57. A metal, whose temperature coefficient (α) of resistivity is $5\times10^{-4}\ ^oC^{-1}$, is heated from 100 ^{o}C to 1100 ^{o}C. By what factor does the mobility of electrons in the metal change due to this change in temperature?

[A] 3/2 [B] $\sqrt{3}/2$ [C] $\sqrt{2}$ [D] 2/3 ✓

(1) $\mu = \frac{v_d}{E} = \frac{e\tau}{m}$, e = charge on e^-, m = mass of e^-, τ = relaxation time

$\therefore \mu \propto \tau$

(2) $\rho_2 = \rho_1 [1 + \alpha \Delta T]$

$\frac{\rho_2}{\rho_1} = 1 + 5\times10^{-4} \times (1100 - 100 = 10^3)$

$= 1 + 5 \times 10^{-1} = \frac{3}{2}$

$\therefore \frac{\rho_2}{\rho_1} = \frac{3}{2}$

(3) $\sigma = \frac{1}{\rho}$ (σ: conductivity, ρ: resistivity)

(4) $\sigma = \frac{ne^2\tau}{m}$ } n = concentration (no. of charge carriers p.u. volume)

$\therefore \sigma \propto \tau$

$\frac{\rho_2}{\rho_1} = \frac{3}{2}$

$\mu \propto \tau$, $\tau \propto \sigma$, $\sigma \propto \frac{1}{\rho}$

$\mu \propto \frac{1}{\rho}$

$\frac{\mu_2}{\mu_1} = \frac{2}{3}$

$\mu_2 = \frac{2}{3}\mu_1$