# 2020B F=ma Exam: Problem 23 

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We have from dimensional analysis,

$$
\begin{gathered}
F \propto R^{\alpha} \rho^{\beta} v^{\gamma} \\
\frac{M L}{T^{2}}=L^{\alpha}\left(\frac{M}{L^{3}}\right)^{\beta}\left(\frac{L}{T}\right)^{\gamma}
\end{gathered}
$$

so counting powers of dimensions,

$$
\begin{gathered}
1=\beta \\
-2=-\gamma \\
1=\alpha-3 \beta+\gamma
\end{gathered}
$$

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

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

For the same drag force, we have

$$
\begin{gathered}
R^{2} v^{2}=R^{2} v^{\prime 2} \\
v^{\prime}=\frac{R v}{R^{\prime}}=50 \mathrm{~m} / \mathrm{s}
\end{gathered}
$$

so the answer is C .

