Exercise 1.18: Recall $\frac{m<v^2>}{2} = \frac{3}{2}k_bT$. If we fill in we get $\frac{(2*2.3258671\times10^{-26}kg)<v^2>}{2} = \frac{3}{2}(1.38064852\times 10^{-23}m^2kgs^{-2}K^{-1})(295K)$ we then see $<v^2>= 1.3134\times10^5m^2/s^2$ or rms $= 362m/s$.

Exercise 1.21: After a quick bit of research (watching YouTube videos) I have concluded that hailstones colliding with a object is a inelastic process, they bounce back with trivial velocity if they don't stick. The force exerted by the hailstones would be $F_1 = .002kg * \sqrt{2}/2 * 15m/s * 30/s = 0.63640N$ thus the pressure would be $1.2728Pa$, whereas the atmospheric pressure is $101,000Pa$. However before one concludes that a glass window can easily support a hailstorm note that the pressure exerted by the atmosphere is exerted on both sided of the glass and thus does not actually put stress on the glass.

Exercise 1.34: (a) For A and C there is no change in volume and thus no work is done. Define $\Delta P = P_2 - P_1$ and $\Delta V = V_2 - V_1$. The work done on the system for D is $w_D = P_1\Delta V$ and for B it would be $w_B = -P_2\Delta V$. For each step $\Delta U = U_f - U_i = 5/2Nk_b(T_f - T_i)$. Note that we are dealing with a ideal gas thus $PV = Nk_bT$, and so $\Delta U = 5/2(P_fV_f - P_iV_i)$. Now computing the changes in internal energy we get $\Delta U_A = 5/2V_1\Delta P$, $\Delta U_B = 5/2P_2\Delta V$, $\Delta U_C = -5/2V_2\Delta P$, $\Delta U_D = -5/2P_1\Delta V$. Noting that $Q = \delta U - w$ we see $Q_A = 5/2V_1\Delta P$, $Q_B = 5/2P_2\Delta V + P_2\Delta V = 7/2P_2\Delta V$, $Q_C = -5/2V_2\Delta P$, $Q_D = -7/2P_1\Delta V$.

(b) In B a fixed force is applied to the piston while the gas is heated, allowing the gas to expand under constant pressure. In C the piston is locked and the gas is cooled. In D the gas is heated while a constant force is applied to the piston.

(c) The net work would be $w_B + w_D = P_1\Delta V - P_2\Delta V = -\Delta P\Delta V$. The net change in internal energy would be zero since this is a cycle and internal energy is a state function, to confirm $\Delta U_{total} = 5/2(V_1\Delta P + P_2\Delta V - V_2\Delta P - P_1\Delta V) = 5/2(-\Delta V\Delta P + \Delta P\Delta V) = 0$. The heat added to the system should be exactly the negation of the work done on the system thus $Q_{total} = \Delta P\Delta V$. In conclusion this is a cycle where net heat is added and work is extracted.