Assignment 2

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-02-13, 23:59 IST.

The assignment 2 of CRE-II is from the topics covered in Week 2 lectures.

1) For the reaction, \( C \rightarrow A + B \), identify the rate-limiting steps if the experimental data are plotted in the form of reaction rate versus partial pressure of C as shown below.

Which one of the following options helps to conclude the correct rate-limiting step using the above three plots (X, Y and Z)?

- X-adsorption, Y-surface reaction, Z-desorption
- X-surface reaction, Y-adsorption, Z-desorption
- X-adsorption, Y-desorption, Z-surface reaction
- X-desorption, Y-adsorption, Z-surface reaction

No, the answer is incorrect.
Score: 0

Accepted Answers:
X-desorption, Y-adsorption, Z-surface reaction

2) Which of the following corresponds PSSH for the reaction \( A \rightarrow B \)? Note: A and B are adsorbed onto catalysts sites as A.S and B.S, and other symbols have their usual meanings.

- \( r_{\text{A.S}} = 0; r_{\text{B.S}} \neq 0 \)
- \( r_{\text{A.S}} = r_{\text{B.S}} = 0 \)
- \( \frac{r_{\text{A.S}}}{k_i} \leq 0 \)
- \( r_{\text{A.S}} \neq 0 \)

No, the answer is incorrect.
Score: 0

Accepted Answers:
X-desorption, Y-adsorption, Z-surface reaction
the silica gel particles.

**w2q3_alternate**

Consider the following relation for adsorption isotherm: \( C_{ad} = \frac{K C_m P_g}{1 + K P_g} \)

Use the linear regression to fit the above experimental data. What is the value of parameters, \( K \) and \( C_m \), respectively? Units: \( K \) \(=\) atm\(^{-1}\) and \( C_m \) \(=\) gram of n-hexane monolayer/gram of catalyst.

1. \( 1.55 \times 10^{-2} \text{ and } 5.36 \times 10^{-2} \)
2. \( 64.47 \text{ and } 8.31 \times 10^{-4} \)
3. \( 64.47 \text{ and } 83.13 \)
4. \( 1.55 \times 10^{-2} \text{ and } 5.36 \times 10^{3} \)

No, the answer is incorrect.

**Score:** 0

**Accepted Answers:**
- \( 64.47 \text{ and } 8.31 \times 10^{-4} \)

4) The catalytic dehydration of methanol (M) to dimethyl ether (DME) is depicted as shown in the figure below where W stands for Water molecule.

**w2q4_dehydr**

Assuming surface reaction controlling and non-dissociative adsorption of species, the rate law is

\[
\begin{align*}
R'_M &= \frac{-k P_M}{(1 + K_W P_W + K_M P_M)^2} \\
R'_M &= \frac{-k P_M}{1 + K_W P_W + K_M P_M} \\
R'_M &= \frac{-k P_M}{(1 + K_W P_W + K_M P_M)^2} \\
R'_M &= \frac{-k P_W}{1 + K_W P_W + K_M P_M}
\end{align*}
\]

No, the answer is incorrect.

**Score:** 0

**Accepted Answers:**
- \( \frac{-k P_M}{(1 + K_W P_W + K_M P_M)^2} \)

5) A mechanism similar to dehydrogenation of butanol (A) to methyl ethyl ketone (B) was proposed as follows.

\[
\begin{align*}
1) & \quad A + S \rightleftharpoons A \cdot S \\
2) & \quad A \cdot S + S \rightarrow B \cdot S + C \cdot S \\
3) & \quad B \cdot S \rightleftharpoons B + S \\
4) & \quad C \cdot S \rightleftharpoons C + S
\end{align*}
\]

Assuming Step (2) (i.e. irreversible surface reaction) to be the rate-limiting and Steps 1, 3 and 4 to be in Pseudo-steady state, which of the following is the suitable rate law? Note: \( C_T \) is total number of
active sites. Here, $K_3$ and $K_4$ are desorption coefficients.

\[ -r_A' = \frac{k_2 K_1 P_A C_T^2}{(1 + K_1 P_A + P_B/K_3 + P_C/K_4)^2} \]

\[ -r_A' = \frac{k_2 K_1 P_A C_T^2}{1 + K_1 P_A + P_B/K_3 + P_C/K_4} \]

\[ -r_A' = \frac{k_2 K_1 P_A C_T^2}{1 + K_1 P_A + P_B/K_3 + P_C/K_4} \]

\[ -r_A' = \frac{k_2 K_1 P_A C_T^2}{(1 + K_1 P_A + P_B/K_3 + P_C/K_4)^2} \]

No, the answer is incorrect.
Score: 0

Accepted Answers:
\[ -r_A' = \frac{k_2 K_1 P_A C_T^2}{(1 + K_1 P_A + P_B/K_3 + P_C/K_4)^2} \]

6) With reference to the previous question, it is desired to rearrange the rate law 2 points derived in order to fit the experimental data using linear regression. Identify the slope and intercept, respectively. Assume species B and C to be weakly adsorbing. Note: Few parameters like $k_2$, $K_1$, $C_T$ are lumped into single parameter $K_2$ for simplification.

\[ \frac{K_1}{\sqrt{K_2}}, \frac{1}{\sqrt{K_2}} \]

\[ \frac{K_2}{\sqrt{K_1}}, \frac{K_3}{\sqrt{K_1}} \]

\[ \frac{K_2}{\sqrt{K_1}}, \frac{1}{\sqrt{K_1}} \]

\[ \frac{1}{\sqrt{K_2}}, \frac{K_1}{\sqrt{K_2}} \]

No, the answer is incorrect.
Score: 0

Accepted Answers:
\[ \frac{K_1}{\sqrt{K_2}}, \frac{1}{\sqrt{K_2}} \]