

22. Table 20-1 gives $M = 28.0$ g/mol for Nitrogen. This value can be used in Eq. 20-22 with T in Kelvins to obtain the results. A variation on this approach is to set up ratios, using the fact that Table 20-1 also gives the rms speed for nitrogen gas at 300 K (the value is 517 m/s). Here we illustrate the latter approach, using v for v_{rms} :

$$\frac{v_2}{v_1} = \frac{\sqrt{\frac{3RT_2}{M}}}{\sqrt{\frac{3RT_1}{M}}} = \sqrt{\frac{T_2}{T_1}}.$$

- (a) With $T_2 = 20.0 + 273.15 \approx 293$ K, we obtain

$$v_2 = (517 \text{ m/s}) \sqrt{\frac{293 \text{ K}}{300 \text{ K}}} = 511 \text{ m/s}.$$

- (b) In this case, we set $v_3 = \frac{1}{2}v_2$ and solve $v_3/v_2 = \sqrt{T_3/T_2}$ for T_3 :

$$T_3 = T_2 \left(\frac{v_3}{v_2} \right)^2 = (293 \text{ K}) \left(\frac{1}{2} \right)^2 = 73 \text{ K}$$

which we write as $73 - 273 = -200^\circ\text{C}$.

- (c) Now we have $v_4 = 2v_2$ and obtain

$$T_4 = T_2 \left(\frac{v_4}{v_2} \right)^2 = (293 \text{ K})(4) = 1.17 \times 10^3 \text{ K}$$

which is equivalent to 899° .