Units & Measurement and Dimensions

Question1

The number of significant figures in 0.03240 is

AP EAPCET 2025 - 26th May Morning Shift

Options:

A.

5

B.

4

C.

6

D.

3

Answer: B

Solution:

Number of significant figure in 0.03240 = 4

Leading zeros are not significant, while trailing zeros after the decimal point are significant. Therefore, the significant figures are 3, 2, 4 and trailing zero.

Question2

If force $= \frac{\alpha}{\text{density} + \beta^3}$, then the dimensional formulae of α and β are respectively

Options:

A.

$$\left[\text{ML}^2\,\text{T}^{-2}\right], \left[\text{ML}^{-1/3}\,\text{T}^0\right]$$

B.

$$\left[M^2 L^4 T^{-2}\right], \left[M^{1/3} L^{-1} T^0\right]$$

C.

$$\left[\text{M}^2\,\text{L}^{-2}\,\text{T}^{-2}\right], \left[\text{M}^{1/3}\,\text{L}^{-1} mathrm\, T^0\right]$$

D.

$$\left[\text{M}^2\,\text{L}^{-2}\,\text{T}^{-2}\right], \left[\text{ML}^{-3}\,\text{T}^0\right]$$

Answer: C

Solution:

Force $= \frac{\alpha}{\text{density} + \beta^3}$

According to principle of homogeneity,

$$[\beta^3] = [\text{ density }]$$
$$[\beta^3] = [ML^{-3}T^0]$$
$$\Rightarrow \quad [\beta] = \left[M^{\frac{1}{3}} L^{-1} T^0\right]$$

And $[\alpha] = [\text{ density }] \times [\text{ force }]$
$$= \left[\text{ML}^{-3}\,\text{T}^0\right] \times \left[\text{MLT}^{-2}\right]$$
$$= \left[\text{M}^2\,\text{L}^{-2}\,\text{T}^{-2}\right]$$

Question3

If the error in the measurement of the surface area of a sphere is 1.2%, then the error in the determination of the volume of the sphere is

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Options:

A.

2.4%

B.

1.8%

C.

1.2%

D.

0.6%

Answer: B

Solution:

Given:

Error in surface area $S = 1.2\%$

We need to find the percentage error in **volume** V of a sphere.

Relations:

For a sphere of radius r:

$S = 4\pi r^2$

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

Step 1: Express relative errors

For small errors,

$\frac{dS}{S} = 2\frac{dr}{r}$

$$\frac{dV}{V} = 3\frac{dr}{r}$$

Step 2: Connect the two

From the first equation:

$$\frac{dr}{r} = \frac{1}{2}\frac{dS}{S}$$

Substitute into the second:

$$\frac{dV}{V} = 3 \times \frac{1}{2}\frac{dS}{S} = \frac{3}{2}\frac{dS}{S}$$

Step 3: Substitute given error

Error in $V = \frac{3}{2} \times 1.2\% = 1.8\%$

✅ **Final Answer: Option B) 1.8%**

Question4

If the equation for the velocity of a particle at time ' t ' is $v = $ at $+\frac{b}{t+c}$, then the dimensions of a, b, c are respectively

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Options:

A.

$\left[\mathrm{LT}^{-2}\right], [\mathrm{L}], [\mathrm{T}]$

B.

$\left[\mathrm{L}^2\right], [\mathrm{L}], [\mathrm{T}]$

C.

$\left[\mathrm{LT}^{-2}\right], [\mathrm{LT}], [\mathrm{L}]$

D.

$[\mathrm{L}], [\mathrm{LT}], \left[\mathrm{L}^2\right]$

Answer: A

Solution:

Let's restate the given problem carefully:

The velocity of a particle is given by

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

We need to find the **dimensions of a, b, and c**.

Step 1. Dimensional formula of velocity

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

Step 2. Dimensional analysis of first term at

In the expression $v = at + \frac{b}{t+c}$, both terms on the right-hand side must have the **same dimensions** as velocity.

The first term: at

$$[a][t] = [v] = [LT^{-1}]$$

$$[a] = \frac{[LT^{-1}]}{[T]} = [LT^{-2}]$$

So,

$$[a] = [LT^{-2}]$$

Step 3. The second term $\frac{b}{t+c}$

This term must also have the dimensions of velocity:

$$\left[\frac{b}{t+c}\right] = [LT^{-1}]$$

Now, $t + c$ is a sum — you can only **add quantities with the same dimensions**, so:

$$[c] = [t] = [T]$$

Then,

$$[b] = [LT^{-1}] \cdot [t + c] = [LT^{-1}] \cdot [T] = [L]$$

So,

$$[b] = [L]$$

✅ **Final Dimensions:**

$$[a] = [LT^{-2}], \quad [b] = [L], \quad [c] = [T]$$

✅ **Correct Option:**

Option A: $\left[LT^{-2}\right], [L], [T]$

Question5

Of the following, the pair of physical quantities not having the same dimensional formula is

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Options:

A.

work and torque

B.

angular momentum and Planck's constant

C.

stress and linear momentum

D.

surface tension and force constant

Answer: C

Solution:

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

$\Rightarrow$ [Stress] $= \frac{[F]}{[A]} = \frac{[MLT^{-2}]}{[L^2]} = \left[ML^{-1} T^{-2} \right]$

Linear momentum, $p = mv$

$[p] = [m][v]$
$\quad = [M] \left[LT^{-1} \right] = \left[MLT^{-1} \right]$

Question6

The number of significant figures in the simplification of $\frac{0.501}{0.05}(0.312 - 0.03)$ is

Options:

A.

1

B.

3

C.

2

D.

5

Answer: C

Solution:

Significant digit in simplification of $\frac{0.501}{0.05}(0.312 - 0.03)$

In the subtraction of $0.312 - 0.03$.

The number 0.03 has two digits after decimal.

So, $0.312 - 0.03 = 0.282$

But only upto two decimal places it can be written as 0.28 .

Now, $\frac{0.501}{0.05}$ the term 0.05 has two digits after decimal

$\frac{0.501}{0.05} = 10.02 \approx 10$

Now, $10.02 \times 0.28 = 2.8056$

But this number should be rounded of to 2.8 .

So, number of significant digit is 2 .

Question7

The dimensional formula of Planck's constant is

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Options:

A.

$$\left[ML^2\,T^{-3}\right]$$

B.

$$\left[ML^2\,T^0\right]$$

C.

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

D.

$$\left[M^0\,L^0\,T^0\right]$$

Answer: C

Solution:

Let's determine the **dimensional formula of Planck's constant (h)**.

We know from quantum theory:

$E = h\nu$

where

E = energy = $[ML^2T^{-2}]$

ν = frequency = $[T^{-1}]$

So,

$h = \frac{E}{\nu} = [ML^2T^{-2}] \div [T^{-1}] = [ML^2T^{-1}]$

✅ **Therefore, the dimensional formula of Planck's constant is**

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

Correct option: C

Question8

If the maximum and minimum temperatures at a place on a day are measured as $44°\text{C} \pm 0.5°\text{C}$ and $22°\text{C} \pm 0.5°\text{C}$ respectively, then the temperature difference is

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Options:

A.

$22°\text{C} \pm 1°\text{C}$

B.

$22°\text{C} \pm 0.5°\text{C}$

C.

$22°\text{C} \pm 0.25°\text{C}$

D.

$22°\text{C} \pm 1.5°\text{C}$

Answer: A

Solution:

The uncertainty in the difference is the sum of the uncertainties.

i.e. $(0.5 + 0.5) = 1.0°\text{C}$

The difference in the central values

$= 44 - 22 = 22°\text{C}$

Thus, temperature difference

$= 22°\text{C} \pm 1°\text{C}$

Question9

Among the following, the physical quantity having the dimensions of Young's modulus is

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Options:

A.

strain

B.

gravitational potential

C.

surface energy

D.

energy density

Answer: D

Solution:

Young's modulus

$$[Y] = \frac{[\text{ Stress }]}{[\text{ Strain }]} = \frac{\left[\frac{F}{A}\right]}{\left[M^0 \, L^0 \, T^0\right]}$$

$$= \left[\frac{MLT^{-2}}{L^2}\right] = \left[ML^{-1} \, T^{-2}\right]$$

$$[\text{ Energy density }] = \left[\frac{E}{V}\right] = \frac{\left[ML^2 \, T^{-2}\right]}{[L^3]}$$

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

Question10

Which of the following is not a unit of permeability?

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Options:

A. Henry metre $^{-1}$

B. Weber ampere $^{-1}$ metre $^{-1}$

C. Ohm second metre $^{-1}$

D. Volt second metre $^{-1}$

Answer: D

Solution:

The SI unit of permeability μ is henry per metre, i.e.

$[\mu] = \frac{H}{m}$.

Now let's check each option:

Henry metre^{-1}

$\frac{H}{m}$

⇒ correct unit.

Weber ampere^{-1} metre^{-1}

$\frac{Wb}{A\,m} = \frac{(V \cdot s)}{A\,m} = \frac{H}{m}$

⇒ equivalent to H/m.

Ohm second metre^{-1}

$\frac{\Omega \cdot s}{m} = \frac{H}{m}$

(since 1 H = 1 Ω·s)

⇒ also H/m.

Volt second metre^{-1}

$\frac{V \cdot s}{m} = \frac{Wb}{m}$

which is missing the "per ampere" factor, so it is **not** H/m.

Answer: Option D.

Question11

In the equation $\left(p + \frac{a}{V^2}\right)(V - b) = RT$, where p is pressure, V is volume, T is temperature, R is universal gas constant, a and b are constants. The dimensions of a are

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Options:

A. $\left[ML^{-1}\,T^{-2}\right]$

B. $\left[ML^5T^{-2}\right]$

C. $\left[M^0L^3T^0\right]$

D. $\left[ML^3\,T^{-2}\right]$

Answer: B

Solution:

In the given equation, $\left(p + \frac{a}{V^2}\right)(V - b) = RT$, we need to find the dimensions of a.

Since a pressure can only be added to another pressure, this implies that $\frac{a}{V^2}$ must have the same dimensions as pressure p.

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

Solving for a, we get:

$a = p \times V^2$

The dimensions of pressure p are $\left[ML^{-1}T^{-2}\right]$.

The dimensions of volume V are $\left[L^3\right]$.

Therefore, substituting the dimensions into the equation for a:

$[a] = \left[ML^{-1}T^{-2}\right] \times \left[L^3\right]^2$

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

Simplifying, we find:

$[a] = \left[ML^5T^{-2}\right]$

Thus, the dimensions of a are $\left[ML^5T^{-2}\right]$.

Question12

The length of the side of a cube is 1.2×10^{-2} m. Its volume up to correct significant figure is

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Options:

A. $1.732 \times 10^{-6} \text{ m}^3$

B. $1.73 \times 10^{-6} \text{ m}^3$

C. $1.70 \times 10^{-6} \text{ m}^3$

D. $1.7 \times 10^{-6} \text{ m}^3$

Answer: D

Solution:

Given:

The length of the side of the cube, $L = 1.2 \times 10^{-2}\,\text{m}$.

To find the volume of the cube, we use the formula:

Volume of the cube $= L^3 = (1.2 \times 10^{-2})^3$

Calculating the volume:

$= 1.728 \times 10^{-6}\,\text{m}^3$

Since the length L is given with 2 significant figures, the calculated volume should also be expressed in 2 significant figures. Therefore, the volume of the cube is:

$1.7 \times 10^{-6}\,\text{m}^3$

Question13

Find the dimension formula of $\frac{a}{b}$ in the equation $F = a\sqrt{x} + bt^2$, where F is force, x is distance and t is time.

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Options:

A. $\left[M^0 L^{-1/2} T^2\right]$

B. $\left[M^0 L^0 T^{3/2}\right]$

C. $\left[M^0 L^1 T^{-4}\right]$

D. $\left[M^0 L^{3/2} T^4\right]$

Answer: A

Solution:

Given the equation:

$F = a\sqrt{x} + bt^2$

where:

F is force with the SI unit of $\text{kg} \cdot \text{m/s}^2$,

x represents distance in meters (m),

t is time in seconds (s).

From the principle of dimensional consistency, equating similar terms gives us:

$\text{kg} \cdot \text{m/s}^2 = a\sqrt{\text{m}} + bt^2$

Dimensional Analysis

Analyzing $a\sqrt{x}$:

$a\sqrt{x}$ must have the same dimensions as force, i.e., $\text{kg} \cdot \text{m/s}^2$.

For $a\sqrt{\text{m}} = \text{kg} \cdot \text{m/s}^2$,

$a(\text{m}^{1/2}) = \text{kg} \cdot \text{m/s}^2$

Solving for a, we find:

$a = \text{kg} \cdot \dfrac{\text{m}^{1/2}}{\text{s}^2}$

Analyzing bt^2:

bt^2 also has the dimension of force.

For $b(s^2) = \text{kg} \cdot \text{m/s}^2$,

$b = \text{kg} \cdot \text{m/s}^4$

Finding the Ratio $\frac{a}{b}$:

To derive the dimensions of $\frac{a}{b}$:

$$\frac{a}{b} = \frac{\text{kg} \cdot \frac{\text{m}^{1/2}}{\text{s}^2}}{\text{kg} \cdot \text{m/s}^4}$$

Simplifying, we get:

$$= \frac{\frac{1}{\text{m}^{1/2}} \cdot \text{s}^2}{1}$$

The dimensional formula for $\frac{a}{b}$:

$$\left[M^0 L^{-1/2} T^2 \right]$$

Question14

E, M, L, G represent energy, mass, angular momentum and gravitational constant, respectively. The dimensions of $\frac{EL^2}{M^5 G^2}$ will be that of

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Options:

A. angle

B. length

C. mass

D. time

Answer: A

Solution:

The dimensional formulas for energy E, mass M, angular momentum L, and the gravitational constant G are given as follows:

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

$[M] = [M]$

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

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

To find the dimensions of $\frac{EL^2}{M^5G^2}$, we proceed as follows:

$$\Rightarrow \frac{[ML^2T^{-2}][ML^2T^{-1}]^2}{[M^5][M^{-1}L^3T^{-2}]^2}$$

Simplifying further:

$$= \frac{[ML^2T^{-2}][M^2L^4T^{-2}]}{[M^5][M^{-2}L^6T^{-4}]}$$

$$= \frac{[M^3L^6T^{-4}]}{[M^3L^6T^{-4}]}$$

$$= [M^0L^0T^0]$$

This shows that the expression $\frac{EL^2}{M^5G^2}$ is dimensionless. A dimensionless quantity is equivalent to an angle in terms of its dimensional representation.

Question15

The percentage error in the measurement of mass and velocity are 3% and 4%, respectively. The percentage error in the measurement of kinetic energy is

AP EAPCET 2024 - 19th May Evening Shift

Options:

A. 11%

B. 12%

C. 14%

D. 8%

Answer: A

Solution:

The kinetic energy K is given by:

$K = \frac{1}{2}mv^2$

To calculate the percentage error in the measurement of kinetic energy, we apply the rule of propagation of errors. According to this rule, the relative error in multiplication is the sum of the relative errors of the quantities involved. For kinetic energy:

$\frac{\Delta K}{K} \times 100\% = \frac{\Delta m}{m} \times 100\% + 2\frac{\Delta v}{v} \times 100\%$

Given that the percentage error in mass ($\Delta m/m$) is 3% and the percentage error in velocity ($\Delta v/v$) is 4%, we can substitute these values into the formula:

$\frac{\Delta K}{K} \times 100\% = 3\% + 2 \times 4\%$

$= 3\% + 8\%$

$= 11\%$

Thus, the percentage error in the measurement of kinetic energy is 11%.

Question16

The energy of E of a system is function of time t and is given by $E(t) = \alpha t - \beta t^3$, where α and β are constants. The dimensions of α and β are

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Options:

A. $\left[ML^2T^{-1}\right]$ and $\left[ML^2T\right]$

B. $\left[LT^{-1}\right]$ and $[LT]$

C. $\left[ML^2\,T^{-3}\right]$ and $\left[ML^2\,T^{-5}\right]$

D. $\left[MLT^{-1}\right]$ and $[MLT]$

Answer: C

Solution:

Energy of the system as a function of time, $E(t) = \alpha t - \beta t^3$.

Where, α and β are constant.

According to principle of homogenity, dimension of αt = dimension of energy i.e

$\Rightarrow \quad [\alpha][t] = [E]$

$\Rightarrow \quad [\alpha][\text{T}] = \left[\text{ML}^2\,\text{T}^{-2}\right]$

$\Rightarrow \quad [\alpha] = \left[\text{ML}^2\,\text{T}^{-3}\right]$

Again, dimension of βt^3 = dimension of energy

$\Rightarrow \quad [\beta]\left[t^3\right] = \left[\text{ML}^2\,\text{T}^{-2}\right]$

$\Rightarrow \quad [\beta]\left[\text{T}^3\right] = \left[\text{ML}^2\,\text{T}^{-2}\right]$

$\Rightarrow \quad \quad [\beta] = \left[\text{ML}^2\,\text{T}^{-5}\right]$

Question17

In SI units, $\text{kg} - \text{m}^2\,\text{s}^{-2}$ is equivalent to which of the following?

AP EAPCET 2022 - 4th July Evening Shift

Options:

A. Newton

B. Watt

C. Joule

D. Pascal

Answer: C

Solution:

In SI units, we know that:

Work = Force × Displacement

$\quad$ = Mass × Acceleration × Displacement

$\quad$ = $\text{kg} \times \text{m}\,\text{s}^{-2} \times \text{m}$

$\quad$ = $\text{kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$

Therefore, the SI unit of work is $\text{kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$, which is equivalent to a Joule.

Question18

If N_A, N_B and N_C are the number of significant figures in $A = 0.001204$ m, $B = 43120000$ m and $C = 1.200$ m respectively, then

Options:

A. $N_A = N_B = N_C$

B. $N_A > N_B > N_C$

C. $N_A < N_B < N_C$

D. $N_A > N_B < N_C$

Answer: A

Solution:

Given,

$A = 0.001204$ m
$B = 43120000$ m, and $C = 1.200$ m

We know that, zeroes at the right hand side of any number are non significant, hence number of significant figure in B, $N_B = 4$. Zeroes after decimal point and before any number are not significant. Therefore, no. of significant figure in A, $N_A = 4$.

Zeroes at the R.H.S adjacent to number after the decimal point are significant.

$\therefore$ No. of significant figure in C, $N_C = 4$

$\therefore \quad N_A = N_B = N_C = 4$

Question19

Which year was declared as the Internationalyear of Physics?

Options:

A. 2002

B. 2003

C. 2005

D. 2007

Answer: C

Solution:

United State declared 2005 as Internationalyear of Physics, because that was the 100thanniversary of Albert Einstein.

Question20

One angstrom $\left(\overset{o}{A} \right)$ is equal to

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Options:

A. 10^{-6} mm

B. 10^{-7} mm

C. 10^{-8} mm

D. 10^{-9} mm

Answer: B

Solution:

As we know that,

$1\overset{o}{A} = 10^{-10}$ m

and 1 mm = 10^{-3} m

$\therefore 1 \overset{o}{A} = 10^{-7}$ mm

Question21

The dimensions of stress is

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Options:

A. $\left[ML^{-1}\, T^{-2}\right]$

B. $\left[ML^{-3}\, T^{-1}\right]$

C. $\left[ML^{2}T^{-2}\right]$

D. $\left[ML^{-3}\, T^{-2}\right]$

Answer: A

Solution:

As we know that,

Stress = Force / Area

In terms of dimensional formula,

$[\text{ Stress }] = \frac{[MLT^{-2}]}{[L^2]} = \left[ML^{-1}\, T^{-2}\right]$

Question22

The speed of ripples (v) on water surface depends on surface tension (σ), density (ρ) and wavelength (λ). Then, the square of speed (v) is proportional to

Options:

A. $\frac{\sigma}{\rho\lambda}$

B. $\frac{\rho}{\sigma\lambda}$

C. $\frac{\lambda}{\sigma\rho}$

D. $\sqrt{\frac{\rho\lambda}{\sigma}}$

Answer: A

Solution:

Given, speed of ripple of water $= v$

Surface tension $= \sigma$

Density $= \rho$

Wavelength $= \lambda$

As we know that, $\sigma = \frac{\text{Force}}{\text{Length}}$

and dimensional formula of $\sigma = \frac{[MLT^{-2}]}{[L]} = [ML^0T^{-2}]$

and dimensional formula of ρ, v and λ are $[ML^{-3}T^0], [M^0LT^{-1}]$ and $[M^0LT^0]$.

Let $\quad [\sigma] = [\rho]^a[v]^b[\lambda]^c$

$\Rightarrow \quad \left[ML^0\,T^{-2}\right] = \left[ML^{-3}\,T^0\right]^a\left[M^0LT^{-1}\right]^b\left[M^0LT^0\right]^c$
$= \left[M^a\,L^{-3a+b+c}\,T^{-b}\right]$
$\Rightarrow \quad a = 1 \Rightarrow b = 2$
$-3a+b+c = 0 \Rightarrow -3+2+c = 0$
$c = 1$
$\therefore \quad [\sigma] = [\rho]^1[v]^2[\lambda]^1$
Hence, $\quad \sigma \propto \rho v^2 \lambda$
$\Rightarrow \quad v^2 \propto \frac{\sigma}{\rho\lambda}$