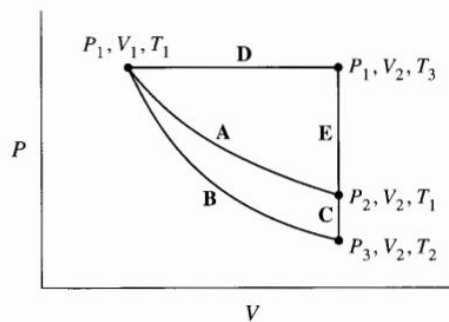


## Course: CHM202

### Energetics and dynamics of chemical reactions

#### Assignment – IV

- Q.1** A heat engine operates between 723 °C and 223 °C.
- What is the maximum efficiency of the engine?
  - Calculate the maximum work that can be done by for each 1.0 kJ of heat supplied by the hot source.
  - 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 °C 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  $\Delta S$  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 ( $\Delta S$ ) when 5.00 g of water vapor condenses to liquid at 100 °C and 1 atm.