

English Test for Entrance Examination of Postgraduate Institute:(2 points for each question)

I. Please choose the fittest answer to complete the sentence in each question.

- ___1. The student raced out of the classroom and bumped ___ a teacher who was carrying a cup of coffee.
(A) into (B) at (C) to (D) on
- ___2. Ann says the party will be ____, so I suggest you wear a nice dress.
(A) familiar (B) formal (C) fluent (D) funny
- ___3. Nancy gained four kilograms during the holidays, so she decided to go ___ a diet.
(A) on (B) to (C) in (D) up
- ___4. Don't follow that car too ____. If it stops quickly, there could be an accident.
(A) directly (B) exactly (C) nearly (D) closely
- ___5. After we ate the fried chicken, our fingers were oily, so we asked the waitress for more
(A) napkins (B) packages (C) orders (D) menus
- ___6. The sea ___ seventy-five percent of the surface of our world.
(A) making up (B) makes up (C) make up what is (D) which makes up
- ___7. A laser beam ___ a concentration of pure light.
(A) consists of (B) which consists of (C) exhibiting (D) exhibit
- ___8. The universe ___ we know it might have begun with a great explosion.
(A) as (B) that (C) and which (D) and
- ___9. The bus was full, but Judy saw an empty seat next to an old woman. "___ I sit here?" she asked her.
(A) Should (B) Would (C) May (D) Will
- ___10. Mr. Li teaches mathematics at a public high school in Kaohsiung. He ___ there since 1995.
(A) is (B) was (C) will be (D) has been
- ___11. Being a newcomer, Alice is ___ with the area.
(A) informative (B) unfamiliar (C) aware (D) confident
- ___12. Cars and motorcycles are ___ in this area; people can only walk around here.
(A) permitted (B) promoted (C) banned (D) favored
- ___13. From the window, we got a(n) ___ view of the mountains.
(A) breathtaking (B) chilly (C) excited (D) moral
- ___14. Despite losing the use of his legs and some use of his arms, the ___ boy managed to ski with the help of a special device.
(A) shy (B) scared (C) disabled (D) elegant
- ___15. Jeff's English had improved so ___ that everyone was surprised.
(A) gradually (B) critically (C) bitterly (D) dramatically
- ___16. The violent storm almost destroyed the area. People living there really ___ an ordeal.
(A) scored (B) dragged (C) resisted (D) underwent
- ___17. ___ computer use may not cause wrist injuries, it can still give you a headache or make your eyes dry.
(A) Once (B) When (C) While (D) Despite
- ___18. ___ he restrained himself from blurting out those hurtful words, his girlfriend would not have left.
(A) Because (B) Had (C) Should (D) When
- ___19. Einstein was Jewish, and in 1933 the Nazi government ___ his property and German citizenship.
(A) taken away (B) took away (C) has taken away (D) was taken away

20. The trash can, ___ with rejected term paper, sat in the corner of the dorm room.
(A) fill (B) to fill (C) filling (D) filled
21. Sleep and exercise are ___ health.
(A) in essence (B) essentially (C) essential to (D) essential for
22. He not only read the copy, but ___ on it.
(A) reported (B) apologized (C) regretted (D) commented
23. Mr. Anderson says that in many ways he ___ his success to his wife's support.
(A) owes (B) distributes (C) deceives (D) betrays
24. The spread of knowledge could be ___ by means of books.
(A) accomplished (B) defined (C) claimed (D) exported
25. If you abide by your promise, you will keep your promise _____.
(A) temporarily (B) periodically (C) permanently (D) unwillingly

II. Please choose the item that interprets best the sentence in each question.

26. Education has its fashion, and like all other fashions they come and go. This means that
(A) Education should make us fashionable
(B) Education is sometimes popular, sometimes unpopular
(C) Students study and leave school after some time
(D) Ideas on education change all the time
27. He isn't above lying when it suits his needs.
(A) He will lie when he feels it's necessary.
(B) He knows it is always necessary to tell the truth.
(C) He never lies even when it would benefit him to do so
(D) He usually lies down when he needs to rest.
28. People's interest in their health and their demand for various forms of medical care have enormously increased.
(A) People are taking more interest in their health than in medical care.
(B) People are taking more interest in their health but demanding less medical care.
(C) People are taking more interest in their health and demanding much more medical care.
(D) Medical care, drugs and hospital care grow more and more costly.
29. Primitive man was probably more concerned with fire as a source of warmth and as a means of cooking food than as a source of light.
(A) In the ancient times fire was used for getting warmth and cooking food rather than for getting light.
(B) Primitive man had nothing to do with light.
(C) In the ancient times the main use of fire was not for getting warmth and cooking food but for getting light.
(D) Primitive man regarded fire as the chief source of light.
30. A bookstore is the last place in the world I expect to meet you.
(A) I finally find you in a bookstore.
(B) If I want to meet you, I should go to a bookstore.
(C) I met you in a bookstore last time.
(D) It is impossible for us to meet in a bookstore.
31. Mr. Braun is a friend of mine whose profession is to advise or represent others in legal matters. Mr. Braun is
(A) a judge (B) a lawyer (C) a policeman (D) a guide
32. For the American masses their civilization is a canned food civilization, so that the house wives, instead of being pressed by domestic chores, have plenty of time for reading and social activities, but on the other hand, people must be content with uniform and unpalatable dishes.
(A) It seems that American housewives are pressed by the jobs of cooking and washing dishes, etc.
(B) American housewives scarcely spend time visiting old friends or doing a lot of reading.
(C) American housewives enjoy ready-made food very much.
(D) It seems that Americans can't enjoy delicious food.

33. A general feature of modern society is the gap that separates the adult from the young, and it is most painfully felt between parents and children. In this paragraph, we are talking about the gap between ____.
- (A) families (B) society (C) parents (D) generations
34. One should read the classics in winter, because then one's mind is more concentrated; read history in summer, because one has more time; read ancient philosophers in autumn, because they have such charming ideas; and read the collected works of later authors in spring, because the Nature is coming back to life. What kind of reading requires most concentration?
- (A) History (B) Modern writing. (C) The classics. (D) Philosophy.
35. It may be said that the problem in adult education seems to be not the piling up of facts but practice in thinking.
- (A) Education methods for adults and young people should differ.
(B) Adults do not seem to retain new facts.
(C) Adults seem to think more than young people
(D) Adult education should stress ability to think.

III. Please choose the most proper item for each blank in the essays.

ESSAY 1

Jane lived near the sea, and she often went down to the beach to sit on the sand. Being by the sea was like being in a different 36. In front of her was the deep blue water; it slowly moved 37 her and then moved away again. Sometimes it came up very quickly and then her feet were covered by the salty water. 38 her, soft white clouds continually floated across the pretty blue sky. Noisy white 39 were flying over her head as well. 40 they dived down suddenly to catch a fish, and then they flew right back up into the air. Jane often sat by the sea for hours to enjoy this special place.

- ___ 36. (A) way (B) part (C) lake (D) world
___ 37. (A) for (B) with (C) toward (D) from
___ 38. (A) Above (B) Ahead (C) Besides (D) Next
___ 39. (A) sands (B) birds (C) clouds (D) ships
___ 40. (A) Sometimes (B) Although (C) When (D) If

ESSAY 2

Champ is a young male chimpanzee. Recently, he did something that surprised scientists. The scientists had 41 some grapefruit in the sand, and only Champ knew where the grapefruit was. When the other chimps were in the area, however, Champ 42 that he did not know where the grapefruit was. Later, when the other chimps 43 Champ went right to the spot 44 the grapefruit was hidden, dug it up, and ate it. 45, Champ was able to make plans and trick his friends.

- ___ 41. (A) buried (B) eaten (C) grown (D) dug
___ 42. (A) realized (B) pretended (C) wondered (D) admitted
___ 43. (A) fell asleep (B) fall asleep (C) will fall asleep (D) are going to fall asleep
___ 44. (A) which (B) there (C) what (D) where
___ 45. (A) To the scientists' relief (B) Amazingly (C) To make matters worse (D) However

ESSAY 3

"Culture shock," according to specialists in intercultural studies, refers to the feelings which people 46 when they come into a new environment. 47 their studies, scientists have found that there are three stages of culture shock. In the first stage, the newcomers like their environment. Then, when the novelty 48, they begin to hate the people, the apartment, and everything 49 in their new environment. In the final stage of culture shock, the newcomers 50 their surroundings and, as a result, enjoy their life there.

- ___ 46. (A) experience (B) experiencing (C) experienced (D) to experience
___ 47. (A) Of (B) Despite (C) For (D) In
___ 48. (A) takes off (B) puts off (C) wears off (D) takes over
___ 49. (A) too (B) else (C) more (D) as
___ 50. (A) live with (B) appeal to (C) adjust to (D) escape from

解釋名詞 (10 %)

- A. glycosaminoglycan
- B. GM₁
- C. T_m of membrane
- D. HRE (hormone response element)

解釋下列物質之功能,角色 (10 %)

- A. chi sequence
- B. SINEs
- C. Okazaki fragment
- D. RNAi
- E. SOS response

簡答題 (80 %, 作答時專有名詞以英文書寫)

1. 同一反應在酵素催化之下及無酵素作用之下,那一項反應的性質受到改變 ? (3 %)

2. 某酵素遵守 Michaelis-Menten equation, 請利用下列其 V_o , [S] 數據估算此酵素之 K_m 值 (5 %)

V_o ($\mu\text{mole}/\text{min}$)	substrate added (mmole/L)
217	0.8
325	2
433	4
488	6
647	1000

- 3. 簡述人體內 amino acid 其碳骨架(carbon backbone)代謝的可能途徑 (5 %)
- 4. 變性蛋白質(denatured proteins)如何再逆回去原始蛋白質(native proteins)? 並寫出變性蛋白質與原始蛋白質性質上的相異性 (5 %)
- 5. 何謂 protein targeting ? (5 %)
- 6. 人體內 amino acid 其 amino group 代謝過程中的 NH_4^+ 主要以那兩種 amino acid 形式於血液中運輸 ? (2 %)

7. 人類主要儲存何種分子為其細胞能量來源？就結構觀點解釋不同分子其儲存量及氧化產生能量效益差異性之可能原因 (5%)
8. 何謂 pyruvate-alanine cycle？並闡述其生理意義 (5%)
9. 脂肪組織(adipose tissue)lipoprotein lipase 的 K_m 值高達心臟(heart)的 100 倍之多,解釋其生理意義 (5%)
10. 簡述飲食膽固醇(cholesterol)經腸道吸收至血液循環而進入肝臟的可能途徑若進入肝外組織則可能的途徑又為何？(6%)
11. 簡述一分子 acetyl-CoA 經檸檬酸循環(citric acid cycle)氧化生成水與二氧化碳過程中,能量生成的情形 (5%)
12. NADH 經"respiratory chain" 氧化並生成 ATP 的過程中,連結"electron transfer" 及"ATP 生成"的事件為何？(4%)
13. protein kinase 催化蛋白質磷酸化(protein phosphorylation)此反應可能於蛋白質的那些 amino acid 上進行？
並簡述一個包含 second messenger 及 protein phosphorylation 的訊息傳遞途徑 (signal transduction pathway) (7%)
14. 寫出參與大腸桿菌(E.coli) mismatch pair 過程之蛋白質及酵素 (5%)
15. 解釋 promoter 及 enhancer, 並描述決定 promoter sequence 之方法 (5%)
16. 簡述基因表現(gene expression)過程中,調解蛋白質(regulatory protein)的 protein-protein interaction 種類 (4%)
17. 何謂 trans fatty acid？對人體健康有何影響性？(4%)

說明：1. 請依序作答並標明題號

2 計算、證明題請寫出過程，只寫答案不予計分 (可用電子計算機)

3. Useful constants:

$$\text{Planck constant } h = 6.626 \times 10^{-34} \text{ J s}$$

$$\text{Boltzmann constant } k = 1.381 \times 10^{-23} \text{ J K}^{-1}$$

$$\text{Avogadro constant } N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$\text{Electron mass} = 9.1094 \times 10^{-31} \text{ kg}$$

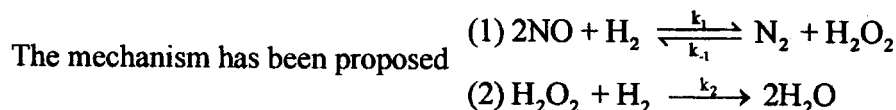
1. (5 %) Which of these following were not true. (A) If a process is carried out at constant pressure, dq behaves like an exact differential. (B) $dw = -PdV$ is correct for all simple systems. (C) ΔH and ΔU values are nearly equal for all processes. (D) Since enthalpy is a convenience variable, it would be possible to carry out thermodynamic calculations without using it. (E) The difference between C_p and C_v can be neglected in gases.
2. (15 %) Define these phrases :
 - a. Reversible process :
 - b. The Zero Law of thermodynamic :
 - c. Kelvin statement the 2nd Laws of Thermodynamics :
3. (10 %) The reversible Carnot cycle consists of four steps: (1) isothermal expansion, (2) adiabatic expansion, (3) isothermal compression, and (4) adiabatic compression. Draw the P-V diagram of the four steps of Carnot cycle. Derive the heat (q), work (w), and internal energy change (U) involved in each step.
4. (10 %) Find ΔH and q if 2.000 mol of supercooled liquid water at -15.00°C freezes irreversibly at a constant pressure of 1.000 atm to ice at -15.00°C . Assume the molar heat capacity of liquid water to be constant and equal to $67.1 \text{ JK}^{-1}\text{mol}^{-1}$, and that of ice to be constant and equal to $37.15 \text{ JK}^{-1}\text{mol}^{-1}$. (Specific enthalpy for Melting of per water = -333.5 J/g)
5. (10 %) For first-order and second-order reactions, write down their rate laws and obtain the expressions of their half-lives.

6. (10 %) Chloroethane from the gas phase is adsorbed on a sample charcoal at 273.15°K. The mass adsorbed for each concentration in the gas phase is:

[C ₂ H ₅ Cl]/mol/L	0.00117	0.00294	0.00587	0.0117	0.0176
Mass/g	3.0	3.8	4.3	4.7	4.8

- a. Find the value of θ for each concentration and the value of θ_{∞} .
- b. If each chloroethane molecule occupies an area of 0.260 nm², find the area of the sample of charcoal. (hint: use Langmuir isotherm equation and $M_{[\text{chloroethane}]}=64.515 \text{ g mol}^{-1}$)

7. (10 %) For the gaseous reaction: $2\text{NO} + 2\text{H}_2 \rightarrow \text{N}_2 + 2\text{H}_2\text{O}$



Apply the steady-state approximation to this reaction:

- a. Find the rate law if the steady-state approximation is used without the reverse of step 1.
- b. Find the rate law if the steady-state approximation is used with inclusion of the reverse of step 1.
8. (10 %) Carry out the algebra to obtain Schrödinger Eq.8.2 from classical coordinate wave Eq.8.1

$$\frac{d^2\psi}{dx^2} + \frac{4\pi^2}{\lambda^2}\psi = 0 \text{ --- (8.1)}$$

$$-\frac{\hbar^2}{2m} \frac{d^2\psi}{dx^2} + V(x)\psi = E\psi \text{ --- (8.2)}$$

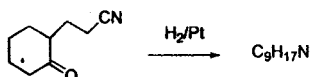
9. (10 %) Calculate the wavelength and frequency of the photon emitted if an electron in a one-dimensional box of length 1.000 nm makes a transition from $n=3$ to $n=2$ and the energy difference is entirely converted into the energy of the photon.
10. (10 %) Show that the function $\Psi(x,t) = Fe^{ikx-iEt/\hbar}$, represents a traveling wave moving to the left, and find its speed.

- Describe the preparation of 500 ml of 0.0105 M Cl^- solution from solid $\text{BaCl}_2 \cdot 2 \text{H}_2\text{O}$ (244.3 g/mol).
- The mean and standard deviation of a set of data are 0.754 ppm Pb and 0.0038 ppm, respectively. Calculate (a) the relative standard deviation in parts per thousand (b) the coefficient of variation.
- Calculate the hydroxide ion concentration in a 0.0100 M sodium hypochlorite (NaOCl) solution. (HOCl , $K_a = 1.0 \times 10^{-8}$)
- What is the ionic strength of a solution that is 0.05 M in KNO_3 and 0.1 M in Na_2SO_4 ?
- A 0.2356 g sample, containing only NaCl (58.44 g/mol) and BaCl_2 (208.23 g/mol), yielded 0.4637 g of dried AgCl (143.32 g/mol). Calculate the percent of each halogen compound in the sample.
- Calculate the hydronium ion concentration for a buffer solution that is 2.00 M in phosphoric acid and 1.50 M in potassium dihydrogen phosphate. (H_3PO_4 , $K_{a1} = 7.11 \times 10^{-3}$, $K_{a2} = 6.34 \times 10^{-8}$)
- Calculate the thermodynamic potential of the following cell and the free energy change associated with the cell reaction.
 $\text{Cu} \mid \text{Cu}^{2+} (0.0100 \text{ M}) \parallel \text{Ag}^+ (0.0100 \text{ M}) \mid \text{Ag}$
 $\text{Ag}^+ + e^- \rightleftharpoons \text{Ag(s)} \quad E^\circ = 0.799 \text{ V}$
 $\text{Cu}^{2+} + 2 e^- \rightleftharpoons \text{Cu(s)} \quad E^\circ = 0.337 \text{ V}$
- Substances A and B have retention times of 16.40 and 17.63 min, respectively, on a 30.0 cm column. The peak widths (at base) for A and B are 1.11 and 1.21 min, respectively. Calculate (a) the column resolution (b) the plate height.
- Define the following (a) ion-exchange chromatography (b) affinity chromatography.
- Pure hexane has negligible ultraviolet absorbance above a wavelength of 200 nm. A solution prepared by dissolving 25.80 mg of benzene (78.114 g/mol) in hexane and diluting to 250.0 ml had an absorption peak at 256 nm and an absorbance of 0.266 in a 1.000-cm cell. A sample of hexane contaminated with benzene had an absorbance of 0.070 at 256 nm in a cell with a 5.000-cm pathlength. Find the concentration of benzene in milligrams per liter.

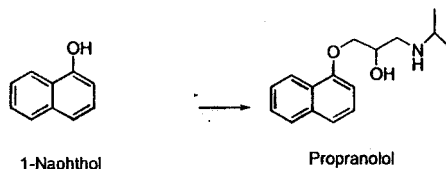
I. Draw structures corresponding to the following names: (15%)

- | | |
|--|----------------------------------|
| 1. <i>cis</i> -3- <i>tert</i> -Butylcyclohexancarbaldehyde | 2. Benzophenone |
| 3. 2,6-Dimethyloctane | 4. Acetaminophen |
| 5. <i>trans</i> -1,3-Dichlorocycloheptane | 6. Oxalic acid |
| 7. Caprolactam | 8. <i>N,N</i> -Dimethylbenzamide |
| 9. Phthalic anhydride | 10. Imidazole |
| 11. <i>E</i> -4-Methyl-2-hexene | 12. Guanine |
| 13. Thymine | 14. 2'-Deoxyribose |
| 15. 1-Hepten-6-yne | |

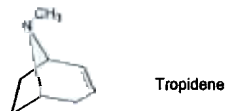
II. Propose a structure for the product with formula $C_9H_{17}N$ that results when 2-(2-cyanoethyl)cyclohexanone is reduced catalytically. (5%)



III. How would you synthesize the beta-blocker, propranolol (inderal) starting from 1-naphthol and any other reagents needed? (5%)



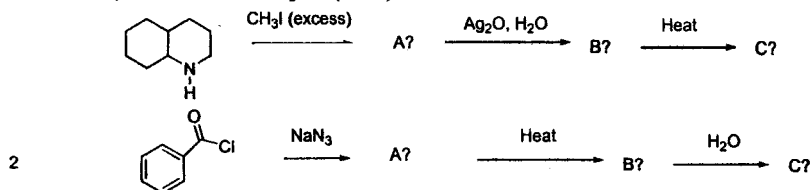
IV. Atropine, $C_{17}H_{23}NO_3$, is a poisonous alkaloid isolated from the leaves and roots of *Atropa belladonna*. On basic hydrolysis atropine yields tropic acid, $C_6H_5CH(CH_2OH)COOH$, and tropine, $C_8H_{15}NO$. Tropine is an optically inactive alcohol that yields tropidene on dehydration with H_2SO_4 . Propose a structure for atropine. (5%)

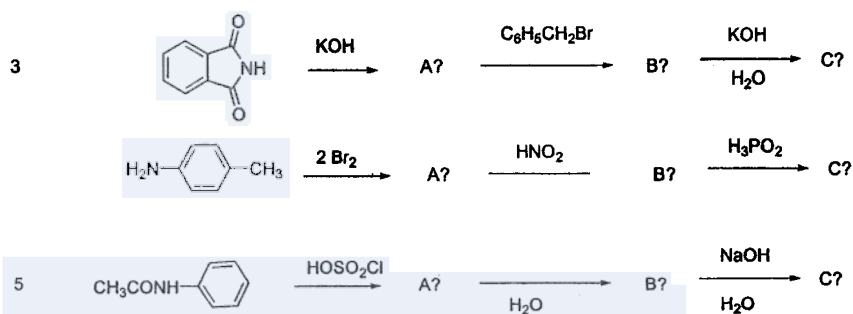


V. Give one reaction example or a general reaction to explain each of the following name reactions: (15%)

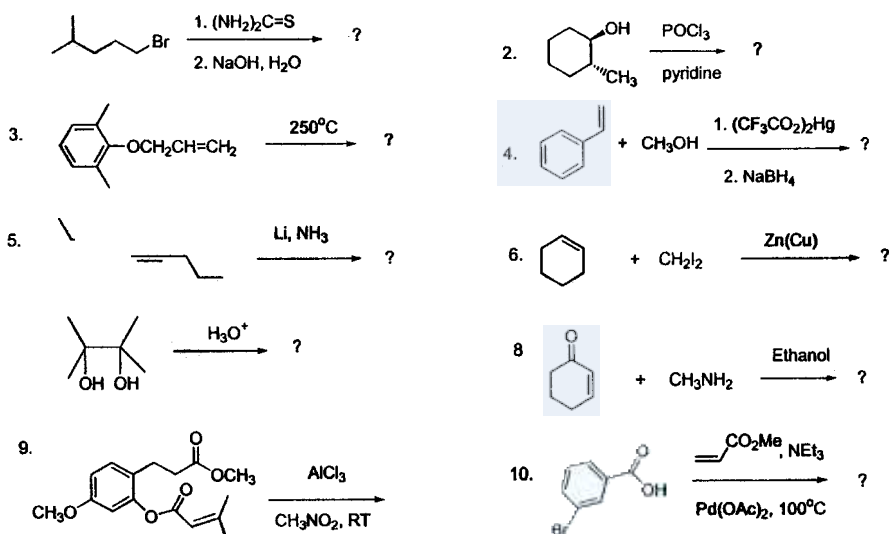
1. Suzuki coupling; 2. Swern oxidation; 3. Mitsunobu's reaction

VI. Predict the product(s) of the following reactions. If more than one product is formed, tell which is major. (15%)





VII. Predict the product of each of the following reactions: (20%)



VIII. How might you use mass spectrometry to distinguish between the following pairs of isomers (4%)

- 3-Methyl-2-hexanone and 4-methyl-2-hexanone
- 2-Methylpentanal and 3-methylpentanal

IX. Propose a structure consistent with the following spectral data for a compound

$C_8H_{18}O_2$: (4%)

IR: 3350 cm^{-1}

$^1\text{H-NMR}$: δ 1.24 (12H, s), 1.56 (4H, s), 1.95 (2H, s)

X. Propose a structure consistent with the following spectral data for a compound:

(4%)

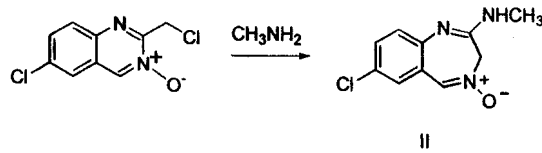
M^+ : m/z 113

IR: 2270, 1735 cm^{-1}

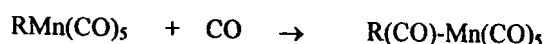
$^1\text{H-NMR}$: δ 1.30(3H, t), 3.50 (2H, s), 4.35 (2H, q)

$^{13}\text{C-NMR}$: five different carbons in this compound.

- XI. Compound A, C_7H_{12} , was found to be optically active. On catalytic reduction over a palladium catalyst, 2 equivalents of hydrogen were absorbed, yielding compound B, C_7H_{16} . On ozonolysis of A, two fragments were obtained. One fragment was identified as acetic acid. The other fragment, compound C, was an optically active carboxylic acid, $C_5H_{10}O_2$. Write the reactions, and draw structures for compound A, B, and C. (4%)
- XII. Treatment of quinazoline (I) with methyl amine yields libruim (II). Propose a mechanism. (4%)



1. Explain the following term: (18%)
1) trans effect, 2) D-CB mechanism, 3) β -elimination, 4) B-strain and 5) chelate effect, 6) superacid.
2. Determination the point group of the following compounds: CO_2 , ethane(staggered conformation), borazine(planar) and C_3H_4 (allene). (8%).
3. Using ligand field theory to explain the splitting the d energy levels in a square planar complex. (8%)
4. What do the following pairs or groups of structure have in common, and how do they differ in 3-2PO, 3-2PT and 2-2 PT.(4%)
5. Predict the structure of the following compounds: ICl_2^- and ClF_3 .(6%)
6. Give the valence electron count for the following species.(9%)
 $\text{Mn}_2(\text{CO})_{10}$, b) $(\eta^5\text{-C}_5\text{H}_5)(\text{NO})_2\text{Cr}(\text{CONHMe})$ c) $(\eta^2\text{-cot})\text{CoCp}_2$
7. Compare and explain the order stretching frequency(ν_{CO}) for the following compound: $\text{Mn}(\text{CO})_6^+$, $\text{Cr}(\text{CO})_6$ and $\text{V}(\text{CO})_6^-$.(5%)
8. Compare and explain the basicity of following compounds: NH_3 , Me_3N , Me_2NH , MeNH_2 in aqueous solution.(6%)
9. Describe and prove the mechanism of CO insertion into M-R.(6%)



10. Determine the number of IR-active C-O stretching modes for $\text{Mn}(\text{CO})_5$. (8%)
11. Give the bond order and the number of unpaired electrons for B_2^+ and superoxide.(4%)
12. What are the formula and name of following ligands: trien, tren, phen and gly.(8%)
13. Figure shows ^{13}C -NMR spectra of $\text{Rh}_4(\text{CO})_{12}$ in CD_2Cl_2 and CDCl_3 solutions at various temperature. Rationalize the spectral changes observed in terms of a dynamic intramolecular process.(Rh, I = 1/2)(10%)

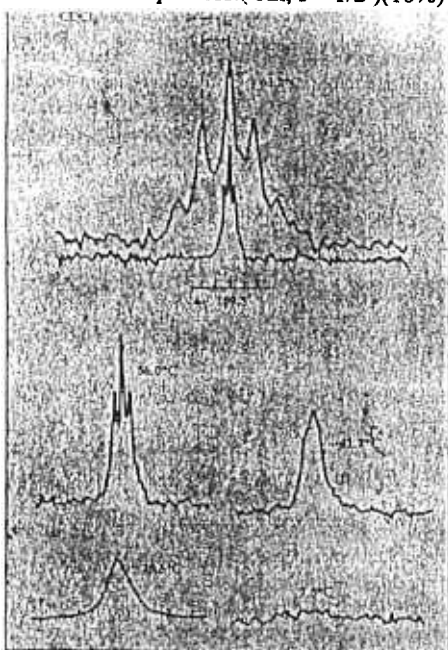
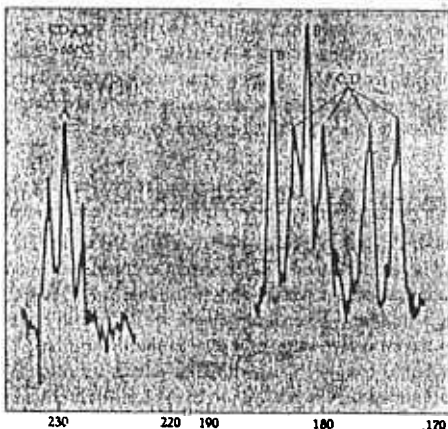


FIGURE ^{13}C -NMR spectra of $\text{Rh}_4(\text{CO})_{12}$ in CD_2Cl_2 and CDCl_3 solutions at various temperatures. Chemical shifts are in δ relative to TMS. The spectrum at $+63.2^\circ\text{C}$ is enlarged to show the quintet structure more clearly. Adapted from F. A. Cotton, et al., *J. Am. Chem. Soc.*, **94**, 6191 (1972), and L. M. Jackman and F. A. Cotton, eds., *Dynamic Nuclear Magnetic Resonance Spectroscopy* (New York: Academic Press, 1975), p. 520.



D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_6$	$3\sigma_v$	(x axis coincident with C_2)	
A_1'	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_2'	1	1	-1	1	1	-1	R_z	
E'	2	-1	0	2	-1	0	(x, y)	$(x^2 - y^2, xy)$
A_1''	1	1	1	-1	-1	-1		
A_2''	1	1	-1	-1	-1	1	z	
E''	2	-1	0	-2	1	0	(R_x, R_y)	(xz, yz)