



DEPARTMENT OF CHEMICAL ENGINEERING
FACULTY OF ENGINEERING
PRINCE OF SONGKLA UNIVERSITY

Midterm Examination: 1st Semester

Academic year: 2011

Date: December 16th, 2012

Time: 9:00 – 12:00

Subject: 230-520 Catalyst

Room: S 817

ทูลงรลทในการสอบ โทษขั้้นด้าปรลบกในรายวลขานั้้น หรลือ พักการเรลยลน
 1 ภาคการศลลขาล และ โทษสูงสลุคลือ ให้ออก

ค้าลสั่ง

1. ห้ามนำข้อสอบชุดนี้ออกจากห้องสอบ
2. เป็นการสอบแบบห้ามนำเอกสารเข้าห้องสอบ
3. อนุญาตให้ใช้เครื่องคำนวณทุกชนิด และใช้ดินสอในการทำข้อสอบ
4. ห้ามพูดคุยหรือหยิบยืมเอกสาร เครื่องคำนวณ หรือเครื่องเขียน
5. หากท่านทำข้อสอบเสร็จก่อนหมดเวลา ให้นั่งอยู่กับที่แล้วยกมือแจ้งกรรมการคุมสอบ

ข้อสอบมี 7 ข้อ 9 หน้า (รวมปก)

Problem	1	2	3	4	5	6	7	Total
Score	15	35	20	20	15	20	20	145
You got								

Sukritthira Ratanawilai

December 2012

1. (15 points; 3 points/each subject) Give a brief definition or description and an example (when requested) of the following subjects.

1.1 Elementary reaction (give example)

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1.2 Bulk density, Solid density

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1.3 Sledgehammer approach and Feather approach

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1.4 Textural promoter

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1.5 Explain Fischer-Tropsch reaction (give example).

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2. (35 points; 5 points/each question) Find the answer of each question

2.1 What are cacination and reduction; how different?

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2.2 What are physisorption and chemisorption; how different?

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2.3 Explain the important points of catalyst?

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2.4 What are co-precipitation and impregnation; how different?

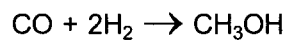
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3. (20 points) Based on the providing conditions, choose the best support from the following choices.

Support choices: **Silica, Alumina, Zeolite, Activated carbon, Titania**

- 3.1 Can use at high temperature and high pressure without sintering and structural deterioration, respectively.....
.....
- 3.2 A porous structure that can exchange cations, such as Na^+ , K^+ , and Ca^{2+} used to call "aluminosilicate members"
.....
- 3.3 High chemical stability, low cost, good for photocatalysis, have different phase depend on temperature.....
.....
- 3.4 Usually in the form of β -, γ -, and α -
.....
- 3.5 Can use as an acid catalyst in petrochemical reaction especially for control molecular weight of desired product.....
.....
- 3.6 Can use for odor removal.....
.....
- 3.7 Use as additive in polymer process, easily to evaporate at higher temperature and very difficult to make a pellet.
.....
- 3.8 Have solid phase at room temperature.....
.....
- 3.9 Can prepare in a form of "Nano" particle.....
.....
- 3.10 If you would like to make your own catalyst which support you would choose and why.....
.....
.....
.....

4. (20 points) What is the rate of formation of methanol in mol/s g of catalyst (metal plus support)



In this reaction, uses 1 wt% Cu on ZnO as catalyst, the catalyst dispersion percentage of atoms exposed, determined from hydrogen chemisorption, was found to be 48%. At a pressure of 988 kPa and a temperature of 475 K, TOF of 0.05 s^{-1} was reported for CH_3OH

Information: - MW of Cu 63.5 g/mol

- Avogadro's number = $6.022 \times 10^{23} \text{ mol}^{-1}$

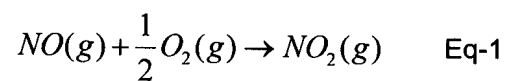
5. (15 points) Derive the Langmuir adsorption and concentration of adsorbed and vacant site (θ) for the following cases:

5.1 Dissociate adsorption of NO_2 (5 points)

5.2 A and B has different surface site as Δ and \blacksquare site, respectively. A and B react in order to produce C on \blacksquare site. (10 points)



6. (20 points) NO oxidized with O₂ on Cu-ZSM-5 is occurred as in Eq-1. Propose kinetics mechanism and derive a rate expression by using Eley-Rideal model.



7. (20 points) you would like to make 50 grams of 0.5% wt of Pt on TiO_2 . Calculate the amount of platinum-oxide (PtO_2), amount of solvent and amount of TiO_2 . In addition explain step by step for making this catalyst.

Information:

- MW of Pt 195 g/mol, MW of O 16 g/mol, MW of K 39 g/mol MW of H 1 g/mol,
MW of Ti 48 g/mol, MW of Na 23 g/mol

- Wetness point of TiO_2 = 2.7 cc of KOH /g of TiO_2

- Wetness point of TiO_2 = 2.9 cc of NaOH /g of TiO_2

- Solution of KOH and NaOH were prepared and ready to use and PtO_2 is better dissolve in NaOH

- Boiling point of KOH = 105 °C, Boiling point of NaOH = 120 °C