# Assignment – Physics 2

$\Delta E = Q - W$ $W<0$ $\Delta V = 200cm^3$ $W = P\Delta V$

P **1/** A gas is compressed from 400 cm$^3$ to 200 cm$^3$ at a constant pressure of 100 kPa. At the same time, 100 J of heat energy is transferred out of the gas. What is the change in internal energy of the gas during this process? $Q = -100J$

**2/** A gas within a closed chamber undergoes a cycle shown in Figure 1. Calculate the net heat added to the system in the complete cycle.

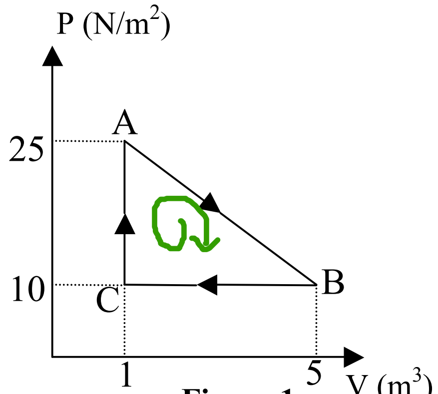


**Figure 1**

**3/** A sample of gas is taken through cycle abca shown in the p-V diagram of Figure 2. The net work done is +2.0 J. Along path ab, the magnitude of the work done is 4.0 J, the energy transferred to the gas as heat is +5.0 J. Along path ca, the energy transferred to the gas as heat is +3.0 J.

(a) What is the change in internal energy along path ab?

(b) How much energy is transferred as heat along path bc?

$Q_{bc} = Q_{net} - Q_{ab} - Q_{ca} =$

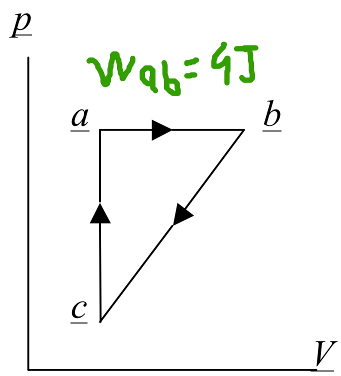


**Figure 2**

**4/** A 0.9 mol sample of an ideal gas undergoes an isothermal process. The initial volume is 0.20 m$^3$ and the final volume is 0.40 m$^3$. If the heat added to the gas is 2000 J, find the temperature of the gas.

**5/** In an intestellar gas cloud (e.g., a star-forming region) at 20.0 K, the pressure is $1.0\times10^{-8}$ Pa. Assuming that the molecular diameters of the gases in the cloud are all 15.0 nm, what is their mean free path?

**6/** Two moles of nitrogen are in a 3-liter container at a pressure of $5.0\times10^{6}$ Pa. Find the average translational kinetic energy of a molecule.

**7/** An ideal gas ($\gamma$ = 1.40) expands slowly and adiabatically. If the final temperature is one third the initial temperature, by what factor does the volume change?

$\gamma = 3$

**8/** An ideal monatomic gas undergoes an adiabatic compression from state 1 with pressure $p_1$=1 atm, volume $V_1$=8 L, and temperature $T_1$=300 K to state 2 with pressure $p_2$=32 atm, volume $V_2$=1 L.

(a) What is the temperature of the gas in state 2? $\frac{PV}{T} = \frac{PV}{T}$

(b) How many moles of gas are present?

$PV = nRT$

$K = \frac{3}{2} nRT$

(c) What is the average translational kinetic energy per mole before and after the compression?
(d) What is the ratio of the squares of the rms speeds before and after the compression? $v_{RMS} = \sqrt{\frac{3RT}{m}}$
(e) If we do not know that the ideal gas here is monatomic, demonstrate that the gas is truly monatomic. $pV^{\gamma} = pV^{\gamma}$

$\gamma = 3$

? **9/** A 2.0 mol sample of an ideal monatomic gas undergoes a reversible process at constant volume, increasing its temperature from 400 K to 600 K. What is the entropy change of the gas? $\Delta S = n C_v \ln\left(\frac{T}{T_0}\right)$ $\left(\frac{J}{K}\right)$

**10/** Calculate the change in entropy of gases in the following cases:
a) A 3.0 mol sample of an ideal gas expands reversibly and isothermally at 350 K until its volume doubled.
b) The temperature of 1.0 mol of an ideal monatomic gas is raised reversibly from 200 K to 300 K, with its volume kept constant.

$\Delta S = nR \ln\left(\frac{V}{V_0}\right)$