國立臺北科技大學九十九學年度碩士班招生考試

系所組別：3301、3302 材料科學與工程研究所

第一節　普通熱力學　試題

注意事項：

1. 本試題共 14 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

Section A. Chose "one" correct answers for each of the followings.
【5% for each one, total 40%】

1. $\left(\frac{\partial \alpha}{\partial \beta}\right)_{\gamma}\left(\frac{\partial \beta}{\partial \gamma}\right)_{\alpha}\left(\frac{\partial \gamma}{\partial \alpha}\right)_{\beta}$ = _____

   (a)1, (b)0, (c)-1, (d)∞

2. Figure 1 shows idealized reversible cycles of the _____ engine.
   (a)diesel, (b)Otto, (c)Carnot, (d)turbo

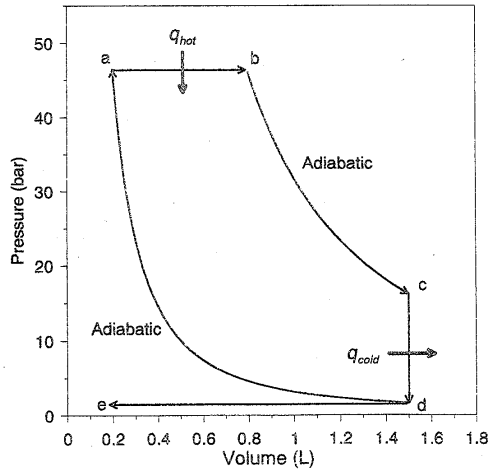

Figure 1.

3. $\left(\frac{\partial G}{\partial T}\right)_{p}$ = _____

   (a)$\left(\frac{\partial U}{\partial V}\right)_{T}$, (b)–P, (c) V,(d) –S

4. 30 mTorr = _____ Pa
   (a)1, (b)2, (c)3, (d)4

5. Apparatus shows in figure 2 is a constant pressure calorimeter which suitable for measuring the _____ of a salt in a solution.
   (a)work, (b)enthalpy, (c) melting point,(d) formation energy

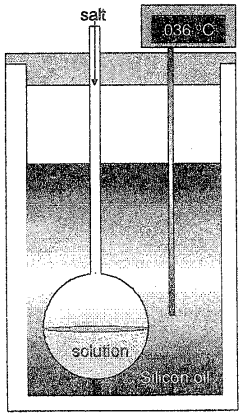

Figure 2

6. Clausius inequality state:
   ds ____ dq/T
   (a)<, (b)>, (c)≤, (d)≡

注意：背面尚有試題

7. The First law of thermodynamic state:
(a)It is impossible for a system to undergoes a cyclic process whose sole effects are the flow of heat into the system from a heat reservoir and the performance of an equivalent amount of work by the system on the surroundings.
(b)The entropy of a pure, perfectly crystalline substance (element of compound) is zero at zero Kelvin.
(c)It is impossible for a system to undergoes a cyclic process whose sole effects are the flow of heat into the system from a cold reservoir and the performance of an equivalent amount of heat out of the system into a hot reservoir.
(d)The internal energy of an isolated system is constant.

8. A mixture of oxygen and hydrogen is analyzed by passing it over hot copper oxide. Hydrogen reduces the CuO according to the reaction $CuO + H_2 \rightarrow Cu + H_2O$ and oxygen reoxidizes the copper formed according to $Cu + 1/2\ O_2 \rightarrow CuO$. At 25°C and 750 Torr, 100.0 cm^3 of the mixture yields 55 cm^3 of dry oxygen measured at 25°C and 750 Torr after passage over CuO.
What is the original composition of the mixture?
O_2:H_2=(a)50:50(b)70:30(c)80:20(d)90:10

Section B. Calculations
【10% for each one, total 60%】

9. A petroleum factory using a gas tank to storing ethane gas. The pressure in the tank is 20 MPa, 25°C, and the tank capacity is 800 m^3.
Calculate how many moles of ethane are stored in the tank and show the density of ethane gas. (assume C_2H_6 obey ideal gas behavior)

10. A balloon, its empty weight is 100 g. Using He gas to fill it, finally filled as 1 m^3, 1.5×10^5 Pa, at room temperature. When you release it in atmosphere. Is it rise? Calculate to show the reason.

11. A refrigerator is operated by a 0.5-hp (1 hp = 746 watts) motor. If the interior is to be maintained at –23°C and the room temperature is 27°C, the coefficient of performance is 60% of the maximum theoretical value, what is the maximum heat leak that can be tolerated?

12. Use the values in table to calculate $\Delta H^\circ_{reaction}$ and $\Delta U^\circ_{reaction}$ at 298.15 K for the following reactions:
$2NO_2(g) \rightarrow 2NO(g) + O_2(g)$

13. The temperature of 1 mol of an ideal gas increases from 20.0 °C to 60.0 °C as the gas is compressed adiabatically. Calculate heat(q), work(w), internal energy(ΔU) and enthalpy(ΔH) for this process assuming that $C_{V,m} = 3/2R$.

14. The following thermodynamic data apply to the complete oxidation of butane at 25°C:
$CH_3OH(g) + 3/2O_2(g) \rightarrow 1CO_2(g) + 2H_2O(l)$

$\Delta H^0 = -891 kJmol^{-1}$
$\Delta S^0 = -186.3 JK^{-1}mol^{-1}$

Suppose that a completely efficient fuel cell could be set up utilizing this reaction. Calculate (a) the maximum electrical work and (b) the maximum total work that be obtained at 25 °C

Appendix
Table 1. symbol

q	Heat	G	Gibbs energy
w	Work	T	Temperature
U	Internal energy	V	Volume
H	Enthalpy	P	Pressure
S	Entropy	C	Heat capacity

Table 2. Thermodynamic data.

	ΔH^0_f ($kJmol^{-1}$)	ΔG^0_f ($kJmol^{-1}$)	S^0 ($JK^{-1}mol^{-1}$)	$C^0_{p,m}$ ($JK^{-1}mol^{-1}$)	Molecular weight
N(g)	472.7	455.5	153.3	20.8	14.007
NH_3(g)	-45.9	-16.5	192.8	35.1	17.03
NO(g)	91.3	87.6	210.8	29.9	30.01
N_2O(g)	81.6	103.7	220.0	38.6	44.01
NO_2(g)	33.2	51.3	240.1	37.2	46.01

Molar gas constant = 8.314 $JK^{-1}mol^{-1}$