

32.23 $50^\circ F$ water has a thermal conductivity of $0.334 \frac{Btu}{hr \cdot ft \cdot ^\circ F}$. What is the Prandtl number?

- A. 0.3
- B. 0.7
- C. 7.6
- D. 9.5

The **Prandtl Number** is often determined by looking it up in a table. It is also defined by the formula below as shown in the Reference Handbook. Prandtl number is a function of specific heat capacity, dynamic viscosity, and thermal conductivity.

$$Pr = \frac{c_p \mu}{k}$$

The specific heat capacity is taken as $c_p = 1 \frac{Btu}{lb_m \cdot ^\circ F}$. The thermal conductivity, k , is given. The dynamic viscosity is available using the **Properties of Water** table. Ideally, it would be best to have the absolute dynamic viscosity in units of $\frac{lb_m}{ft \cdot hr}$. Since this is not available in the Reference Handbook, recognize that multiplying the numerator by gravitational constant, g_c , gets most of the units to work. It is also necessary to align seconds with hours. Solve for Pr .

$$Pr = \frac{\left(1 \frac{Btu}{lb_m \cdot ^\circ F}\right) \left(2.735 \times 10^{-5} \frac{lb_f \cdot s}{ft^2}\right) \left(32.2 \frac{lb_m \cdot ft}{lb_f \cdot s^2}\right)}{\left(0.334 \frac{Btu}{hr \cdot ft \cdot ^\circ F}\right) \left(\frac{1hr}{3600s}\right)} = 9.49$$

Answer D