The work done by a gas molecule in an isolated system is given by,

$$W = \alpha\beta^2 e^{-\frac{x^2}{\alpha kT}}$$

where x is the displacement, k is the Boltzmann constant and T is the temperature, α and β are constants. Then the dimension of β will be :

(1) $[M\,L^2\,T^{-2}]$

(2) $[M\,L\,T^{-2}]$

(3) $[M^2\,L\,T^2]$

(4) $[M^0\,L\,T^0]$

(b) $\frac{x^2}{\alpha kT} \rightarrow$ dimensionless

$$\Rightarrow [\alpha] = \frac{[x^2]}{[kT]} = \frac{L^2}{ML^2T^{-2}} = M^{-1}T^2$$

Now, $[W] = [\alpha]\,[\beta]^2$

$$[\beta]^2 = \frac{[W]}{[\alpha]}$$

$$[\beta] = \left(\frac{ML^2T^{-2}}{M^{-1}T^2}\right)^{\frac{1}{2}} = MLT^{-2}$$