CHEM-E1130 Catalysis
Exam
April 3, 2017 at 9 a.m. -1 p.m.

Answer all questions, each question (1-5) is worth 6 points, max. points 30. If you have completed the homework in 2017, one exam question can be replaced with the homework. However, you can answer all five questions, and in case the points are better in the homework, those will be taken into account in the evaluation. With the extra question in the end you can get extra points, not included in max. points.

No material allowed.

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1. Definition of a catalyst
   On the basis of the definition, how does the catalyst affect a chemical process? What are the requirements for an industrial catalyst? (6 points)

2. Exhaust gas cleaning in gasoline-fuelled vehicles. (6 points)

3. 0.5 % Pt/Al_2O_3 has been widely used as a catalyst in the catalytic reforming reaction in oil refining
   a) Describe the typical structure of the catalyst (bulk and surface structure) (3 points)
   b) When the catalyst is used in a real process, deactivation by coking is observed on this catalyst. Explain how and why the deactivation takes place, how it is observed and how it can be compensated and regenerated. (3 points)

4. Explain briefly, what are the main similarities and differences between the catalyst characterization techniques in the following pairs. Choose three pairs of techniques. A pair, that contains your group's topic, cannot be chosen. (2 points each pair, total 6 points)
   a) Physisorption & Chemisorption
   b) Raman spectroscopy & DRIFTS
   c) SEM & TEM
   d) XPS & XAFS

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5. Explain the following terms related to homogeneous catalysis (total 6 points):

a) monodentate ligand

b) cone angle

c) coordinaton number

d) chelate complex

e) metallocene catalyst

f) 18 valence electron rule

\+ Extra question (total 2 extra points): Photocatalysis

a) How is the photocatalysis differing from the traditional heterogeneous catalysis? (0.5 p)

b) Introduce the most common materials that have photocatalytic activity (0.5 p)

c) Which parameters are influencing the reaction rate in photocatalytic applications and how? (1 p)