

Name:

Date:

Period:

Seat #:

Show all work. Complete the following.

[1] The catalytic converter in an automobile uses NiO and Pt metal to speed the combustion of CO to CO ₂ . This is an example of:	
a) homogeneous catalysis	
b) heterogeneous catalysis	
c) acid hydrolysis	
d) enzyme catalysis	

[2] The decomposition of N ₂ O ₅ (g) → NO ₂ (g) + NO ₃ (g) proceeds as a first order reaction with a half-life of 30.0 seconds at a certain temperature. If the initial concentration [N ₂ O ₅] ₀ = 0.400 M, what is the concentration after 120 seconds?	
a) 0.000 M	
b) 0.100 M	
c) 0.025 M	
d) 0.200 M	
e) 0.050 M	

[3] What is the rate constant of the reaction in Problem #2?	
a) 2.31 x 10 ⁻² s ⁻¹	
b) 30.0 s ⁻¹	
c) 20.7 s ⁻¹	
d) 43.3 s ⁻¹	

[4] Which equation below best gives the concentration of N₂O₅ versus time in Problem #2?

a) $[N_2O_5] = \frac{[N_2O_5]_0}{t_{1/2}}$

b) $[N_2O_5] = kt$

c) $[N_2O_5] = [N_2O_5]_0 e^{-kt}$

d) $\frac{1}{[N_2O_5]} = \frac{1}{[N_2O_5]_0} + kt$

[5] Radioactive isotope concentrations typically decay by:

- a) no simple order
- b) zero order kinetics
- c) second order kinetics
- d) first order kinetics

[6] The collision theory of reaction rates:

- I. helps to expose how temperature affects the rate.
 - II. assumes that the rate depends on the frequency at which reactants collide
 - III. assumes that reactants must be in correct orientation to react
 - IV. assumes that only collisions with energy above the activation energy are successful
- a) I, II, and III are correct. IV is incorrect.
 - b) I, III, and IV are correct. II is incorrect
 - c) II, III, and IV are correct. I is incorrect
 - d) All are correct statements

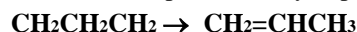
[7] The relationship between the rate constant and temperature is expressed by the:

- a) Arrhenius equation
- b) rate law
- c) integrated rate equation
- d) reaction mechanism

[8] Identify the **INCORRECT** statement below:

- a) The rate of a typical reaction doubles with a 10° C rise in temperature.
- b) The overall rate of reaction is determined by the rate of the fastest elementary step
- c) The reaction mechanism is a step-by-step pathway by which reaction occurs
- d) The reaction mechanism is typically a series of elementary reaction steps
- e) Reaction orders for a single elementary step are equal to the balancing coefficients for that step

[9] Calculator problem - Cyclopropane rearranges to form propene:



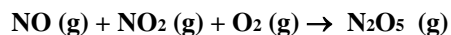
by first-order kinetics. The rate constant is $k = 2.74 \times 10^{-3} \text{ s}^{-1}$. The initial concentration of cyclopropane is 0.290 M. What will be the concentration of cyclopropane after 100 seconds?

a) 0.220 M	Show work:
b) 0.760 M	
c) $2.74 \times 10^{-1} \text{ M}$	
d) $7.94 \times 10^{-2} \text{ M}$	

[10] For the reaction given below, what is the instantaneous rate for each of the reactants and products?



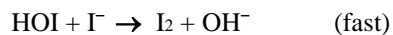
[11] Given the following experimental data, find the rate law and the rate constant for the reaction:



Run	$[\text{NO}]_0, \text{ M}$	$[\text{NO}_2]_0, \text{ M}$	$[\text{O}_2]_0, \text{ M}$	Initial Rate, Ms^{-1}
1	0.10	0.10	0.10	$2.1\text{E}-2$
2	0.20	0.10	0.10	$4.2\text{E}-2$
3	0.20	0.30	0.20	$1.26\text{E}-1$
4	0.10	0.10	0.20	$2.1\text{E}-2$

[12] The half-life of a radioisotope is found to be 4.55 minutes. If the decay follows first order kinetics, what percentage of isotope will remain after 2.00 hours?

The mechanism of a reaction is shown below.



- a) What is the overall reaction?
- b) Which compounds are intermediates?
- c) Predict the rate law based on this mechanism
- d) What is the overall order of the reaction?

[14] For the reaction $A + B \rightarrow C$, the rate constant at 215°C is 5.0×10^{-3} and the rate constant at 452°C is 1.2×10^{-1}

a) What is the activation energy in kJ/mol?

b) What is the rate constant at 100°C

$$\ln \left(\frac{k_2}{k_1} \right) = \frac{E_A}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

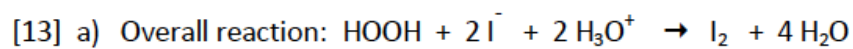
Answers [1-14]:

1)b 2)c 3)a 4)c 5)d 6)d 7)a 8)b 9)a

$$[10] \quad -\frac{1}{3} \frac{\Delta[A]}{\Delta t} = -\frac{1}{2} \frac{\Delta[B]}{\Delta t} = \frac{1}{4} \frac{\Delta[C]}{\Delta t}$$

$$[11] \quad \text{Rate} = k[\text{NO}][\text{NO}_2] \quad k = 2.1 \text{ M}^{-1}\text{s}^{-1}$$

$$[12] \quad k = 0.152 \text{ min}^{-1} \quad A_t = 1.15 \times 10^{-6} \% \text{ (not much!!)}$$



b) Intermediates: OH^- and HOI

c) Predicted mechanism: $\text{Rate} = k[\text{HOOH}][\text{I}^-]$

d) Overall order: 2nd order

$$[14] \quad \text{a) } 39.4 \text{ kJ/mol} \quad \text{b) } 2.50 \times 10^{-4} \text{ s}^{-1}$$