## UNIT \& DIMENSION

1. The dimension of $\frac{B^{2}}{2 \mu_{0}}$, where $B$ is magnetic field and $\mu_{0}$ is the magnetic permeability of vacuum, is :
(1) $\mathrm{ML}^{-1} \mathrm{~T}^{-2}$
(2) $\mathrm{ML}^{2} \mathrm{~T}^{-1}$
(3) $\mathrm{MLT}^{-2}$
(4) $\mathrm{ML}^{2} \mathrm{~T}^{-2}$
2. The dimension of stopping potential $V_{0}$ in photoelectric effect in units of Planck's constant ' h ', speed of light 'c' and Gravitational constant ' $\mathrm{G}^{\prime}$ and ampere A is :
(1) $h^{2} G^{3 / 2} c^{1 / 3} A^{-1}$
(2) $\mathrm{h}^{-2 / 3} \mathrm{c}^{-1 / 3} \mathrm{G}^{4 / 3} \mathrm{~A}^{-1}$
(3) $h^{1 / 3} G^{2 / 3} c^{1 / 3} A^{-1}$
(4) $h^{2 / 3} c^{5 / 3} G^{1 / 3} A^{-1}$
3. A quantity $f$ is given by $f=\sqrt{\frac{h c^{5}}{G}}$ where $c$ is speed of light, G universal gravitational constant and $h$ is the Planck's constant. Dimension of f is that of :
(1) Momentum
(2) Area
(3) Energy
(4) Volume
4. If speed $V$, area $A$ and force $F$ are chosen as fundamental units, then the dimension of Young's modulus will be :
(1) $\mathrm{FA}^{-1} V^{0}$
(2) $\mathrm{FA}^{2} \mathrm{~V}^{-1}$
(3) $\mathrm{FA}^{2} \mathrm{~V}^{-3}$
(4) $\mathrm{FA}^{2} \mathrm{~V}^{-2}$
5. If momentum (P), area (A) and time (T) are taken to be the fundamental quantities then the dimensional formula for energy is :
(1) $\left[\mathrm{PA}^{-1} \mathrm{~T}^{-2}\right]$
(2) $\left[\mathrm{PA}^{1 / 2} \mathrm{~T}^{-1}\right]$
(3) $\left[\mathrm{P}^{2} \mathrm{AT}^{-2}\right]$
(4) $\left[\mathrm{P}^{1 / 2} \mathrm{AT}^{-1}\right]$
6. Amount of solar energy received on the earth's surface per unit area per unit time is defined a solar constant. Dimension of solar constant is:
(1) $\mathrm{ML}^{2} \mathrm{~T}^{-2}$
(2) $\mathrm{MLT}^{-2}$
(3) $\mathrm{M}^{2} \mathrm{~L}^{0} \mathrm{~T}^{-1}$
(4) $\mathrm{ML}^{0} \mathrm{~T}^{-3}$
7. A quantity $x$ is given by ( $I F v^{2} / W^{4}$ ) in terms of moment of inertia I, force F, velocity v , work W and Length $L$. The dimensional formula for $x$ is same as that of :
(1) Planck's constant
(2) Force constant
(3) Energy density
(4) Coefficient of viscosity
8. The quantities $x=\frac{1}{\sqrt{\mu_{0} \epsilon_{0}}}, y=\frac{E}{B} \quad$ and $\mathrm{Z}=\frac{1}{\mathrm{CR}}$ are defined where C-capacitance, R-Resistance, l-length, E-Electric field, $B$-magnetic field and $\epsilon_{0}, \mu_{0}$, free space permittivity and permeability respectively. Then :
(1) Only $x$ and $y$ have the same dimension
(2) $x, y$ and $z$ have the same dimension
(3) Only $x$ and $z$ have the same dimension
(4) Only $y$ and $z$ have the same dimension

## SOLUTION

1. NTA Ans. (1)

Sol. Magnetic energy stored per unit volume is
$\frac{\mathrm{B}^{2}}{2 \mu_{0}} \Rightarrow$ Dimension is $\mathrm{ML}^{-1} \mathrm{~T}^{-2}$
2. NTA Ans. (BONUS)

Sol. $\mathrm{v}_{0}=\mathrm{h}^{\mathrm{x}} \mathrm{c}^{\mathrm{y}} \mathrm{G}^{\mathrm{z}} \mathrm{A}^{\mathrm{w}}$
$\frac{\mathrm{ML}^{2} \mathrm{~T}^{-2}}{\mathrm{AT}}=\left(\mathrm{ML}^{2} \mathrm{~T}^{-1}\right)^{\mathrm{x}}\left(\mathrm{LT}^{-1}\right)^{\mathrm{y}}\left(\mathrm{M}^{-1} \mathrm{~L}^{3} \mathrm{~T}^{-2}\right)^{\mathrm{z}} \mathrm{A}^{\mathrm{w}}$
$\Rightarrow \mathrm{w}=-1$
( $\mathrm{x}-\mathrm{z}=1$ )
$2 \mathrm{x}+\mathrm{y}+3 \mathrm{x}=2$
$-x-y-2 z=-3$

$$
\begin{aligned}
& \quad 2 \mathrm{x}=0 \\
& \mathrm{x}=0 \\
& \mathrm{z}=-1 \\
& 2 \times 0+\mathrm{y}+3 \mathrm{x}-1=2 \\
& \mathrm{y}=5 \quad \Rightarrow \mathrm{v}_{0}=\mathrm{h}^{0} \mathrm{c}^{5} \mathrm{G}^{-1} \mathrm{~A}^{-1}
\end{aligned}
$$

So Bonus
3. NTA Ans. (3)

Sol. $[\mathrm{h}]=\mathrm{M}^{1} \mathrm{~L}^{2} \mathrm{~T}^{-1}$
$[\mathrm{C}]=\mathrm{L}^{1} \mathrm{~T}^{-1}$
$[\mathrm{G}]=\mathrm{M}^{-1} \mathrm{~L}^{3} \mathrm{~T}^{-2}$
$[f]=\sqrt{\frac{\mathrm{M}^{1} \mathrm{~L}^{2} \mathrm{~T}^{-1} \times \mathrm{L}^{5} \mathrm{~T}^{-5}}{\mathrm{M}^{-1} \mathrm{~L}^{3} \mathrm{~T}^{-2}}}=\mathrm{M}^{1} \mathrm{~L}^{2} \mathrm{~T}^{-2}$
4. Official Ans. by NTA (1)

Sol. $\mathrm{Y}=\mathrm{F}^{\mathrm{x}} \mathrm{A}^{y} \mathrm{~V}^{\mathrm{z}}$
$\mathrm{M}^{1} \mathrm{~L}^{-1} \mathrm{~T}^{-2}=\left[\mathrm{MLT}^{-2}\right]^{x}\left[\mathrm{~L}^{2}\right]^{y}\left[\mathrm{LT}^{-1}\right]^{2}$
$M^{1} L^{1} T^{-2}=[M]^{x}[L]^{x+2 y+2}[T]^{-2 x-2}$
comparing power of ML and T
$\mathrm{x}=1 \ldots$ (1)
$x+2 y+z=-1$
$-2 \mathrm{x}-\mathrm{z}=-2$
after solving
$\mathrm{x}=1$
$y=-1$
$\mathrm{z}=0$
$\mathrm{Y}=\mathrm{FA}^{-1} \mathrm{~V}^{0}$
5. Official Ans. by NTA (2)

Sol. Let $[\mathrm{E}]=[\mathrm{P}]^{\mathrm{x}}[\mathrm{A}]^{\mathrm{y}}[\mathrm{T}]^{\mathrm{z}}$
$\mathrm{ML}^{2} \mathrm{~T}^{-2}=\left[\mathrm{MLT}^{-1}\right]^{\mathrm{x}}\left[\mathrm{L}^{2}\right]^{y}[\mathrm{~T}]^{2}$
$\mathrm{ML}^{2} \mathrm{~T}^{-2}=\mathrm{M}^{\mathrm{x}} \mathrm{L}^{\mathrm{x}+2 \mathrm{y}} \mathrm{T}^{-\mathrm{x}+\mathrm{z}}$
$\rightarrow \mathrm{x}=1$
$\rightarrow \mathrm{x}+2 \mathrm{y}=2$
$1+2 y=2$
$y=\frac{1}{2}$
$\rightarrow-\mathrm{x}+\mathrm{z}=-2$
$-1+z=-2$
$\mathrm{Z}=-1$
$[\mathrm{E}]=\left[\mathrm{PA}^{1 / 2} \mathrm{~T}^{-1}\right]$
6. Official Ans. by NTA (4)

Sol. $\mathrm{S}=\frac{\mathrm{P}}{\mathrm{A}}=\frac{\mathrm{ML}^{2} \mathrm{~T}^{-3}}{\mathrm{~L}^{2}}=\mathrm{MT}^{-3}$
7. Official Ans. by NTA (3)

Sol. $\mathrm{x}=\frac{\mathrm{IFV}^{2}}{\mathrm{WL}^{4}}$
$[\mathrm{x}]=\frac{\left[\mathrm{ML}^{2}\right]\left[\mathrm{MLT}^{-2}\right]\left[\mathrm{LT}^{-1}\right]^{2}}{\left[\mathrm{ML}^{2} \mathrm{~T}^{-2}\right][\mathrm{L}]^{4}}$
$[\mathrm{x}]=\left[\mathrm{ML}^{-1} \mathrm{~T}^{-2}\right]$
$\left[\right.$ Energy density] $=\left[\frac{E}{V}\right]$

$$
\begin{aligned}
& =\left[\frac{\mathrm{ML}^{2} \mathrm{~T}^{-2}}{\mathrm{~L}^{3}}\right] \\
& =\left[\mathrm{ML}^{-1} \mathrm{~T}^{-2}\right] \\
& \text { Same as } \mathrm{x}
\end{aligned}
$$

8. Official Ans. by NTA (2)

Sol. $\quad \mathrm{x}=\frac{1}{\sqrt{\mu_{0} \varepsilon_{0}}}=$ speed $\Rightarrow[\mathrm{x}]=\left[\mathrm{L}^{1} \mathrm{~T}^{-1}\right]$
$y=\frac{E}{B}=$ speed $\Rightarrow[y]=\left[L^{1} T^{-1}\right]$
$\mathrm{z}=\frac{\ell}{\mathrm{RC}}=\frac{\ell}{\tau} \Rightarrow[\mathrm{z}]=\left[\mathrm{L}^{1} \mathrm{~T}^{-1}\right]$
So, $\mathrm{x}, \mathrm{y}, \mathrm{z}$ all have the same dimensions.

