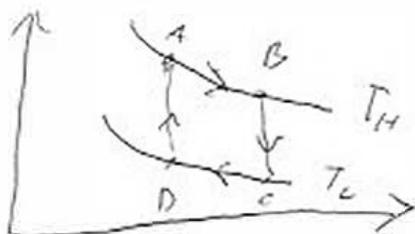Worksheet# 6 (Total number of points you can get is 3 pts)

1. a) (0.5 pts) Draw a Carnot cycle in a PV diagram, and indicate in the which processes are isothermal or adiabatic.

isothermal: $A \to B$, $C \to D$

adiabatic: $B \to C$, $D \to A$

b) (0.5 pts) Indicate in which process the engine absorbs or releases heat, and write down the amount of heat absorbed or released. $R \ln \frac{V_2}{V_1} > 0$

$C \to D$: releases heat $\quad Q_{CD} = R T_c \ln \frac{V_4}{V_3} < 0$

c) (0.5 pts) What is the change in entropy in a Carnot cycle? What is the change in internal energy

$$\oint S = 0 \qquad \Delta U = 0$$

2. A Carnot engine operates between $T_c = 200$ K and a higher temperature T_H.

a. (0.5 pts) If the entropy change in the isothermal expansion at T_H is 100 J/K, what is the amount of heat Q_c released at T_c?

$$\Delta S = \frac{Q_H}{T_H}, \quad \frac{Q_H}{T_H} + \frac{Q_c}{T_c} = 0 \Rightarrow Q_c = -\Delta S \cdot T_c$$
$$= -100 \tfrac{J}{K} \cdot 200 K = -20 kJ$$

b. (0.5 pts) If the engine produces 10kJ of work per cycle, what amount of heat Q_H is absorbed at T_H?

$$W = -\left(Q_H + Q_c\right) \Rightarrow Q_H = -W - Q_c : \quad \underline{W = -10 kJ}$$
$$= 10 kJ + 20 kJ = \underline{30 kJ}$$

c. (0.5 pts) What is the value of T_H?

$$\frac{Q_H}{T_H} + \frac{Q_c}{T_c} = 0 \Rightarrow T_H = -T_c \frac{Q_H}{Q_c} = 200 K \cdot \frac{30}{20} = 300 K$$