Chemistry 12

Rates of Reaction # 3 Reaction Mechanisms Worksheet

Key.

1. Examine the following reaction mechanism:

Step 1: OCI +
$$H_2O$$
 ---> HOCI + OH

Step 2:
$$HOCl + I \longrightarrow HOI + Cl$$

Step 3:
$$HOI + OH^- \longrightarrow H_2O + OI^-$$

- (a) Identify the catalyst in the mechanism and explain how you were able to make your identification. H2O, is used up in step 1 but regenerated in step 3
- (b) Explain why OH would be called a reaction intermediate.

(c) List any additional reaction intermediates.

2. The reaction between NO₂ and CO is slow and has the overall equation:

$$NO_{2(g)} + CO_{(g)} ---> NO_{(g)} + CO_{2(g)}$$

One step in the two-step mechanism of this reaction is:

$$CO_{(g)} + NO_{3(g)} ---> NO_{2(g)} + CO_{2(g)}$$
 FAST

- (a) Write the equation for the other step in the mechanism. $NO_2 + NO_2 \longrightarrow NO + NO_3$
- (b) State whether your proposed step is slow or fast and explain your choice.

 Slow, the overall reaction is slow and the other is fast

3. The proposed mechanism for a reaction is:

Step 1:
$$CH_3OH + HCl ---> CH_3^+ + H_2O + Cl^-$$

Step 2:
$$CH_3^+ + Cl^- --- > CH_3Cl$$

(a) What is the overall reaction being studied?

(b) List any reaction intermediates.

4. The proposed mechanism for a reaction is:

Step 1:
$$NO_2Cl \longrightarrow NO_2 + Cl$$
 slow

Step 2:
$$NO_2Cl + Cl \rightarrow NO_2 + Cl_2$$
 fast

(a) Describe the overall reaction.

5. Consider the following fast reaction:

$$H^+ + I^- + H_2O_2 ---> H_2O + HOI$$

A student proposes the following two-step mechanism for the above fast reaction:

Step 1:
$$H^+ + H^+ + H_2O_2 ---> H_4O_2^{2+}$$

Step 2: $H_4O_2^{2+} + I^- ---> H_2O + HOI + H^+$

Would you agree or disagree with the proposed mechanism? Explain.

Disagree, step 1 involves a 3 particle collision, which is untilledy especially material rx 6. Consider the following reaction:

$$CO + NO_2 \longrightarrow CO_2 + NO$$

The first step in each of two proposed reaction mechanisms for the above reaction (a) is listed below. If each proposed reaction mechanism consists of only two steps, determine the second step for each mechanism.

proposed mechanism one:

Step 1:
$$2NO_2 \longrightarrow NO_3 + NO$$
 SLOW
Step 2: $CO + NO_3 \longrightarrow NO_2 + CO_2$ FAST

proposed mechanism two:

Step 1:
$$2NO_2 \longrightarrow N_2O_4$$
 FAST
Step 2: $N_2O_4 + CO \longrightarrow CO_2 + NO_7NO_2^SLOW$

- Experimental data shows that the rate of the reaction is not affected by a change (b) in the CO concentration. Which of the two proposed reaction mechanisms would be consistent with the data? Explain. The first mechanism. CO := not a recutant
- in the rate determining step of this mechanism. 7. Consider the following reaction mechanism:

Step 1:
$$NO_2 + Mn \longrightarrow NO_2Mn$$

Step 2:
$$NO_2Mn + NO_2 \longrightarrow NO_3 + NO + Mn$$

STep 3:
$$NO_3 + CO -> NO_2 + CO_2$$

- (a) Identify the catalyst. Mn, No,
- (b) Identify a reaction intermediate. NO2Mn, NO3
- Identify the products of the overall reaction. (c) NO, CO2