
UNIVERSITI SAINS MALAYSIA

Final Examination
Academic Session 2008/2009

April 2009

JIK 418 – ORGANOMETALLIC / ADVANCED INORGANIC CHEMISTRY
[KIMIA ORGANOLOGAM / KIMIA TAKORGANIK LANJUTAN]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains **SEVEN** printed pages before you begin the examination.

Answer **FIVE** questions. You may answer **either** in Bahasa Malaysia or in English.

All answers must be written in the answer booklet provided.

Each question is worth 20 marks and the mark for each sub question is given at the end of that question.

*Sila pastikan bahawa kertas peperiksaan ini mengandungi **TUJUH** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*

*Jawab **LIMA** soalan. Anda dibenarkan menjawab soalan **sama ada** dalam Bahasa Malaysia atau Bahasa Inggeris.*

Setiap jawapan mesti dijawab di dalam buku jawapan yang disediakan.

Setiap soalan bernilai 20 markah dan markah subsoalan diperlihatkan di penghujung subsoalan itu.

1. Organotransition metal complexes is widely used as homogeneous catalyst in the fine chemicals industry. State and elaborate the properties of these homogeneous catalyst that makes them effective when compared to heterogeneous catalyst.

Sebatian organologam banyak digunakan sebagai mangkin homogen di dalam industri penyediaan 'fine chemicals'. Nyatakan dan huraikan keistimewaan mangkin homogen yang menyebabkan penggunaannya lebih berkesan berbanding dengan mangkin heterogen.

[20 marks]

2. Describe and discuss the following types of organometallic reactions. You are required to provide suitable examples.

Jelaskan dan bincangkan jenis-jenis tindak balas organologam berikut. (Anda dikehendaki memberikan contoh-contoh yang sesuai).

- (a) Oxidative addition

Penambahan oksidaan

[5 marks]

- (b) Reductive elimination

Penyingkiran menurun

[5 marks]

- (c) Insertion

Penyelitan

[5 marks]

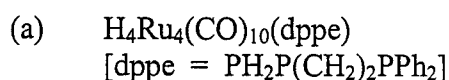
- (d) Metallation

Pelogaman

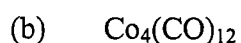
[5 marks]

3. Assuming that the following organometallic clusters have a 'closo' structure and obeys the Effective Atomic Number (EAN) rule, calculate the number of metal-metal (M – M) bonds in the following complexes.

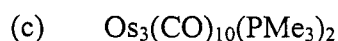
Andaikan gugusan organologam berikut mempunyai struktur 'kloso' dan mematuhi peraturan Nombor Atom Efektif (EAN). Anda dikehendaki mengira bilangan ikatan logam-logam (M – M) untuk sebatian berikut :-



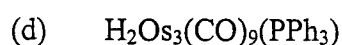
[4 marks]



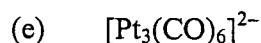
[4 marks]



[4 marks]



[4 marks]



[4 marks]

4. (a) Discuss briefly back bonding between CO and a transition metal. You are required to illustrate this phenomenon by giving suitable examples.

Bincangkan secara ringkas ikatan berbalik di antara CO dan suatu logam peralihan. Anda dikehendaki menggambarkan fenomena ini dengan menggunakan contoh-contoh yang sesuai.

[10 marks]

- (b) The carbonyl stretching frequency (ν_{CO}) for free CO is 2143 cm^{-1} . The ν_{CO} for the following carbonyl complexes are as follows :

Complexes	$\nu_{\text{CO}} \text{ cm}^{-1}$
$[\text{Ag}(\text{CO})]^+$	2204
$\text{Ni}(\text{CO})_4$	2060
$[\text{Co}(\text{CO})_4]^-$	1890
$[\text{Fe}(\text{CO})_4]^{2-}$	1790

Please explain and discuss the above data.

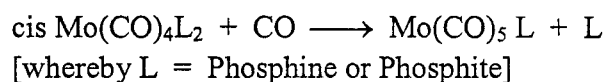
Frekuensi renggangan karbonil untuk CO (ν_{CO}) bebas ialah 2143 cm^{-1} . ν_{CO} untuk kompleks karbonil berikut adalah :

Kompleks	$\nu_{\text{CO}} \text{ cm}^{-1}$
$[\text{Ag}(\text{CO})]^+$	2204
$\text{Ni}(\text{CO})_4$	2060
$[\text{Co}(\text{CO})_4]^-$	1890
$[\text{Fe}(\text{CO})_4]^{2-}$	1790

Jelaskan dan bincangkan data di atas.

[10 marks]

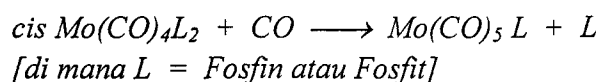
5. For the following chemical reaction :



The data for the reaction as follows :

Ligand, L	Cone angle of ligand	Rate of reaction ($\times 10^{-5} \text{ s}^{-1}$)
$\text{P}(\text{OPh})_3$	128°	< 1
PMePh_2	136°	1.3
$\text{P}(\text{O}-o\text{-tolyl})_3$	141°	16
PPh_3	145°	320
$\text{PPh}(\text{cyclohexyl})_2$	162°	6400

Data untuk tindak balas



adalah seperti berikut :

Ligan, L	Sudut Kon ligan	Kadar tindak balas ($\times 10^{-5} \text{ s}^{-1}$)
$P(\text{O}Ph)_3$	128°	< 1
$P\text{MePh}_2$	136°	1.3
$P(\text{O}-o-\text{tolil})_3$	141°	16
PPh_3	145°	320
$PPh(\text{sikloheksil})_2$	162°	6400

- (a) Describe and elaborate regarding cone angle?

Terangkan dan jelaskan sudut kon?

[8 marks]

- (b) From the above data, explain the different rate of reaction.

Daripada data-data di atas, jelaskan kadar tindak balas yang berbeza.

[12 marks]

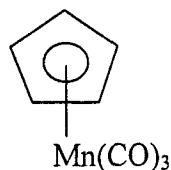
6. (a) Name the following organometallic complexes according to the IUPAC recommendations.

Namakan sebatian organologam berikut mengikut sistem penamaan IUPAC.

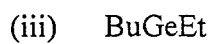
- (i) BuSnCl_2Br

[1 marks]

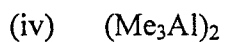
- (ii)



[2 marks]

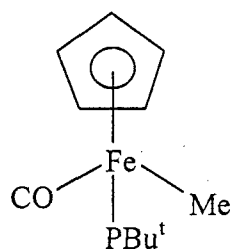


[1 marks]



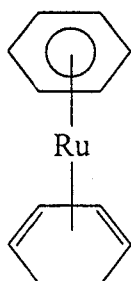
[2 marks]

(v)



[2 marks]

(vi)

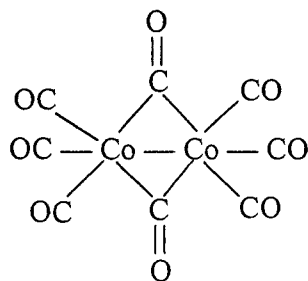


[2 marks]

(b) Calculate the number of valence electron per metal for the following organometallic complexes.

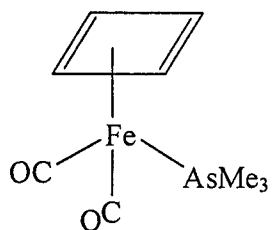
Kira bilangan elektron valens per logam untuk sebatian-sebatian berikut.

(i)



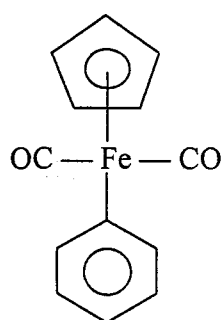
[2 marks]

(ii)



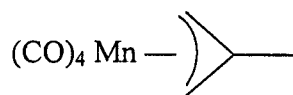
[2 marks]

(iii)



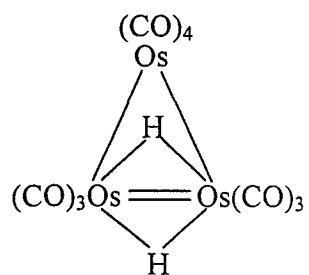
[2 marks]

(iv)



[2 marks]

(v)



[2 marks]