Rate Law Worksheet

1. The rate of a reaction is given by k [A][B]. The reactants are gases. If the volume occupied by the reacting gases is suddenly reduced to one-fourth the original volume, what is the rate of reaction (relative to the original rate)?

2. The following data are for Questions a through f and refer to the reaction:
$A + 2B + 3C \rightarrow 2Y + Z$. All data were taken at 50.0°C.

trial	initial [A]	initial [B]	initial [C]	Rate of [Y]
#1	0.10	0.02	0.04	10 *M*/s
#2	0.10	0.03	0.04	15 *M*/s
#3	0.20	0.02	0.08	80 *M*/s
#4	0.20	0.02	0.16	160 *M*/s
#5	0.05	0.01	0.08	?

a. What is the rate of formation of Y if [B] is doubled?
b. What is the rate of formation of Z in trial 3 (in M/s)?
c. What is the rate of disappearance of C in trial 2 (in M/s)?
d. What is the rate law derived for the above data?
e. What is the missing rate (trial 5) in M/s?
f. What is the rate constant?

3. The times listed in the following table are those required for the concentration of $S_2O_8^{-2}$ to decrease by 0.00050 M as measured in an "iodine clock" reaction at 23°C. What is the rate law? The net reaction is: $S_2O_8^{-2} + 2\,I^- \rightarrow I_2 + 2\,SO_4^{-2}$

trial	initial [$S_2O_8^{2-}$]	initial [I^-]	Time (sec)
#1	0.0400	0.0800	39
#2	0.0400	0.0400	78
#3	0.0100	0.0800	156
#4	0.0200	0.0200	?

a. Calculate the expected time in seconds for trial 4.
b. What is the rate law?
c. What is the rate constant?

4. Determine the rate law and calculate the rate constant for the following data.

trial	initial [A]	initial [B]	Rate (M/s)
#1	1.00×10^{-3}	0.25×10^{-3}	0.26×10^{-9}
#2	1.00×10^{-3}	0.50×10^{-3}	0.52×10^{-9}
#3	1.00×10^{-3}	1.00×10^{-3}	1.04×10^{-9}
#4	2.00×10^{-3}	1.00×10^{-3}	4.16×10^{-9}
#5	3.00×10^{-3}	1.00×10^{-3}	9.36×10^{-9}
#6	4.00×10^{-3}	1.00×10^{-3}	16.64×10^{-9}

5. Determine the rate law and calculate the rate constant for the following data.

trial	initial [X]	initial [Y]	Rate (M/s)
#1	1.00×10^{-2}	4.00×10^{-4}	6.00×10^{-3}
#2	2.00×10^{-2}	4.00×10^{-4}	1.20×10^{-2}
#3	4.00×10^{-2}	4.00×10^{-4}	2.40×10^{-2}
#4	1.00×10^{-2}	8.00×10^{-4}	6.00×10^{-3}

Answer Key Rate Law Worksheet

1. 16x

2, a. doubled
   b. 40 M/s
   c. 22.5 M/s
   d. $R=k[A]^2[B][C]$
   e. 2.5 M/s
   f. $1.25 \times 10^6\ M^{-3}s^{-1}$

3. a. 312s
   b. $R=k[S_2O_8^{-2}][I^-]$
   c. $k=4.0 \times 10^{-3}\ M^{-1}s^{-1}$

4. $R=k[A]^2[B]$ $k=1.04\ M^{-2}s^{-1}$

5. $R=k[X]$ The reaction is zeroth order as to [Y] changes in the [Y] does not affect the reaction rate.
   $k=0.600\ s^{-1}$