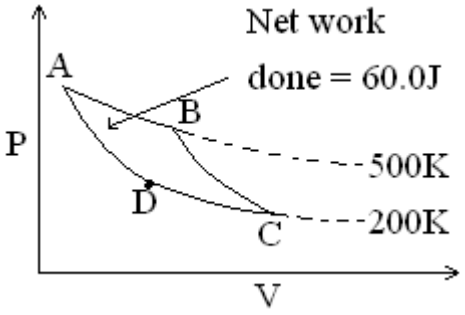
一、**(a). What is the Boyle temperature? (3%) (b).Use the following table to list the gases from most ideal to least ideal and explain why? (3%) (C). The van der Waals constant for hydrogen is a= 0.244 atm.L^2/ mol^2, b= 0.0266 L/ mol, calculate the Boyle temperature of hydrogen? (4%)**

Boyle temperatures for various gases

Gas	T_B (K)
H_2	110
He	25
Ne	127
Ar	410
N_2	327
O_2	405
CO_2	713
CH_4	509

二、 **Determine the difference between △H and △U at 25℃ for the following reaction:** $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(\ell)$ **(10%)**

三、 **The accompanying diagram represents a reversible Carnot cycle for an ideal gas: (a). What is the thermodynamic efficiency of the engine? (4%) (b). How much heat is absorbed at 500 K? (4%) (c). How much heat is rejected at 200 K? (4%) (d). In order for the engine to perform 1.00 kJ of work, how much heat must be absorbed? (3%)**



四、 **10.0 grams of helium behaved ideally is compressed isothermally and reversibly at 100.0 ℃ from 2.00 atm to 10.0 atm . Calculate q (3%) and w (3%) and each of the thermodynamic quantities △U (1%), △H (1%), △G (3%), △A (2%), and △S (2%)？**

五、 **The $\triangle G^0$ for the following reaction is +3.40 kJ/mol : H_2 (g) + I_2 (s) $\rightleftharpoons$ 2HI (g)**

(a). Calculate the equilibrium constant for the reaction？ (5%) (b). If the partial pressure of H_2 at equilibrium is 0.20 bar, please calculate the partial pressure of

hydrogen iodide in the mixture？ (5%) P^0 = 1 bar.

六、 **What pressure is necessary to change the boiling point of water from its 1.000 atm value of 100°C (373 K) to 97°C (370 K)? (10%) The heat of vaporization of water is 40.7 kJ/mol. The density of water at 100°C 0.985 g/mL, and the density of steam is 0.5983 g/L. You will have to use the relationship 101.32 J = 1 L-atm.**

七、 **Calculate ΔH_{mix} (2%), ΔU_{mix} (2%), ΔG_{mix} (3%), ΔS_{mix} (3%) for a system that mixes 1.00 mole of toluene and 3.00 mole of benzene? Assume ideal behavior and 298K.**

八、 **For the reaction:**

$3Ag(s) + NO_3^-(aq) + 4H^+(aq) \longrightarrow 3Ag^+(aq) + NO(g) + 2H_2O \quad E^o = 0.165\ V$

Calculate (a). ΔG^o (5%) and (b). K (5%) at 25℃.

九、**Consider the first-order decomposition of A. The rate constant doubles when the temperature increases from 15°C to 25°C and the rate constant for the decomposition at 40°C is 0.0125 s^{-1}. Calculate (a). What is the activation energy for the decomposition? (3%) (b). What is the half-life of A at 78°C? (3%) (c). What is the rate of decomposition of a 0.200 M solution of A at at 78°C? (2%) (d). At what temperature will the rate of decomposition of 0.165 M be 0.124 $mol/L \cdot s$? (2%)**