

東吳大學 112 學年度碩士班研究生招生考試試題

第1頁，共4頁

系級	化學系碩士班	考試時間	100 分鐘
科目	綜合化學	本科總分	100 分

※一律作答於答案卷上(題上作答不予計分)；並務必標明題號，依序作答。

Part A

1. Explain the following terms: (a) Pauli exclusion principle, (b) oxidative addition and reductive elimination, (c) Hard Soft Acid Base, (d) geometric isomers, (e) paramagnetic and diamagnetic compounds. (2% for each)
2. What are the possible numbers of unpaired electrons of Fe(II) ion in tetrahedral, Fe(II) ion in octahedral, and Ni(II) ion in square-planar complexes by using crystal field theory (draw the *d* orbitals splitting diagram)? (8%)
3. Draw the Lewis structures for the following molecules: (a) ClF₃ (b) SF₆ (c) SF₄ (d) XeF₂ (e) TeF₄²⁻ (f) PF₅ (g) BF₃. (1 % for each)

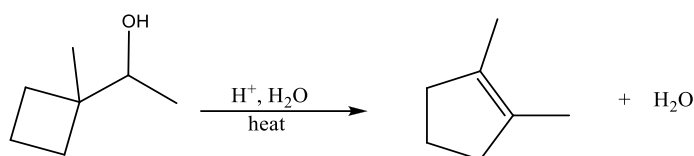
Part B

1. For 1.25 mole of an ideal gas, $P_{\text{external}} = P = 3.5 \times 10^5$ Pa. The temperature is changed from 135°C to 21.2°C, and $C_{V,m} = 3R/2$. Calculate q , w , ΔU , and ΔH . (8 %)
2. You have containers of pure O₂ and N₂ at 298 K and 1 atm pressure. Calculate ΔG_{mixing} relative to the unmixed gases of
 - (a) a mixture of 10 mole of O₂ and 10 mole of N₂
 - (b) a mixture of 10 mole of O₂ and 20 mole of N₂
 - (c) Calculate ΔG_{mixing} if 10 mole of pure N₂ is added to the mixture of 10 mole of O₂ and 10 mole of N₂. (6 %)
3. At 350 K, pure toluene and hexane have vapor pressures of 3.57×10^4 Pa and 1.30×10^5 Pa, respectively. (6 %)
 - (a) Calculate the mole fraction of hexane in the liquid mixture that boils at 350 K at a pressure of 1 atm.
 - (b) Calculate the mole fraction of hexane in the vapor that is in equilibrium with the liquid of part (a)
4. Calculate the wavelength of the light emitted when an electron in a one-dimensional box of length 5.0 nm makes a transition from the $n = 7$ state to the $n = 6$ state. (5 %)

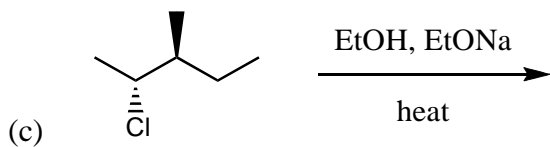
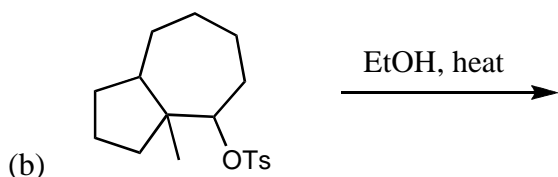
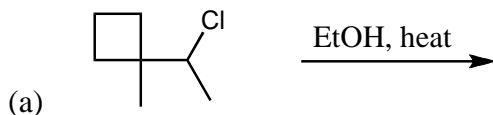
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Part C

1. Draw a mechanism to justify the following transformation: (5 %)



2. Please predict the *major* product of the following reactions. (6%)

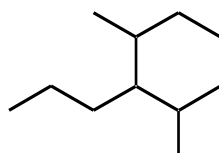


3. Please provide the IUPAC name for the following compounds. (4%)

(a)

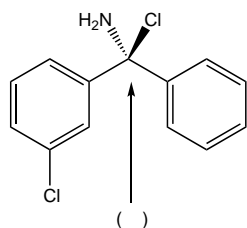


(b)

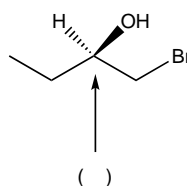


4. Designate the (R) or (S) configuration at each chirality center in the following molecules. (4%)

(a)



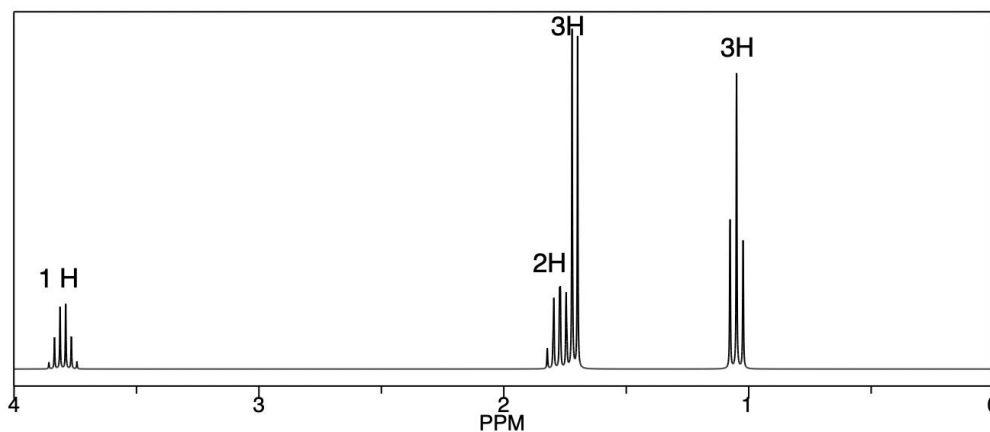
(b)



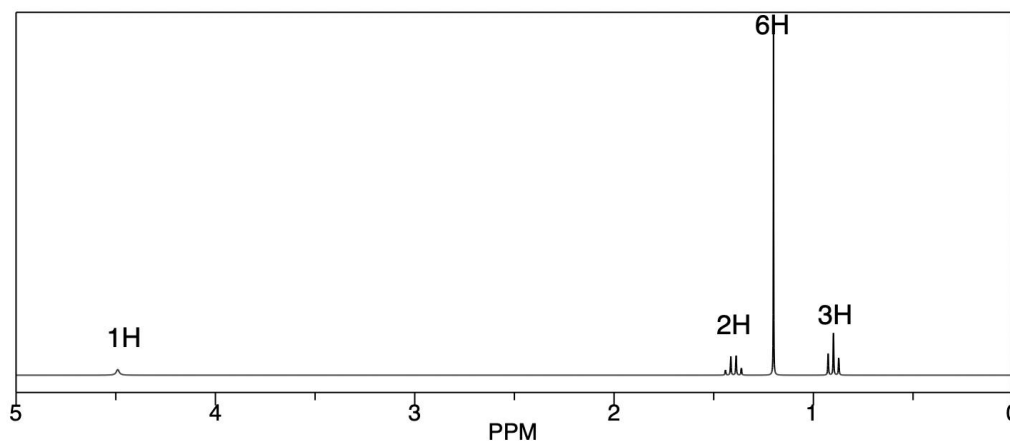
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5. Proposed structures for the compounds whose ^1H NMR spectra are shown below: (6%)

(a) $\text{C}_4\text{H}_9\text{Br}$



(b) $\text{C}_5\text{H}_{12}\text{O}$



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6. Consider the following set of replicate measurements of the K^+ in the solution: 0.514, 0.503, 0.486, 0.497, 0.472 ppm K^+ . Calculate the (a) mean; (b) median; (c) standard deviation; (d) coefficient of variation (CV); (e) the interval mean at the 95% confidence interval; (f) If s is a good estimate of σ , what is the interval mean value at the 95% confidence interval; (g) apply the Q test (95% confidence interval) to determine whether the outlier should be rejected from the set of results. (共 15%)

Confidence Level, %	z
50	0.67
68	1.00
80	1.28
90	1.64
95	1.96
95.4	2.00
99	2.58
99.7	3.00
99.9	3.29

Degrees of Freedom	80%	90%	95%	99%	99.9%
1	3.08	6.31	12.7	63.7	637
2	1.89	2.92	4.30	9.92	31.6
3	1.64	2.35	3.18	5.84	12.9
4	1.53	2.13	2.78	4.60	8.61
5	1.48	2.02	2.57	4.03	6.87
6	1.44	1.94	2.45	3.71	5.96
7	1.42	1.90	2.36	3.50	5.41

7. Estimate the absolute standard deviation and round the answers for the question, so that it contains only significant digits. (hint: $y = ??(\pm ??)$) (5%)

$$y = \frac{187(\pm 6) - 89(\pm 3)}{1240(\pm 1) + 57(\pm 8)}$$

8. (a) Calculate the molar solubility of $Ba(IO_3)_2$ in water. K_{sp} for $Ba(IO_3)_2$ is 1.57×10^{-9} .
 (b) Calculate the molar solubility of $Ba(IO_3)_2$ in a solution that is 0.0200 M in $Ba(NO_3)_2$.
 (c) Please describe why the solubility decreased. (共 5%)

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