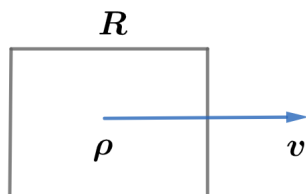


2020B F=ma Exam: Problem 23

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We have from dimensional analysis,

$$F \propto R^\alpha \rho^\beta v^\gamma$$

$$\frac{ML}{T^2} = L^\alpha \left(\frac{M}{L^3}\right)^\beta \left(\frac{L}{T}\right)^\gamma$$

so counting powers of dimensions,

$$1 = \beta$$

$$-2 = -\gamma$$

$$1 = \alpha - 3\beta + \gamma$$

Then $\alpha = 2, \beta = 1, \gamma = 2$ and

$$F \propto R^2 \rho v^2$$

For the same drag force, we have

$$R^2 v^2 = R'^2 v'^2$$

$$v' = \frac{Rv}{R'} = 50 \text{ m/s}$$

so the answer is C.