5. In an adiabatic process, the density of a diatomic gas becomes 32 times its initial value. The final pressure of the gas is found to be n times the initial pressure. The value of n is :   [Main 5 Sep. 2020 (II)]

(a) 32   (b) 326   (c) 128   (d) $\dfrac{1}{32}$

ans (c) In adiabatic process

$$PV^\gamma = \text{constant}$$

$$\therefore P\left(\frac{m}{\rho}\right)^\gamma = \text{constant} \qquad \left(\because V = \frac{m}{\rho}\right)$$

As mass is constant

$$\therefore P \propto \rho^\gamma$$

If P_i and P_f be the initial and final pressure of the gas and ρ_i and ρ_f be the initial and final density of the gas. Then

$$\frac{P_f}{P_i} = \left(\frac{\rho_f}{\rho_i}\right)^\gamma = (32)^{7/5}$$

$$\Rightarrow \frac{nP_i}{P_i} = (2^5)^{7/5} = 2^7$$

$$\Rightarrow n = 2^7 = 128.$$