東吳大學 113 學年度碩士班招生考試試題

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. In the reversible adiabatic expansion of 2 mol of an ideal gas from an initial temperature of 25°C, the work done on the surroundings is 1000 J. If $C_{v,m}$ = 3R/2, please calculate *q*, *w*, final temperature T_f and △H. (8%)

2. Calculate the frequency and wavelength of the light emitted when an electron in a one-dimensional box of length 4 nm makes a transition from the n = 5 state to the n = 4 state. (8%)

3. How far on average does N_2 molecule travel in 1 second at 350 K and 1.5 atm? How does this distance compare to that of Ar under the same conditions? Write down the ratio and distance of Ar. (9%)

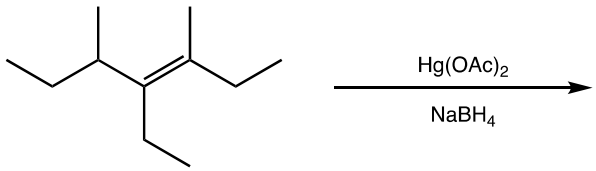
4. Draw the correct molecular structures for the following molecules (the underline elements are the central atoms): (a) $\underline{Be}F_2$ (b) $\underline{B}F_3$ (c) $\underline{C}F_4$ (d) $\underline{P}F_5$ (e) $\underline{S}F_6$ (f) $\underline{O}F_2$ (g) $\underline{N}F_3$ (h) $\underline{S}F_4$ (i) $\underline{Br}F_3$ (9%)

5. Explain the following terms: (a) Pauli exclusion principle, (b) Hund's rule, (c) Nodal surface, (d) paramagnetic and diamagnetic compounds, (e) geometric isomers (g) oxidative addition and reductive elimination. (8%)

6. For a substitution reaction of $[M(H_2O)_6]^{2+}$, state the reaction law for an association and a dissociation reaction, respectively, and state the difference between association and dissociation mechanisms for their reaction rate: reaction order, entropy change, volume change, geometry of transition state, charge effect and steric effect. (8%)

Part B

1. Draw the reaction mechanism and final products for the following reaction. (6%)



2. Draw the structure and their Newman projection formula for the most stable conformation of the following compounds: (每小題 3%)

(A) 3-methylpentane (B) 2,3-dimethylpentane (C) 3-bromo-2-methylpentane

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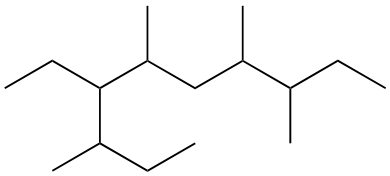
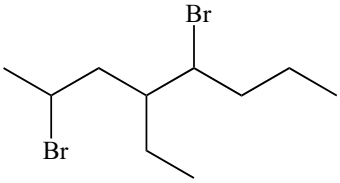
3. Give the structure IUPAC names for each of the following: (每小題 2%)

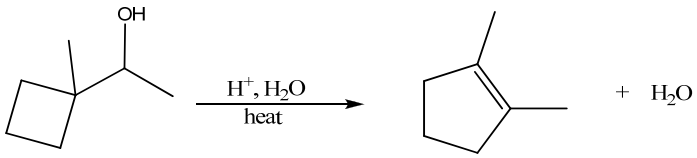
(A)



(B)



4. Draw a mechanism to justify the following transformation. (6%)



5. Estimate the absolute standard deviation and round the answers for the question, so that it contains only significant digits. (6%) (hint: y=??(±??))

(A) $y = 29.2(\pm 0.3) \times 2.03(\pm 0.02) \times 10^{-17}$

(B) $$y = \frac{[14.3(\pm 0.2) - 11.6(\pm 0.2)] \times 0.050(\pm 0.001)}{[820(\pm 10) + 1030(\pm 5)] \times 42.3(\pm 0.4)}$$

6. The solubility-product constant (K_{sp}) for $Ce(IO_3)_3$ is 3.2×10^{-10}. What is the Ce^{3+} concentration in a solution prepared by mixing 50.00 mL of 0.0500 M Ce^{3+} with 50.00 mL of (25°C)

(A) water? (2%)

(B) 0.0500 M IO_3^- ? (2%)

(C) Please describe why the solubility decreased. (1%)

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7. 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. (14%)

Appendix

Confidence Levels for Various Values of *z*

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

Values of *t* for Various Levels of Probability

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