ROSEDALE ACADEMY

Rate Expressions Worksheet – Answers

1) Write the following for the reaction $N_2 + 3\ H_2 \rightarrow 2\ NH_3$
- The rate expression for the reaction
- The order of the reaction in each of the reagents
- The overall order of the reaction

Rate = $k[N_2][H_2]^3$
The reaction is first order in nitrogen and third order in hydrogen.
The overall order of the reaction is fourth order.

2) The rate constant for the reaction $HNO_3 + NH_3 \rightarrow NH_4NO_3$ is 14.5 L / mol·sec If the concentration of nitric acid is 0.050 M and the concentration of ammonia is 0.10 M, what will the rate of this reaction be?

Rate = $k[HNO_3][NH_3]$
Rate = (14.5 L / mol·sec)(0.050 M)(0.10 M)
Rate = 0.073 mol / L· sec

3) When two compounds, A and B, are mixed together, they form compound C, by a reaction that's not well understood. Fortunately, the following rate information was experimentally determined, as shown below:

[A] (mol/L)	[B] (mol/L)	Rate (mol/L·sec)
0.050	0.050	4.0×10^{-3}
0.10	0.050	8.0×10^{-3}
0.050	0.10	1.6×10^{-2}

a) Determine the rate expression for this reaction.
When you double the concentration of A, the rate doubles, which suggests that the reaction is first order in A. When you double the concentration of B, the rate quadruples, which suggests that the reaction is second order in B. Using this to generate a rate equation, we get:
Rate = $k[A][B]^2$

b) Determine the rate constant for this reaction.
Plugging the concentrations into the equation with the rate, we solve for k (incidentially, it doesn't matter which trial we use – the numbers work out the same):

4.0×10^{-3} mol/L·sec = k(0.05 mol/L)$(0.05\ mol/L)^2$
k = 32 L^2 / mol^2·sec

Note: Rate constants may have a variety of strange units using L, mol, and sec. This is so the rate will always work out in m