Physics 202, practice exam 1
Short Answer (4 pts each)

1. In an ideal gas, temperature is inversely proportional to what variable(s)?

2. Heat flows out of a gas as it is expanding. What are the signs of Q, W, and ΔE_{int}?

3. Which factor(s) affect the internal energy of a substance?

4. What term describes the total amount of disorder in a thermodynamic system?

5. At room temperature, which gas molecule has higher speed, CO or CO_2?

6. By what factor does the force change on a charge when the distance separating two point charges increases by a factor of 3?

7. By what factor does the electric field change along the axis of a dipole (when r>>d) when the distance increases from 2 meter to 5 meters?

8. Draw the electric field near a dipole

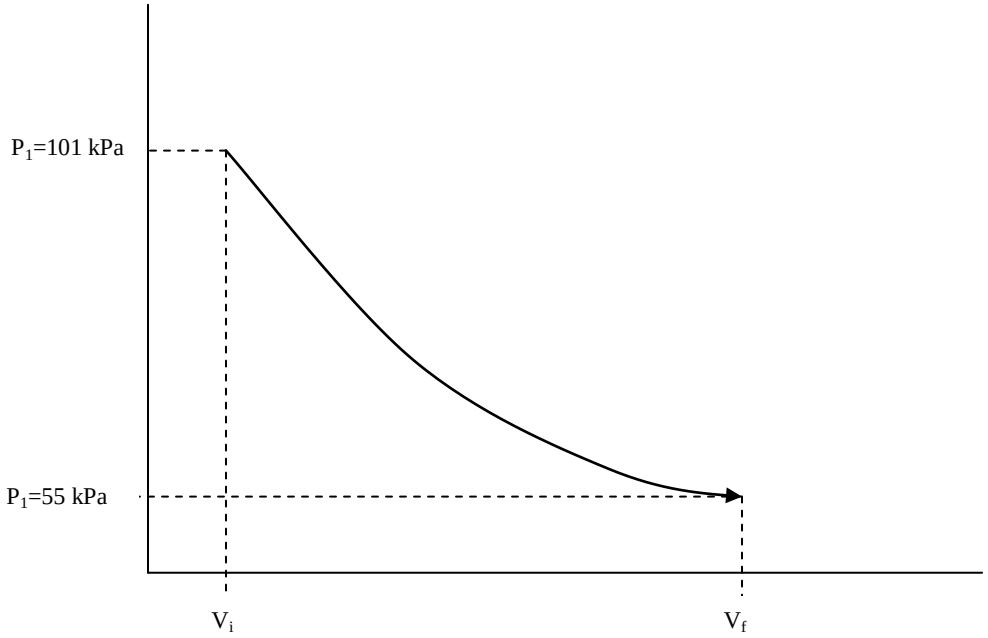
9. List 2 *physical* factors that affect the rate of heat conduction through a material.

10. What three conditions are necessary to simplify the integration of electric flux in Gauss's Law?

Problems, 12 pts. each

1. I need to defrost 2 kg of chicken soup straight from the cold freezer (L_f=2.8x10^5 J/kg, T_0= -15 C) and warm it up to 60 C. How long will this take my 800 W microwave? The specific heat of the frozen soup is 1997 J/kgK, the liquid soup is 3090 J/kgK.

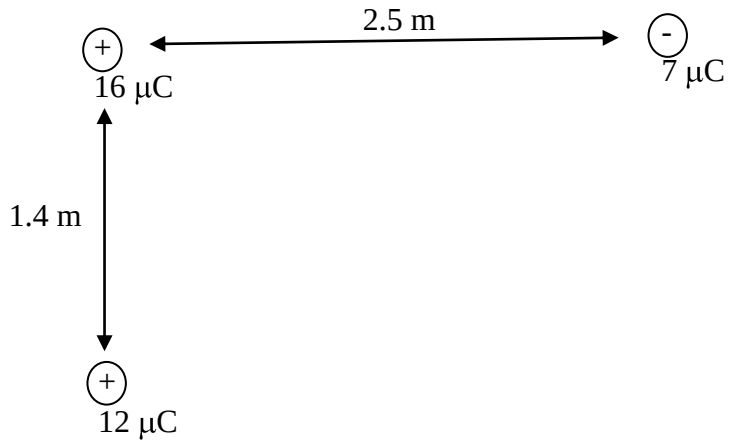
2. An antique steam-engine tractor requires 9.2 x 10^8 J of work to plow Gary McDonald's pumpkin patch. The steam is under high pressure at 250 °C and he's plowing on a cold April day. If 110 kg of oak wood had to be burned to supply enough heat to fuel the engine (heat of combustion of oak is 18 MJ/kg.), what was the temperature outside (the cold reservoir)?



3. During the above constant-temperature expansion, 13 moles of N_2 gas begins at atmospheric pressure (1.01×10^5 Pa) and temperature (293 K). R=8.314 J/mol K

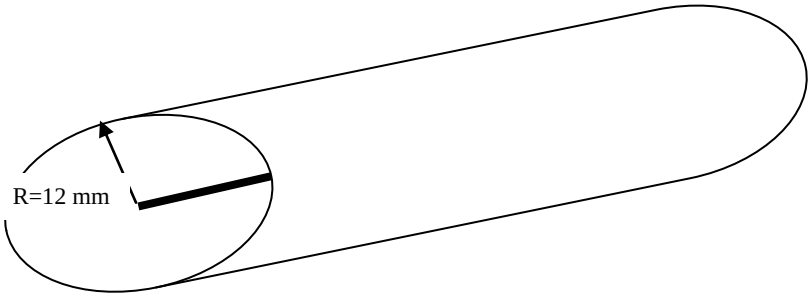
Find V_i, V_f, ΔE_{int}, and W. Does heat flow into or out of the gas?

4. What is the direction (in degrees) and magnitude of the force on the negative charge in the following configuration of charges? k=8.99x10^9 Nm^2/C^2 and ϵ_0= 8.85 x10^{-12} C^2/ Nm^2 (You may assume a right angle.)



5. The van de Graf generator is capable of producing electrical breakdown over a distance of about 20 cm from the surface of the charged sphere on a dry day. Given that electrical breakdown requires a minimum E=3x10^6 N/C along the spark path, and the radius of the charged sphere as 12 cm, determine the magnitude of total charge on the sphere. (You may assume the electric field is only generated by the charged sphere)

6. Given a long thin wire containing negative charge density $\lambda = -8 \times 10^{-6}$ C/m, surrounded by a long, thin cylindrical conducting shell with $\lambda = +12 \times 10^{-6}$ C/m and R=12 mm. Determine the magnitude and direction of the electric field at the following locations radially outward from the central wire:



a) r = 6 mm

b) r = 18 mm