## Unit 5 MC Practice

**Use the following information to answer questions 1–3.**

The following experimental data was collected for the hypothetical decomposition reaction A → B + C.

| Experiment | [A] (M) | T (K) | $t_{1/2}$ (min) |
|---|---|---|---|
| 1 | 0.200 | 298 | 0.270 |
| 2 | 0.400 | 298 | 0.270 |
| 3 | 0.200 | 273 | 0.350 |
| 4 | 0.400 | 273 | 0.350 |

1. Based on the information above, what is the order of the reaction?
   a. The reaction is first order, because the stoichiometric coefficient of the reactant is 1.
   (b.) The reaction is first order, because half-life is independent of reactant concentration.
   c. The reaction is zero order, because changing the reactant concentration did not affect the half-life.
   d. The reaction is zero order, because decreasing the temperature of the reaction decreased the half-life.

2. For which experiment is the intial rate of the reaction highest?
   a. Experiment 1, because fewer reactant molecules will need to be converted into product.
   (b.) Experiment 2, because both the temperature and reactant concentration are maximized.
   c. Experiment 3, because a lower temperature will decompose A most efficiently.
   d. Experiment 4, because a lower temperature and higher [reactant] maximizes reaction rate.

3. Calculate the rate constant, *k*, for this reaction at 298 K.
   a. 2.86 $min^{-1}$ b. 2.86 $min^{-1} M^{-1}$ (c.) 1.98 $min^{-1}$ b. 1.98 $min^{-1} M^{-1}$

$t_{y_2} = \frac{0.693}{k} \Rightarrow k = \frac{0.693}{t_{y_2}} = \frac{0.693}{0.350\,min} \approx 2\,min^{-1}$

$2H_2O_2 \rightarrow 2H_2O + O_2$

4. The decomposition of hydrogen peroxide is shown above and has the following proposed mechanism:

$$H_2O_2 + I^- \rightarrow H_2O + IO^-$$
$$H_2O_2 + IO^- \rightarrow H_2O + O_2 + I^-$$

Which of the following substances serves as a catalyst for this reaction?

a. $H_2O_2$ (b.) $I^-$ c. $H_2O$ d. $IO^-$

5. For the reaction whose rate law is given below, a plot of which of the following is a straight line?

rate = *k*[X] ⇒ 1st order

a. [X] vs time b. 1/[X] vs time c. ln[X] vs 1/time (d.) ln[X] vs time

6. A + B → C + D rate = $k[A][B]^2$

What are the potential units for the rate constant for the above reaction?

a. $s^{-1}$ b. $s^{-1} M^{-1}$ (c.) $s^{-1} M^{-2}$ d. $s^{-1} M^{-3}$

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**Use the following information to answer questions 7–8.**

Reactant A underwent a decomposition reaction: A → 2B + C. The concentration of A was measured periodically and recorded in the chart below.

| Time (Hours) | [A] *M* |
|---|---|
| 0 | 0.40 |
| 1 | 0.20 |
| 2 | 0.10 |
| 3 | 0.05 |

7. Based on the data in the chart, which of the following is the rate law for the reaction?

(a.) rate = $k$[A] b. rate = $k$[A]$^2$ c. rate = 2$k$[A] d. rate = ½ $k$[A]

constant ½ life!

8. What would be the concentration of B after two hours?

a. 0.15 M b. 0.20 M c. 0.30 M (d.) 0.60 M

After 2 hours, [A] used = 0.40 − 0.10 = 0.30 M A $\times \frac{2 \text{ mol B}}{1 \text{ mol A}}$ = 0.60 M B

**Use the following information to answer questions 9–10.**

$$2NO(g) + Br_2(g) \leftrightarrow 2NOBr(g)$$

The above experiment was performed several times, and the following data was gathered:

| Trial | $[NO]_{init}$ (*M*) | $[Br_2]_{init}$ (*M*) | Initial Rate of Reaction (*M*/min) |
|---|---|---|---|
| 1 | 0.20 *M* | 0.10 *M* | $5.20 \times 10^{-3}$ = 5E-3 |
| 2 2x | 0.20 *M* | 0.20 *M* 2x | $1.04 \times 10^{-2}$ = 10 E-3 2x |
| 3 | 0.40 *M* | 0.10 *M* | $2.08 \times 10^{-2}$ = 20 E-3 4x |

9. What is the rate law for this reaction?

a. rate = $k$[NO][$Br_2$]$^2$ b. rate = $k$[NO]$^2$[$Br_2$]$^2$ c. rate = $k$[NO][$Br_2$] (d.) rate = $k$[NO]$^2$[$Br_2$]

10. What would be the initial rate of the reaction if $[NO]_{init}$ = 0.40 M and $[Br_2]_{init}$ = 0.20 M? 2x expt. 3!

a. $2.08 \times 10^{-2}$ M/min (b.) $4.16 \times 10^{-2}$ M/min c. $6.24 \times 10^{-2}$ M/min d. $8.32 \times 10^{-2}$ M/min

11. A proposed mechanism for a reaction is as follows:

$NO_2 + F_2 \rightarrow NO_2F + F$ slow step rate = k [$NO_2$] [$F_2$]

$F + NO_2 \rightarrow NO_2F$ fast step

What is the order of the overall reaction?

a. zero order b. first order (c.) second order d. third order

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$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

12. The following data was collected at 25°C and 1 atm of pressure for the reaction shown above.

| Time (minutes) | $[N_2O_5]$ (mol/L) |
|---|---|
| 0 | $1.24 \times 10^{-2}$ |
| 10. | $0.92 \times 10^{-2}$ |
| 20. | $0.68 \times 10^{-2}$ |
| 30. | $0.50 \times 10^{-2}$ |
| 40. | $0.37 \times 10^{-2}$ |
| 50. | $0.28 \times 10^{-2}$ |
| 70. | $0.15 \times 10^{-2}$ |

$\frac{1.24}{2} = 0.62$

~ 50%

Which of the following best represents the half-life for this reaction?

a. 15 min b. 18 min (c.) 23 min d. 36 min

**Use the following information to answer questions 13–14.**

$$2A_2 + B_2 \rightarrow 2C$$

Step I $A_2 + B_2 \rightarrow R + C$ (*slow*)
Step II $A_2 + R \rightarrow C$

13. The activated complex that forms in Step I of the mechanism shown above could have which of the following structures? (The dotted lines represent partial bonds.)

**A**


**B**


**C**


**(D)**


← partial bonds in reactants $A_2 + B_2$

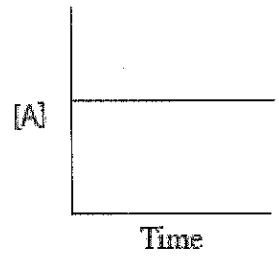
14. Which of the following rate law expressions best agrees with the proposed mechanism?

a. rate = $k[A_2]$ b. rate = $k[A_2]^2$ c. rate = $k[A_2][R]$ (d.) rate = $k[A_2][B_2]$

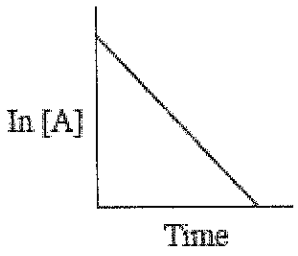
$$A \rightarrow B + C \qquad \text{rate} = k[A]^2$$

15. Which of the following graphs may have been created using data gathered from the above reaction?

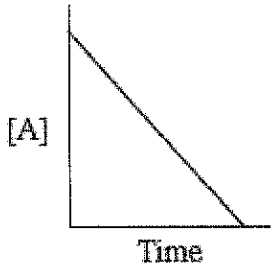
(A)



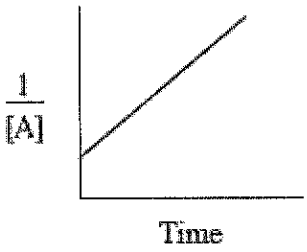

(C)



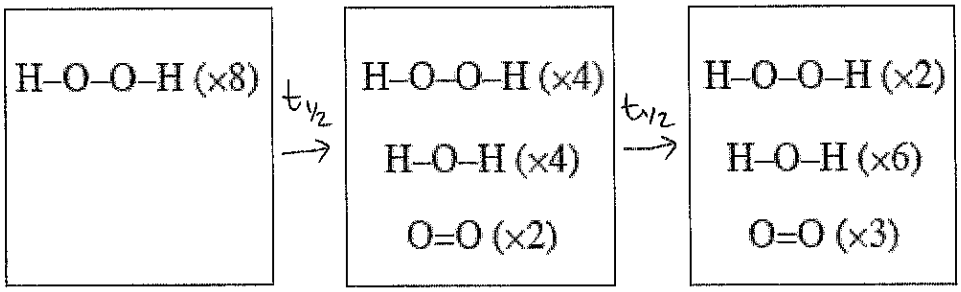

(B)




(D)




$$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$




16. The above diagrams show the decomposition of hydrogen peroxide in a sealed container in the presence of a catalyst. What is the overall order for the reaction?

a. zero order (b.) first order c. second order d. third order

constant $t_{1/2}$!