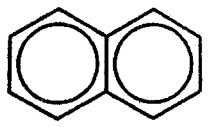
※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之部份及題號。

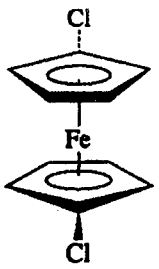
無機化學

1.Describe the point group of each following molecule: (10 pts)

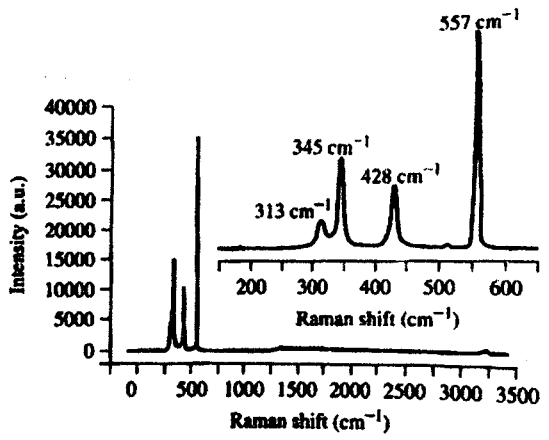
a. Chloroethylene　b. Borazine (planar)

c. Naphthalene　d. S_8 (puckered ring)　e. 1,1'-Dichloroferrocene





2.White elemental phosphorus consists of tetrahedral P_4 molecules and is an important source of phosphorus for synthesis. In contrast, tetrahedral As_4 is unstable, and decompose to a grey As allotrope with a sheet structure. However, AsP_3 has been isolated at ambient temperature as a white solid, in which As atom replace one vertex of the tetrahedron. (a)The Raman spectrum of AsP_3 exhibits four absorptions (as below). Is this consistent with the proposed structure ? Why ?(10 pts) (b)Could a pure sample of P_4 be distinguished from pure AsP_3 simply on the basis of the number of Raman peaks ? Why ?(5 pts)



3.On the basis of the 18-electron rule, identify the first-row transition metal for the following equations: (8 pts)

a.$[M(CO)_7]^+$

b.$H_3CM(CO)_5$

c.$[(\eta^4\text{-}C_4H_4)(\eta^5\text{-}C_5H_5)M]^+$

d.$[M(CO)_3(NO)]^-$ with a linear M—N—O (M: second-row transition metal)

4.To consider the following complexes, (a)Why are two of these complexes tetrahedral and the rest octahedral? (7 pts) (b)Why is tetrahedral geometry more stable for Co(II) than for Ni(II)? (4 pts)

$[Co(CO)_4]^-$; $[Cr(CN)_6]^{4-}$; $[Fe(H_2O)_6]^{3+}$; $[Co(NO_2)_6]^{4-}$; $[Co(NH_3)_6]^{3+}$; $[Cu(H_2O)_6]^{2+}$; MnO_4^-

5. To consider the donor-acceptor complexes $(CH_3)_3N—SO_3$ and $H_3N—SO_3$ in the gas phase, (a)Which has the longer N—S bond? Why?(3 pts) (b)Which has the larger N—S—O angle? Why?(3 pts).

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C_{3v}	E	$2C_3$	$3\sigma_v$		
A_1	1	1	1	z	$x^2 + y^2, z^2$
A_2	1	1	−1	R_z	
E	2	−1	0	$(x, y), (R_x, R_y)$	$(x^2 - y^2, xy), (xz, yz)$

C_{2v}	E	C_2	$\sigma_v(xz)$	$\sigma_v'(yz)$		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	−1	−1	R_z	xy
B_1	1	−1	1	−1	x, R_y	xz
B_2	1	−1	−1	1	y, R_x	yz

T_d	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$		
A_1	1	1	1	1	1		$x^2 + y^2 + z^2$
A_2	1	1	1	−1	−1		
E	2	−1	2	0	0		$(2z^2 - x^2 - y^2, x^2 - y^2)$
T_1	3	0	−1	1	−1	(R_x, R_y, R_z)	
T_2	3	0	−1	−1	1	(x, y, z)	(xy, xz, yz)

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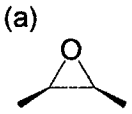
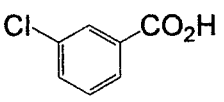
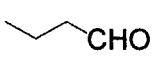
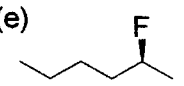
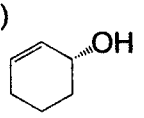
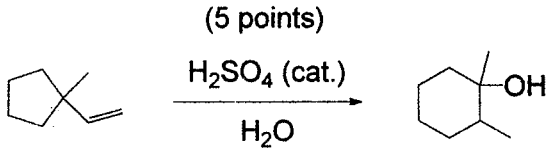
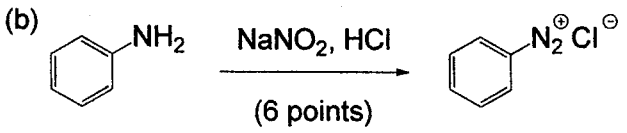
Organic Chemistry (50 points)

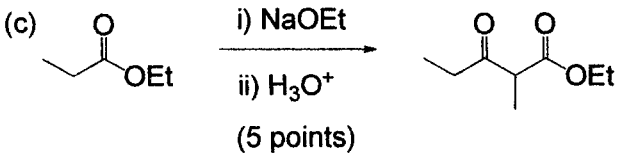
1. Please name the following compounds (in ***English***). (6 points)

(a) 
(b) 
(c) 
(d) 
(e) 
(f) 

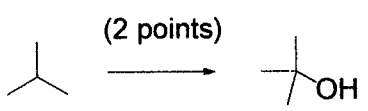
2. Write a detailed mechanism for the following reactions. (16 points)

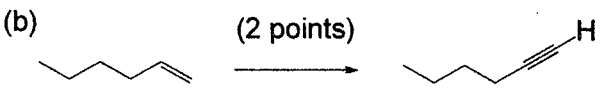
(a) 

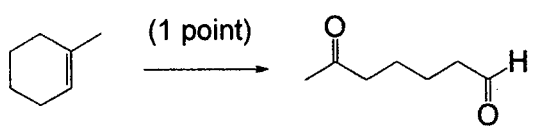
(b) 

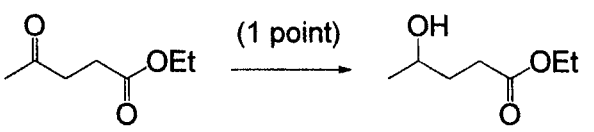
(c) 

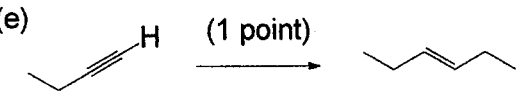
3. Provide proper conditions for the following transformations. Some will need more than one step and you may use any needed reagents. (14 points)

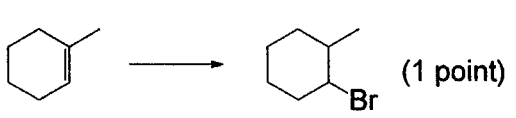
(a) 

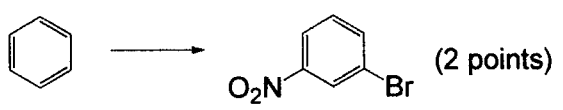
(b) 

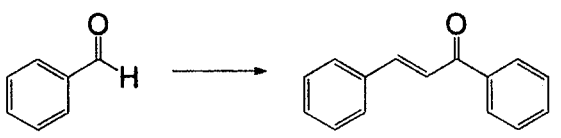
(c) 

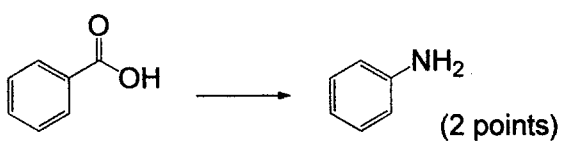
(d) 

(e) 

(f) 

(g) 

(h) 

(i) 

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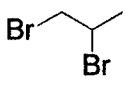
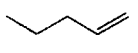
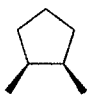
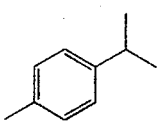
4. How many signals would each compound give in its ^{1}H-NMR spectrum? Also provide the ratio of the signal areas. (8 points)

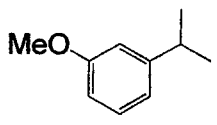
(a) 

(b) 

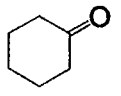
(c) 

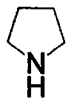
(d) 

5. For each of the following, identify the product that would be formed through the indicated sequence of steps from the given starting material. (6 points)

(a) 

i) Br_2, hν
ii) NaOEt, EtOH, heat
iii) BF_3:THF
iv) H_2O_2, OH^-
A

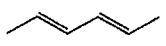
(b) 

i) 

, HA (cat.)
ii) MeI
iii) H_3O^+
iv) (a) LAH, (b) H_3O^+
B

(c) 

i) 

ii) H_3O^+
iii) Swern oxidation
iv) 
, heat
C

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