The University of Jordan
School of Engineering
Chemical Engineering Department

7/10

(0905422) Chemical Reaction Engineering II — **First Semester – 2019/2020**

Quiz # 1 (Chapter 10)

Name: Rama Zaki Darwesh **ID #** 0164707

The following reaction is carried out over a cobalt molybdenum catalyst:

$$C_2H_4 + H_2 \rightarrow C_2H_6$$

The following data were obtained for this reaction.

Run number	Reaction rate $(mol/kg\text{-}catalyst \cdot s)$	$P_E\ (atm)$	$P_{EA}\ (atm)$	$P_H\ (atm)$
1	1.04	1	1	1
2	3.13	1	1	3
3	5.21	1	1	5
4	3.82	3	1	3
5	4.19	5	1	3
6	2.33	0.5	1	3
7	2.25	0.5	3	3
8	0.75	0.5	5	1
9	0.40	0.5	15	1

(a) To what class of catalysts does cobalt molybdenum belong to?

heterogenous

(b) Determine which of the following rate laws best describes the experimental data, supporting your answer (on the back of the paper) by discussing the relevant experimental data runs:

a. $-r'_E = \frac{kP_EP_H}{1+K_{EA}P_{EA}+K_EP_E}$

b. $-r'_E = \frac{kP_EP_H}{1+K_EP_E}$

c. $-r'_E = \frac{kP_EP_H}{(1+K_EP_E)^2}$

(c) Suggested a mechanism consistent with your chosen rate law, naming the type of chemisorption and surface reaction you are suggesting.

hydrogenation

$C_2H_4 + S \rightleftarrows C_2H_4 \cdot S$ ← adsorption

$C_2H_4 \cdot S + H_2 \rightarrow C_2H_6 \cdot S$ ← surface reaction

$C_2H_6 \cdot S \rightleftarrows C_2H_6 + S$ ← desorption

From Run 1 and 2

$-r_E' \propto P_H$ ✓

From run 4 and 5 ✗ ✓

$-r_E' \propto P_E$

From run 8 and 9 ✓

$-r_E' \frac{1}{\propto} P_{EA}$

$-r_E' \propto \frac{1}{P_{EA}}$