Week 14- Problems

14-1. a) What is the difference between a reversible thermodynamic process and an irreversible thermodynamic process? b) A gas is expanded by a factor of 3 in (i) a reversible isotherm and (ii) an irreversible isotherm. Draw these processes on a P-V diagram.

14-2. Show that (i) two ischores, (ii) two isobars, (iii) two isotherms and (iv) two adiabatics can never intersect.

14-3. Given that in an adiabatic process is an ideal gas is described by the equation

$$PV^{\gamma} = Const. \qquad \gamma = \frac{C_p}{C_V}$$

Show that an equivalent way of writing this equation is

$$TV^{\gamma-1} = Const.$$

14-4. Why is it necessary to introduce entropy?

14-5. Draw the Carnot Cycle on a P-V Diagram and show that if T_H, T_C are the temperatures of the hot and cold reservoirs respectively and DQ_H, DQ_C the heats picked up and rejected then

$$\frac{DQ_H}{T_H} + \frac{DQ_C}{T_C} = 0$$

14-6. In a Carnot Cycle the temperature of the hot reservoir is 100°C. What must be the temperature of the cold reservoir if we desire an efficiency of 0.4?

14-7. A heat pump is essentially a device which takes heat from a cold reservoir and rejects it into a hot reservoir. Its coefficient of performance is

$\text{COP} = \dfrac{Q_H}{Q_H - Q_C} = \dfrac{T_H}{T_H - T_C}$, *where* $W = (Q_H - Q_C)$ is the energy input. If a heat pump is used in your house when the temperature outside is 0°C and inside is 25°C and the input is 1 kJ. What is the COP and how much energy per cycle is delivered.