Consider the following reaction for the next three questions: [F 02, ex 3]

$$S_2O_8^{2-} + 3\,I^- \rightarrow 2\,SO_4^{2-} + I_3^-$$

1. If the rate of change in I^-, $\Delta[I^-]/\Delta t$, at a particular time is -3.0 M/s, what is the rate of change of I_3^-, $\Delta[I_3^-]/\Delta t$, at the same time?

(a) -3.0 M/s (b) 1.0 M/s (c) -0.33 M/s
(d) 0.33 M/s (e) 3.0 M/s

2. The rate law for this reaction is rate $= k[S_2O_8^{2-}][I^-]$. What is the overall kinetic order of the reaction?

(a) 1st (b) 2nd (c) 3rd (d) zero (e) -3^{rd}

3. The rate of this reaction is 1.4×10^{-5} M/s when $[S_2O_8^{2-}] = 0.038$ M and $[I^-] = 0.060$ M. Given the rate law in the previous question, what is the value of the rate constant for this reaction? Your answer should have the proper units.

(ab) $3.2\times10^{-8}\ s^{-1}M^{-2}$ (ac) 1.6×10^{2} sM (ad) $3.2\times10^{-8}\ s^{-1}$
(ae) $6.1\times10^{-3}\ s^{-1}M^{-2}$ (bc) $1.6\times10^{2}\ s^{-1}M^{-1}$ (bd) $6.1\times10^{-3}\ s^{-1}M^{-1}$

Consider the following reaction for the next <u>two</u> questions: [S 02, ex 3]

$$2\,NO(g) + 2\,H_2(g) \rightarrow N_2(aq) + 2\,H_2O(g)$$

4. The rate law for this reaction has been determined to be second order in NO and first order in H_2. What is the rate law? (Caution: Look at all the choices before selecting your answer – some are quite similar, but only one is correct.)

(a) rate $= k[NO]^2[H_2]$ (b) rate $= K[NO]^2[H_2]$ (c) rate $= [NO]^2[H_2]$
(d) $K = \dfrac{[N_2][H_2O]^2}{[NO]^2[H_2]^2}$ (e) $k = \dfrac{[NO]^2[H_2]}{[N_2][H_2O]^2}$ (ab) rate $= 2[NO]^2[H_2]$

5. At 1000 °C, the rate of the reaction is 1.5 M/s when $[NO] = 0.050$ M and $[H_2] = 0.010$ M. What is the value of the rate constant (with correct units) at this temperature? (Note: You have to use the information provided in the previous question to answer this.)

(a) $6.0\times10^{4}\ M^{-3}s^{-1}$ (b) $3.0\times10^{3}\ M^{-2}s^{-1}$ (c) $3.8\times10^{-5}\ s^{-1}$
(d) $3.8\times10^{-5}\ M^{-1}s^{-1}$ (e) $6.0\times10^{4}\ M^{-2}s^{-1}$ (ab) $3.0\times10^{3}\ s^{-1}$

6. The rate information given below was measured for the following reaction: [F 02, ex 3]

$$2\ HgCl_2(aq) + C_2O_4^{2-}(aq) \rightarrow 2\ Cl^-(aq) + 2\ CO_2(g) + Hg_2Cl_2(s)$$

Experiment	Initial $[HgCl_2]$, M	Initial $[C_2O_4^{2-}]$, M	Initial rate, M/s
1	0.105	0.15	1.8×10^{-5}
2	0.105	0.30	7.1×10^{-5}
3	0.052	0.30	3.5×10^{-5}
4	0.052	0.15	8.9×10^{-6}

Based on the above information, what is the rate law for this reaction?

(a) rate = $k[HgCl_2]^2[C_2O_4^{2-}]^2$
(b) rate = $k[HgCl_2][C_2O_4^{2-}]$
(c) rate = $k[HgCl_2][C_2O_4^{2-}]^2$
(d) rate = $k[C_2O_4^{2-}]^2$
(e) rate = $k[HgCl_2]^2[C_2O_4^{2-}]^4$

7. The rate information given below was measured for the following reaction: [S 02, ex 3]

$$H_2O_2(aq) + 3\ I^-(aq) + 2\ H^+(aq) \rightarrow I_3^-(aq) + 2\ H_2O(l)$$

Experiment	Initial $[H_2O_2]$, M	Initial $[I^-]$, M	Initial $[H^+]$, M	Initial rate, M/s
1	0.010	0.010	0.00050	1.15×10^{-6}
2	0.020	0.010	0.00050	2.30×10^{-6}
3	0.010	0.020	0.00050	2.30×10^{-6}
4	0.010	0.010	0.00100	1.15×10^{-6}

Based on the above information, what is the rate law for this reaction?

(a) rate = $k[H_2O_2][I^-]^3[H^+]^2$
(b) rate = $k[H_2O_2][I^-]$
(c) rate = $k[H_2O_2][I^-][H^+]$
(d) rate = $k[H_2O_2]^2[I^-]^2$
(e) rate = $k[H_2O_2][I^-][H^+]^{-1}$

8. $SO_2Cl_2(g)$ decomposes by a first order reaction with a rate constant of 7.92×10^{-2} hr^{-1} at 320 °C. How long will it take for 90% of the $SO_2Cl_2(g)$ initially present in a sample to decompose at this temperature? [F 02, ex3]

(a) 0.182 hr (b) 1.33 hr (c) 29.1 hr (d) 8.34×10^{-3} hr (e) 16.3 hr

9. Consider the reaction in the previous question. How long will it take until 90% of the $SO_2Cl_2(g)$ initially present in a sample is left? [*Do you see how this question is different than the previous question?*]

(a) 0.182 hr (b) 1.33 hr (c) 29.1 hr (d) 8.34×10^{-3} hr (e) 16.3 hr

Consider the following reaction for the next two questions:

$$Cr^{3+}(aq) + SCN^-(aq) \rightarrow CrSCN^{2+}(aq)$$

In the presence of excess thiocyanate, SCN^-, the reaction is first order in Cr^{3+} with a rate constant of 2.0×10^{-6} s^{-1} at a particular temperature. [Fall 01, ex 3]

10 Under these conditions, what will be the rate of the reaction when $[Cr^{3+}] = 2.5\times10^{-3}$ M?

(a) 5.0×10^{-9} M/s (b) 1.2×10^{-23} M/s (c) 8.0×10^{-4} M/s
(d) 1.2×10^{3} M/s (e) 2.0×10^{8} M/s

11. How many <u>hours</u> will it take for 80% of the Cr^{3+} to be converted to $CrSCN^{2+}$ under these conditions?

(a) 72 hr (b) 31 hr (c) 8.9×10^{-10} hr
(d) 1.8 hr (e) 2.2×10^{2} hr

12. The rate law for the following reaction, discussed in lecture, is rate = $k[NO_2]^2$.

$$NO_2(g) + CO(g) \rightarrow NO(g) + CO_2(g)$$

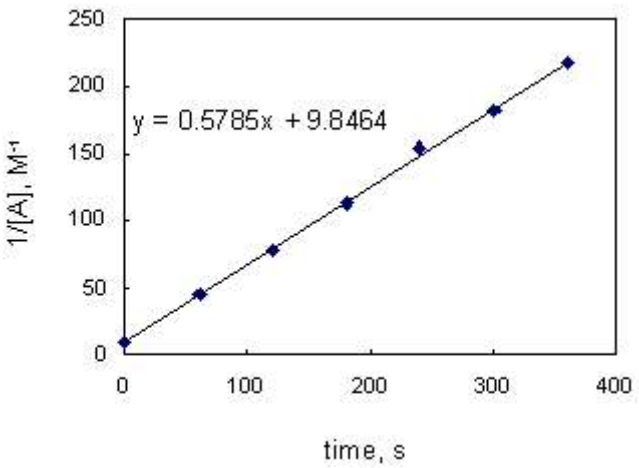
At a certain temperature the rate constant for this reaction is 2.55×10^{-2} $M^{-1}s^{-1}$. If the initial concentration of NO_2 is 1.50×10^{-3} M, what will be the concentration of NO_2 after 1.00 hour? [Spr 01, ex 3]

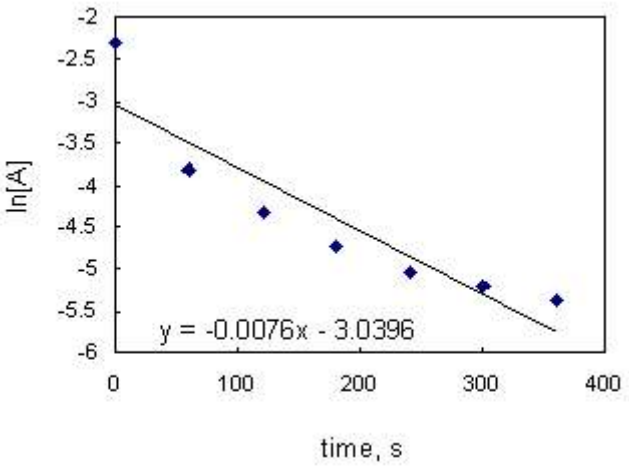
(a) 1.49×10^{-3} M (b) 2.03×10^{-43} M (c) 1.32×10^{-3} M
(d) 5.83×10^{-3} M (e) 8.99×10^{-7} M

13. Methyl isonitrile, CH_3NC, rearranges to acetonitrile, CH_3CN, by a first order reaction. The rate constant for this reaction is 5.1×10^{-5} s^{-1} at 199 °C. What percentage of the original amount of CH_3NC will be left after 15 min at this temperature? [Spr 00, ex 3]

(a) 95.5% (b) 99.9% (c) 58.5% (d) 4.5% (e) 37.6%

14. In order to determine the rate law and rate constant for the reaction A → B, the concentration of A was measured as a function of time. Using this data the following two plots were made. The equations shown on the plots are those for the best fit line through the data points. Based on this information, what is the rate law and rate constant for this reaction? [F 02, ex 3]





(a) rate = k[A] $k = 0.58\ s^{-1}M^{-1}$
(b) rate = k[A] $k = 7.6\times10^{-3}\ s^{-1}$
(c) rate = $k[A]^2$ $k = 0.58\ s^{-1}M^{-1}$
(d) rate = $k[A]^2$ $k = 7.6\times10^{-3}\ s^{-1}$
(e) rate = $k[A]^2$ $k = 9.8\ s^{-1}M^{-1}$
(ab) rate = k[A] $k = 3.0\ s^{-1}$

15. The kinetics of the reaction A→B was studied by monitoring the concentration of A as a function of time. A plot of ln[A] vs t gave a straight line with a slope of -3.05×10^{-2} 1/s. What can be concluded from this information? [S 01, ex 3]

(a) the reaction is 2nd order with a rate constant of 32.8 s
(b) the reaction is 2nd order with a rate constant of 3.05×10^{-2} 1/s
(c) the reaction is 1st order with a rate constant of 32.8 s
(d) the reaction is 1st order with a rate constant of 3.05×10^{-2} 1/s
(e) the reaction is neither 1st order or 2nd order
(ab) nothing can be concluded without further study

16. The reaction A→B + C is studied by monitoring the [A] vs. time. Plots of ln[A] vs time and 1/[A] vs. time both give curved lines. What can be concluded from this information? [Fall 00, ex 3]

(a) The reaction is first order. (b) The reaction is second order.
(c) The reaction is third order. (d) The reaction is neither first order nor second order.
(e) Nothing can be concluded.

Answers: 1 b, 2 b, 3 bd, 4 a, 5 e, 6 c, 7 b, 8 c, 9 b, 10 a, 11 e, 12 c, 13 a, 14 c, 15 d, 16 d