Complete these studio problems, and demonstrate your answers to one of the instructors by the end of class today.

1. For each of the unit combinations below, determine what kind of quantity (e.g., surface tension, energy, acceleration, energy density, viscosity, etc.) could be expressed in that unit. (The tables on pages 161-2 in the text may be helpful.)

   \begin{align*}
   \text{atm} \cdot \text{in}^3 & \\
   \frac{\text{m}}{(\Omega \cdot \text{F})^2} & \\
   \frac{\text{C} \cdot \text{T} \cdot \text{V}}{\text{m} \cdot \text{Wb}} & \\
   \frac{\text{J}}{\text{Hz} \cdot \text{m}^3} & \\
   \frac{\text{F} \cdot \text{V}^2}{\text{m}^2} & \\
   \end{align*}

2. Assume that the velocity of sound in a gas, \( v \), depends on some of these variables:

   Mass density \( \rho \)
   Gas pressure \( P \)
   Gas dynamic viscosity \( \mu \)

   Using dimensional analysis, determine a formula for the velocity of sound in a gas. Follow these steps:

   (a) Determine the dimensions for each of the variables \( v \), \( \rho \), \( P \), and \( \mu \).

   (b) Assume a proportionality expression

   \[ v \propto \rho^\alpha P^\beta \mu^\gamma \]

   (c) Equating the dimensions on each side of this expression, solve for the constants \( \alpha \), \( \beta \), \( \gamma \).

   (d) Use these results to express \( v \) in terms of the assumed variables.
3. Use scaling arguments to explain why:

Elephants have much larger ears, relative to their overall size, than humans.
Spiders have very thin legs, relative to their size, than humans.
Many insects can walk on water, but humans cannot.