YAKEEN NEET 2.0

2026

Units and Measurements

Physics | Lecture - 9

By- Manish Raj (MR Sir)

Topics to be covered

1. #
2.
3.
4.

Todays Goal

Ph.D on error

M.R. Time Table

10:30 PM → 11:30 PM

MORNIY → 6:00 AM – 6:30 AM

6:30 AM → Revision
3-day in a week

7:00 AM to 8:00 AM
Sunday / GYM

8:30 AM
or 8:45 AM
Class

Absolute error = Magnitude of diffrence b/w True & measured value.

- $\Delta x = |x_T - x_m|$

Unit same as P.Q. ✓

Unit & dimension less

- Relative error $= \frac{\Delta x}{x_T}$
- % error $= \frac{\Delta x}{x_T} \times 100$

Representation of error

$l = (5 \pm 0.4)\ m$

5 → value of length

0.4 → Absolute error

$l = 5m \pm 2\%$

% error

error me se error Nahi subtract hota but, Yaha to measured vale ko error ke sath represent Kiyaha.

error in mathematical expression

$$Z = A + B$$

$$\frac{dz}{dt} = \frac{dA}{dt} + \frac{dB}{dt}$$

$$dz = dA + dB$$

$$\Delta Z = \Delta A + \Delta B$$

↳ absolute error in Z

Relative error in 'Z'

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

$$\therefore \text{error } \frac{\Delta Z}{Z} \times 100 = \frac{\Delta A + \Delta B}{A+B} \times 100$$

$$Z = A - B$$

$$\Delta Z = \Delta A + \Delta B$$ *

↳ error me se error nahi subtra

Relative error in 'Z'

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

$$\left[100 \times \frac{\Delta Z}{Z}\right] = \left[\frac{\Delta A + \Delta B}{A - B} \times 100\right]$$

∴ error in Z

$Y = A \cdot B$ (Product)

(differentiation) of Product Rule

$dy = B\,dA + A\,dB$

$\Delta y = B\,\Delta A + A\,\Delta B$

divide by Y both side

$$\frac{\Delta y}{y} = \frac{B\Delta A + A\Delta B}{AB}$$

$$\frac{\Delta y}{y} = \frac{B\Delta A}{AB} + \frac{A\Delta B}{AB}$$

$$\# \quad \frac{\Delta y}{y} = \left(\frac{\Delta A}{A}\right) + \left(\frac{\Delta B}{B}\right)$$

Absolute error in y

$$\Delta y = y\left(\frac{\Delta A}{A} + \frac{\Delta B}{B}\right)$$

for division

$$y = \frac{A}{B} = AB^{-1}$$

$$\left(\frac{\Delta y}{y}\right) = \frac{\Delta A}{A} + \frac{\Delta B}{B}$$

for a function which have some power

$y = A^n$

diff^n of y w.r.t A

$$\frac{dy}{dA} = \frac{dA^n}{dA}$$

$$\frac{dy}{dA} = n A^{n-1}$$

$$dy = n A^{n-1} dA$$

Relative error in y

$$\frac{dy}{y} = \frac{n A^{n-1} dA}{A^n}$$

$$= \frac{n\, dA}{A^{n-n+1}}$$

$$\left(\frac{dy}{y}\right) = \frac{n\, dA}{A}$$

Relative error in y

absolute error in y $dy = y\left(\frac{n\, dA}{A}\right)$

Some constant is multiplied with function.

$$y = nA$$

→ diff^{n} w.r.t 'A'

$$\frac{dy}{dA} = n\frac{dA}{dA}$$

$$\# \boxed{dy = n\,dA}$$

divide by Y both side

$$\left(\frac{dy}{y}\right) = \frac{n\,dA}{nA}$$

$$\left[\frac{dy}{y}\right] = \left[\frac{dA}{A}\right]$$

→ Const^{n} kha gya
↳ usko goli mar diya

$Z = A + B$

$\Delta Z = \Delta A + \Delta B$

Absolute

$Z = A - B$

$\Delta Z = \Delta A + \Delta B$

$Y = A \cdot B$

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

MR* Box → Pyar se formula Ko dekhenge agar +,- hai absolute error lenge agar ×, ÷, pows hai to direct relative error lenge.

$Z = A/B$

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

*

$Y = nA$

$\frac{\Delta Y}{Y} = \frac{\Delta A}{A}$

$Y = A^n$

$\frac{\Delta Y}{Y} = n\frac{\Delta A}{A}$

mixed formula

$$y = \frac{3A^2\sqrt{B}}{C^4}$$

Direct Relative error le rahe hai

$$\frac{\Delta y}{y} = 2\frac{\Delta A}{A} + \frac{1}{2}\frac{\Delta B}{B} + 4\frac{\Delta C}{C}$$

$$100 \times \frac{\Delta y}{y} = \left[2\frac{\Delta A}{A} + \frac{1}{2}\frac{\Delta B}{B} + 4\frac{\Delta C}{C}\right] \times 100$$

Question karte hai

Question

A physical quantity is represented by $X = [M^a L^b T^{-c}]$. If percentage error in the measurement of M, L and T are $\alpha\%$, $\beta\%$ and $\gamma\%$ respectively, then maximum percentage error in measurement of X should be (Given that α, β and γ are very small)

NEET

1. $(\alpha a - \beta b + \gamma c)\%$
2. $(\alpha a + \beta b + \gamma c)\%$
3. $(\alpha a - \beta b - \gamma c)\%$
4. $(\alpha a + \beta b - \gamma c)\%$

Question Note me

A physical quantity P is given as

$$P = \frac{a^2 b^3}{c\sqrt{d}}$$

$\frac{\Delta a}{a} \times 100 = 1$

The percentage error in the measurement of a, b, c and d are 1%, 2%, 3% and 4% respectively. The percentage error in the measurement of quantity P will be

[10 Apr, 2023]

1. 13%
2. 14%
3. 12%
4. 16%

$$P = \frac{a^2 b^3}{c\sqrt{d}}$$

$$100 \times \frac{\Delta P}{P} = \left(2\frac{\Delta a}{a} + 3\frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{1}{2}\frac{\Delta d}{d}\right) \times 100$$

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

$= 13\%$

Question H/W

If temperature $T_1 = (340K \pm 5K)$ and $T_2 = (300K \pm 10K)$. Find error in tempearure difference?

1. 50K
2. 40K
3. 15K
4. 5K

Question

H/W

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

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

Question

H/w

The temperature of two bodies measured are $\theta_1 = 10°C \pm 0.4°C$ and $\theta_2 = 40°C \pm 0.3°C$. Find the sum and difference in temperature with error limit.

Question

H/w

Percentage error in measuring the radius and mass of a solid sphere are 2% & 1% respectively. Then error in measurement of moment of inertia with respect to its diameter is:

1. 3%
2. 6%
3. 5%
4. 4%

Question H/W

The resistance of a conductor $R = V/I$ where $V = (50 \pm 2)$ volt and $I = (9 \pm 0.3)$ Amp, find percentage error in R. aAlso find absolute error in R.

Question

H/W

If percentage error in speed and mass are 1% and 2% then find percentage error in K.E.

Question

H/W

Find percentage error in length of simple pendulum if percentage error in time is 4% and acceleration due to gravity is 2%.

Question

H/W

The radius of a sphere is (5.3 ± 0.1) cm. The percentage error in its volume is

1. $\frac{0.1}{5.3} \times 100$
2. $3 \times \frac{0.1}{5.3} \times 100$
3. $\frac{3}{2} \times \frac{0.1}{5.3} \times 100$
4. $6 \times \frac{0.1}{0.3} \times 100$

Question

H/W

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:

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

Question

A force F is applied on a square area of side L. If the percentage error in the measurement of L is 2% and that in F is 4%, what is the maximum percentage error in pressure?

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

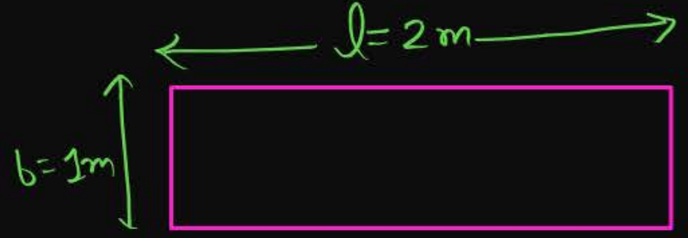
Question

Note me

l Δl b Δb

A rectangular plate has length (2 ± 0.02) cm and width (1 ± 0.01) cm. The maximum percentage error in the measurement of its area is

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



$$A = l \times b$$

$$100 \times \left[\frac{\Delta A}{A}\right] = \left[\frac{\Delta l}{l} + \frac{\Delta b}{b}\right] \times 100$$

$$= \left[\frac{0.02}{2} + \frac{0.01}{1}\right] \times 100 = 0.02 \times 100 = 2\%$$

Question likho

A body of mass (5 ± 0.5) kg is moving with a velocity of (20 ± 0.4) m/s. Its kinetic energy will be

[13 Apr, 2023]

1. (1000 ± 140) J ✓
2. (1000 ± 0.14) J ✗
3. (500 ± 0.14) J ✗
4. (500 ± 140) J ✗

MRX → ek soch hai

$m = (5 \pm 0.5)$ kg

$V = (20 \pm 0.4)$ m/s

$K.E = \frac{1}{2}mv^2 = \frac{1}{2}5(20)^2 = \frac{1}{2}5 \times 400 = 1000$

$\frac{\Delta K.E}{K.E} = \frac{\Delta m}{m} + 2\frac{\Delta v}{v}$

$\Delta K.E = K.E\left(\frac{\Delta m}{m} + 2\frac{\Delta v}{v}\right) = 1000\left[\frac{0.5}{5} + 2\frac{\times 0.4}{20}\right]$

$= 1000 \times 0.14 = 140$ J

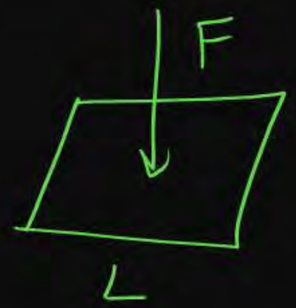
9:55 → 10:00

Jisne 6 spam kiya
tha Neet ki
Kasa
hai Next
5 mint
1 leg start

Question

A force F is applied on a square area of side L. If the percentage error in the measurement of L is 2% and that in F is 4%, what is the maximum percentage error in pressure?

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



$$P = \frac{F}{A} = \frac{F}{L^2}$$

$$100 \times \left[\frac{\Delta P}{P}\right] = \left[\frac{\Delta F}{F} + 2\frac{\Delta L}{L}\right] \times 100$$

$$= [4\% + 2 \times 2\%]$$

$$= 8\%$$

Question

A cylindrical wire of mass (0.4 ± 0.01)g has length (8 ± 0.04) cm and radius (6 ± 0.03)mm. The maximum error in its density will be **[08 Apr, 2023]**

1. 1%
2. 3.5%
3. 4%
4. 5%

$M = (0.4 \pm 0.01)\,g$

$l = (8 \pm 0.04)\,cm$

$R = (6 \pm 0.03)\,mm$

$$\rho = \frac{M}{\pi R^2 l}$$

$$100 \times \frac{\Delta\rho}{\rho} = \left[\frac{\Delta M}{M} + 2\frac{\Delta R}{R} + \frac{\Delta l}{l}\right] \times 100$$

$$= \left[\frac{0.01\,g}{0.4\,g} + \frac{2 \times 0.03}{6} + \frac{0.04}{8}\right] \times 100$$

$$= \frac{1}{0.4} + \frac{2}{6} + \frac{4}{82}$$

$$= 2.5 + 1 + 0.5 = 4\%$$

32%

(a) wrong → गदहे 5 पचपन मारना है (Mausi Kasam)

✓(b) correct

Question

If $Z = \frac{A^2B^3}{C^4}$, then the relative error in Z will be:

[25 June, 2022]

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

Question (imp* question)

A public park, in the form of a square, has an area of $(100 \pm 0.2)\ m^2$. The side of park is

1. (10 ± 0.01) m — 40%
2. (10 ± 0.1)m
3. (10 ± 0.02) m
4. (10 ± 0.2)m

$A = (100 \pm 0.2)\ m^2$

$A = 100\ m^2$

$\Delta A = 0.2\ m^2$

$l = \sqrt{A}$

$\Delta l = \sqrt{\Delta A}$ ✗

$l^2 = A$

$l = \sqrt{A} = \sqrt{100} = 10$

$l = A^{1/2}$

$\frac{\Delta l}{l} = \frac{1}{2}\frac{\Delta A}{A}$

Rdude

$\Delta l = \frac{l}{2}\frac{\Delta A}{A}$

$= \frac{10}{2} \times \frac{0.2}{100}$ (0.1)

$\Delta l = 0.01$

Question

A torque meter is calibrated to reference standards of mass, length and time each with 5% accuracy. After calibration, the measured torque with this torque meter will have net accuracy

[27 July, 2022]

1. 15%
2. 25%
3. 75%
4. 5%

$F = mLT^{-2}$

$\frac{\Delta F}{F} = \frac{\Delta m}{m} + \frac{\Delta L}{L} + 2\frac{\Delta T}{T}$

$\tau = mL^2T^{-2}$

$\% \text{ error} = \frac{\Delta \tau}{\tau} = \left[\frac{\Delta m}{m} + 2\frac{\Delta L}{L} + 2\frac{\Delta T}{T}\right] \times 100$

$= 5\% + 2 \times 5 + 2 \times 5\%$

$= 25\%$

Question

The acceleration due to gravity is measured on the surface of earth by using a simple pendulum. If α and β are relative errors in the measurement of length and time period respectively, then percentage error in the measurement of acceleration due to gravity is

1. $\left(\alpha + \frac{1}{2}\beta\right)$
2. $(\alpha - 2\beta)$
3. $(2\alpha + \beta) \times 100$
4. $(\alpha + 2\beta) \times 100$

Ans

error me se error subtract नहीं होता।

$T = 2\pi\sqrt{\frac{l}{g}}$

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

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

$2\frac{\Delta T}{T} = \frac{\Delta l}{l} + \frac{\Delta g}{g}$

$\frac{\Delta g}{g} = \left(2\frac{\Delta T}{T}\right) + \left(\frac{\Delta l}{l}\right)$

$(\omega) \times \frac{\Delta g}{g} = (2\beta + \alpha)\omega$

$a = LT^{-2}$

$= \frac{\Delta L}{L} + 2\frac{\Delta T}{T}$

The time period of a simple pendulum is given by $T = 2\pi\sqrt{\frac{l}{g}}$. The measured value of the length of pendulum is 10 cm known to a 1 mm accuracy. The time for 200 oscillations of the pendulum is found to be 100 second using a clock of 1 s resolution. The percentage accuracy in the determination of 'g' using this pendulum is 'x'. The value of 'x' to the nearest integer is,

A 0.03

B 0.05

C 0.04

D 0.02

IIT-Advance level

10 cm = 100 mm

Absolute error is = least count of the instrument

$g = L T^{-2}$

$100 \times \frac{\Delta g}{g} = \left[\frac{\Delta L}{L} + 2\frac{\Delta T}{T}\right] \times 100$

$100 \times \frac{\Delta g}{g} = \left[\frac{1\,mm}{10\,cm} + 2\frac{1\,sec}{100\,sec}\right] \times 100$

$\%\ erring = \left[\frac{1\,mm}{100\,mm} + \frac{2}{100}\right] \times 100$

% erring = 3%

% error = 1 + 2 = 3%

$= 3\% = \frac{3}{100}$

Question गिनती

Measured mass of object is 2.5 gram find absolute and percentage error in measurement of mass. **[IIT 2006]**

Measure value of mass $\Rightarrow M = 2.5$ gm

$\Delta m = 0.1$ gm → absolute error

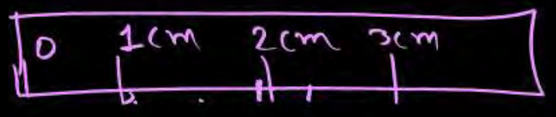
$\%$ error $= \frac{\Delta m}{m} \times 100 = \frac{0.1\,g}{2.5\,g} \times 100$

$= \frac{1}{25} \times 100$

$= 4\%$

least count = max^m error Produced by instrument = absolute error

$l = 4$ cm	$l = 4.3$ cm	$l = 4.38$ cm
$\Delta l = 1$ cm	$\Delta l = 0.1$ cm	$\Delta l = 0.01$ cm



L.C = max^n cm = 1cm

absolute

Question

A silver wire has a mass (0.6 ± 0.006)g, radius (0.5 ± 0.005)mm and length (4 ± 0.04)cm. The maximum percentage error in the measurement of its density will be:

[27 June, 2022]

1. 4%
2. 3%
3. 6%
4. 7%

Question

H/W

A physical 'y' is represented by the formula $y = m^2 r^{-4} g^x \ell^{-\frac{3}{2}}$ if the percentage errors found in y, m, r, ℓ and g are $18, 1, 0.5, 4$ and p respectively, then find the value of x and p.

[24 July 2021]

1. 5 and ± 2
2. $\frac{16}{3}$ and $\pm\frac{3}{2}$
3. 8 and ± 2
4. 4 and ± 3

Question H/W

The resistance $R = \frac{V}{I}$, where $V = (50 \pm 2)V$ and $I = (20 \pm 0.2)$A. The percentage error in R is 'x'%. The value of 'x' to the nearest integer is _____.

[16 March, 2021]

Question

The radius of a sphere is measured to be (7.50 ± 0.85)cm. Suppose the percentage error in its volume is x. The value of x, to the nearest integer, is _____.

[18 March, 2021]

Question

H/W

In the experiment of Ohm's law, a potential difference of 5.0 V is applied across the end of a conductor of length 10.0 cm and diameter of 5.00 mm. The measured current in the conductor is 2.00 A. The maximum permissible percentage error in the resistivity of the conductor is: **[18 March, 2021]**

1. 3.9
2. 8.4
3. 3.0
4. 7.5

Question

H/W

A wire of 1Ω has a length of 1 m. It is stretched till its length increases by 25%. The percentage change in resistance to the nearest integer is: **[26 Feb, 2021]**

1. 56%
2. 76%
3. 12.5%
4. 25%

Question

M/W

The least count of a stop watch is 1/5 second. The time of 20 oscillations of a pendulum is measured to be 25 seconds. The maximum percentage error in the measurement of time will be

1. 0.1%
2. 0.8%
3. 1.8%
4. 8%

Question

H|W

If the length of the pendulum in pendulum clock increases by 0.1%, then the error in time per day is

[26 Aug, 2021]

1. 8.64 s
2. 43.2 s
3. 86.4 s
4. 4.32 s

Question

The period of oscillation of a simple pendulum is given by $T = \pi\sqrt{l/g}$, where l is about 100 cm and is known to have 1 mm accuracy. The time of 100 oscillations is measured by a stop watch of least count 0.1 s. The percentage error in g is:

[BHU 2006]

1. 0.1%
2. 1%
3. 0.2%
4. 0.8%

Question

Note में लिखना है।

$\cot \pi/6 = \frac{1}{\tan 30^\circ} = \sqrt{3}$

$y = \sin\theta$ find percentage error in y if percentage error in θ is 2% at $\theta = \pi/6$ rad.

$y = \sin\theta$

diff^n w.r.t θ

$\frac{dy}{d\theta} = \cos\theta$

$dy = \cos\theta\, d\theta$ — (1)

$\frac{dy}{y} = \frac{\cos\theta\, d\theta}{\sin\theta}$

$\frac{\Delta\theta}{\theta} \times 100 = 2\%$

$\left(\frac{\Delta y}{y}\right) = ??$ at $\theta = \pi/6$ rad.

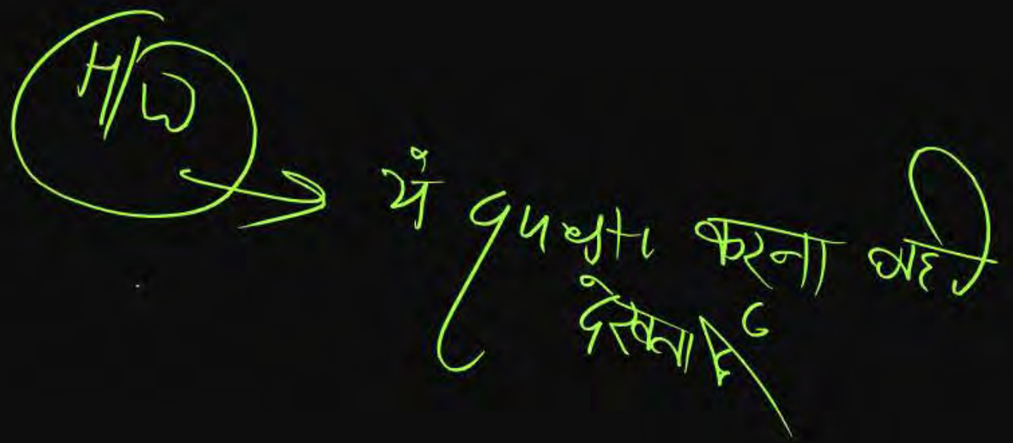
$\frac{dy}{y} = \cot\theta \frac{d\theta}{\theta} \times \theta \times 1$

$= \cot \pi/6 \times 2 \times \frac{\pi}{6} = \frac{\pi}{\sqrt{3}}$

y-पार्ट एवर पर क्वे।

Question

If $= y = m \tan \theta$, where m is constant then find angle at which percentage error in 'y' will be minimum.



$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{R_2} = \frac{1}{R_1} + \frac{1}{R_2}$$

→ aise formula ka error next class me karenge.

THANK YOU