32.4 What is the viscosity of $150°F$ water?

A. $5 \times 10^{-6} \frac{lb_m}{ft \cdot hr}$

B. $9 \times 10^{-6} \frac{lb_m}{ft \cdot hr}$

C. $3 \times 10^{-4} \frac{lb_m}{ft \cdot hr}$

D. $1 \frac{lb_m}{ft \cdot hr}$

The question is ambiguous in terms of whether the Absolute i.e. Dynamic Viscosity is to be used or the Kinematic Viscosity. Look up the values in the table Properties of Water and note the units.

$$\mu = .905 \times 10^{-5} \frac{lb_f \cdot sec}{ft^2}$$

$$\nu = .476 \times 10^{-5} \frac{ft^2}{sec}$$

Note the answer choices have units of $\frac{lb_m}{ft \cdot hr}$. Choose to work with the dynamic viscosity as it is best suited for conversion to the desired units.

Recall from physics the relationship between force, mass, and acceleration due to gravity:

$$F = mg$$

where g is the constant acceleration due to gravity and the typical units are:

$$[1lb_f] = [1lb_m] \left[32.2 \frac{ft}{sec^2} \right]$$

Make a substitution for lb_f in the units of μ, evaluate, and simplify:

$$\mu = 0.905 \times 10^{-5} \frac{sec}{ft^2} \left(32.2 \frac{lb_m \cdot ft}{sec^2} \right) = .000291 \frac{lb_m}{ft \cdot sec}$$

Convert seconds to hours for alignment with answer choice units:

$$\mu = .000291 \frac{lb_m}{ft \cdot sec} \left(\frac{60sec}{1min} \right) \left(\frac{60min}{1hr} \right) = 1.05 \frac{lb_m}{ft \cdot hr}$$

Answer D