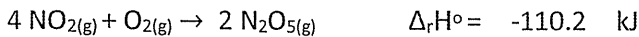※ 考生請注意：本試題可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Please explain the following terminology in detail : (1)Virial coefficients; (2)Phase boundaries ; (3)Kirchhoff's law; (4)Born interpretation; (5) Planck constant ; (20%，each 4%)

2. What is the total random kinetic energy of all the molecules in 2 mole of hydrogen at a temperature of 400 K ?(5%)

3. For a binary liquid mixture A-B，choose the correct one: (5%)
   (1) Both the molar volume of the solution and partial molar volume for each component are always positive.
   (2) The molar volume of mixing is always zero.
   (3) The Gibbs energy of the solution is always increased with increasing the temperature.
   (4) The Gibbs energy of the solution is always increased with increasing the pressure.
   (5) None is correct.

4. Given the following data；Calculate:
   (1) the Equilibrium Constant of $H_{2(g)} + I_{2(s)} \rightarrow 2HI_{(g)}$　　　at T = 298K。(5%)
   (2) the Equilibrium Constant of $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$　at T = 298K。(5%)

	$\Delta_f G^\circ$ / kJ mol^{-1}
$H_{2(g)}$	0
$HI_{(g)}$	1.7
$N_{2(g)}$	0
$NH_{3(g)}$	-16.5

5. Calculate the standard enthalpy of formation for N_2O_5: (10%)

   $2\ NO_{(g)} + O_{2(g)} \rightarrow 2\ NO_{2(g)}$　　　$\Delta_r H^\circ = -114.1$　kJ
   $4\ NO_{2(g)} + O_{2(g)} \rightarrow 2\ N_2O_{5(g)}$　　$\Delta_r H^\circ = -110.2$　kJ
   $N_{2\ (g)} + O_{2(g)} \rightarrow 2\ NO_{(g)}$　　　　$\Delta_r H^\circ = +180.5$　kJ

6. Please estimate the temperature : (1) in decomposition of $CaCO_3$ (5%) (2) in dewatering of $CuSO_4 \cdot 5H_2O$(5%)

T=298K	$\Delta_f H^\circ$ / kJ mol^{-1}	$\Delta_f G^\circ$ / kJ mol^{-1}	ΔS° / JK^{-1} mol^{-1}	$C_{p,m}$ / JK^{-1} mol^{-1}
$CaCO_{3(s)}$	-1206.9	-1128.8	92.9	81.88
$CaO_{(s)}$	-635.09	-604.03	39.75	42.80
$CO_{2(g)}$	-393.51	-394.36	213.74	37.11
$CuSO_{4(s)}$	-771.36	-661.8	109	100.0
$CuSO_4 \cdot 5H_2O_{(s)}$	-2279.7	-1979.7	300.4	280
$H_2O_{(g)}$	-241.82	-228.57	188.83	33.58

7. Draw the two graphs of V vs. T and of H vs. T that show the characteristic first-order phase transition and explain them。(10%)

8. The ionic strength of a solution contains 0.02 mol/kg $NaNO_3$ and 0.08 mol/kg $Mg(NO_3)_2$? (10%)

9. The half-life of the first order reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$ is 7.3 hours at 25'C.
   Please calculate the rate coefficient for this reaction. {10%}

10. 3.0 mole of a perfect gas at 350K is expanded isothermally and reversibly from 3.0 atm to 1.0 atm .
    Determine the values of (a)q (b) w (c) ΔU (d) ΔH (e) ΔS　　(10%，each 2%)