Physicsaholics

DPP – 2 (Unit & Dimension)

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Q 1. In $S = a + bt + ct^2$, S is measured in meters and t in seconds. The unit of c is:
(a) ms^{-2} (b) m
(c) ms^{-1} (d) None

Q 2. A physical quantity x depends on quantities y and z as follows:
$x = Ay + B\tan(Cz)$, where A, B and C are constants. Which of the following do not have the same dimensions?
(a) x and B (b) C and z^{-1}
(c) y and B/A (d) x and A

Q 3. In the relation $P = \frac{\alpha}{\beta} e^{-\frac{\alpha z}{k\theta}}$, P is pressure, Z is the distance, k is Boltzmann constant and θ is the temperature. The dimensional formula of β will be
(Hint:- Unit of Boltzmann constant is J/K)
(a) $[M^0L^2T^0]$ (b) $[M^1L^2T^1]$
(c) $[M^1L^0T^{-1}]$ (d) $[M^0L^2T^{-1}]$

Q 4. The radius of nucleus is $r = r_0 A^{1/3}$, where A is mass number. The dimensions of r_0 is:
(a) $[MLT^{-2}]$ (b) $[M^0L^0T^{-1}]$
(c) $[M^0LT^0]$ (d) none of these

Q 5. A and B have different dimensions. Then which of the following relation will be meaningful?
(a) $\left[\frac{A}{B}\right]$ (b) $[A - B]$
(c) $[A + B]$ (d) $\left[e^{\frac{A}{B}}\right]$

Q 6. If $v = \frac{A}{t} + Bt^2 + ct^3$ where v is velocity, t is time A, B and C are constant then the dimensional formula of B is:
(a) $[M^0LT^0]$ (b) $[ML^0T^0]$
(c) $[M^0L^0T^0]$ (d) $[M^0LT^{-3}]$

Q 7. $X = 3YZ^2$ find dimensions of Y in (MKSA) system, if X and Z are the dimensions of capacitance and magnetic field respectively:
[Hint:- Unit of capacitance of a capacitor is $coulamb^2/J$ and unit of magnetic field = kg.$s^{-2}.A^{-1}$]
(a) $[M^{-3}L^{-2}T^{-4}A^{-1}]$ (b) $[ML^{-2}]$

(c) $[M^{-3}L^{-2}T^{4}A^{4}]$ (d) $[M^{-3}L^{-2}T^{8}A^{4}]$

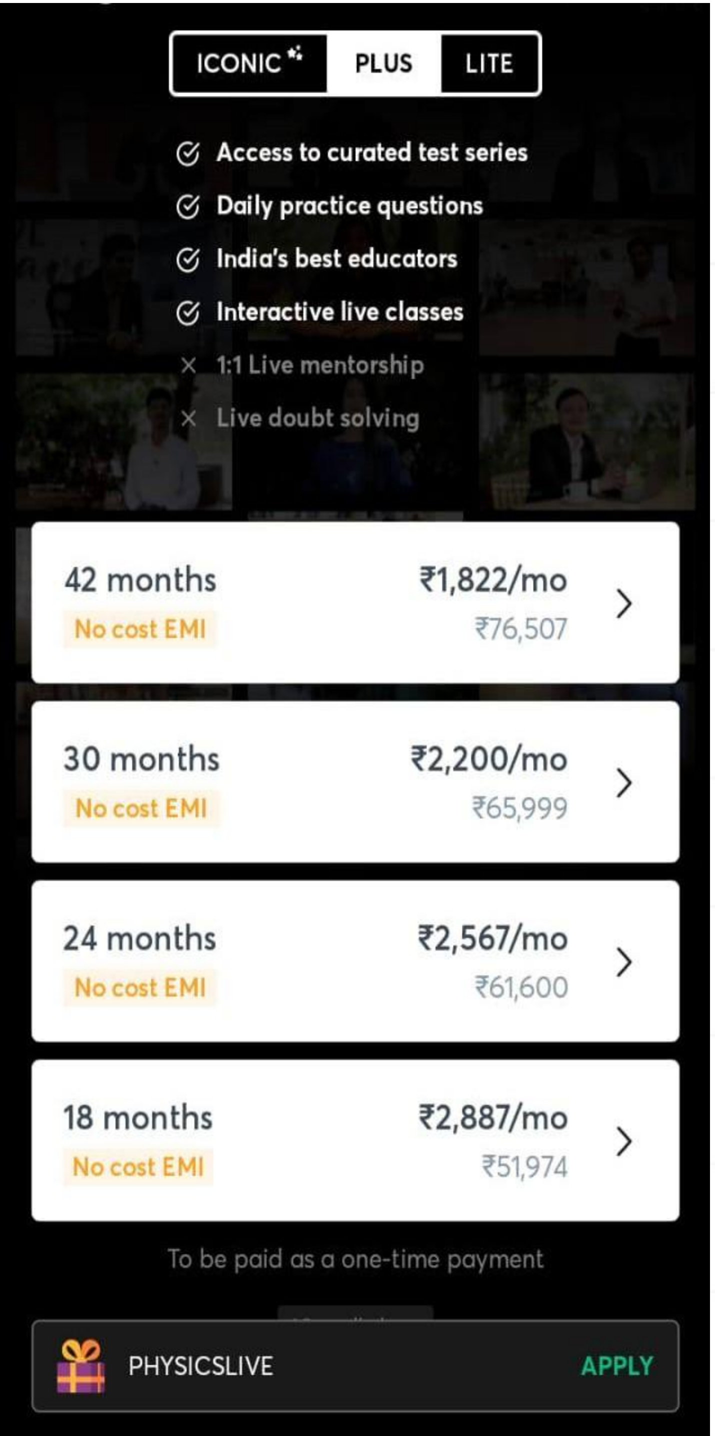
Q 8. The dimensions of $\frac{a}{b}$ in the equation $P = \frac{a-t^2}{bx}$ where P is pressure, x is distance and t is time are:
(a) M^2LT^{-3} (b) MT^{-2} (c) ML^3T^{-1} (d) LT^{-3}

Q 9. The division of energy by time is X. The dimensional formula of X is same as that of [Hint:- Momentum = mass × velocity, Power = force × velocity, Torque = Force × perpendicular distance]
(a) Momentum (b) Power
(c) Torque (d) None of these

Q 10. Write the dimensions of a × b in the relation $E = \frac{b-x^2}{at}$. Where E is the energy, x is the displacement and t is time
(a) ML^2T (b) $M^{-1}L^2T^1$
(c) ML^2T^{-2} (d) MLT^{-2}

Answer Key

Q.1 a	Q.2 d	Q.3 a	Q.4 c	Q.5 a
Q.6 d	Q.7 d	Q.8 b	Q.9 b	Q.10 b



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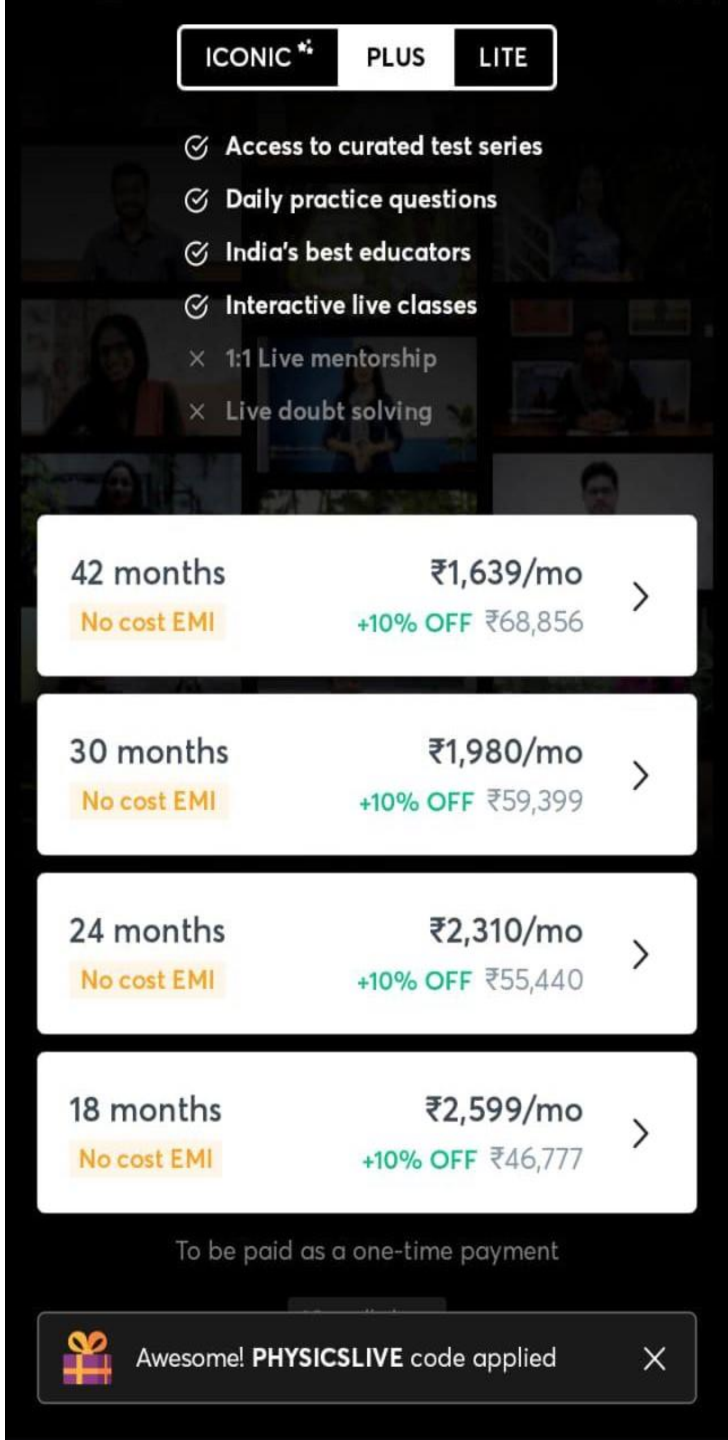

Written Solution

DPP-2 Principle of Homogeneity

By Physicsaholics Team

Solution: 1

$S = a + bt + ct^2$

unit of c = ?

to add two physical quantities their unit should be same.

so; unit of s = unit of a = unit of bt = unit of ct^2

unit of s = m then unit of c = $m s^{-2}$

Ans. a

Solution: 2

$$x = Ay + B\tan(cz)$$

$[c][z]$ = Dimensionless

so, $[c] = [z^{-1}]$

And $[x] = [Ay]$

so,

And $[Ay] = [B]$, $[y] = \left[\frac{B}{A}\right]$

so, $[x] \neq [A]$ $\because [x] = [Ay]$

Ans. d

Solution: 3

$$P = \frac{\alpha}{\beta} e^{-\frac{\alpha Z}{K\theta}}$$

energy $E = \frac{3}{2} K\theta$

Power is dimensionless $\Rightarrow [\alpha] = \left[\frac{K\theta}{Z}\right] = \left[\frac{E}{Z}\right] = \frac{ML^2T^{-2}}{L}$

$\Rightarrow [\alpha] = MLT^{-2}$

Since $e^{-\frac{\alpha Z}{K\theta}}$ is dimensionless. $\Rightarrow [P] = \left[\frac{\alpha}{\beta}\right]$

$\Rightarrow [\beta] = \left[\frac{\alpha}{P}\right] = \frac{MLT^{-2}}{ML^{-1}T^{-2}} = M^0L^2T^0$

Ans. a

Solution: 4

$r = r_0 A^{1/3}$ = Radius of Nuclei

A → Mass number of atom.

= Dimensionless

So, $[r] = [r_0]$

$[r] = L$

So, $[r_0] = L$ or $M^0 L^1 T^0$

Ans. c

Solution: 5

If A & B has different dimensions

then $A \pm B$ = Not possible

$A - B$ = Not Possible

$e^{\frac{A}{B}}$ = Not possible

$\because \frac{A}{B}$ = must have some dimension

but $e^{A/B}$ Power of e

cannot have dimension.

$\therefore \frac{A}{B}$ = Possible only.

Ans. a

Solution: 6

$$V = \frac{A}{t} + Bt^2 + Ct^3$$

$$[V] = \left[\frac{A}{t}\right] = [Bt^2] = [Ct^3]$$

$$[V] = [Bt^2]$$

$$LT^{-1} = [B]T^2$$

$$[B] = LT^{-3} \text{ or } M^0L^1T^{-3}$$

Ans. d

Solution: 7

Unit of capacitance $= \frac{\text{Coulomb}^2}{J} = \frac{A^2 Sec^2}{J}$

$\Rightarrow \quad [X] = \frac{A^2 T^2}{ML^2T^{-2}} = M^{-1}L^{-2}T^4A^2$

$[Z^2] = [B^2] = (MT^{-2}A^{-1})^2 = M^2T^{-4}A^{-2}$ (from unit of magnetic field)

$[Y] = \frac{[X]}{[Z^2]} = \frac{M^{-1}L^{-2}T^4A^2}{M^2T^{-4}A^{-2}} = M^{-3}L^{-2}T^8A^4$

Ans (d)

Solution: 8

$$P = \frac{a - t^2}{bx}$$

for $a - t^2$

$$[a] = [t^2]$$

$$[a] = T^2 \quad \text{— (1)}$$

& $$[P] = \left[\frac{a - t^2}{bx}\right]$$

$$[b] = \frac{[a - t^2]}{[P][x]}$$

$$[b] = \frac{T^2}{M L^{-1} T^{-2} \cdot L}$$

$$[b] = M^{-1} T^4$$

So; $$\left[\frac{a}{b}\right] = \frac{T^2}{M^{-1} T^4} = M^1 T^{-2}$$

or

$$M^1 L^0 T^{-2}$$

$\Rightarrow$ OR

$$P = \frac{a}{bx} - \frac{t^2}{bx}$$

$$\Rightarrow [P] = \left[\frac{a}{bx}\right]$$

$$\Rightarrow \left[\frac{a}{b}\right] = [P][x]$$

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

$$= M^1 L^0 T^{-2}$$

Ans. b

Solution: 9

$$x = \frac{\text{Energy}}{\text{time}}$$

$$x = \frac{ML^2T^{-2}}{T}$$

$$\boxed{x = ML^2T^{-3}}$$

& Power = Energy/time

$$[\text{Power}] = ML^2T^{-3}$$

So; $\boxed{x = \text{Power}}$

Ans. b

Solution: 10

$$E = \frac{b - x^2}{at}$$

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

$[x] = L$

$[t] = T$

$b - x^2 \rightarrow b$ & x^2 will have same dimensions

$[b] = [x^2] = L^2$

& $[at] = \frac{[b - x^2]}{[E]} = \frac{L^2}{ML^2T^{-2}}$

$[a]T = M^{-1}L^0T^2$

$[a] = M^{-1}T^1$

So, $[a \times b] = [a] \times [b]$

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

$[a \times b] = M^{-1}L^2T^1$ Ans

Ans. b

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