1.3) The pressure and temperature at a certain point in an air flow are 130 kPa and 30°C, respectively. Find the air density at this point in kg/m^3 and lbm/ft^3.
Solution:
Given $p = 130\,\text{kPa} = 130 \times 10^3\,\text{Pa}$, $T = 30°\text{C} = 30 + 273 = 303\,\text{K}$.
The density can be calculated using ideal gas law as,

$$\boxed{\rho = \frac{p}{R\,T} = \frac{130 \times 10^3}{287 \times 303} = 1.495\,\text{kg/m}^3}\,.$$

The density in lbm/ft^3 can be calculated using the following conversions $1\,\text{kg} = 2.2046\,\text{lbm}$, $1\,\text{m} = 3.2808\,\text{ft}$. Therefore in lbm/ft^3,

$$\rho = 1.495\,\text{kg/m}^3 = 1.495 \times 2.2046/3.2808^3\,\text{lbm/ft}^3$$

$$\boxed{\rho = 0.09333\,\text{lbm/ft}^3}\,.$$