18.53. **Solve:** **(a)** The rms speed is

$$v_{rms} = \sqrt{\frac{3k_B T}{m}} \Rightarrow \frac{v_{rms\ hydrogen}}{v_{rms\ oxygen}} = \sqrt{\frac{32\ u}{2\ u}} = 4$$

(b) The average translational energy is $\varepsilon = \frac{3}{2}k_B T$. Thus

$$\frac{\varepsilon_{avg\ hydrogen}}{\varepsilon_{avg\ oxygen}} = \frac{T_{hydrogen}}{T_{oxygen}} = 1$$

(c) The thermal energy is

$$E_{th} = \frac{5}{2}nRT$$

$$\Rightarrow \frac{E_{th\ hydrogen}}{E_{th\ oxygen}} = \frac{n_{hydrogen}}{n_{oxygen}} = \frac{m_{hydrogen}}{2.0\ g\ /\ mol} \frac{32.0\ g\ /\ mol}{m_{oxygen}} = 16$$