

UNIVERSITI SAINS MALAYSIA
Peperiksaan Semester Pertama

Sidang 1991/92

Oktober/November 1991

KTA 213 Kimia Bersistem

Masa : [2 jam]

Jawab sebarang EMPAT soalan sahaja.

Hanya EMPAT jawapan yang pertama sahaja akan diperiksa.

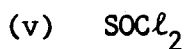
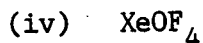
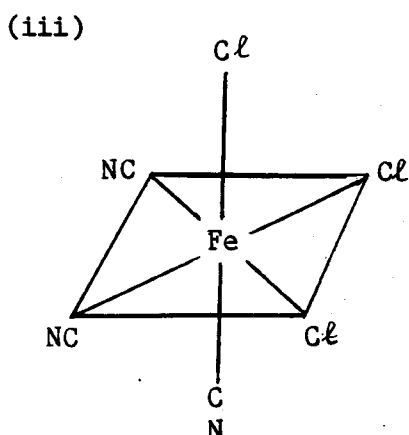
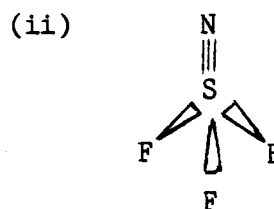
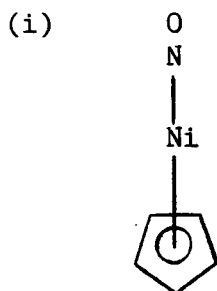
Jawab tiap-tiap soalan pada muka surat yang baru.

Kertas ini mengandungi LIMA soalan semuanya (3 muka surat).

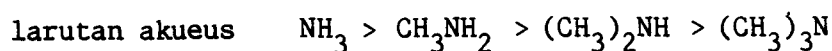
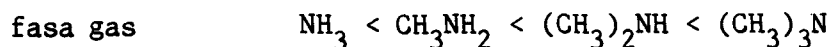
1. (a) Tindak balas di antara $(\text{CH}_3)_2\text{N-PF}_2$ bersama BH_3 dan BF_3 telah menghasilkan dua jenis kompleks yang membentuk ikatan nitrogen-boron dan fosforus-boron. Berikan kedua-dua persamaan tindak balas dan penjelasan tentang perbezaan pembentukan ikatan.

(10 markah)

- (b) Berikan kumpulan titik bagi setiap molekul berikut:



2. (a) Kekuatan bes-bes amina di dalam fasa gas dan di dalam larutan akueus, menunjukkan tertib turutan seperti berikut:-



- (i) Berikan penjelasan bagi tertib turutan bes-bes amina di dalam fasa gas seperti di atas.
- (ii) Berikan penjelasan tentang kesan pensolvatan terhadap perbezaan tertib turutan bagi bes-bes amina di dalam larutan akueus.

(10 markah)

- (b) Telah banyak perkara yang memperkatakan tentang pemusnahan lapisan ozon oleh sebatian-sebatian fluoroklorokarbon. Berikan satu ulasan ringkas tentang masalah tersebut dan sertakan tindak-tindak balas yang menyebabkan pemusnahan tersebut. Sertakan di dalam ulasan anda langkah-langkah yang mungkin boleh meredakan masalah tersebut.

(10 markah)

3. (a) Berikan persamaan, keadaan dan penjelasan (bahagian v) bagi setiap perkara berikut :

- (i) Penyediaan fosfazan, $(\text{PNCl}_2)_3$
- (ii) Penyediaan sebatian S_4N_4
- (iii) Tindak balas satu logam blok p bersama halida organik
- (vi) Tindak balas di antara metil lithium dengan trifenilklorosilan
- (v) Pelarutan kaca SiO_2 oleh asid hidrofluorik (HF)

(10 markah)

- (b) Dengan menggunakan molekul yang sesuai, lengkapkan jadual pendaraban C_{2h} dengan operasi simetri E, C_2 , σ_h , dan i.

(10 markah)

.../3-

4. (a) Pertimbangkan satu molekul oktahedral ML_6 (M sebagai logam pusat dan L sebagai ligan). Tunjukkan bagaimana anda boleh mendapatkan molekul-molekul dengan kumpulan titik D_{4h} , C_{4h} , D_3 , C_{3v} , C_3 , D_{2h} dan C_s , daripada molekul asal ML_6 dengan menukarkan ligan atau ligan-ligan L dengan ligan X, L—L atau X—L .

(10 markah)

(b) Bincangkan dengan ringkas tentang sebatian-sebatian gelang boron-nitrogen mengikut tajuk-tajuk :

- (i) Jenis dan kaedah penyediaan
- (ii) Sifat-sifat kimia berbanding dengan sebatian-sebatian gelang organik yang umum
- (iii) Kegunaan

Lengkapkan perbincangan dengan contoh-contoh persamaan.

(10 markah)

5. Molekul dengan lima ikatan, seperti $Fe(CO)_5$, mempunyai dua struktur yang berkemungkinan.

- (i) Lukiskan kedua struktur tersebut bagi molekul $Fe(CO)_5$ dan berikan kumpulan titik bagi setiap struktur.
- (ii) Dapatkan perwakilan terturunkan dan perwakilan takterturunkan bagi setiap struktur di atas dengan menggunakan ikatan Fe—CO sebagai fungsi dasar.
- (iii) Apakah penjelasan mengikut simetri dapat membezakan di antara kedua-dua struktur yang berbeza? Jelaskan.

(20 markah)

ooo000ooo

LAMPIRANJADUAL KARAKTOR :

1. The Nonaxial Groups

C_1	E
A	1

C_1	E	σ_h			C_1	E	i	
A'	1	1	x, y, R_z	x^2, y^2, z^2, xy	A_g	1	1	R_x, R_y, R_z
A''	1	-1	z, R_x, R_y	yz, xz	A_u	1	1	x, y, z
								x^2, y^2, z^2 xy, xz, yz

2. The C_n Groups

C_2	E	C_2		
A	1	1	z, R_z	x^2, y^2, z^2, xy
B	1	-1	x, y, R_x, R_y	yz, xz

C_3	E	C_3	C_3^2		$i = \exp(2\pi i/3)$
A	1	1	1	z, R_z	$x^2 + y^2, z^2$
E	$\begin{Bmatrix} 1 & i & i^* \\ 1 & i^* & i \end{Bmatrix}$			$(x, y)(R_x, R_y)$	$(x^2 + y^2, xy)(xz, xz)$

(KTA 213)

The C_n Groups (continued)

C_4	E	C_4	C_2	C_4^3		
A	1	1	1	1	z, R_z	$x^2 - y^2, z^2$
B	1	-1	1	1		$x^2 - y^2, xy$
E	$\begin{Bmatrix} 1 & i & -1 & i \\ 1 & -i & -1 & i \end{Bmatrix}$				$(x, y)(R_x, R_y)$	(yz, xz)

C_5	E	C_5	C_5^2	C_5^3	C_5^4		$\epsilon = \exp(2\pi i/5)$
A	1	1	1	1	1	z, R_z	$x^2 - y^2, z^2$
E_1	$\begin{Bmatrix} 1 & \epsilon & \epsilon^2 & \epsilon^{2*} & \epsilon^* \\ 1 & \epsilon^* & \epsilon^{2*} & \epsilon^2 & \epsilon \end{Bmatrix}$					$(x, y)(R_x, R_y)$	(yz, xz)
E_2	$\begin{Bmatrix} 1 & \epsilon^2 & \epsilon^* & \epsilon & \epsilon^{2*} \\ 1 & \epsilon^{2*} & \epsilon & \epsilon^* & \epsilon^2 \end{Bmatrix}$						$(x^2 - y^2, xy)$

C_6	E	C_6	C_3	C_2	C_3^2	C_6^5		$\epsilon = \exp(2\pi i/6)$
A	1	1	1	1	1	1	z, R_z	$x^2 + y^2, z^2$
B	1	-1	1	1	1	-1		
E_1	$\begin{Bmatrix} 1 & \epsilon & -\epsilon^* & 1 & \epsilon & \epsilon^* \\ 1 & \epsilon^* & -\epsilon & 1 & -\epsilon^* & \epsilon \end{Bmatrix}$						(x, y) (R_x, R_y)	(xz, yz)
E_2	$\begin{Bmatrix} 1 & -\epsilon^* & -\epsilon & 1 & -\epsilon^* & -\epsilon \\ 1 & -\epsilon & -\epsilon^* & 1 & -\epsilon & \epsilon^* \end{Bmatrix}$							$(x^2 - y^2, xy)$

C_7	E	C_7	C_7^2	C_7^3	C_7^4	C_7^5	C_7^6		$\epsilon = \exp(2\pi i/7)$
A	1	1	1	1	1	1	1	z, R_z	$x^2 - y^2, z^2$
E_1	$\begin{Bmatrix} 1 & \epsilon & \epsilon^2 & \epsilon^3 & \epsilon^{3*} & \epsilon^{2*} & \epsilon^* \\ 1 & \epsilon^* & \epsilon^{2*} & \epsilon^{3*} & \epsilon^3 & \epsilon^2 & \epsilon \end{Bmatrix}$							(x, y) (R_x, R_y)	(xz, yz)
E_2	$\begin{Bmatrix} 1 & \epsilon^2 & \epsilon^{3*} & \epsilon^* & \epsilon & \epsilon^3 & \epsilon^{2*} \\ 1 & \epsilon^{2*} & \epsilon^3 & \epsilon & \epsilon^* & \epsilon^{3*} & \epsilon^2 \end{Bmatrix}$								$(x^2 - y^2, xy)$
E_3	$\begin{Bmatrix} 1 & \epsilon^3 & \epsilon^* & \epsilon^2 & \epsilon^{2*} & \epsilon & \epsilon^{3*} \\ 1 & \epsilon^{3*} & \epsilon & \epsilon^{2*} & \epsilon^2 & \epsilon^* & \epsilon^3 \end{Bmatrix}$								

C_8	E	C_8	C_4	C_2	C_4^3	C_8^5	C_8^7	C_8^6		$\epsilon = \exp(2\pi i/8)$
A	1	1	1	1	1	1	1	1	z, R_z	$x^2 - y^2, z^2$
B	1	1	1	1	-1	-1	1	1		
E_1	$\begin{Bmatrix} 1 & \epsilon & i & 1 & i & \epsilon^* & -\epsilon & \epsilon^* \\ 1 & \epsilon^* & -i & 1 & i & \epsilon & \epsilon^* & \epsilon \end{Bmatrix}$							(x, y) (R_x, R_y)	(xz, yz)	
E_2	$\begin{Bmatrix} 1 & i & -1 & 1 & 1 & i & i & i \\ 1 & -i & 1 & 1 & -1 & i & -i & i \end{Bmatrix}$								$(x^2 - y^2, xy)$	
E_3	$\begin{Bmatrix} 1 & \epsilon & i & -1 & -i & \epsilon^* & \epsilon & -\epsilon^* \\ 1 & -\epsilon^* & i & -1 & i & \epsilon & \epsilon^* & -\epsilon \end{Bmatrix}$									

(KTA 213)

3. The D_n Groups

D_2	E	$C_2(z)$	$C_2(y)$	$C_2(x)$		
A_1	1	1	1	1		x^2, y^2, z^2
B_1	1	1	1	1	z, R_z	xy
B_2	1	1	1	1	y, R_y	xz
B_3	1	1	1	1	x, R_x	yz

D_3	E	$2C_3$	$3C_2$		
A_1	1	1	1		$x^2 + y^2, z^2$
A_2	1	1	1	z, R_z	
E	2	1	0	$(x, y)(R_x, R_y)$	$(x^2 - y^2, xy)(xz, yz)$

D_4	E	$2C_4$	$C_2(-C_4^2)$	$2C_2'$	$2C_2''$		
A_1	1	1	1	1	1		$x^2 + y^2, z^2$
A_2	1	1	1	1	-1	z, R_z	
B_1	1	-1	1	1	1		$x^2 - y^2$
B_2	1	1	1	1	1		xy
E	2	0	-2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)

D_5	E	$2C_5$	$2C_5^2$	$5C_2$		
A_1	1	1	1	1		$x^2 + y^2, z^2$
A_2	1	1	1	-1	z, R_z	
E_1	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	$(x, y)(R_x, R_y)$	(xz, yz)
E_2	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0		$(x^2 - y^2, xy)$

D_6	E	$2C_6$	$2C_3$	C_2	$3C_2'$	$3C_2''$		
A_1	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_2	1	1	1	1	1	1	z, R_z	
B_1	1	1	1	1	1	1		
B_2	1	1	1	1	1	1		
E_1	2	1	1	2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)
E_2	2	1	1	2	0	0		$(x^2 - y^2, xy)$

4. The C_m Groups

C_m	E	C_m	$\sigma_1(xz)$	$\sigma_1'(xz)$		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	1	1	R_2	xy
B_1	1	1	1	1	x, R_1	xz
B_2	1	1	1	1	y, R_1	yz

C_m	E	$2C_3$	$3\sigma_2$		
A_1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	1	R_2	
E	2	1	0	$(x, y)(R_x, R_y)$	$(x^2 - y^2, xy)(xz, yz)$

C_m	E	$2C_4$	C_2	$2\sigma_1$	$2\sigma_d$		
A_1	1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	1	1	1	R_2	
B_1	1	1	1	1	1		$x^2 - y^2$
B_2	1	1	1	1	1		xy
E	2	0	2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)

C_m	E	$2C_3$	$2C_3^2$	$5\sigma_2$		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	1	1	R_2	
E_1	2	$2 \cos 72$	$2 \cos 144$	0	$(x, y)(R_x, R_y)$	(xz, yz)
E_2	2	$2 \cos 144$	$2 \cos 72$	0		$(x^2 - y^2, xy)$

C_m	E	$2C_6$	$2C_3$	C_2	$3\sigma_1$	$3\sigma_d$		
A_1	1	1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	1	1	1	1	R_2	
B_1	1	1	1	1	1	1		
B_2	1	1	1	1	1	1		
E_1	2	1	1	2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)
E_2	2	1	1	2	0	0		$(x^2 - y^2, xy)$

6. The D_{nh} Groups

D_{2h}	E	$C_2(z)$	$C_2(y)$	$C_2(x)$	i	$\sigma(xy)$	$\sigma(xz)$	$\sigma(yz)$		
I_g	1	1	1	1	1	1	1	1		x^2, y^2, z^2
B_{1g}	1	1	1	-1	1	1	1	1	R_z	xy
B_{2g}	1	1	-1	1	1	1	1	1	R_y	xz
B_{3g}	1	1	-1	-1	1	1	1	1	R_x	yz
A_{1u}	1	1	1	1	-1	-1	-1	-1		
B_{1u}	1	1	1	-1	-1	-1	-1	-1		
B_{2u}	1	1	-1	1	-1	-1	-1	-1		
B_{3u}	1	1	-1	-1	-1	-1	-1	-1		

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_6$	$3\sigma_v$		
I_h	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_1'	1	1	1	1	1	1	R_z	
E_2'	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''	2	1	0	2	-1	0	(R_x, R_y)	(xz, yz)

D_{4h}	E	$2C_4$	C_2	$2C_2'$	$2C_2''$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$	
A_{1g}	1	1	1	1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A_{2g}	1	1	1	1	1	1	1	1	1	1	R_z
B_{1g}	1	1	1	1	-1	1	1	1	1	1	$x^2 - y^2$
B_{2g}	1	1	1	1	-1	1	1	1	1	1	xy
E_g	2	0	2	0	0	2	0	2	0	0	(R_x, R_y)
A_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1	
A_{2u}	1	1	1	1	1	-1	-1	-1	-1	-1	z
B_{1u}	1	1	1	1	-1	-1	-1	-1	-1	-1	
B_{2u}	1	1	1	1	-1	-1	-1	-1	-1	-1	
E_u	2	0	2	0	0	2	0	2	0	0	(x, y)

D_{5h}	E	$2C_5$	$2C_5^2$	$5C_2$	σ_h	$2S_5$	$2S_5^3$	$5\sigma_v$	
A_1'	1	1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A_2'	1	1	1	1	1	1	1	1	R_z
E_1'	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	(x, y)
E_2'	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	$(x^2 - y^2, xy)$
A_1''	1	1	1	1	-1	-1	-1	-1	
A_2''	1	1	1	1	-1	-1	-1	-1	z
E_1''	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	(R_x, R_y)
E_2''	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	(xz, yz)

D_{6h}	E	$2C_6$	$2C_3$	C_2	$3C_2'$	$3C_2''$	i	$2S_6$	$2S_6^5$	σ_h	$3\sigma_d$	$3\sigma_v$	
A_{1g}	1	1	1	1	1	1	1	1	1	1	1	1	$x^2 + y^2, z^2$
A_{2g}	1	1	1	1	1	1	1	1	1	1	1	1	R_z
B_{1g}	1	1	1	1	1	-1	1	1	1	1	1	1	
B_{2g}	1	1	1	1	1	-1	1	1	1	1	1	1	
E_{1g}	2	1	1	2	0	0	2	1	1	2	0	0	(R_x, R_y)
E_{2g}	2	1	1	2	0	0	2	1	1	2	0	0	$(x^2 - y^2, xy)$
A_{1u}	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	
A_{2u}	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	z
B_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	
B_{2u}	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	
E_{1u}	2	1	1	2	0	0	2	1	1	2	0	0	(x, y)
E_{2u}	2	1	1	2	0	0	2	1	1	2	0	0	

6. The D_{nh} Groups

D_{2h}	I	$C_2(z)$	$C_2(y)$	$C_2(x)$	i	$\sigma(xy)$	$\sigma(xz)$	$\sigma(yz)$		
A_g	1	1	1	1	1	1	1	1		x^2, y^2, z^2
B_{1g}	1	1	1	-1	1	1	1	1	R_z	xy
B_{2g}	1	1	-1	1	1	1	1	1	R_x	xz
B_{3g}	1	1	-1	-1	1	1	1	1	R_y	yz
A_u	1	1	1	1	-1	-1	-1	-1		
B_{1u}	1	1	1	-1	-1	-1	-1	-1	z	
B_{2u}	1	1	-1	1	-1	-1	-1	-1	x	
B_{3u}	1	1	-1	-1	-1	-1	-1	-1	y	

D_{3h}	I	$2C_3$	$3C_2$	σ_h	$2S_6$	$3\sigma_v$		
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)

D_{4h}	I	$2C_4$	C_2	$2C_2'$	$2C_2''$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$		
A_{1g}	1	1	1	1	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_{2g}	1	1	1	1	1	1	1	1	1	1	R_z	
B_{1g}	1	1	1	1	1	1	1	1	1	1		$x^2 - y^2$
B_{2g}	1	1	1	1	1	1	1	1	1	1		xy
E_g	2	0	2	0	0	2	0	2	0	0	(R_x, R_y)	(xz, yz)
A_{1u}	1	1	1	1	1	1	1	1	1	1		
A_{2u}	1	1	1	1	1	1	1	1	1	1	z	
B_{1u}	1	1	1	1	1	1	1	1	1	1		
B_{2u}	1	1	1	1	1	1	1	1	1	1		
E_u	2	0	2	0	0	2	0	2	0	0	(x, y)	

D_{5h}	E	$2C_5$	$2C_5^2$	$5C_2$	σ_h	$2S_5$	$2S_5^3$	$5\sigma_v$		
A_1'	1	1	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_2'	1	1	1	1	1	1	1	1	R_z	
E_1'	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	(x, y)	
E_2'	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0		$(x^2 - y^2, xy)$
A_1''	1	1	1	1	1	1	1	1		
A_2''	1	1	1	1	1	1	1	1	z	
E_1''	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	2	$2 \cos 72^\circ$	$2 \cos 144^\circ$	0	(R_x, R_y)	(xz, yz)
E_2''	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0	2	$2 \cos 144^\circ$	$2 \cos 72^\circ$	0		

D_{6h}	I	$2C_6$	$2C_3$	C_2	$3C_2'$	$3C_2''$	i	$2S_6$	$2S_6^5$	σ_h	$3\sigma_d$	$3\sigma_v$		
A_{1g}	1	1	1	1	1	1	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_{2g}	1	1	1	1	1	1	1	1	1	1	1	1	R_z	
B_{1g}	1	1	1	1	1	1	1	1	1	1	1	1		
B_{2g}	1	1	1	1	1	1	1	1	1	1	1	1		
E_{1g}	2	1	1	2	0	0	2	1	1	2	0	0	(R_x, R_y)	(xz, yz)
E_{2g}	2	1	1	2	0	0	2	1	1	2	0	0		$(x^2 - y^2, xy)$
A_{1u}	1	1	1	1	1	1	1	1	1	1	1	1		
A_{2u}	1	1	1	1	1	1	1	1	1	1	1	1	z	
B_{1u}	1	1	1	1	1	1	1	1	1	1	1	1		
B_{2u}	1	1	1	1	1	1	1	1	1	1	1	1		
E_{1u}	2	1	1	2	0	0	2	1	1	2	0	0	(x, y)	
E_{2u}	2	1	1	2	0	0	2	1	1	2	0	0		