

# 中原大學 97 學年度碩專班入學考試

3 月 15 日 09:00-10:30 化學系

誠實是我們珍視的美德，  
我們喜愛「拒絕作弊，堅守正直」的你！

科目：綜合化學

(共 2 頁第 1 頁)

可使用計算機，惟僅限不具可程式及多重記憶者  不可使用計算機

## Analytical Chemistry (25%)

- (a) In a particular trace analysis via FTIR, a set of 16 interferograms were collected. The signal-to-noise ratio (S/N) associated with a particular spectral peak was approximately 5:1. How many interferograms would have to be collected and averaged if the goal is to obtain a  $S/N = 20/1$ ? (5%)  
(b) Why do double-focusing mass spectrometers give narrower peaks and higher resolution than single-focusing instruments? (5%)  
(c) How do the spectra for electron-impact, field ionization and chemical ionization sources differ from one another? (5%)
- A bottle of concentrated aqueous sulfuric acid, labeled 98.0 wt %  $H_2SO_4$ , has a concentration of 18.0 M.  
(a) How many milliliters of reagent should be diluted to 1.000L to give 1.00 M  $H_2SO_4$ ? (5%)  
(b) Calculate the density of 98.0 wt %  $H_2SO_4$  (5%).

## 3. Inorganic Chemistry (25%)

- Which one of the following molecules is paramagnetic? (2%)  
(a)  $O_2$  (b)  $Na_2$  (c)  $N_2$  (d)  $H_2$
- Which one of the following ligands will generate the largest ligand field of the "d" orbital? (2%)  
(a)  $Cl^-$  (b)  $H_2O$  (c)  $NH_3$  (d)  $CN^-$
- Which ion is the hardest to ionize? (2%)  
(a)  $Cl^-$  (b)  $Al^{3+}$  (c)  $S^{2-}$  (d)  $Na^+$
- Which has highest melting point? (2%)  
(a)  $NaF$  (b)  $MgF_2$  (c)  $SiF_4$  (d)  $SF_6$
- Choose the strongest Lewis acid. (2%)  
(a)  $BF_3$  (b)  $B(CH_3)_3$  (c)  $BH_3$  (d)  $BI_3$
- Red rubies are alumina doped with what impurity? (3%)  
(a)  $V^{3+}$  (b)  $Ti^{4+}$  (c)  $Cr^{3+}$  (d)  $Fe^{3+}$
- The metal with the strongest bonding preference for  $O^{2-}$ ? (3%)  
(a)  $Al^{3+}$  (b)  $Hg^{2+}$  (c)  $Cs^+$  (d)  $Cu^+$
- Which form of carbon has the weakest carbon-carbon bonds? (3%)  
(a) graphite (b) diamond (c)  $C_{60}$  (d) ethylene ( $CH_2CH_2$ )
- Predict the structure of  $[Co(H_2O)_6]^{3+}$ ? (3%)  
(a) Tetrahedral (b) Square planar (c) Trigonal bipyramidal (d) Octahedral
- Which of the following diatomic species do you expect to have the longest bond length? (3%)  
(a)  $NO^+$  (b)  $O_2^-$  (c)  $CO$  (d)  $O_2^+$

# 中原大學 97 學年度碩專班入學考試

3 月 15 日 09:00-10:30 化學系

誠實是我們珍視的美德，  
我們喜愛「拒絕作弊，堅守正直」的你！

科目：綜合化學

(共 2 頁第 2 頁)

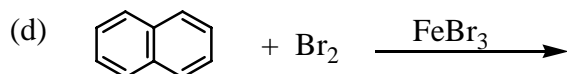
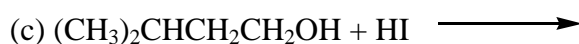
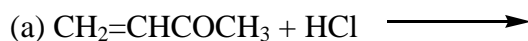
可使用計算機，惟僅限不具可程式及多重記憶者

不可使用計算機

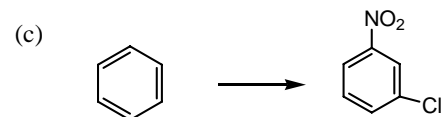
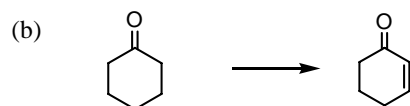
## Organic Chemistry (25%)

4. Give the major product of each of the following reactions. Explain your answers.

(16%)



5. Fill in suitable reagents to carry out the following transformations. (9%)



## Physical Chemistry (25%)

6. Explain the following terminologies : (10 %)

(a) Aufbau principles

(b) Pauli exclusion principle

(c) Spin-orbital coupling

(d) Hund's maximum multiplicity rule

(e) Heisenberg's uncertainty principle

7. Explain :

(a) how the perfect gas equation of state arises by combination of Boyle's law, Charles's law, and Avogadro's principle (10%)

(b) what are the meanings of  $a$  and  $b$  in the corresponding van der Waals equation of state  $(p + a)(v - b) = nRT$  ? (5%)