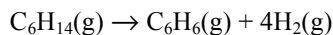


### Chapter 13 MC Review Key

1. For the following reaction,  $\Delta P(\text{C}_6\text{H}_{14})/\Delta t$  was found to be  $-6.2 \times 10^{-3}$  atm/s.



Determine  $\Delta P(\text{H}_2)/\Delta t$  for this reaction at the same time.

- A.  $6.2 \times 10^{-3}$  atm/s  
**C.  $2.5 \times 10^{-2}$  atm/s**  
 E.  $-2.5 \times 10^{-2}$  atm/s
2. For the overall chemical reaction shown below, which one of the following statements can be rightly assumed?
- $$2\text{H}_2\text{S}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{S}(\text{s}) + 2\text{H}_2\text{O}(\text{l})$$
- A. The reaction is third-order overall.  
 B. The reaction is second-order overall.  
 C. The rate law is, rate =  $k[\text{H}_2\text{S}]^2 [\text{O}_2]$ .  
 D. The rate law is, rate =  $k[\text{H}_2\text{S}] [\text{O}_2]$ .  
**E. The rate law cannot be determined from the information given.**
3. The reaction  $\text{A} + 2\text{B} \rightarrow \text{products}$  has the rate law, rate =  $k[\text{A}][\text{B}]^3$ . If the concentration of B is doubled while that of A is unchanged, by what factor will the rate of reaction increase?  $[2]^3 = 8$
- A. 2  
**D. 8**  
 B. 4  
 C. 6  
 E. 9
4. Appropriate units for a first-order rate constant are
- A. M/s.  
**C. 1/s.**  
 B. 1/M·s.  
 D. 1/M<sup>2</sup>·s.
5. It takes 42.0 min for the concentration of a reactant in a first-order reaction to drop from 0.45 M to 0.32 M at 25°C. How long will it take for the reaction to be 90% complete?
- A. 13.0 min  
 D. 222 min  
 B. 86.0 min  
**E. 284 min**  
 C. 137 min
6. Use the following data to determine the rate law for the reaction
- $$2\text{NO} + \text{H}_2 \rightarrow \text{N}_2\text{O} + \text{H}_2\text{O}$$
- | Expt. # | $[\text{NO}]_0$ | $[\text{H}_2]_0$ | Initial Rate |
|---------|-----------------|------------------|--------------|
| 1       | 0.021           | 0.065            | 1.46 M/min   |
| 2       | 0.021           | 0.260            | 1.46 M/min   |
| 3       | 0.042           | 0.065            | 5.84 M/min   |
- A. rate =  $k[\text{NO}]$   
 C. rate =  $k[\text{NO}][\text{H}_2]$   
 E. rate =  $k[\text{NO}]^2[\text{H}_2]^2$   
**B. rate =  $k[\text{NO}]^2$**   
 D. rate =  $k[\text{NO}]^2[\text{H}_2]$
7. A certain first-order reaction  $\text{A} \rightarrow \text{B}$  is 25% complete in 42 min at 25°C. What is the half-life of the reaction?
- A. 21 min  
 D. 120 min  
 B. 42 min  
**E. 101 min**  
 C. 84 min

8. A first-order reaction has a rate constant of  $3.00 \times 10^{-3}$  s<sup>-1</sup>. The time required for the reaction to be 75.0% complete is
- A. 95.8 s.  
 D. 201 s.  
**B. 462 s.**  
 E. 41.7 s.  
 C. 231 s.
9. The reaction  $2\text{NO}_2(\text{g}) \rightarrow 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$  is suspected to be second order in  $\text{NO}_2$ . Which of the following kinetic plots would be the most useful to confirm whether or not the reaction is second order?
- A. a plot of  $[\text{NO}_2]^{-1}$  vs. t**  
 B. a plot of  $\ln [\text{NO}_2]$  vs. t  
 C. a plot of  $[\text{NO}_2]$  vs. t  
 D. a plot of  $\ln [\text{NO}_2]^{-1}$  vs. t  
 E. a plot of  $[\text{NO}_2]^2$  vs. t
10. For the chemical reaction  $\text{A} \rightarrow \text{B} + \text{C}$ , a plot of  $[\text{A}]_t$  versus time is found to give a straight line with a negative slope. What is the order of reaction with respect to A?
- A. zeroth**  
 C. second  
 E. Such a plot cannot reveal the order of the reaction.  
 B. first  
 D. third
11. Which one of the following changes would alter the rate constant (k) for the reaction  $2\text{A} + \text{B} \rightarrow \text{products}$ ?
- A. increasing the concentration of A  
 B. increasing the concentration of B  
**C. increasing the temperature**  
 D. measuring k again after the reaction has run for a while
- k depends only on T and E<sub>a</sub>.**
12. The activation energy for the reaction
- $$\text{CH}_3\text{CO} \rightarrow \text{CH}_3 + \text{CO}$$
- is 71 kJ/mol. How many times greater is the rate constant for this reaction at 170°C than at 150°C?
- A. 0.40  
 D. 4.0  
 B. 1.1  
 E. 5.0  
**C. 2.5**
13. At 30°C, by how much is a reaction's activation energy decreased by the addition of a catalyst if the catalyst triples the reaction rate?
- A. 2.77 kJ/mol**  
 C. 2.70 J/mol  
 E. 1.20 kJ/mol  
 B. 274 J/mol  
 D. 119 J/mol
- ~~14. The reaction  $\text{A} \rightarrow \text{B} + \text{C}$  follows zero-order kinetics. The rate constant at 25°C is  $5.0 \times 10^{-4}$  M/s. For an experiment starting with  $[\text{A}]_0 = 1.0 \times 10^{-3}$  M, what is the first half-life of the reaction?~~
- ~~A.  $2.0 \times 10^6$  s  
 C.  $4.0 \times 10^9$  s  
 E. 1.0 s  
 B. 2.0 s  
 D.  $1.4 \times 10^3$  s~~

15. Given that  $E_a$  for a certain biological reaction is 48 kJ/mol and that the rate constant is  $2.5 \times 10^{-2} \text{ s}^{-1}$  at  $15^\circ\text{C}$ , what is the rate constant at  $37^\circ\text{C}$ ?

- A.  $2.7 \times 10^{-2} \text{ s}^{-1}$       B.  $2.5 \times 10^{-1} \text{ s}^{-1}$   
**C.  $1.0 \times 10^{-1} \text{ s}^{-1}$**       D.  $6.0 \times 10^{-3} \text{ s}^{-1}$   
 E.  $1.1 \text{ s}^{-1}$

16. According to the collision theory, all collisions do not lead to reaction. Which choice gives *both* reasons why not all collisions between reactant molecules lead to reaction?

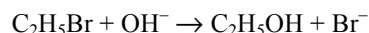
- The total energy of two colliding molecules is less than some minimum amount of energy.
- Molecules cannot react with each other unless a catalyst is present.
- Molecules that are improperly oriented during collision will not react.
- Solids cannot react with gases.

- A. 1 and 2      **B. 1 and 3**      C. 1 and 4  
 D. 2 and 3      E. 3 and 4

17. For the reaction  $\text{X}_2 + \text{Y} + \text{Z} \rightarrow \text{XY} + \text{XZ}$ , it is found that the rate equation is  $\text{rate} = k [\text{X}_2][\text{Y}]$ . Why does the concentration of Z have no effect on the rate?

- A. The concentration of Z is very small and the others are very large.  
**B. Z must react in a step after the rate-determining step.**  
 C. Z is an intermediate.  
 D. The fraction of molecules of Z that have very high energies is zero.  
 E. The activation energy for Z to react is very high.

18. The following reaction in aqueous solution was found to be first order in  $[\text{OH}^-]$ , first order in  $[\text{C}_2\text{H}_5\text{Br}]$ , and inverse first order in  $\text{Br}^-$ .



Which one of the following mechanisms is consistent with the observed reaction order?

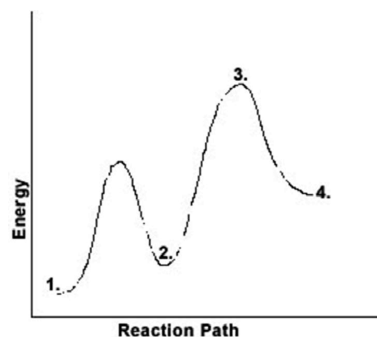
- A.  $\text{C}_2\text{H}_5\text{Br} \rightleftharpoons \text{C}_2\text{H}_5^+ + \text{Br}^-$  *fast*  
 $\text{C}_2\text{H}_5^+ + \text{OH}^- \rightarrow \text{C}_2\text{H}_5\text{OH}$  *slow*  
 B.  $\text{C}_2\text{H}_5\text{Br} + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_5\text{OH} + \text{H}^+ + \text{Br}^-$  *slow*  
 $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$  *fast*  
 C.  $\text{C}_2\text{H}_5\text{Br} \rightleftharpoons \text{C}_2\text{H}_5^+ + \text{Br}^-$  *slow*  
 $\text{C}_2\text{H}_5^+ + \text{OH}^- \rightarrow \text{C}_2\text{H}_5\text{OH}$  *fast*  
 D.  $\text{C}_2\text{H}_5\text{Br} \rightleftharpoons \text{C}_2\text{H}_5^+ + \text{Br}^-$  *slow*  
 $\text{OH}^- + \text{Br}^- \rightarrow \text{HOBr}$  *fast*  
 $\text{HOBr} + \text{C}_2\text{H}_5^+ \rightarrow \text{C}_2\text{H}_5\text{OH} + \text{Br}^-$  *fast*

19. Which of the following statements is *false*?

- A. A catalyst increases the rate of the forward reaction, but does not alter the reverse rate.**  
 B. A catalyst alters the mechanism of reaction.  
 C. A catalyst alters the activation energy.  
 D. A catalyst may be altered in the reaction, but is always regenerated.  
 E. A catalyst increases the rate of reaction, but is not consumed.

20. With respect to the figure at right, which choice correctly identifies all the numbered positions?

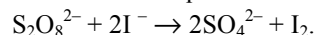
- |                 | 1.               | 2.                  | 3.                       | 4.             |
|-----------------|------------------|---------------------|--------------------------|----------------|
| A. Row 1        | reactants        | intermediate        | activated complex        | product        |
| B. Row 2        | reactants        | activated complex   | intermediate             | product        |
| C. Row 3        | reactants        | activated complex   | catalyst                 | product        |
| <b>D. Row 4</b> | <b>reactants</b> | <b>intermediate</b> | <b>activated complex</b> | <b>product</b> |
| E. Row 5        | reactants        | intermediate        | activated complex        | catalyst       |



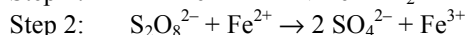
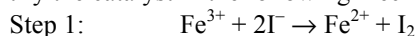
21. In which of the forms listed below would 0.5 g aluminum react the fastest with gaseous chlorine at  $25^\circ\text{C}$ ?

- A. 0.5 g aluminum in one piece  
 B. 0.5 g aluminum divided into 10 pieces  
 C. 0.5 g aluminum divided into 100 pieces  
**D. 0.5 g aluminum divided into 1,000 pieces**  
 E. All the choices will react at the same rate since the temperature is the same.

22. Peroxodisulfate ion can oxidize iodide ions to iodine according to the balanced equation



The reaction is catalyzed by certain chemical species. Identify the catalyst in the following mechanism:



- A.  $\text{Fe}^{3+}$**       B.  $\text{I}^-$       C.  $\text{S}_2\text{O}_8^{2-}$   
 D.  $\text{Fe}^{2+}$       E.  $\text{SO}_4^{2-}$       F.