國立臺北科技大學

九十二學年度有機高分子研究所入學考試

物理化學試題

填准考證號碼

注意事項：

1. 本試題共[redacted]題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

請依照考題前後次序作答

1. Explain the following terms: (30%)
   (a) Boyle temperature
   (b) collision mean free path
   (c) internal pressure
   (d) Clausius inequality
   (e) Phase rule
   (f) Heisenberg Uncertainty Principle

2. Real gases show deviations from the perfect gas law because molecules interact with each other. Use the potential energy variation of two molecules on their separation to explain two basic types of molecular interactions. (10%)

3. Calculate the minimum work that must be expanded in the compression of 1 kg of ethylene (C_2H_2) from 10^{-1} m^3 to 10^{-2} m^3 at a constant temperature of 300 K, assuming the gas to be (a) ideal (b) Van der Waals. (gas constant R = 8.314 J $K^{-1}mol^{-1}$, The Van der Waals constants are: a = 4.47 L^2 atm mol^{-2}, b = 0.0571 L mol^{-1}, respectively.) (10%)

4. Calculate the heat absorbed, ΔH, at constant pressure when one mole of $N_{2(g)}$ is heated

from 25℃ to 150℃. The heat capacity at constant pressure is : $C_p = 6.76 + 0.606 \times 10^{-3} T + 1.3 \times 10^{-7} T^2$ cal $K^{-1}mol^{-1}$. (10%)

5. What is the change in entropy when argon at 25℃ and 1 atm pressure is expanded isothermally from 500 cm^3 to 1000 cm^3 and simultaneously heated to a temperature of 100 ℃? C_v of argon = 12.6 $J \cdot K^{-1} \cdot mol^{-1}$. (10%)

6. Alpha particles(mass = 6.6×10^{-24} g) emitted from radioactive radium has an energy of 4.8 million electron volts (MeV). Calculate the de Broglie wavelength of one of these alpha particles. (Planck constant h = 6.6×10^{-27} erg sec, 1 MeV = 1.6×10^{-6} erg, 1 erg = 1 g cm^2 sec^{-2}) (10%)

7. For a particle in a one-dimensional box, the ground state wavefunction is:

$$\Phi = (2/a)^{1/2} \sin(\pi x/a)$$

Calculate the probability that the particle (a) in the right half of the box, and (b) in the middle third of the box. (10%)

8. For the first-order gas reaction: $N_2O_5 <=> 2\ NO_2 + 1/2\ O_2$, the rate constants are listed below:

T/K	273	298	308	318	328	338
$k/10^{-5}\ s^{-1}$	0.0787	3.46	13.5	49.8	150	487

Determine the values of the activation energy and the pre-exponential factor. (10%)