37.7 A fan delivers $10,000 cfm$ of $70°F$ air at sea level. How much volume will the same fan deliver when used at $4000 ft$ elevation to distribute $50°F$ air?

A. $8,000 cfm$

B. $9,000 cfm$

C. $11,000 cfm$

D. $12,000 cfm$

Qualitatively, it stands to reason that increasing the elevation at which the fan is used will increase the capacity of the fan in terms of volume flow rate because air is less dense higher in the atmosphere. However, reducing the temperature of the air makes it more dense, and reduces the capacity of the fan. These factors will compete and must be considered separately.

Search for Temperature and Altitude Corrections and use the table to look up the Density Factors for both the temperature and elevation change.

The Density Factor for the temperature requires interpolation.

Temperature [$°F$]	Density Factor
0	1.152
50	DF_T
70	1

$$\frac{70-50}{70-0} = \frac{1-DF_T}{1-1.152} = 0.2857$$

$$1 - DF_T = -0.0434 \rightarrow DF_T = 1.043$$

Look up the Density Factor for the altitude.

$$DF_A = 0.864$$

Although it is not explicitly stated in the reference handbook whether the original cfm should be multiplied or divided by the density factors, the previous reasoning provides the expectation that the decreased temperature will tend to reduce the fan capacity and the increased altitude will tend to increase the fan capacity. Therefore, the original cfm should be *divided* by the density factors.

$$Q_{4000ft} = \frac{Q_{sea\,level}}{DF_T \cdot DF_A} = \frac{10,000cfm}{(1.043)(0.864)} = 11,097cfm$$

Answer C