Organometallic Chemistry Written Examination
– examen écrit

Name (Nom):

Points : /50

Student ID number (numéro carte d'étudiant):

The following will be provided:

Periodic Table

Please note that this is not an open-book exam. No material other than the exam paper and attachments are permitted. Use both sides of the paper. Please place your photo IDs for identity verification.

Veuillez prendre note que cet examen n'aura pas lieu à livre ouvert. Les ordinateurs ne peuvent pas être utilisés. Les seuls matériels autorisés sont les feuilles d'examen et les annexes. Ecrivez sur le recto et le verso des feuilles. Vous êtes priés de prendre une pièce d'identité avec photo pour le contrôle de votre identité.

1 a. (10 points) Draw structures and give the valence electron (NEV) count and formal oxidation state of the metal for the following compounds.

(a) $[Fe(\eta^5\text{-}C_5H_5)(\eta^6\text{-}C_6H_6)]^+$ OS= NE=

(b) $[Cp_2ZrCl(OMe)]$ (Cp = $\eta^5\text{-}C_5H_5$) OS= NE=

(c) $[(PMe_3)_2Pt(\eta^3\text{-}C_3H_5)]^+$ OS= NE=

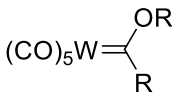
(d) $[Mn(CO)_5]$ OS= NE=

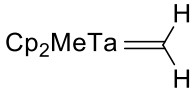
(e) $[Ni(\eta^4\text{-}C_4H_4)_2]$ OS= NE=

1 b. (4 points) Which of the compounds (**a-e**) is most reactive and what type of reaction does it undergo?

2. (4 points) Draw (with a simple diagram) the Dewer-Chatt-Duncanson model for metal-alkene bonding. Indicate what type of bonding interactions are involved

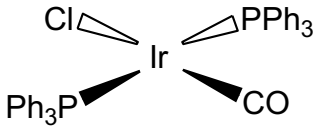
3. (2 points) The compounds below are metal carbene complexes. Name whether the example is a Fischer or Schrock carbene.





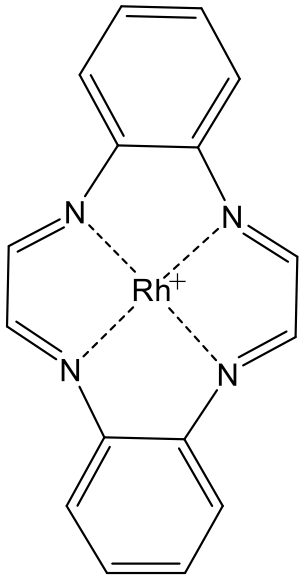
A: carbene B : carbene

4 a. (2 points) Draw the product of the oxidative addition of H_2 to Vaska's complex.



Vaska's complex

4 b. (2 points) The square planar rhodium complex shown below is inflexible/rigid. Does it undergo oxidative addition with (i) H_2 and/or (ii) MeI?



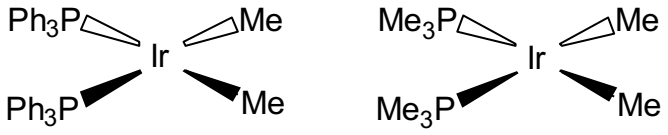
4 c. (2 points) Which of the following is most reactive toward oxidative addition? a or b?

a) trans-[Ir(PPh_3)$_2$(CO)Cl] b) *trans*-[Ir{$P(C_6F_5)_3$}$_2$(CO)Cl]

4d. (2 point) The bond dissociation energies of aryl-halide (Ph-X) bonds are shown in the table below. Which aryl-halide (Ph-X) will be most reactive to oxidative addition?

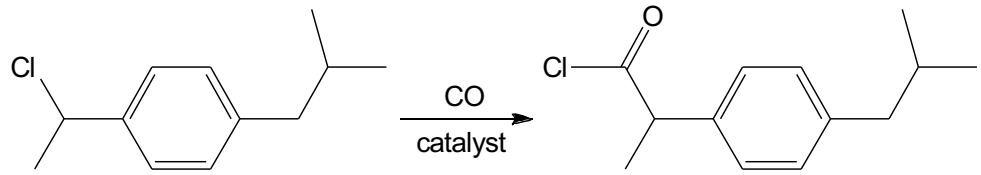
Bond	Dissociation energy (kJ mol^{-1})
Ph–F	533
Ph–Cl	407
Ph–Br	346
Ph–I	280

4. d (2 points) Which of the two complexes shown below (i or ii) is more reactive to reductive elimination?

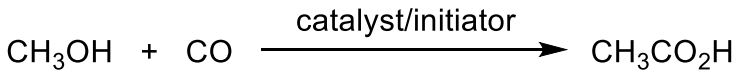


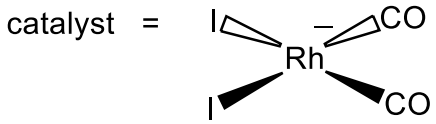
(**i**) (**ii**)

5. (5 points) A key step in the synthesis of ibubrofen is shown below. The active catalyst species is 'Pd(PPh_3)$_2$'. Propose a mechanism for the reaction.



6. (10 points) Propose a catalytic cycle for the reaction shown below including the structure of the intermediates, the number of valence electrons and oxidation state of the intermediates, and the name of each reaction step.





$[Rh(I)_2(CO)_2]^-$

initiator = HI

7 .(5 points). Label the steps in the boxes for the following cyclization catalytic cycle: