一. 某一熱力系統由狀態1到狀態2，若其所含 entropy 是呈現減少現象，試問此系統必發生何種過程(process)變化？

(10%)

二. 欲使一個動力循環(power cycle)系統效率提高，亦即要儘量減小因不可逆(irreversibility)所造成效率減低，試問應如何着手改進？

(10%)

三. 已知某一氣體狀態方程式為

$$pv = RT + ap$$

其中 p, v, T 分別為壓力，比容和溫度，a 為一常數，R 為氣體常數，試導 $du = ?$ $dh = ?$ $ds = ?$ [u: internal energy; h: enthalpy; s: entropy]

(20%)

四. 對一個封閉系統(closed system)而言，由狀態1到狀態2之變化，得底下之關係式

$$I_{12} = -(\Psi_2 - \Psi_1)_{sys} - \sum_K Q_K\left(1 - \frac{T_0}{T_K}\right) - W_{12,useful}$$

其中 I_{12} = 不可逆性(irreversibility)

$(\Psi_2 - \Psi_1)_{sys}$ = 系統可用能(availability)變化

Q_K = 熱傳量(heat flux)

$W_{12,useful}$ = 系統所做之有用功(useful work)

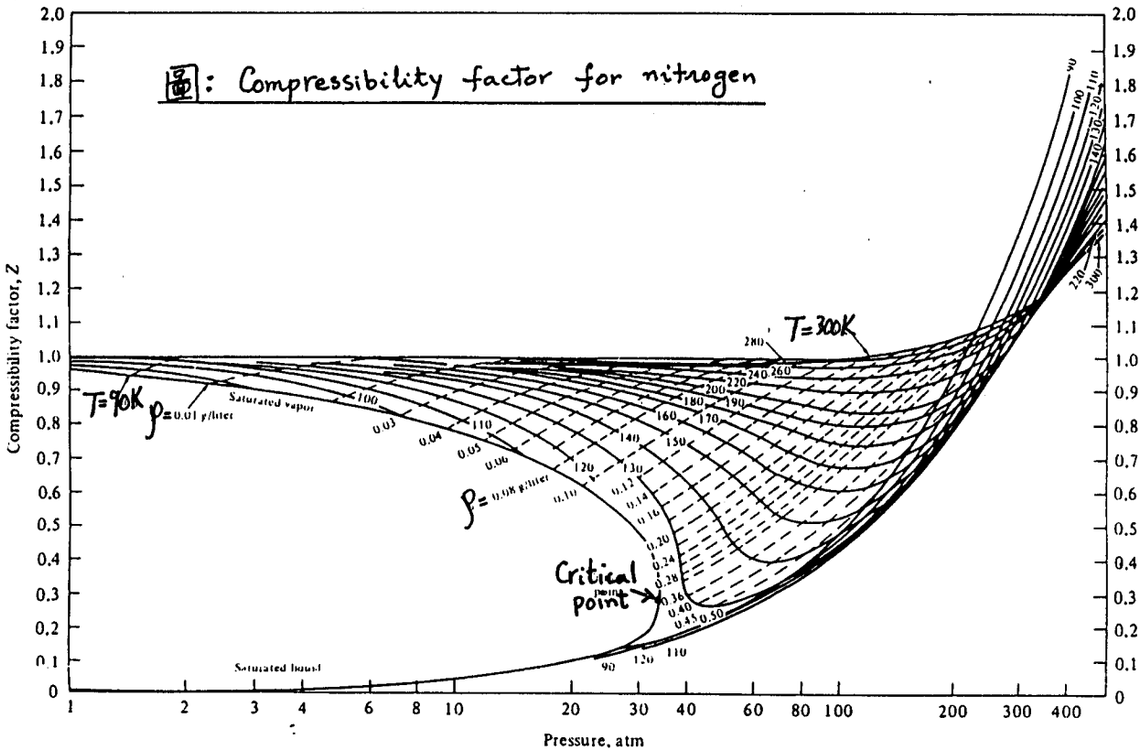
1.9

請依上式說明 I_{12} 所代表之實際涵意。

(20%)

五、依底下之圖(Compressibility factor for nitrogen),說明此圖能給予我們何種結論. (20%)

圖: Compressibility factor for nitrogen



六. Steam enters a turbine with a pressure and temperature of 15 MPa and 600°C and leaves at 100 kPa as a saturated vapor. The flow area at the turbine inlet is 0.045 m^2 and at the exit it is 0.31 m^2. The steam flows steadily through the turbine at a mass flow rate of 30 kg/s. Calculate the power that can be produced by the turbine, assuming negligible heat transfer from the system.

P(MPa)	T(°C)	V(m^3/kg)	h(KJ/kg)	u(KJ/kg)
15	600	0.02491	3582.3	3208.6
0.1	99.63	1.6940	2675.5	2506.1

(20%)