Physics 212	**Midterm II**		18 November 98
7:30–8:50 PM	Closed Book		No Notes
$N_A = 6.02 \times 10^{23} mol^{-1}$	$pV = nRT = NkT$	$R = 8.31 J/mol \cdot K$	$T = T_C + 273^o$
$1cal = 4.186J$	$Q = cm\Delta T = Cn\Delta T$	$W = \int_i^f pdV$	$Q = W + \Delta U$
$KE_{trans} = \frac{3}{2}kT$	$\frac{1}{2}kT/^o freedom$	$F_c = \frac{q_1 q_2}{(4\pi\epsilon_0)r^2}$	$V = \frac{q}{(4\pi\epsilon_0)r}$
$E = F_c/q$	$E_d = 2k\frac{p}{z^3}$	$\vec{\tau} = \vec{p} \times \vec{E}$	$\epsilon \oint \kappa \vec{E} \cdot d\vec{A} = q$
$k = 1.38 \times 10^{23} J/K$	$\frac{1}{4\pi\epsilon_0} = \frac{8.99 \times 10^9 N \cdot m^2}{C^2}$	$e = 1.60 \times 10^{-19} C$	$W_{ext} = q\Delta V$
$V = \frac{q}{4\pi\epsilon_0 r}$	$x = x_0 + v_0 t + \frac{1}{2}at^2$	$PE = \frac{q_1 q_2}{4\pi\epsilon_0 r}$	$m_e = 9.11 \times 10^{-31} kg$

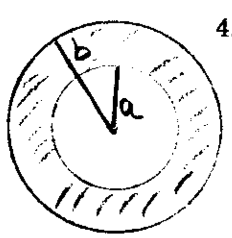
♠ There are 4 questions. For full credit [n points] show physics-based reasoning, work, and units.
♠ Use no auxiliary aids. Calculators *without* stored equations are OK.
♠ Place all books, notes, packs, etc up front.
♠ All answer sheets must be handed in (do not separate them).
♠ The back of pages will *not* be graded *unless* you so indicate on the front.

1. For a certain ideal gas C_V is $6.00 cal/mol \cdot K$. The temperature of 7.0 moles of the gas is raised 25 K by each of three different processes: at constant volume, at constant pressure, and by an adiabatic expansion. Complete the table (on your answer sheet) showing for each process the heat Q added (or subtracted), the work W done by the gas, the change ΔU in internal energy of the gas, and the change ΔK in total translational kinetic energy of the gas.

Part	Process	Q	W	ΔU	ΔK
(a) [9]	Constant V	—	—	—	—
(b) [9]	Constant p	—	—	—	—
(c) [9]	Adiabatic	—	—	—	—

2. Two charges $+2 \times 10^{-6}$ C and -1×10^{-6} C are separated by a distance of 300 cm.
   (a) Determine the point (other than at infinity) at which the electric field vanishes. [12]
   (b) Sketch the electric field lines and the equipotential surfaces in the plane of the page for these charges (indicate the $\vec{E} = 0$ point). [12]

3. A uniform electric field exists in a region between two oppositely-charged horizontal plates. An electron is released from rest at the surface of the negatively charged upper plate and strikes the surface of the lower plate, 5.0 cm below, in a time 2.0×10^{-6} s.
   (a) Explain why you can ignore gravity for this problem. [2]
   (b) What is the speed of the electron as it strikes the second plate? [6]
   (c) What is the magnitude and direction of the electric field $\vec{E}$? [6]
   (d) If the top plate is grounded (set to $V = 0$) and the bottom plate placed at 6 volts, draw three equipotential surfaces for this device and label with potential values. [8]



4. A hollow spherical conducting shell with inner radius a and an outer radius b has a charge $-4q$ on it. A point charge $+q$ is placed at the center of this conductor.
   (a) What charge appears on the inner surface of the shell? [4]
   (b) What charge appears on the outer surface of the shell? [4]
   (c) Draw the electric field lines for all regions of space. [4]
   (d) Deduce expressions for the net electric field for the three regions [9]
   $r > b$,
   $r < a$,
   $a < r < b$.
   (e) Draw a graph showing the electric potential $V(r)$ as a function of r (explain your reasoning). [6]