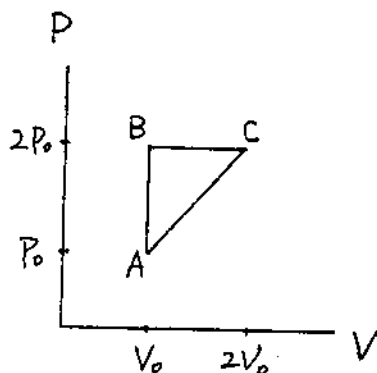


- (1) (a) Determine the acceleration of the center of mass of a uniform hoop rolling down an incline making an angle θ with the horizontal. (b) What is the minimum coefficient of friction required to maintain pure rolling motion for the hoop? (20%)

- (2) A mole of an ideal gas (Gas constant $R=8.3 \text{ J/mol.K}$, $c_v=3 \text{ cal/mol.K}$, $c_p=5 \text{ cal/mol.K}$) undergoes the processes shown in the figure. (where $P_0=5 \times 10^4 \text{ N/m}^2$, and $V_0=0.083 \text{ m}^3$) (a) Find the heat absorbed by the gas during the process from A through B to C. (b) Find the net heat added to the gas during one complete cycle. (20%)



- (3) A solid cylindrical conductor of radius a and charge density per unit length λ is coaxial with a cylindrical shell of negligible thickness, radius $b > a$, and charge density per unit length $-\lambda$. (a) Determine the electric field in the region $a < r < b$. (b) Find the capacitance of the cable per unit length. (20%)
- (4) Light of wavelength 580 nm is incident on a slit having a width of 0.300 mm . The viewing screen is 2.00 m from the slit. Find the positions of the first dark fringes and the width of the central bright fringe. (20%)
- (5) (a) The energies of the quantum states for a hydrogen atom are given by $E_n = -13.6/n^2 \text{ eV}$. A photon is emitted as a hydrogen atom undergoes a transition from the $n=6$ state to the $n=2$ state. Find the wavelength of the emitted photon. (b) An electron ($m=9.11 \times 10^{-31} \text{ kg}$) moves at $1.00 \times 10^7 \text{ m/s}$. Find the wavelength of the electron. (20%)