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Drag Eqⁿ,

$$F_D = \frac{1}{2} \rho v^2 C_d \, S.A.$$

Where, F_D = Drag Force

ρ = Density of Air

V = Max velocity of the rocket

C_d = Coefficient of Drag

$S.A.$ = Surface Area of the rocket

Total downward forces acting on the rocket,

$$F = F_D + mg$$

But $F = ma$

$$\therefore ma = \frac{1}{2} \rho v^2 C_d \, S.A. + mg$$

$$\therefore C_d = \frac{(ma - mg)}{\frac{1}{2} \rho v^2 \, S.A.}$$

$$= \frac{2m(a-g)}{\rho v^2 \, S.A.}$$

Neglecting 'g' because it is accounted in the simulati

$$C_d = \frac{2ma}{\rho v^2 \, S.A.}$$

where, '$\frac{a}{v^2}$' varies with time and '$\frac{2m}{\rho \, S.A.}$'

remains constant.

Using Least Square Regression Method to get the value of 'a/v^2' from the data obtained from the simulation where a = rise and v^2 = run.

$sum(x) = sum(v^2) = 1955161.83052365$

$sum(y) = sum(a) = -351889.4364$

$sum(x \times y) = sum(v^2 \times a) = -4179116163.37065$

$sum(x^2) = sum(v^4) = 23503302773.0809$

$(sum(x))^2 = (sum(v^2))^2 = 3822657783536.57$

$N = 293$

$$m = slope = \frac{N\Sigma(xy) - \Sigma x \Sigma y}{N\Sigma(x^2) - (\Sigma x)^2}$$

$$b = intercept = \frac{\Sigma y - m\Sigma x}{N}$$

$$\therefore m = \frac{-536480241253.842}{3063509928976.14} = -0.17510232478198\ 2$$

$\therefore b = -32.5462612638706$

$$\therefore \frac{a}{v^2} = m = -0.175102324781982$$

Surface Area of rocket = πr^2 + Fin Area $\times 6$

$r = 3.81$ cm

Fin Area $= 0.3 \times 11.4 = 3.42\ cm^2$

$\therefore S.A. = \pi \times (3.81 \times 3.81) + (0.3 \times 11.4 \times 3)$
$= 55.8636731 \times 10^{-4}\ m^2$

Mass of Rocket = 1394 gram = 1.394 Kg

Standard value of air Density, $\rho = 1.225\ kg/m^3$

$\boxed{\therefore Cd = -71.3377003}$

$\therefore Fd = \frac{1}{2} \rho V^2\ Cd\ S.A.$

$= \frac{1}{2} \times 1.225 \times (V_{max})^2 \times (-71.3377003) \times 55.86731 \times$

Since, $V_{max} = 24.114\ m/s$ from simulation

$\boxed{\therefore FD = -141.936208\ N}$

$\therefore$ Total Drag force in downward direction is 141.936208 N ~~is downwards~~

$\therefore$ Coefficient of Drag in downward direction is 71.3377003.