Chapter 4 Chemical Kinetic

1. Which of the following is **not** one of the five factors mentioned in the text that can affect the rate at which a reaction proceeds?
    a. temperature
    b. the ability of reactants to come in contact with each other
    c. catalysts
    d. concentration
    e. none of the above

2. The rate of a chemical reaction in solution can be measured in the units
    a. L^2 mol^{-1} s^{-1}
    b. mol L^{-1} s^{-1}
    c. s^{-2}
    d. mol s L^{-1}
    e. sec L^{-1} mol^{-1}

3. A reaction has the rate law, **rate = k[A][B]^2**. Which change will cause the greatest increase in the reaction rate?
    a. decreasing the temperature without changing the concentrations
    b. doubling the concentration of B
    c. quadrupling the concentration of A
    d. tripling the concentration of B
    e. doubling the concentration of A

4. The reaction, **2 NO(*g*) + O_2(*g*) → 2 NO_2(*g*),** was found to be first order in each of the two reactants and second order overall. The rate law is therefore
    a. rate = $k[NO]^2$
    b. rate = $k[NO][O_2]$
    c. rate = $k[NO_2]^2[NO]^{-2}[O_2]^{-½}$
    d. rate = $k[NO]^2[O_2]^2$
    e. rate = $k([NO][O_2])^2$

5. The units of the rate constant for a particular reaction are **min^{-1}**. What is the overall order of the reaction?
    a. Zero
    b. First
    c. Second
    d. Third
    e. Fourth

6. For the reaction, **2 XO + O_2 → 2 XO_2**, data obtained from measurement of the initial rate of reaction at varying concentrations are given below.

Experiment	**[XO]**	**[O_2]**	**Rate (mmol L^{-1} s^{-1})**
1	**0.010**	**0.010**	**2.5**
2	**0.010**	**0.020**	**5.0**
3	**0.030**	**0.020**	**45.0**

The rate law is therefore

a. rate = $k[XO]^2 [O_2]$
b. rate = $k[XO][O_2]^2$
c. rate = $k[XO][O_2]$
d. rate = $k[XO]^2 [O_2]^2$
e. rate = $k[XO]^2/[O_2]^2$

7. Nitrogen monoxide reacts with bromine at elevated temperatures according to the equation: **2NO(*g*) + Br_2(*g*) → 2NOBr(*g*)**

In a certain reaction mixture the rate of formation of NOBr(*g*) was found to be 4.50 x 10^{-4} mol L^{-1} s^{-1}. What is the rate of consumption of Br_2(*g*)?

a. 4.50 x 10^{-4} mol L^{-1} s^{-1}
b. 2.25 x 10^{-4} mol L^{-1} s^{-1}
c. 9.00 x 10^{-4} mol L^{-1} s^{-1}
d. 2.12 x 10^{-4} mol L^{-1} s^{-1}
e. 2.03 x 10^{-3} mol L^{-1} s^{-1}

8. For the reaction, **3B + C → E + 2F**, initial rate measurements were carried out and data for three runs are shown below

Experiment	**[B]**	**[C]**	**Rate (mol L^{-1} s^{-1})**
1	**0.100**	**0.250**	**0.000250**
2	**0.200**	**0.250**	**0.000500**
3	**0.100**	**0.500**	**0.00100**

The rate law, therefore, is

a. rate = $k[B]^3[C]$
b. rate = $k[B][C]$
c. rate = $k[B]^2[C]^2$
d. rate = $k[B]^2[C]$
e. rate = $k[B][C]^2$

9. The reaction, **A + 2 B $\rightarrow$ products**, was studied. The reagents A and B were mixed and the *time interval* until a certain *quantity* of product C accumulated was measured. The data were obtained

Experiment	**[A]**	**[B]**	**Time (secs)**
1	**0.100**	**0.140**	**25**
2	**0.050**	**0.140**	**50**
3	**0.100**	**0.070**	**100**

We can conclude that:

a. the reaction is first order with respect to substance A.
b. the reaction is zero order with respect to substance A.
c. the reaction is one-half order with respect to substance A.
d. the reaction is second order with respect to substance A.
e. the reaction is third order with respect to substance B

10. The following data was found for the reaction: **A + B $\rightarrow$ Products**

Exp.	**Initial [A]**	**Initial [B]**	**Initial Rate M/s**
1	**0.015**	**0.022**	**0.125**
2	**0.030**	**0.044**	**0.500**
3	**0.060**	**0.044**	**0.500**
4	**0.060**	**0.066**	**1.125**
5	**0.085**	**0.088**	**?**

What is the numerical value of the rate constant, (k), for this reaction?

a. 258.2
b. 378.8
c. 1.72×10^4
d. 8.33
e. 1.125

11. If a reaction involving a single reactant is first order with a rate constant of $4.50 \times 10^{-2}\ s^{-1}$, how much time is required for 75.0% of the initial quantity of reactant to be used up?

a. 16.7 seconds
b. 30.9 seconds
c. 23.1 seconds
d. 25.3 seconds
e. 11.6 seconds

12. In a first order reaction with only one reagent, the reaction was started with a concentration of reactant equal to 0.0800 M. After exactly two hours, the concentration had fallen to 0.0400 M. What is the molarity after exactly four hours?
    a. 0.0000 M
    b. 0.0100 M
    c. 0.0150 M
    d. 0.0200 M
    e. 0.0300 M

13. The initial concentration of a reactant in a first order reaction is 0.620 M. What will be its concentration after 3 half-lives?
    a. 0.0865 M
    b. 0.310 M
    c. 0.0775 M
    d. 0.103 M
    e. 0.207 M

14. A reaction is first order overall. For a given sample, its initial rate is 0.0200 mol L^{-1} s^{-1} and 25.0 days later its rate dropped to 6.25 x 10^{-4} mol L^{-1} s^{-1}. What is its half-life?
    a. 25.0 days
    b. 50.0 days
    c. 12.5 days
    d. 5.0 days
    e. 37.5 days

15. The rate constant for a first order decomposition reaction is 0.0111 min^{-1}. What is the half-life of the reaction?
    a. 111 min
    b. 62.4 min
    c. 5000 sec
    d. 31.25 min
    e. 27.1 min

16. In a first order reaction, what fraction of the reactant will remain after 4 half-lives?
    a. 1/16
    b. 1/8
    c. 1/9
    d. 1/4
    e. 1/3

17. A variable which has **no** effect on the rate of a chemical reaction under any circumstances is:

a. energy of activation.
b. a catalyst.
c. the concentration of the reactants.
d. the temperature.
e. the standard enthalpy of reaction for the system.

18. For a one step reaction, the activation energy for the forward reaction is 40.0 kJ mol^{-1}, and the enthalpy of reaction is -20.0 kJ mol^{-1}. Calculate the activation energy for the reverse reaction.

a. +60.0 kJ mol^{-1}
b. -20.0 kJ mol^{-1}
c. -1200 kJ kJ mol^{-1}
d. +20.0 kJ kJ mol^{-1}
e. +1200 kJ kJ mol^{-1}

19. For a chemical reaction, the rate constant at 42.0 $^{\circ}$C is 0.00395 s^{-1}, while the rate constant at 67.4 $^{\circ}$C is 0.0133 s^{-1}. Calculate the value of the energy of activation, in kilojoules per mole.

a. 42.65
b. 1.13
c. 0.421
d. 18.5
e. 0.617

20. A reaction has the rate law, rate = $k[A][B]^2$. Which change will cause the greatest increase in the reaction rate?

a. decreasing the temperature without changing the concentrations
b. doubling the concentration of B
c. quadrupling the concentration of A
d. tripling the concentration of B
e. doubling the concentration of A