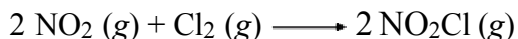


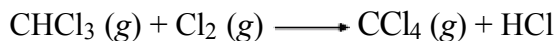
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CHE-112 – CHAPTER 13 – PRACTICE QUESTIONS

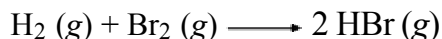
1. Express the rate of the following reaction equation in terms of the rate of concentration change of NO_2Cl :



- A) rate of reaction = $\Delta[\text{Cl}_2]/\Delta t$
B) rate of reaction = $-\frac{1}{2} (\Delta[\text{NO}_2\text{Cl}]/\Delta t)$
C) rate of reaction = $\frac{1}{2} (\Delta[\text{NO}_2\text{Cl}]/\Delta t)$
D) rate of reaction = $-\frac{1}{2} (\Delta[\text{NO}_2]/\Delta t)$
2. Express the rate of the following reaction equation in terms of the rate of concentration change of CHCl_3 :



- A) rate of reaction = $\Delta[\text{CCl}_4]/\Delta t$
B) rate of reaction = $2(\Delta[\text{CHCl}_3]/\Delta t)$
C) rate of reaction = $\Delta[\text{CHCl}_3]/\Delta t$
D) rate of reaction = $-\Delta[\text{CHCl}_3]/\Delta t$
3. Let the rate of the reaction described by the equation



be expressed as $-\Delta[\text{Br}_2]/\Delta t$. Express the rate of reaction in terms of the rate of concentration change of HBr .

- A) rate of reaction = $-\frac{1}{2} \Delta[\text{HBr}]/\Delta t$
B) rate of reaction = $-\Delta[\text{H}_2]/\Delta t$
C) rate of reaction = $\frac{1}{2} \Delta[\text{HBr}]/\Delta t$
D) rate of reaction = $2\Delta[\text{HBr}]/\Delta t$

4. Let the rate of the reaction described by the equation



be expressed as $\Delta[\text{I}_2]/\Delta t$. Express the rate of reaction in terms of the rate of concentration change of ICl.

- A) rate of reaction = $\Delta[\text{ICl}]/\Delta t$
- B) rate of reaction = $-\frac{1}{2} \Delta[\text{ICl}]/\Delta t$
- C) rate of reaction = $-\Delta[\text{ICl}]/\Delta t$
- D) rate of reaction = $-2\Delta[\text{ICl}]/\Delta t$

5. The rate law for the reaction described by the equation



at 343 K is first order in $[\text{N}_2\text{O}_5]$ with a rate constant $k = 1.80 \text{ h}^{-1}$. Given that $[\text{N}_2\text{O}_5]_0 = 0.112 \text{ M}$, calculate the rate of the reaction at $t = 0$.

- A) 0.112 M.h^{-1}
- B) 0.202 M.h^{-1}
- C) 1.80 M.h^{-1}
- D) 69.1 M.h^{-1}

6. The rate law for the reaction described by the equation



at 598 K is:

$$\text{rate of reaction} = (0.54 \text{ M}^{-1}.\text{s}^{-1})[\text{NO}_2]^2$$

Given that $[\text{NO}_2]_0 = 8.33 \cdot 10^{-2} \text{ M}$, calculate the rate of the reaction at $t = 0 \text{ s}$.

- A) $3.7 \cdot 10^{-2} \text{ M.s}^{-1}$
- B) $8.3 \cdot 10^{-2} \text{ M.s}^{-1}$
- C) $3.7 \cdot 10^{-3} \text{ M.s}^{-1}$
- D) $6.9 \cdot 10^{-3} \text{ M.s}^{-1}$

7. The rate law for the reaction described by the equation



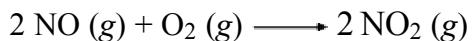
is:

$$\text{rate of reaction} = k[\text{CHCl}_3][\text{Cl}_2]^{1/2}$$

What is the overall order of this reaction?

- A) 1
- B) 2
- C) 3/2
- D) 5/2

8. Nitrogen monoxide and oxygen react according to the reaction equation

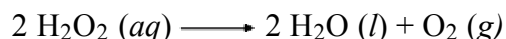


Using the following initial rate data, determine the rate constant for the reaction.

Run	[NO] ₀ /M	[O ₂]/M	Initial rate of formation of NO ₂ (g)/Mds ⁻¹
1	0.0228	0.0105	1.35 · 10 ⁻⁵
2	0.0456	0.0105	5.40 · 10 ⁻⁵
3	0.0228	0.0210	2.70 · 10 ⁻⁵

- A) 2.47 M⁻².s⁻¹
- B) 0.0564 M⁻².s⁻¹
- C) 1.35 · 10⁻³ M⁻².s⁻¹
- D) 1.23 M⁻².s⁻¹

9. Hydrogen peroxide decomposes according to the reaction equation



This reaction is first order in $[\text{H}_2\text{O}_2]$ at 70°C with a rate constant of $k = 0.0444 \text{ min}^{-1}$. If the initial concentration is $[\text{H}_2\text{O}_2]_0 = 0.25 \text{ M}$, then what is the value of $[\text{H}_2\text{O}_2]$ 45.0 minutes after the solution is prepared?

- A) 0.0043 M
 - B) 0.035 M
 - C) 0.055 M
 - D) 0.15 M
10. Argon-41 is a γ -emitter with a half-life of 109.2 minutes. What fraction of a sample of Ar-41 remains after 37.5 hours?
- A) $6.29 \cdot 10^{-7}$
 - B) $7.70 \cdot 10^{-7}$
 - C) $4.09 \cdot 10^{-6}$
 - D) $6.92 \cdot 10^{-6}$
11. If a sample of sodium-24 chloride contains 0.075 mg of sodium-24, how much sodium-24 remains after 9.63 hours? The half-life of sodium-24 is 14.96 hours.
- A) 0.027 mg
 - B) 0.048 mg
 - C) 0.072 mg
 - D) 0.084 mg
12. You order a sample of Na_3PO_4 containing the radioisotope phosphorus-32 ($t_{1/2} = 14.28$ days) on Monday. You don't get to it until Thursday, 3.0 days after it was prepared and shipped. How much of the activity remains in your sample?
- A) 15%
 - B) 32%
 - C) 69%
 - D) 87%

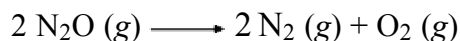
13. The gas-phase decomposition of $\text{CH}_3\text{CHO} (g)$ occurs according to the equation



The reaction is second order with $k = 0.105 \text{ M}^{-1} \cdot \text{s}^{-1}$ at 490°C . If the concentration of $\text{CH}_3\text{CHO} (g)$ is 0.022 M initially, what will its concentration be 4.3 minutes later?

- A) 0.0013 M
- B) 0.0089 M
- C) 0.014 M
- D) 0.020 M

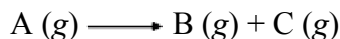
14. The rate law for the reaction described by the equation



is second order in $\text{N}_2\text{O} (g)$. The reaction was carried out at 900 K with an initial concentration of $\text{N}_2\text{O} (g)$ of $3.5 \cdot 10^{-2} \text{ M}$. If it took 91.3 minutes for $[\text{N}_2\text{O}]$ to fall to half its original value, what is the value of the rate constant for this reaction?

- A) $3.5 \cdot 10^{-3} \text{ M}^{-1} \cdot \text{s}^{-1}$
- B) $4.8 \cdot 10^{-3} \text{ M}^{-1} \cdot \text{s}^{-1}$
- C) $5.2 \cdot 10^{-3} \text{ M}^{-1} \cdot \text{s}^{-1}$
- D) $8.4 \cdot 10^{-3} \text{ M}^{-1} \cdot \text{s}^{-1}$

15. The rate law for the reaction described by the equation

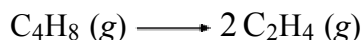


is second order in $\text{A} (g)$ with an rate constant $k = 1.13 \cdot 10^{-2} \text{ M}^{-1} \cdot \text{s}^{-1}$ at 550 K . If the reaction is carried out at 550 K with an initial concentration of $\text{A} (g)$ of $5.84 \cdot 10^{-2} \text{ M}$, how long will it take for $[\text{A}]$ to fall to half its original value?

- A) 1450 seconds
- B) 1520 seconds
- C) 1600 seconds
- D) 1920 seconds

16. How does tripling the concentration of a reactant change the rate of a reaction that is second order in that reactant?
- A) The rate increases by a factor of three: $(3)^1$.
 - B) The rate increases by a factor of six: $(2)(3)$.
 - C) The rate increases by a factor of eight: $(2)^3$.
 - D) The rate increases by a factor of nine: $(3)^2$.

17. Cyclobutane, C_4H_8 (g), decomposes to ethylene, C_2H_4 (g), at 700 K:



The reaction is first order in $[\text{C}_4\text{H}_8]$ with $k = 0.015 \text{ min}^{-1}$. If the initial concentration of C_4H_8 (g) is 1.33 M, what is its concentration after 5.5 minutes?

- A) 0.36 M
 - B) 0.63 M
 - C) 0.98 M
 - D) 1.2 M
18. How long does it take for the concentration of a reactant to decrease by 25.6% of its initial value for a first-order reaction with $k = 1.35 \text{ min}^{-1}$?
- A) 13.1 s
 - B) 0.200 min
 - C) 1.01 min
 - D) 21.9 s
19. If the half-life of uranium-238 is $4.47 \cdot 10^9$ years, then how long will it take for the amount of radioactivity in a sample to decrease to 0.050% of its original value?
- A) 5.74 half-lives
 - B) 12.7 half-lives
 - C) $1.93 \cdot 10^{10}$ years
 - D) $4.90 \cdot 10^{10}$ years

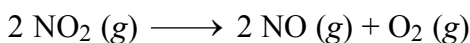
20. Dinitrogen pentoxide decomposes according to the reaction equation



If the initial concentration of $\text{N}_2\text{O}_5 (\text{g})$ is $[\text{N}_2\text{O}_5]_0 = 0.832 \text{ M}$, and if $[\text{N}_2\text{O}_5] = 0.166 \text{ M}$ at $t = 65.0 \text{ min}$, then what is $[\text{NO}_2]$ at $t = 65.0 \text{ min}$?

- A) 0.525 M
- B) 0.666 M
- C) 1.05 M
- D) 1.33 M

21. Incomplete initial rate data are given below for the reaction described by



Run	$[\text{NO}_2]_0/\text{M}$	$(\text{rate of reaction})_0/\text{M}\text{s}^{-1}$
1	1.10	0.65
2	1.60	1.38
3	2.25	x

What is the rate of reaction, x , for Run 3?

- A) $1.53 \text{ M}\cdot\text{s}^{-1}$
 - B) $2.22 \text{ M}\cdot\text{s}^{-1}$
 - C) $2.73 \text{ M}\cdot\text{s}^{-1}$
 - D) $2.89 \text{ M}\cdot\text{s}^{-1}$
22. How does halving the concentration of a reactant change the rate of a reaction that is first order in that reactant?
- A) The rate decreases by a factor of two: $(1/2)^1$.
 - B) The rate does not change: $(1)^{1/2}$.
 - C) The rate increases by a factor of 1.4: $(2)^{1/2}$.
 - D) The rate increases by a factor of two: $(2)^1$.

23. If plotting your rate data as $\ln[A]$ vs. t results in a straight line, then which of the following represents the slope (m) of that line?
- A) $-k$
 - B) $\ln[A]_0$
 - C) $1/k$
 - D) $1/[A]_0$

Answer Key - Chapter 13 Practice Problems

1. C
2. D
3. C
4. B
5. B
6. C
7. C
8. A
9. B
10. A
11. B
12. D
13. C
14. C
15. B
16. D
17. D
18. A
19. D
20. D
21. C
22. A
23. A