Question #78221, Physics / Other

A body moving through air at high speed V is found to experience a retarding force F, given be relating F=kAeV^a, where 'A' is the surface area of the body, 'e' the density of air and k is the numerical constant. Use dimensional analysis to deduce the value of 'a'.

Solution

$F = kAeV^a$;

$$[F] = kAeV^a = 1 \times m^2 \times \frac{kg}{m^3} \times \left(\frac{m}{s}\right)^a = N = \frac{kg \cdot m}{s^2};$$

$$m^2 \times \frac{kg}{m^3} \times \left(\frac{m}{s}\right)^a = \frac{kg \cdot m}{s^2};$$

$$\frac{1}{m} \times \left(\frac{m}{s}\right)^a = \frac{m}{s^2};$$

$$\frac{m^{a-1}}{s^a} = \frac{m}{s^2};$$

$a = 2$

Answer: $a = 2$