instrumental

Accuracy → Average near true

Precision → Nearby values



Round off

odd S → +1

even S → same

Significant Figures

✱ 1000^ → 1

0^.001000 ↘ 4

Absolute Error = Δa

Relative $\Delta a/a$

Percentage $\Delta a/a \times 100\%$

Rules Error

+/− use absolute error

×/÷ use relative error

$C=a\pm b$ $\quad \Delta C=\Delta a+\Delta b$

$C=ab$ $\quad \frac{\Delta C}{C}=\frac{\Delta a}{a}+\frac{\Delta b}{b}$

Always added (error)

$a=b^n$ $\quad \frac{\Delta a}{a}=n\frac{\Delta b}{b}$

Rules for S.F.

+/− Only after decimal

÷/× Full S.F.

Jo choto wo sahi

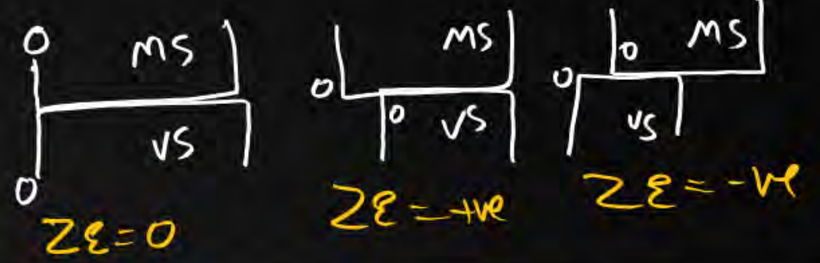
Vernier Caliper

LC = MSD − VSD → N div on vernier scale = N − 1 division on main scale,

$L.C.=\left(\frac{1}{N}\right)MSD$

$\ell = MSR + LC \times VSR$

$\ell = \ell' - \text{Zero Error}$

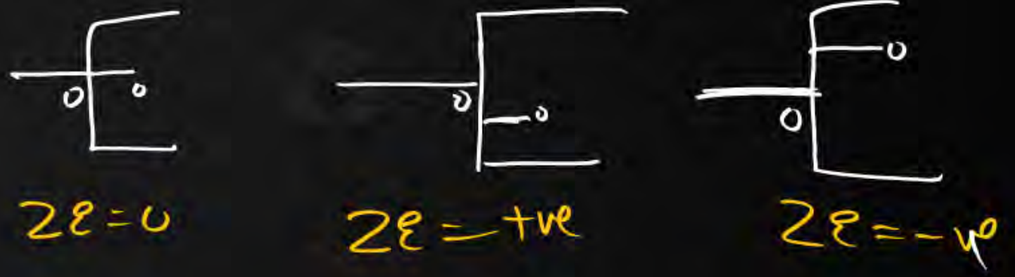


Micrometer

$L.C. = \text{pitch}/N$

$\ell' = MSR + L.C. \times CSR$

$\ell = \ell' - \text{Zero Error}$



Part 7 – Theory & AR Based Questions

QUESTION-109 (Assertion and Reason)

Assertion: The units of some physical quantities can be expressed as combination of the base units.

Reason: We need only a limited number of units for expressing the derived physical quantities.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-110 (Assertion and Reason)

Assertion: When we change the unit of measurement of a quantity, its numerical value changes.

Reason: Smaller the unit of measurement smaller is its numerical value.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-111 (Assertion and Reason)

Assertion: The number 1.202 has four significant figures and the number 0.0024 has two significant figures.

Reason: All the non zero digits are significant.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-112 (Assertion and Reason)

Assertion: A number 2.746 rounded off to three significant figures is 2.75, while the number 2.743 would be 2.74.

Reason: In rounding off the uncertain digits, the preceding digit is raised by 1 if the insignificant digit to be dropped is more than 5 and is left unchanged if the latter is less than 5.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-113 (Assertion and Reason)

Assertion: The given equation $x = x_0 + u_0 t + \frac{1}{2} a t^2$ is dimensionally correct, where x is the distance travelled by a particle in time t, initial position x_0 initial velocity u_0 and uniform acceleration a is along the direction of motion.

Reason: Dimensional analysis can be used for checking the dimensional consistency or homogeneity of the equation.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-114 (Assertion and Reason)

Assertion: Force can be added to pressure.

Reason: Force and pressure have same dimensions.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.

If both assertion and reason are false.

QUESTION-115 (Assertion and Reason)

Assertion: Light year and wavelength have same dimensional formula.

Reason: Both have the dimensions of time.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-116 (Assertion and Reason)

Assertion : Pressure cannot be subtracted from pressure gradient.

Reason: Pressure and pressure gradient have different dimensions.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.

If both assertion and reason are false.

QUESTION-117 (Assertion and Reason)

Assertion : Both velocity and speed have same dimensions.

Reason: Velocity cannot be added to speed.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-118 (Assertion and Reason)

Assertion : The dimensional formula of surface energy is $[M^1L^2T^{-2}]$.

Reason: Surface energy has same dimensions as that of potential energy.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-119 (Assertion and Reason)

Assertion: Light year and year, both measure time.

Reason: Light year is the time that light takes to reach the Earth from the Sun.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-120 (Assertion and Reason)

Assertion: Force cannot be added to pressure.

Reason: Because their dimensions are different.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.

If both assertion and reason are false.

QUESTION-121 (Assertion and Reason)

Assertion: Parallax method cannot be used for measuring distances of stars more than 100 light years away.

Reason: Parallax angle is reduced to such an extent that it cannot be measured accurately.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.

If both assertion and reason are false.

QUESTION-122 (Assertion and Reason)

Assertion: Mass, length and time are fundamental physical quantities.

Reason: They are independent of each other.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.

   If both assertion and reason are false.

QUESTION-123 (Assertion and Reason)

Assertion: Density is a derived physical quantity.

Reason: Density cannot be derived from the fundamental physical quantities.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-124 (Assertion and Reason)

Assertion: When we change the unit of measurement of a quantity, its numerical value changes.

Reason: Smaller the unit of measurement, smaller is its numerical value.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-125 (Assertion and Reason)

Assertion: Dimensional constants are quantities whose values are constant.

Reason: Dimensional constants are dimensionless.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-126 (Assertion and Reason)

Assertion: The time period of a pendulum is given by the formula, $T = 2\pi\sqrt{l/g}$.

Reason: According to the principle of homogeneity of dimen- sions, only that formula is correct in which the dimensions of LHS is equal to dimensions of RHS.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-127 (Assertion and Reason)

Assertion: Avogadro number is the number of atoms in one gram mole of a substance.

Reason: Avogadro number is a dimensionless constant.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-128 (Assertion and Reason)

Assertion: L/R and CR both have the same dimensions.

Reason: L/R and CR both have the dimension of time.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-129 (Assertion and Reason)

Assertion: The quantity $(1/\sqrt{\mu_0 \varepsilon_0})$ is dimensionally equal to velocity and numerically equal to velocity of light.

Reason: μ_0 is permeability of free space and ε_0 is the permittivity of free space.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-130 (Assertion and Reason)

Assertion: A screw gauge having a smaller value of pitch has greater accuracy.

Reason: The least count of screw gauge is directly propor- tional to the number of divisions on circular scale.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-131 (Assertion and Reason)

Assertion: In a meter bridge, if its wire is replaced by another wire having the same length, same material but twice the cross-sectional area, the accuracy decreases.

Reason: Accuracy of meter bridge depends on the length of wire.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-132 (Assertion and Reason)

Assertion: SI units are logical and coherent.

Reason: SI system of units is a rationalised system.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-133 (Assertion and Reason)

Assertion: The dimensional formula for product of resistance and conductance is the same as for dielectric constant.

Reason: Both have dimensions of time constant.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-134 (Assertion and Reason)

Assertion: Power of an engine depends on mass, angular speed, torque and angular momentum, so the formula of power is not derived with the help of dimensional method.

Reason: In mechanics, if a particular quantity depends on more than three quantities, then we cannot derive the formula of the quantity by the help of dimensional method.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.

If both assertion and reason are false.

QUESTION-135 (Assertion and Reason)

Assertion: Heat can be added to work done.

Reason: Heat and work have the same dimensions.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-136 (Assertion and Reason)

Assertion: All physical quantities have some unit.

Reason: All unitless physical quantities are only mathematical constant numbers.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-137 (Assertion and Reason)

Assertion: All unitless quantities are dimensionless.

Reason: Dimensions are exponent raised to fundamental units in derived units.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-138 (Assertion and Reason)

Assertion: All dimensionless quantities are unitless.

Reason: All unitless quantities are dimensionless.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-139 (Assertion and Reason)

Assertion: Universal gravitation constant is a dimensional constant.
Reason: $G = 6.67 \times 10^{-11}\ Nm^2\ kg^{-2}$.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-140 (Assertion and Reason)

Assertion: Magnifying power of an optical instrument is the ratio of vision angle.

Reason: Magnifying power of optical instrument is dimensionless.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-141 (Assertion and Reason)

Assertion: Angular momentum and Planck's constant have the same dimensional formula.

Reason: Angular momentum and Planck's constant are dimensional constants.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-142 (Assertion and Reason)

Assertion: Quality factor is dimensionless.

Reason: Quality factor depends on resistance, inductance and capacitance of LCR series circuit.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-143 (Assertion and Reason)

Assertion: All dimensionally correct formula must be numerically correct.

Reason: All numerically correct formula may be dimensionally incorrect.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-144 (Assertion and Reason)

Assertion: The magnitude of any physical quantity does not depend on the method of measurement.

Reason: The magnitude of any physical quantity is more in SI system than in CGS system.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-145 (Assertion and Reason)

Assertion: Temperature cannot be expressed as a derived quantity in terms of length and mass.

Reason: Temperature is a fundamental quantity.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-146 (Assertion and Reason)

Assertion: Kilowatt-hour is a unit of energy.

Reason: Kilowatt is the unit of energy.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-147 (Assertion and Reason)

Assertion: The unit of specific resistance is Ohm.

Reason: Specific resistance is another name for specific conductance.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-148 (Assertion and Reason)

Assertion: Parsec is a unit of distance.

Reason: Parsec is short form of parallactic second.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-149 (Assertion and Reason)

Assertion: The unit of EMF is Joule/Coulomb.

Reason: EMF is an electromagnetic force.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-150 (Assertion and Reason)

Assertion: A physical quantity is measured and its value is always found to be nu; where n is the numerical value and u is the unit.

Reason: $n \propto \frac{1}{u}$.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-151 (Assertion and Reason)

Assertion: Faraday is the unit of charge.

Reason: Farad is the unit of capacitance.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-152 (Assertion and Reason)

Assertion: Unit of surface tension is newton per metre.

Reason: Surface tension is the force on the surface of a liquid.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-153 (Assertion and Reason)

Assertion: Dimensional formula for latent heat is $[M^0L^2T^{-2}]$

Reason: Latent heat is the heat required to change the state of any system per unit mass.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-154 (Assertion and Reason)

Assertion: The frequency of vibration of a mass m suspended from a spring of spring constant K is given by a relation of the type, $f = C\ m^x K^y$; where C is a dimensionless quantity.

Reason: $x = 1/2, y = -1/2$

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-155 (Assertion and Reason)

Assertion: Two quantities A and B have different dimensions.

Reason: A + B is meaningless.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-156 (Assertion and Reason)

Assertion: A physical quantity x depends on quantities y and z as follows: $x = Ay + B \tan Cz$, where A, B, C are constants. Only x and A do not have same dimensions.

Reason: From the dimensional homogeneity, only same dimensional quantities can be added or subtracted.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-157 (Assertion and Reason)

Assertion: Accuracy of measurement is determined by absolute error and percentage error both.

Reason: Absolute error is the difference in actual and measured values of physical quantities.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-158 (Assertion and Reason)

Assertion: The quantity percentage error is unitless.

Reason: Percentage error = $\frac{\text{Mean absolute error}}{\text{Mean value}} \times 100\% = \frac{\overline{\Delta a}}{a_m} \times 100\%$;

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-159 (Assertion and Reason)

Assertion: The random error in the arithmetic mean of 100 observations is **x**; then random error in the arithmetic mean of 400 observations would be $x/4$.

Reason: Arithmetic mean of the magnitudes of absolute errors in n measurements of the quantity is represented by $\overline{\Delta a} = \frac{|\Delta a_1| + |\Delta a_2| + \ldots\ldots + |\Delta a_n|}{n}$

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-160 (Assertion and Reason)

Assertion: The period of oscillation of a simple pendulum in the experiment is recorded as 2.63 s, 2.56 s,2.42 s, 2.71 s and 2.80 s, respectively. The average absolute error is 0.11 s.

Reason: Mean absolute error = $\frac{\text{Sum of absolute errors}}{\text{Number of observations}}$

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-161 (Assertion and Reason)

Assertion: If the weight in air is (5.00 ±0.05) N and weight in water is (4.00 ± 0.05) N, then the relative density along with the maximum permissible percentage error is 5.0±11%.

Reason: Relative density = $\frac{\text{Weight in air}}{\text{Weight loss in water}}$

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-162 (Assertion and Reason)

Assertion: In one-dimensional motion distance in time t is given by $S_t = u + \frac{1}{2}a(2t - 1)$; where u is the initial velocity and a is constant acceleration.

Reason: Given equation is both numerically and dimensionally correct.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-163 (Assertion and Reason)

Assertion: Out of the two measurements 50.14 cm and 0.00025 A, the first one has greater accuracy.

Reason: Since for 50.14 cm, significant number is 4 and for 0.00025, significant number is 2.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-164 (Assertion and Reason)

Assertion: Formation and evolution of stars and galaxies are due to gravitational forces.

Reason: Gravitational force is always attractive.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-165 (Assertion and Reason)

Assertion: Velocity gradient has unit of velocity.

Reason: Velocity gradient is change in velocity per unit time.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-166 (Assertion and Reason)

Assertion: Systematic error can be minimised.

Reason: Systematic error can be calculated.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-167 (Assertion and Reason)

Assertion: In random error, we take n as the number of observations.

Reason: Taking n as number of observations, random error reduces to $1/n$.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-168 (Assertion and Reason)

Assertion: Measurement's precision is determined by least count of measuring instrument.

Reason: Smaller the least count, more is the precision

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-169 (Assertion and Reason)

Assertion: A simple everyday example of parallax can be seen in the dashboards of motor vehicles that use a needle-style speedometer gauge.

Reason: Parallax is a displacement or difference in the appar- ent position of an object viewed along two different lines of sight.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-170 (Assertion and Reason)

Assertion: Work done is dimensionally same as torque.

Reason: Work done and torque both are scalar quantities.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-171 (Assertion and Reason)

Assertion: Both plane and solid angles are fundamental units.

Reason: Both have the same units.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-172 (Assertion and Reason)

Assertion: Parallax method is used for measuring distances of nearby star only.

Reason: With increase of distance of star parallactic angle becomes too small to be measured accurately.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-173 (Assertion and Reason)

Assertion: Specific gravity of liquid is dimensionless.

Reason: It is the ratio of density of liquid to density of water.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-174 (Assertion and Reason)

Assertion: Methods of dimensions cannot be used for deriving formula containing trigonometric ratios.

Reason: Trigonometric ratios have no dimensions.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-175 (Assertion and Reason)

Assertion: Permittivity and permeability have the same value for a given medium.

Reason: Permittivity is a property of magnetic field and permeability is a property of electric field.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-176 (Assertion and Reason)

Assertion: Astronomical unit is a unit for measuring large distances.

Reason: It is the distance covered by light in one year.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-177 (Assertion and Reason)

Assertion: Parallactic second is a unit of distance.

Reason: Second is the SI unit of time.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

QUESTION-178 (Assertion and Reason)

Assertion: Distance cannot be added with speed.

Reason: Only same units of quantities could be added.

1. If both A and R are true and reason is the correct explanation of assertion.
2. If both A and R are true but reason is not the correct explanation of assertion.
3. If assertion is true but reason is false.
4. If both assertion and reason are false.

Part 8 – Revision & PUPPY POINTS

PUPPY POINTS-1 Units & Dimensions

Introduction

7 Fundamental
MLT CALT
Mass kg → ☆ (prefix)
Length m
Time sec → ☆ (same in all system)
Current Ampere
Amount of substance mole
Luminous Intensity candela
Temperature Kelvin

2 Supplimentary
[Angle radian
Solid Angle steradian]
↳ Dimensionless (Unit ✓)

Unit → Suitable size, Welldefined, reproducible experimental, not change with T, P, time.

NU = constant



Rules

+, −, = → =
sin(y), log(y), $e^{(y)}$ → [y = 1]

Dimensionally correct may/may not be correct
Dimensionally incorrect must be incorrect

PP-1 Dimensionless

Angle
Solid Angle
] → Unit

Trigonometric
Exponents
Logarithm
Relative density
Relative permittivity
Relative permeability
Dielectric
Susceptibity
Strain
Coefficient of friction
Poisson's Ratio
Refractive Index

Unitless

PP-2 Mechanics

Mass-[M] Length[L] Time[T]
speed/velocity → LT^{-1}
acceleration → LT^{-2}
Force = ma → $[MLT^{-2}]$
Energy = Work = Torque = F.x = $[ML^2T^{-2}]$
Power = $\frac{E}{t}$ = $[ML^2T^{-3}]$
Intensity = $\frac{P}{A}$ = $[MT^{-3}]$
Momentum = Fxt = Impulse = mv = $[MLT^{-1}]$

Pressure = $\frac{F}{A}$ = $\frac{E}{V}$ = Stress = Y/B/G = $\varepsilon_0 E^2$ = $\frac{B^2}{\mu_0}$ = $[ML^{-1}T^{-2}]$

$G = [M^{-1}L^3T^{-2}]$
$h = E \times t = [ML^2T^{-1}]$
$\eta = [M^1L^{-1}T^{-1}]$

PP-3 Rotational

torque = ML^2T^{-2}
Frequency = $1/T$ = $[T^{-1}]$
Wavelength = L
wave number = $1/L$ = $[L^{-1}]$
Angular frequency ω = $[T^{-1}]$
Angular wave number k = $[L^{-1}]$
Angular displacement = θ/R = $[L^1]$
Angular velocity = V/R = $[T^{-1}]$
Angular acceleration = a/R = $[T^{-2}]$
Angular momentum = mvx = h = $[ML^2T^{-1}]$
Moment of Inertia → ML^2 = $[ML^2]$

PP-EM

Charge = [AT]
RC = L/R = $\sqrt{LC}$ = time = [T]
$\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ = C = speed = $[LT^{-1}]$
Voltage = $\frac{Work}{q}$ = $\frac{ML^2T^{-2}}{AT}$
k (Columb's) = $1/\varepsilon$
Resistor = R = V/I = $[M^1A^{-2}L^2T^{-3}]$
Capacitor = RC → time
Inductor = L/R → time
permittivity = ε = $[M^{-1}A^2L^{-3}T^4]$
permeability = μ = $[M^1A^{-2}L^1T^{-2}]$
Electric field = F/q
Magnetic field = F/qv

PP-5 Patterns

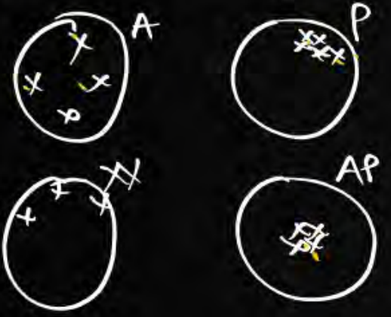
time = RC = L/R = $\sqrt{LC}$
Speed = $\frac{1}{\sqrt{\mu\varepsilon}}$
Energy = work = torque = ML^2T^{-2}
Fxt = Impulse = Momentum = mv = $[MLT^{-1}]$
Energy x t = h = L = mvr = $[ML^2T^{-1}]$
$\frac{E}{V}$ = εE^2 = $\frac{B^2}{\mu_0}$ = P = $\frac{F}{A}$ = Stress = Y/B/G = $[ML^{-1}T^{-2}]$
Thermal conductivity = $\frac{E}{tT}$ = $[MLT^{-3}\theta^{-1}]$ ✓
Thermal Resistance = $[M^{-1}L^{-2}T^3\theta]$

PUPPY POINTS - 2 - Errors & Instruments.

RS-PIT
Random - NE = NE ✓ unpredictable
Systemic - Personal
Instrumental
Technique

☆ Zero is a type of Instrumental

Accuracy → Average near true
Precision → Nearby values



Round off
odds → +1
evens → same

Significant Figures
✗ 0 1000 ^ → 1
0 · 00 1000 ✓ → 4

Absolute Error = Δa
Relative $\Delta a/a$
Percentage $\Delta a/a \times 100\%$

Rules Error
+/− use absolute error
×/÷ use relative error

$C = a \pm b$ $\quad \Delta C = \Delta a + \Delta b$
$C = ab$ $\quad \frac{\Delta C}{C} = \frac{\Delta a}{a} + \frac{\Delta b}{b}$

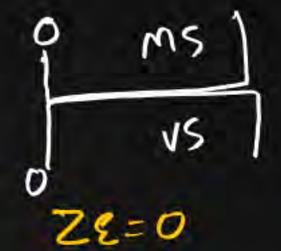
Always added (error)
$a = b^n$ $\quad \frac{\Delta a}{a} = n\frac{\Delta b}{b}$

Rules for S.F.
+/− Only after decimal
×/÷ Full S.F.

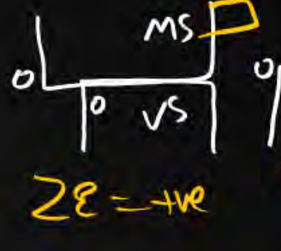
Jo choto wo sahi

Vernier Caliper
LC = MSD − VSD → N div on vernier scale = N − 1 division on main scale,
L.C. = (1/N) MSD ✓

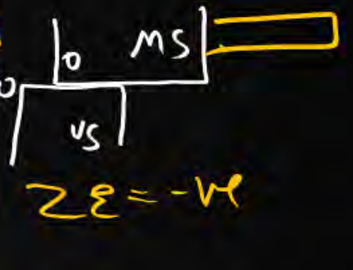
$\ell = MSR + LC \times VSR$
$\ell = \ell' - \text{Zero Error}$



ZE = 0



ZE = +ve



ZE = -ve

Micrometer
L.C. = pitch/N

$\ell = MSR + L.C. \times CSR$
$\ell = \ell' - \text{Zero Error}$


ZE = 0


ZE = +ve


ZE = -ve


THANK YOU
@BROFESSORARMY