Problem Set 12: Kinetic Theory, Temperature and Internal Energy and Work Done by Ideal Gas, Second Law of Thermodynamics, Mechanical Equivalent of Heat

Design Engineering Challenge: "The Big Dig" 2.007 Contest
Pneumatic Energy Storage Strategy

For the Spring 2004 contest ("The Big Dig", see http://pergatory.mit.edu/2.007) the kit includes large plastic syringes which can be compressed and stored just prior to the contest for use as air-springs. The goal here is to develop a strategy for storing the energy and then for releasing it. Assume you seal the end of the syringe and then compress it so the volume is reduced by a factor of four, and then when the contest begins, you want to use this stored energy:
1. What is the pressure in the syringe immediately after you compress it?
2. How much energy have you stored?
3. What is the temperature rise of the gas in the syringe just after you compress it?
4. As the gas cools, how much does it contract?
5. After the system comes to steady state, what is the final pressure, and how much energy have you stored?