UNIVERSITI SAINS MALAYSIA

Final Examination
2015/2016 Academic Session

May/June 2016

JIK 410 – Advanced Inorganic Chemistry
[Kimia Takorganik Lanjutan]

Duration : 3 hours
[Masa : 3 jam]

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

Answer **FIVE** questions. Answer the questions in English. You may also answer the questions in Bahasa Malaysia, but not a mix of both languages.

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.

In the event of any discrepancies in the exam questions, the English version shall be used.

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

*Jawab **LIMA** soalan. Jawab soalan-soalan dalam Bahasa Inggeris. Anda juga dibenarkan menjawab soalan dalam Bahasa Malaysia, tetapi campuran antara kedua-dua bahasa ini tidak dibenarkan.*

Setiap jawapan mesti dijawab di dalam buku jawapan yang disediakan.

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

Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.

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1. (a) Describe and discuss briefly the various methods of preparation of main group organometallic compounds. You are required to give two (2) examples of main group organometallic compounds.
Huraikan dan bincangkan dengan ringkas cara-cara penyediaan sebatian organologam kumpulan utama. Anda dikehendaki memberikan dua (2) contoh sebatian organologam kumpulan utama.

(10 marks/*markah*)

(b) By giving suitable examples and equations, describe and discuss briefly the method of preparation of two (2) organotransition metal carbonyls.
Dengan memberikan contoh-contoh yang sesuai berserta tindak balas, huraikan dan bincangkan dengan ringkas cara penyediaan dua (2) sebatian gugusan organologam karbonil logam peralihan.

(10 marks/*markah*)

2. Describe and discuss briefly the following organometallic reactions.
Huraikan dan bincangkan dengan ringkas jenis-jenis tindak balas organologam berikut:

(a) Oxidative addition
Penambahan oksidaan

(7 marks/*markah*)

(b) Reductive elimination
Penyingkiran reduktif

(6 marks/*markah*)

(c) Insertion reaction
Tindak balas penyelitan

(7 marks/*markah*)

3. Elaborate and discuss the following:
Huraikan dan bincangkan perkara-perkara berikut:

(a) Back bonding between CO and organotransition metal complexes.
Ikatan berbalik di antara ligan CO dengan kompleks organologam kumpulan peralihan.

(10 marks/*markah*)

(b) Phosphine cone angle.
Sudut kon ligan fosfin.

(10 marks/*markah*)

4. If the following organometallic cluster obey the 18 electron rule and adopt the *closo* structure; calculate the number of metal-metal bonds.
[Method of calculation **MUST** be shown, marks will **NOT** be given if the method of calculation is not shown].
Jika gugusan organologam berikut mematuhi hukum 18 elektron dan membentuk struktur kloso, kira bilangan ikatan logam-logam.
*[Cara pengiraan **MESTI** ditunjukkan, markah **TIDAK** akan diberikan sekiranya cara pengiraan tidak ditunjukkan]*.

(i) $H_2Os_3(CO)_{10}$ (4 marks/*markah*)

(ii) $[Pt_3(CO)_6]^{2-}$ (3 marks/*markah*)

(iii) $H_2Os_3(CO)_{10}(AsPh_3)$ (3 marks/*markah*)

(iv) $HRu_3(CO)_9(\mu_3\text{-}SBu^t)$ (3 marks/*markah*)

(v) $Co_4(CO)_{10}(dpam)$

where dpam = $Ph_2AsCH_2AsPh_2$ (3 marks/*markah*)

(vi) $H_4Ru_4(CO)_8$ (dpam) (dppm)

where dpam = $Ph_2AsCH_2AsPh_2$

dppm = $Ph_2PCH_2PPh_2$ (4 marks/*markah*)

5. Calculate the number of valence electron per metal for the following organometallic complexes.

[Assume the multinuclear complexes adopt the *closo* structure and the method of calculation **MUST** be shown. Marks will **NOT** be given if the method of calculation is not shown].

Kira bilangan elektron valens per logam untuk kompleks organologam berikut.

*[Andaikan komples multinukleur membentuk struktur kloso dan anda dikehendaki menunjukkan cara pengiraan anda. Markah **TIDAK** akan diberikan sekiranya cara pengiraan tidak ditunjukkan]*.

(a) $Fe_2(CO)_7(PPh_3)(AsPh_3)$

(b) $Ru_3(CO)_{10}$ $[Ph_2\ As(CH_2)_2\ PPh_2]$

(c) $V(CO)_6$

(d) $Ir_4(CO)_{11}(PEt_3)$

(e) $H_2\ Os_3(CO)_9\ (SbPh_3)$

(f) $Mn_2(CO)_9\ (PPh_3)$

(g) $Os_3(CO)_9\ (Ph_2AsCH_2\ AsPh_2)\ (P(OMe)_3)$

(h) $HRe(CO)_4(NCPh)$

(i) $(\eta^5\text{-}C_5H_5)_2Ni$

(j) $(\eta^5\text{-}C_5H_5)V(CO)_4$

(20 marks/*markah*)

6. In general terms, compare and contrast the typical properties associated with both homogeneous and heterogeneous catalysts. You are required to comment on the thermodynamic principles of activation, reaction conditions and physical factors.
Secara amnya, bandingkan dan bezakan sifat-sifat lazim mangkin homogen dan mangkin heterogen. Anda dikehendaki memberi komen terhadap prinsip keaktifan termodinamik, keadaan tindak balas dan faktor fizikal.

(20 marks/*markah*)

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