Course: CHM202

Energetics and dynamics of chemical reactions

Assignment – IV

Q.1 A heat engine operates between 723 ºC and 223 ºC.

(a) What is the maximum efficiency of the engine?

(b) Calculate the maximum work that can be done by for each 1.0 kJ of heat supplied by the hot source.

(c) How much heat is discharged into the cold sink in a reversible process for each 1.0 kJ supplied by the hot source?

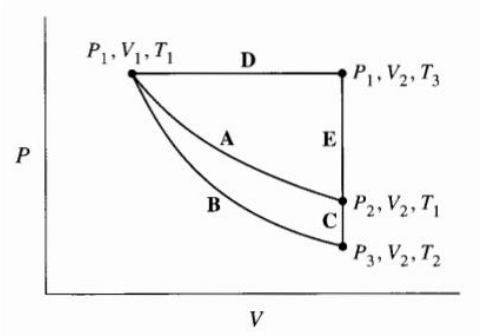
Q.2 What is the maximum possible efficiency of a heat engine that has a hot reservoir of water boiling under pressure at 125 ºC and a cold reservoir at 25 °C?

Q.3 Consider a heat engine that uses reservoirs at 800 °C and 0 °C. (*a*) Calculate the maximum possible efficiency, (*b*) If Q_H is 1000 J, find the maximum value of *w* and the minimum value of Q_C.

Q.4 A Carnot-cycle heat engine does 2.50 kJ of work per cycle and has an efficiency of 45.0%. Calculate *w*, Q_H, and Q_C for one cycle.

Q.5 A 0.1 horsepower motor is used to run a Carnot refrigerator. If the motor runs continuously, what will be the temperature reached inside the box if the heat leak into the box is 500 J/s and the outside temperature is 20 °C? Assume that the machine performs with maximum efficiency. [Given: 1 W = 1 J/s; 1 hp = 746 W].

Q.6 Calculate Q_{rev} and ΔS for a reversible expansion of an ideal gas at constant pressure P_1 from T_1, V_1 to T_3 , V_2 (path D in below figure) followed by a reversible cooling of the gas at constant volume V_2 from P_1, T_3 to P_2 , T_1 (path E).



Q.7 Suppose the internal energy (*U)* is a function of only the temperature for a gas which abide by the following equation of state:

$$P = \frac{RT}{V - b}$$

Here, b is a constant which signifies the size of the molecules. Calculate the change in entropy when one mole of this gas at T and V_1 is allowed to expand into a vacuum to a total volume of V_2.

Q.8 The heat of vaporization of water at 100 °C is 40.66 kJ/mol. Determine the change in entropy (ΔS) when 5.00 g of water vapor condenses to liquid at 100 °C and 1 atm.