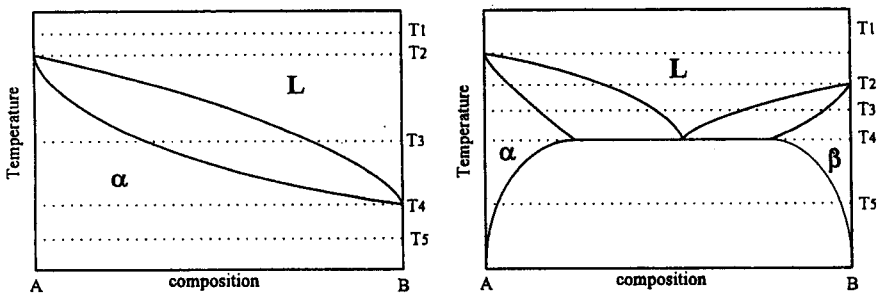
國立臺灣科技大學
九十四學年度碩士班招生考試試題
系所組別：材料科技研究所碩士班
科　　目：熱力學

Closed Book，可使用計算機。
共五題，每題各 20 分，總分 100 分。

1. Explain the following terms:
(a)Phase Rule, (b) Lever Rule, (c) First Law of Thermodynamics (d) Regular Solution.

2. According to these two binary system phase diagrams to draw the each phase relationship of the Gibbs free energy of mixing curve and compositions at indicated temperature.(a).isomorphous system; (b).simple eutectic system.



(a).isomorphous system　　(b).simple eutectic system

3. The P-V diagram of the Air-standard Diesel engine is illustrated in Fig. 3. In step, DA, heat is absorbed by air at constant pressure. Then the air is expanded adiabatically and reversibly (step AB), cooled down at constant volume (step BC), and finally compressed adiabatically and reversibly to the initial state at D. please, drive an equation giving the thermal efficiency of this cycle in relation to the compression ratio r (ratio of volumes at the beginning and the end of the compression step) and the expansion ratio r_e (ratio of volumes at the end and beginning of the expansion step).

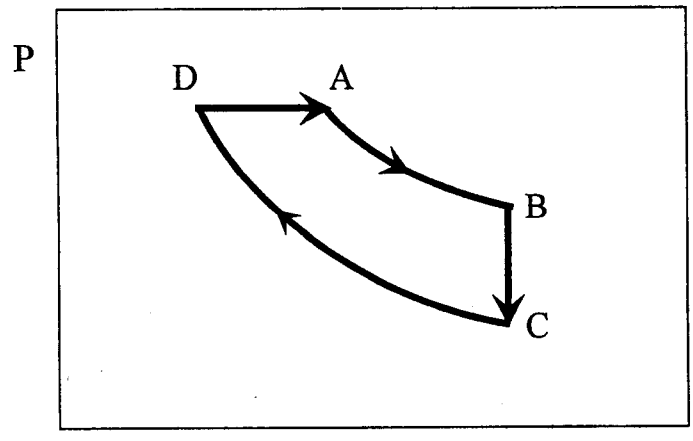


Figure 3 An air-standard Diesel cycle.

國立臺灣科技大學

九十四學年度碩士班招生考試試題

系所組別：材料科技研究所碩士班

科　　目：熱力學

4. What is the Gibbs/Duhem equation? The following equations have been proposed to present activity-coefficient data for a system at fixed T and P:

$$\ln \gamma_1 = Ax_2^2 + Bx_2^2(3x_1 - x_2)$$
$$\ln \gamma_2 = Ax_1^2 + Bx_1^2(x_1 - 3x_2)$$

Do these equations satisfy the Gibbs/Duhem equation? Determine an expression for G^{xs}/RT for the system.

5. The Margules-type (M-type) equation is commonly used to express the molar excess Gibbs free energy. The equation of the P phase for binary system is expressed as follows,

$$\frac{\Delta^{ex}G^P}{RT} = (\frac{1}{2})x_1x_2[(w_{12}^P + w_{21}^P) + (w_{12}^P - w_{21}^P)(x_2 - x_1) - 8\nu_{12}^P x_1x_2]$$

where w_{12}^P、w_{21}^P and ν_{12}^P are all the thermodynamic parameters.

(a)Please use the Margules-type equation to express the partial excess Gibbs free energy of the liquid phase.(15 points)

(b)Use the equation from (a), calculate the equilibrium compositions where the temperature is at 1100 K.(5 points)

All the thermodynamics parameters of the Ag-Cu system as list as follow,

Phase	w_{12}^L	w_{21}^L	w_{12}^α	w_{21}^α
L(liquid)	2116.4/T – 0.419	1553.1/T – 0.191	-	-
FCC(α)	-	-	4874.7/T -0.896	4874.7/T -0.896

$G_{Cu}^{0,L} - G_{Cu}^{0,fcc} = 13054.0 - 9.623T$

$G_{Ag}^{0,L} - G_{Ag}^{0,fcc} = 11945.0 - 9.67T$

p.s.: The values of ν_{ij}^P and ν_{ji}^P are equal to zero in the binary Ag-Cu system; and 1:Ag, 2:Cu.