The rate law of chemical reaction $2NO(g)+O_2(g)\rightarrow 2NO_2(g)$ is given as $rate=k[NO]^2[O_2]$. How does the rate of reaction change if the volume of reaction vessel is reduced to half of its original value assuming the initial moles of both NO (g) and Oxygen gas are unchanged?

(A) Rate is halved (B) Rate is doubled
(C) Rate becomes 1/8 times (D) Rate becomes 8 times

Solution

Let a mole of NO and b mole of O_2 be taken to start the reaction in a vessel of volume V litre.

$$r=k[NO]^2[O_2]=k\left(\frac{a}{V}\right)^2\left(\frac{b}{V}\right)$$

$$\therefore r\propto\frac{1}{V^3}$$

When volume is halved, $r'\propto\frac{1}{(V/2)^3}$

$$\therefore r'\propto\frac{8}{V^3}$$

So, $\frac{r'}{r}=8$

Hence, (D)