NOW WITH SOLUTIONS AT THE END

Chapter 14 practice quiz questions   Spring 2013

1. For the reaction $BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$ at a particular time, $-\Delta[BrO_3^-]/\Delta t = 1.5 \times 10^{-2}$ M/s. What is $-\Delta[Br^-]/\Delta t$ at the same instant?
   - A) 13 M/s
   - B) 7.5×10^{-2} M/s
   - C) 1.5×10^{-2} M/s
   - D) 3.0×10^{-3} M/s
   - E) 330 M/s

2. For the following reaction, $\Delta P(C_6H_{14})/\Delta t$ was found to be -6.2×10^{-3} atm/s.

$$C_6H_{14}(g) \rightarrow C_6H_6(g) + 4H_2(g)$$

Determine $\Delta P(H_2)/\Delta t$ for this reaction at the same time.
   - A) 6.2×10^{-3} atm/s
   - B) 1.6×10^{-3} atm/s
   - C) 2.5×10^{-2} atm/s
   - D) -1.6×10^{-3} atm/s
   - E) -2.5×10^{-2} atm/s

3. The reaction A + 2B → products has the rate law, rate = $k[A][B]^3$. If the concentration of B is doubled while that of A is unchanged, by what factor will the rate of reaction increase?
   A) 2   B) 4   C) 6   D) 8   E) 9

4. Consider the following reaction

$$8A(g) + 5B(g) \rightarrow 8C(g) + 6D(g)$$

If [C] is increasing at the rate of 4.0 mol $L^{-1}s^{-1}$, at what rate is [B] changing?
   - A) -0.40 mol $L^{-1}s^{-1}$
   - B) -2.5 mol $L^{-1}s^{-1}$
   - C) -4.0 mol $L^{-1}s^{-1}$
   - D) -6.4 mol $L^{-1}s^{-1}$
   - E) None of these choices is correct, since its rate of change must be positive.

5. For the reaction

$$3A(g) + 2B(g) \rightarrow 2C(g) + 2D(g)$$

the following data was collected at constant temperature. Determine the correct rate law for this reaction.

Trial	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial Rate (mol/(L·min))
1	0.200	0.100	6.00×10^{-2}
2	0.100	0.100	1.50×10^{-2}
3	0.200	0.200	1.20×10^{-1}
4	0.300	0.200	2.70×10^{-1}

   - A) Rate = $k[A][B]$
   - B) Rate = $k[A][B]^2$
   - C) Rate = $k[A]^3[B]^2$
   - D) Rate = $k[A]^{1.5}[B]$
   - E) Rate = $k[A]^2[B]$

6. For the reaction

$$A(g) + 2B(g) \rightarrow 2C(g) + 2D(g)$$

the following data was collected at constant temperature. Determine the correct rate law for this reaction.

Trial	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial Rate (mol/(L·min))
1	0.125	0.200	7.25
2	0.375	0.200	21.75
3	0.250	0.400	14.50
4	0.375	0.400	21.75

   - A) Rate = $k[A][B]$
   - B) Rate = $k[A]^2[B]$
   - C) Rate = $k[A][B]^2$
   - D) Rate = $k[A]$
   - E) Rate = $k[A]^3$

7. The rate constant for a reaction is 4.65 L $mol^{-1}s^{-1}$. What is the overall order of the reaction?

A) Zero
B) First
C) Second
D) Third
E) More information is needed to determine the overall order.

8. Sulfuryl chloride, $SO_2Cl_2(g)$, decomposes at high temperature to form $SO_2(g)$ and $Cl_2(g)$. The rate constant at a certain temperature is $4.68 \times 10^{-5} s^{-1}$. What is the order of the reaction?

A) Zero
B) First
C) Second
D) Third
E) More information is needed to determine the overall order.

9. The data below were determined for the reaction $S_2O_8^{2-} + 3I^-(aq) \rightarrow 2SO_4^{2-} + I_3^-$.

Expt. #	$[S_2O_8^{2-}]$	$[I^-]$	Initial Rate
1	0.038	0.060	1.4×10^{-5} M/s
2	0.076	0.060	2.8×10^{-5} M/s
3	0.076	0.030	1.4×10^{-5} M/s

The rate law for this reaction must be:

A) rate = $k[S_2O_8^{2-}][I^-]^3$
B) rate = $k[S_2O_8^{2-}]$
C) rate = $k[S_2O_8^{2-}]^2[I^-]^2$
D) rate = $k[I^-]$
E) rate = $k[S_2O_8^{2-}][I^-]$

10. At 25°C the rate constant for the first-order decomposition of a pesticide solution is 6.40×10^{-3} min^{-1}. If the starting concentration of pesticide is 0.0314 M, what concentration will remain after 62.0 min at 25°C?

A) 1.14×10^{-1} M
B) 47.4 M
C) –8.72.0 M
D) 2.11×10^{-2} M
E) 2.68×10^{-2} M

11. A certain first-order reaction A → B is 25% complete in 42 min at 25°C. What is the half-life of the reaction?

A) 21 min B) 42 min C) 84 min D) 120 min E) 101 min

12. A certain first-order reaction A → B is 25% complete in 42 min at 25°C. What is its rate constant?

A) 6.8×10^{-3} min^{-1}
B) 8.3×10^{-3} min^{-1}
C) 3.3×10^{-2} min^{-1}
D) -3.3×10^{-2} min^{-1}
E) 11 min^{-1}

Answers:

1. Ans: B
2. Ans: C
3. Ans: D
4. Ans: B
5. Ans: E
6. Ans: D
7. Ans: C
8. Ans: B
9. Ans: E
10. Ans: D
11. Ans: E
12. Ans: A

(1) $-\frac{\Delta[BrO_3^{-}]}{\Delta t} = -\frac{1}{5}\frac{\Delta[Br^-]}{\Delta t} = 1.5\times10^{-2}\ Ms^{-1}$

so $\frac{\Delta[Br^{-}]}{\Delta t} = 5 \cdot 1.5\times10^{-2}\ Ms^{-1}$

$= 7.5\times10^{-2}\ Ms^{-1}$ (PROBLEM asks for $-\frac{\Delta[Br^-]}{\Delta t}$)

"B"

(2) $\frac{\Delta P(C_6H_{14})}{\Delta t} = -6.2\times10^{-3}\ atm/s$; $\frac{1}{4}\frac{\Delta P_{H_2}}{\Delta t} = -\frac{\Delta P_{(C_6H_{14})}}{\Delta t}$

$\frac{1}{4}\frac{\Delta P_{H_2}}{\Delta t} = -(-6.2\times10^{-3}\ atm/s)$

$\frac{\Delta P_{H_2}}{\Delta t} = 4\times 6.2\times10^{-3}\ atm/s$

$= 24.8\times10^{-3}\ atm/s$

$= 2.5\times10^{-2}\ atm/s$ "C"

(3) Rate $= k[A][B]^3$

↖ substitute 2 so Rate $= k[A]\,2^3 = 8k[A]$

↖ 8 fold increase

"D"

(4) OVERALL Rate $= \frac{1}{8}\frac{\Delta C}{\Delta t} = \frac{1}{8}\times 4\ mol/Ls$ (→ M) $= 0.5\ Ms^{-1} = -\frac{1}{5}\frac{\Delta[B]}{\Delta t}$

$\frac{\Delta[B]}{\Delta t} = -5\times0.5\ Ms^{-1}$

$= -2.5\ Ms^{-1}$ "B"

(5) Compare 2 & 1 for change in A (constant B)
conc doubles (1 vs 2) & Rate increases 4 times
$\frac{4}{2} = 2$ 2nd order in A

for B use 1 & 3
conc doubles (3 vs 1) & Rate doubles $\frac{2}{2} = 1$ first order in B

so; $\boxed{\text{Rate} = k[A]^2[B]}$ "E"

(6) Same idea as 5
Compare 1 & 2 for A Conc. triples, Rate triples $\frac{3}{3} = 1$
first order in A

Compare 2 + 4 for B Conc doubles Rate stays constant
that is ZERO ORDER

so: Rate = $k[A][B]^{0 \to 1}$
$\boxed{\text{Rate} = k[A]}$ "D"

(7) Rate has units of Ms^{-1} (or $\frac{mol}{Ls}$) ∴ k has units to make that happen
Rate(Ms^{-1}) = $k\,M^{-1}s^{-1}\,[A]^1 M \times [B]^1 M$ or = $k\,M^{-1}s^{-1} \times [A]^2 M^2$
cancel M^{-1} + M leaving Ms^{-1} so $\boxed{\text{2nd order}}$ "C"

(8) as above Rate Ms^{-1} = $k\,s^{-1} \times M$ ← concentration of one thing [A]
$\boxed{\text{first order}}$ Rate = k[A]
"B"

(9) Compare 1+2 for $S_2O_8^{2-}$ Double conc Rate doubles
first in $S_2O_8^{2-}$

2+3 for $I^{\ominus}$ Double $[I^{\ominus}]$, double Rate first in $I^{\ominus}$

$\boxed{Rate = k[S_2O_8^{2-}][I^{\ominus}]}$ "E"

(10) $\ln\frac{[A]_t}{[A]_0} = -kt$ can use minutes here because K is in minutes

$\ln\frac{[A]_t}{0.0314M} = -6.40\times10^{-3}\,min^{-1}\times 62.0\,min$

$e^{\left(\ln\frac{[A]_t}{0.0314M}\right)} = e^{(-0.3968)}$ so $\frac{[A]_t}{0.0314M} = 0.672$, $\boxed{[A]_t = 0.0211\,M}$ "D"

(11) $A \rightarrow B$

if rxn is 25% in 42 min then $[A]_t = 75\%$ of $[A]_0$

so $\ln\frac{75\%}{100\%} = -kt$ $\frac{\ln 0.75}{-42\,min} = k$ so $k = 0.00685\,min^{-1}$ $(6.85\times10^{-3}\,min^{-1})$

$t_{1/2} = \frac{0.693}{0.00685} = \boxed{101\,min}$ "E"

(12) see #11 $\boxed{6.85\times10^{-3}\,min^{-1}}$ "A"