Units & Measurement and Dimensions

Question1

A physical quantity ' X ' is related to four measurable quantities ' a ', ' b ', ' c ' and ' d ' as $\mathrm{X}=\mathrm{a}^2 \mathrm{~b}^3 \mathrm{c}^{5/2} \mathrm{~d}^{-2}$. The percentage error in the measurement of 'a', 'b', 'c' and 'd' are 1%, 2%, 2% and 4% respectively. The percentage error in measurement of quantity ' X ' is

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Options:

A.

15%

B.

17%

C.

21%

D.

23%

Answer: C

Solution:

Given: $X=a^2 b^3 c^{5/2} d^{-2}$

$\%$ Error contributed by $\mathrm{a}=2 \times\left(\frac{\Delta \mathrm{a}}{\mathrm{a}} \times 100\right)$

$=2\%$

% Error contributed by b $= 3 \times \left(\frac{\Delta b}{b} \times 100\right)$

$= 6\%$

% Error contributed by c $= \frac{5}{2} \times \left(\frac{\Delta c}{c} \times 100\right)$

$= 5\%$

% Error contributed by d $= 2 \times \left(\frac{\Delta d}{d} \times 100\right)$

$= 8\%$

$\therefore$ Percentage error in X is given as, $\frac{\Delta X}{X} \times 100 =$ (% error contributed by a)

+(% error contributed by b)

+(% error contributed by c)

+(% error contributed by d))

$= (2 + 6 + 5 + 8)\%$
$= 21\%$

Question2

In an experiment four quantities p, q, r and s are measured with percentage $3\%, 2\%, 3\%$ and 1% respectively. Quantity ' A ' is calculated as follows

$A = \frac{pq^2}{r^2 s^4}$, the percentage error in ' A ' is

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Options:

A.

17%

B.

12%

C.

18%

D.

19%

Answer: A

Solution:

We have: $\mathrm{A}=\frac{\mathrm{pq}^2}{\mathrm{r}^2\ \mathrm{s}^4}$

The percentage errors in the measurements are: $p=3\%$, $q=2\%$, $r=3\%$, $s=1\%$.

Step 1: Find the error contributed by each variable.

For p: Because p is multiplied once, its error is just its percentage error:

$=3\%$

For q: q is squared in the formula, so its error is 2 times its percentage error:

$=2\times2\%=4\%$

For r: r is squared in the denominator. Still, we multiply its percentage error by 2:

$=2\times3\%=6\%$

For s: s is to the power 4 in the denominator, so its error is 4 times its percentage error:

$=4\times1\%=4\%$

Step 2: Add all individual percentage errors to get the total error in A.

Total percentage error in A is:

$3\%+4\%+6\%+4\%=17\%$

Question3

The error in the measurement of length and mass is 3% and 4% respectively. The error in the measurement of density will be

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Options:

A. 6%

B. 13%

C. 9%

D. 15%

Answer: B

Solution:

The density of a cube is:

$\rho=\frac{\mathrm{m}}{l^3}$

The error in density is:

$\frac{\Delta \rho}{\rho}=\frac{\Delta \mathrm{m}}{\mathrm{m}}+3 \frac{\Delta l}{l}$

Given $\frac{\Delta \mathrm{m}}{\mathrm{m}} \times 100=4\%$ and $\frac{\Delta l}{l} \times 100=3\%$:

$\frac{\Delta p}{p}=4\%+3 \times 3\%=13\%$

Question4

A force F is applied on a square plate of side L . If the percentage error in determining F is 3% and that in L is 2%, then the percentage error in determining the pressure is

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Options:

A. 7%

B. 5%

C. 3%

D. 2%

Answer: A

Solution:

A square plate of side L is subjected to force F. The pressure is

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

Step 1: Error propagation formula

For a quantity of the form

$Q = \frac{F^a}{L^b}$,

the percentage error is

$\frac{\Delta Q}{Q} \times 100 = a \cdot \frac{\Delta F}{F} \times 100 + b \cdot \frac{\Delta L}{L} \times 100.$

Step 2: Apply to our case

Here

$P = \frac{F}{L^2}, \quad a = 1, \quad b = 2.$

So

percentage error in $P = (1)(\%$ error in $F) + (2)(\%$ error in $L)$.

Step 3: Substitute values

$= 1 \cdot 3\% + 2 \cdot 2\% = 3\% + 4\% = 7\%.$

✅ **Answer: Option A, 7%**

Question5

A wire has a mass 0.3 ± 0.003 gram, radius 0.5 ± 0.005 mm and length 6 ± 0.06 cm. The maximum percentage error in the measurement of its density is

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Options:

A. 2%

B. 5%

C. 4%

D. 3%

Answer: C

Solution:

Here, $\frac{\Delta \mathrm{m}}{\mathrm{m}}=\frac{.003}{0.3}, \frac{\Delta \mathrm{r}}{\mathrm{r}}=\frac{0.005}{0.5}, \frac{\Delta \mathrm{~L}}{\mathrm{~L}}=\frac{0.06}{6}$

As $\rho=\frac{\mathrm{m}}{\left(\pi \mathrm{r}^2\right) \mathrm{L}}$,

$$\begin{aligned} \therefore\left(\frac{\Delta \rho}{\rho}\right) \times 100 & =\left(\frac{\Delta m}{m}+\frac{\Delta r}{r}+\frac{\Delta L}{L}\right) \times 100 \\ & =\left(\frac{0.003}{0.3}+\frac{2 \times 0.005}{0.5}+\frac{0.06}{6}\right) \times 100 \\ & =1+2+1=4 \% \end{aligned}$$

Question6

The pressure on a square plate is measured by measuring the force acting on the plate and length of the sides of the plate. The maximum error in the measurement of force and length are respectively 4% and 2%, the percentage error in the measurement of pressure is

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Options:

A. 1%

B. 2%

C. 6%

D. 8%

Answer: D

Solution:

Step 1: Formula

Pressure:

$P = \frac{F}{A}$

For a square plate of side L:

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

Step 2: Error propagation

For quantities with powers, percentage (relative) errors add with exponents in absolute value:

$\frac{\Delta P}{P} = \frac{\Delta F}{F} + 2\frac{\Delta L}{L}$

Step 3: Substitute given errors

- Error in F: 4%
- Error in L: 2%

So:

$\%$ error in $P = 4\% + 2 \times 2\% = 4\% + 4\% = 8\%$

✅ Final Answer:

Option D: 8%

Question7

Which of the following comes under the category of random errors?

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Options:

A. Improper calibration of thermometer

B. Zero error of 1μ V in voltmeter

C. Student measures 22°, where as the correct angle is 20°

D. Errors resulting from the fluctuations in electric power supply

Answer: D

Solution:

We need to distinguish between **systematic errors** and **random errors**.

- **Systematic errors**: Repeatable, predictable biases → same direction each time.

  Examples: improper calibration, zero error, personal bias.

- **Random errors**: Caused by unpredictable fluctuations, statistical scatter → vary in magnitude and sign.

Now look at the options:

Option A: Improper calibration of thermometer → **Systematic error**.

Option B: Zero error in voltmeter → **Systematic error**.

Option C: Student measures 22° instead of 20° → That's a human/personal error, a kind of **gross error**, not random.

Option D: Errors due to fluctuations in electric power supply → These are unpredictable fluctuations, so this is a **Random error**.

✅ **Correct Answer: Option D**

Question8

The percentage error in the measurement of mass and speed of a particular body is 3% and 4% respectively. The percentage error in the measurement of kinetic energy is

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Options:

A. 9%

B. 10%

C. 11%

D. 12%

Answer: C

Solution:

The kinetic energy of a body is:

$\text{K.E.} = \frac{1}{2}mv^2$

The percentage error in K.E. is,

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

Given: $\frac{\Delta m}{m} \times 100 = 3\%$ and $\frac{\Delta v}{v} \times 100 = 4\%$:

$\therefore \quad \frac{\Delta \text{ K.E.}}{\text{K.E.}} \times 100 = 3\% + 2(4\%) = 3\% + 8\% = 11\%$

Question9

The period of oscillating simple pendulum is $\mathrm{T} = 2\pi\sqrt{\frac{l}{\mathrm{g}}}$ where length ' l ' is 100 cm with error 1 mm . Period is 2 second. The time of 100 oscillations is measured by a stopwatch of least count 0.1s. The percentage error in gravitational acceleration ' g ' is

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Options:

A. 0.2%

B. 0.1%

C. 1%

D. 2%

Answer: A

Solution:

Step 1. Formula for g

For a simple pendulum:

$T = 2\pi\sqrt{\frac{l}{g}} \quad \Rightarrow \quad g = \frac{4\pi^2 l}{T^2}$

Step 2. Error propagation relation

Fractional error:

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

Step 3. Length error

Length: $l = 100\,\text{cm} = 1.00\,\text{m}$

Error = 1 mm = 0.001 m.

Relative error:

$\frac{\Delta l}{l} = \frac{0.001}{1.000} = 0.001 = 0.1\%$

Step 4. Time error

Period $T = 2\,\text{s}$.

For 100 oscillations measured time = $100 \times 2 = 200\,\text{s}$.

Stopwatch least count = 0.1 s.

So measurement error in total time = ±0.1 s.

Relative error in total time:

$\frac{0.1}{200} = 5 \times 10^{-4} = 0.05\%$

Relative error in period T is the same (since $T_{\text{meas}} = \frac{t}{100}$).

So

$\frac{\Delta T}{T} \approx 0.05\%$

Thus contribution in g:

$2\frac{\Delta T}{T} = 0.10\%$

Step 5. Total % error

$\frac{\Delta g}{g} = 0.1\% + 0.1\% = 0.2\%$

✅ **Final Answer: Option A — 0.2%**

Question10

Error in the measurement of radius of the sphere is 2%. The error in the calculated value of its volume is

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Options:

A. 3%

B. 2%

C. 6%

D. 9%

Answer: C

Solution:

We are asked:

Error in measurement of radius of a sphere is 2%. The error in the calculated value of its volume is?

Step 1: Recall formula of volume of a sphere

$V = \frac{4}{3}\pi r^3$

Step 2: Propagation of error rule

If a quantity depends as x^n, the *percentage error* in the quantity is:

$\frac{\Delta Q}{Q} \times 100\% \;=\; n \cdot \frac{\Delta x}{x} \times 100\%$

Step 3: Apply it here

$V \propto r^3$

So percentage error in V is

$\Delta V\% = 3 \cdot \Delta r\%$

Step 4: Substitute value

$\Delta r = 2\% \quad \Rightarrow \quad \Delta V = 3 \times 2\% = 6\%.$

✅ Correct Option: **C) 6%**

Question11

A physical quantity A can be determined by measuring parameters $\mathrm{B, C, D}$ and E using the relation $A = \frac{B^\alpha C^\beta}{D^\gamma E^\delta}$. If the maximum errors

in the measurement are $\mathrm{b}\%, \mathrm{c}\%,\ \mathrm{d}\%$ and $\mathrm{e}\%$ then maximum error in the value of A is

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Options:

A. $(\alpha b+\beta c-\gamma d-\delta e) \%$

B. $(b+c-d-e) \%$

C. $(\alpha b+\beta c+\gamma d+\delta e) \%$

D. $(b+c+d+e) \%$

Answer: C

Solution:

Given: $A=\frac{B^\alpha C^\beta}{D^\gamma E^\delta}$

Error contributed by $\mathrm{B}=\alpha \times\left(\frac{\Delta \mathrm{B}}{\mathrm{B}} \times 100\right)$

$=\alpha \times b \%$

Error contributed by $\mathrm{C}=\beta \times\left(\frac{\Delta \mathrm{C}}{\mathrm{C}} \times 100\right)$

$=\beta \times c \%$

Error contributed by $\mathrm{D}=\gamma \times\left(\frac{\Delta \mathrm{D}}{\mathrm{D}} \times 100\right)$

$=\gamma \times \mathrm{d} \%$

Error contributed by $\mathrm{E}=\delta \times\left(\frac{\Delta \mathrm{E}}{\mathrm{E}} \times 100\right)$

$=\delta \times \mathrm{e} \%$

$\therefore$ Percentage error in A is given as,

$\frac{\Delta A}{A} \times 100=(\%$ error contributed by $B)$

+(% error contributed by C)

+(% error contributed by D)

+(% error contributed by E)

$=(\alpha b+\beta c+\gamma d+\delta e) \%$

Question12

The density of a cube is measured by measuring its mass and length of its sides. The \% error in the measurement of mass and length are 5% and 6% respectively. The percentage error in the measurement of density is

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Options:

A. 21%

B. 23%

C. 25%

D. 27%

Answer: B

Solution:

Let mass of the cube be m and length of the side be a.

Density, ρ, is given by:

$\rho = \frac{m}{a^3}$

Let the percentage error in mass be $\Delta m\% = 5\%$ and in length be $\Delta a\% = 6\%$.

According to error propagation rules (in products and powers):

$\frac{\Delta\rho}{\rho} \times 100 = \left(\frac{\Delta m}{m} + 3\frac{\Delta a}{a}\right) \times 100$

But since we are given the percentage errors directly, sum them (with powers as multipliers):

Total percentage error in $\rho =$ percentage error in $m + 3 \times$ percentage error in a

Substitute the values:

Total percentage error $= 5\% + 3 \times 6\%$

Total percentage error $= 5\% + 18\% = 23\%$

Correct option:

Option B: 23%

Question13

A student measures time for 20 oscillations of a simple pendulum as $30 \mathrm{~s}, 32 \mathrm{~s}, 35 \mathrm{~s}$ and 35 s . If the minimum division in the measuring clock is 1 s , then correct mean time (in second) is

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Options:

A. (33 ± 2)

B. (32 ± 3)

C. (33 ± 3)

D. (32 ± 2)

Answer: A

Solution:

Given times for 20 oscillations: $30 \mathrm{~s}, ~32 \mathrm{~s}, ~35 \mathrm{~s}, ~35 \mathrm{~s}$

Minimum division of clock: $1 \mathrm{~s}$

Step 1: Calculate the mean time

Mean time, $\bar{t}$:

$\bar{t}=\frac{30+32+35+35}{4}=\frac{132}{4}=33 \mathrm{~s}$

Step 2: Find the absolute errors

List the deviations from the mean:

- $|30-33|=3$
- $|32-33|=1$
- $|35-33|=2$
- $|35-33|=2$

Sum of absolute errors: $3+1+2+2=8$

Step 3: Calculate mean absolute error

Mean absolute error, Δt:

$\Delta t = \frac{8}{4} = 2$ s

Step 4: Instrument Least Count

The least count is 1 s. Mean absolute error (2 s) is greater than least count, so error is 2 s.

Step 5: Express final result

Final result:

(33 ± 2) s

Correct answer: Option A

(33 ± 2)

Question14

The initial and final temperatures of water as recorded by an observer are $(38.6 \pm 0.2)^\circ\text{C}$ and $(82.3 \pm 0.3)^\circ\text{C}$. The rise in temperature with proper error limits is

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Options:

A. $(43.7 \pm 0.2)^\circ\text{C}$

B. $(43.7 \pm 0.3)^\circ\text{C}$

C. $(43.7 \pm 0.1)^\circ\text{C}$

D. $(43.7 \pm 0.5)^\circ\text{C}$

Answer: D

Solution:

Given:

- Initial temperature, $T_1 = (38.6 \pm 0.2)^\circ\text{C}$

- Final temperature, $T_2 = (82.3 \pm 0.3)°\mathrm{C}$

Step 1: Calculate the rise in temperature

$\Delta T = T_2 - T_1 = 82.3 - 38.6 = 43.7°\mathrm{C}$

Step 2: Calculate the error in the rise

When we subtract (or add) two measured quantities, the *absolute errors* get **added**:

$\Delta(\Delta T) = \Delta T_1 + \Delta T_2 = 0.2 + 0.3 = 0.5°\mathrm{C}$

Step 3: Write the result with proper error limits

$\Delta T = (43.7 \pm 0.5)°\mathrm{C}$

Final Answer:

Option D

$\boxed{(43.7 \pm 0.5)°\mathrm{C}}$

Question15

If L is the inductance and R is the resistance then the SI unit of $\frac{L}{R}$ is

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Options:

A. second

B. volt

C. ampere

D. per second

Answer: A

Solution:

Given: $\frac{L}{R}$, where L is inductance and R is resistance.

Let us find the SI unit of each:

- **Inductance (L):** SI unit is henry (H)
- **Resistance (R):** SI unit is ohm (Ω)

Now, express both units in terms of base SI units:

- $1\,\mathrm{H} = 1\,\dfrac{\mathrm{V} \cdot \mathrm{s}}{\mathrm{A}}$
- $1\,\Omega = 1\,\dfrac{\mathrm{V}}{\mathrm{A}}$

Now, find the unit of $\dfrac{L}{R}$:

$$\frac{L}{R} = \frac{\text{henry}}{\text{ohm}} = \frac{\frac{\mathrm{V} \cdot \mathrm{s}}{\mathrm{A}}}{\frac{\mathrm{V}}{\mathrm{A}}}$$

Dividing the fractions:

$$= \frac{\mathrm{V} \cdot \mathrm{s}}{\mathrm{A}} \times \frac{\mathrm{A}}{\mathrm{V}} = \mathrm{s}$$

So, the SI unit of $\frac{L}{R}$ is **second**.

Correct option: Option A (second)

Question16

The formula for the physical quantity is $\mathrm{P} = \frac{\mathrm{x}^3\mathrm{y}}{\mathrm{z}^2}$ and the percentage error in the determination of physical quantities $\mathrm{x}, \mathrm{y}, \mathrm{z}$ are 0.6%, 3% and 1.3% respectively. The percentage error in the measurement of P is

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Options:

A. 2.2%

B. 4.9%

C. 5.3%

D. 7.4%

Answer: D

Solution:

Given:

$$P = \frac{x^3 y}{z^2}$$

Percentage errors:

Error in $x = 0.6\%$

Error in $y = 3\%$

Error in $z = 1.3\%$

Step 1: Formula for percentage error propagation

For a formula $Q = \dfrac{a^p b^q}{c^r}$,

the total percentage error in Q is:

Percentage error in $Q = |p|(\text{Error in } a) + |q|(\text{Error in } b) + |r|(\text{Error in } c)$

Step 2: Apply the values for exponents and errors

Here,

- Power of x is 3.
- Power of y is 1.
- Power of z is 2 (in the denominator, so power is -2, but we take its absolute value).

So,

Percentage error in $P = 3 \times (\text{Error in } x) + 1 \times (\text{Error in } y) + 2 \times (\text{Error in } z)$

Step 3: Substitute the given values

$= 3 \times 0.6\% + 1 \times 3\% + 2 \times 1.3\%$

$= 1.8\% + 3\% + 2.6\%$

$= (1.8 + 3 + 2.6)\%$

$= 7.4\%$

Step 4: Write the final answer

The percentage error in the measurement of P is $\boxed{7.4\%}$.

Correct option: D

Question17

Let σ and b be Stefan's constant and Wien's constant respectively, then dimensions of σb are

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Options:

A. $\left[L^1 M^{-1} T^{-3} K^{-3}\right]$

B. $\left[L^1 M^1 T^3 K^{-3}\right]$

C. $\left[L^{-1} M^1 \mathrm{~T}^{-3} \mathrm{~K}^{-3}\right]$

D. $\left[L^1 M^1 T^{-3} K^{-3}\right]$

Answer: D

Solution:

Dimensions of Stefan's constant,

$$[\sigma]=\frac{[u]}{[A][T]^4}=\frac{\left[\mathrm{ML}^2 \mathrm{~T}^{-2}\right] /[T]}{\left[L^2 \mathrm{~K}^4\right]}$$
$$=\left[\mathrm{MT}^{-3} \mathrm{~K}^{-4}\right]$$

Dimensions of Wien's constant,

$$[b]=[\lambda][T]=[\mathrm{LK}]$$
$$\therefore \text { Dimensions of }[\sigma b]=\left[\mathrm{MT}^{-3} \mathrm{~K}^{-4}\right][\mathrm{LK}]$$
$$=\left[L^1 M^{\top} T^{-3} K^{-3}\right]$$

Question18

Let $x=\pi R\left(\frac{P^2-Q^2}{2}\right)$, where P, Q and R are lengths. The physical quantity x is

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Options:

A. area

B. length

C. volume

D. velocity

Answer: C

Solution:

Given, $x=\pi R\left(\frac{P^2-Q^2}{2}\right)$

where, P, Q and R are lengths.

So, units of P, Q and R are metre.

$\therefore \quad$ Unit of $x=\mathrm{m}^3$

Which is unit of volume.

Question19

Let force $F=A \sin (C t)+B \cos (D x)$, where x and t are displacement and time, respectively. The dimensions of $\frac{C}{D}$ are same as dimensions of

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Options:

A. angular velocity

B. velocity

C. angular momentum

D. velocity gradient

Answer: B

Solution:

Given, force, $F=A\sin(Ct)+B\cos(Dx)$

Here, (Ct) and (Dx) are dimensionless as they represents angles.

$\therefore \quad [C]=\frac{1}{[t]}=\left[\mathrm{T}^{-1}\right]$

and $\quad [D]=\frac{1}{[x]}=\left[\mathrm{L}^{-1}\right]$

Dimensions of $\frac{[C]}{[D]}=\frac{\left[\mathrm{T}^{-1}\right]}{\left[\mathrm{L}^{-1}\right]}=\left[\mathrm{LT}^{-1}\right]$

This is same as the dimensions of velocity.

Question20

$\left[\mathrm{L}^2\mathrm{M}^1\,\mathrm{T}^{-2}\right]$ are the dimensions of

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Options:

A. torque

B. force

C. angular acceleration

D. angular momentum

Answer: A

Solution:

Dimension of torque is $\left[L^2\mathrm{M}^1\,\mathrm{T}^{-2}\right]$

Torque $=$ Force $\times$ Perpendicular distance i.e., $\tau=F\times r$

$\therefore$ Dimensional formula of $\tau=\left[\mathrm{ML}^{-2}\right][L]$

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

Question21

The force ' F ' acting on a body of density ' d ' are related by the relation $F = \frac{y}{\sqrt{d}}$. The dimensions of ' y ' are

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Options:

A. $\left[\mathrm{L}^{-\frac{1}{2}} \mathrm{M}^{\frac{3}{2}} \mathrm{~T}^{-2}\right]$

B. $\left[L^{-1} M^{\frac{1}{2}} T^{-2}\right]$

C. $\left[L^{-1} M^{\frac{3}{2}} T^{-2}\right]$

D. $\left[\mathrm{L}^{-\frac{1}{2}} \mathrm{M}^{\frac{1}{2}} \mathrm{~T}^{-2}\right]$

Answer: A

Solution:

The dimensions of force $[\mathrm{F}] = \left[ML \mathrm{~T}^{-2}\right]$

and density $[d] = \left[\mathrm{ML}^{-3} \mathrm{~T}^0\right]$

From the given relation, $F = \frac{y}{\sqrt{d}}$

$\Rightarrow \quad y = F\sqrt{d}$

Substituting the above dimensions, we get

$[y] = [\mathrm{F}][\mathrm{d}]^{1/2} = \left[ML \mathrm{~T}^{-2}\right]\left[\mathrm{ML}^{-3} \mathrm{~T}^0\right]^{1/2}$

$$= \left[M^{3/2} L^{-1/2} T^{-2}\right]$$

Question22

The dimensions of self or mutual inductance are given as

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Options:

A. $\left[L^{-2}M^{1}T^{-2}I^{-2}\right]$

B. $\left[L^{2}M^{2}T^{-2}I^{-2}\right]$

C. $\left[L^{2}M^{1}T^{-2}\right|^{-2}\right]$

D. $\left[L^{2}M^{2}T^{-2}I^{-2}\right]$

Answer: C

Solution:

The self or mutual inductance of a coil is the flux change due to change in current, i.e.

Lor $M = \frac{\phi}{l}$

So, dimensions of Mutual Inductance or Self-Inductance can be given by

$$\Rightarrow \quad [L] = \frac{[\phi]}{[l]}$$
$$= \frac{\left[ML^{2} T^{-2} I^{-1}\right]}{\left[M^{0} L^{0} I^{1}\right]} = \left[ML^{2} T^{-2} I^{-2}\right]$$

Question23

The ratio of the dimensions of Planck's constant to that of moment of inertia is the dimensions of

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Options:

A. angular momentum

B. velocity

C. frequency

D. time

Answer: C

Solution:

The dimensions of Planck's constant,

$$[\mathrm{h}]=\frac{[\mathrm{E}]}{[\mathrm{v}]}=\frac{\left[\mathrm{ML}^2 \mathrm{~T}^{-2}\right]}{\left[\mathrm{M}^0 \mathrm{~L}^0 \mathrm{~T}^{-1}\right]}=\left[\mathrm{ML}^2 \mathrm{~T}^{-1}\right]$$

and that moment of inertia,

$$[I]=[M][R]^2=[M][L]^2=\left[\mathrm{ML}^2 \mathrm{~T}^0\right]$$

$$\therefore \quad \frac{[\mathrm{h}]}{[I]}=\frac{\left[\mathrm{ML}^2 \mathrm{~T}^{-1}\right]}{\left[\mathrm{ML}^2 \mathrm{~T}^0\right]}=\left[\mathrm{T}^{-1}\right]=[\nu]$$

Thus, the ratio of dimensions of Planck's constant to that at moment of inertia is the dimensions of frequency.

Question24

Dimensions of Gyromagnetic ratio are

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Options:

A. $\left[L^1 M^0 T^1 I^1\right]$

B. $\left[L^0 M^{-1} T^1 I^1\right]$

C. $\left[L^1 M^0 T^0 I^{-1}\right]$

D. $\left[L^{-1} M^0 T^1 I^1\right]$

Answer: B

Solution:

Gyromagnetic ratio is the ratio of magnetic dipole moment of revolving electron to its angular momentum,

i.e $\frac{\mu}{L} = \frac{e}{2m_e}$ = gyromagnetic ratio

$$\left[\frac{\mu}{L}\right] = \frac{[\text{ current } \times \text{ time}]}{[\text{ mass }]} = \frac{[\mathrm{A} \times \mathrm{T}]}{[\mathrm{m}]}$$

$$\Rightarrow \quad \left[\frac{\mu}{L}\right] = \left[M^{-1} L^0 T^1 A^1\right] \quad (\because \text{ Current, } I = A)$$

Hence, the dimension of $\left(\frac{\mu}{L}\right)$ is $\left[M^{-1} L^{\circ} T I\right]$
