

5. (a). How to defined  $C_p$  and  $C_v$  ,

where  $C_p$  is specific heat at constant pressure process ,

$C_v$  is specific heat at constant volume process , (5%)

(b). Prove  $C_p - C_v = \frac{\alpha_p^2 v T}{\beta_T}$

where  $v$  is the specific volume ,

$T$  is the temperature ,

$\alpha_p$  is the volume expansivity ,  $\alpha_p \equiv \frac{1}{v} \left( \frac{\partial v}{\partial T} \right)_P$

$\beta_T$  is the isothermal compressibility ,  $\beta_T \equiv -v \left( \frac{\partial p}{\partial v} \right)_T$

(10%)

6. Show that the conduction heat transfer direction from high temperature to low temperature , (10%)

7. (a). Please show the process of ideal Otto cycle on PV and TS diagram , where P is pressure ,

V is volume ,

T is temperature ,

S is entropy ,

(5%)

(b). Given initial state 1 at  $P_1=1\text{atm}$  ,  $T_1=300\text{K}$  ,  $V_1=500\text{cm}^3$  that

compress to  $V_2=50\text{cm}^3$  , find  $P_2$  ,  $T_2$  and compression ratio

$\phi$  ,