(f) $\bar{\ell} = \frac{kT}{\sqrt{2}\pi D^2 P} = \frac{8{,}31 \times 150}{\sqrt{2}\pi \, 6\times10^{+23} \times (4{,}6)^2 \times 10^{-20} \times 4\times10^{-11}}$

$\bar{\ell} = 0{,}55 \times 10^{8}\,m = 5{,}5 \times 10^{4}\,km$

(g) $f = 3 + 3 + 2 = 8$ gr. lib.

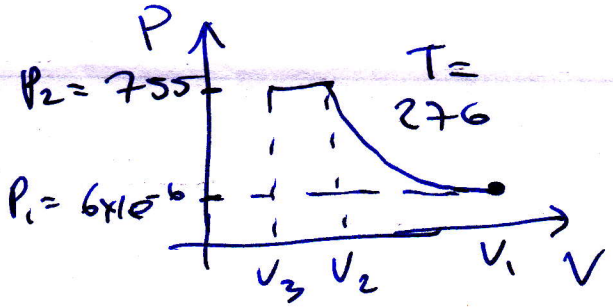
trans. rot. vib.

$C_v = \frac{f}{2} R = 4R$

$C_p = C_v + R = 5R$

$Q = n C_p \Delta T = 10 \times 5 \times 8{,}31 \times 81{,}4 = 33{,}8\,kJ$

(h)



$P_1 V_1 = n R T$

$V_1 = \frac{nRT}{P}$

$V_1 = \frac{10 \times 8{,}31 \times 276}{6\times10^{-6}} = 3{,}82 \times 10^{8}\,m^3$

$W_{21} = nRT \ln\left(\frac{V_1}{V_2}\right)$

$\frac{V_1}{V_2} = \frac{P_2}{P_1} = \frac{755}{6} \times 10^{6} = 1{,}258 \times 10^{8}$

$W_{21} = 10 \times 8{,}31 \times 276 \times \ln(1{,}258\times10^{8}) = 428\,kJ$

($\ln(1{,}258\times10^{8}) \approx 18.65$)

$W_{32} = 755 \times (V_2 - V_3) \approx$

$V_2 = \frac{3{,}82}{1{,}258} = 3{,}04\,m^3$

$V_3 = 180\,cm^3 = 1{,}80\times10^{-4}\,m^3$

$W_{32} \simeq 755\,V_2 = 2{,}3\,kJ$

$Q_{21} = W_{21}$ $Q_{32} = 180 \times 710 = 128\,kJ$

$W = 430\,kJ$

$Q = 556\,kJ$