

Name: _____

Period: _____

Seat#: _____

Directions: Show all work in a way that would earn you credit on the AP Test! This is always the rule! Some answers are provided at the end. If you need more space, use binder paper and staple to your worksheet.

1) Catalytic converters in automobiles use NiO and Pt to speed the combustion of CO to CO₂. This is an example of:

- a) homogeneous catalysis
- b) heterogeneous catalysis
- c) acid hydrolysis
- d) enzyme catalysis

2) The decomposition of N₂O₅(g) → NO₂(g) + NO₃(g) proceeds as a 1st order rxn with a half-life of 30.0 seconds at a certain temperature. If the initial concentration [N₂O₅]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

Show work:

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

Show work:

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

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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: $\text{CH}_2\text{CH}_2\text{CH}_2 \rightarrow \text{CH}_2=\text{CHCH}_3$ 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?

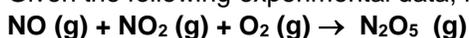
- a) 0.220 M
- b) 0.760 M
- c) $2.74 \times 10^{-1} \text{ M}$
- d) $7.94 \times 10^{-2} \text{ M}$

Show work:

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	2.1E^{-2}
2	0.20	0.10	0.10	4.2E^{-2}
3	0.20	0.30	0.20	1.26E^{-1}
4	0.10	0.10	0.20	2.1E^{-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 isotopewill remain after 2.00 hours?

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13) The mechanism of a reaction is shown below.	
$\text{HOOH} + \text{I}^- \rightarrow \text{HOI} + \text{OH}^-$ (slow) $\text{HOI} + \text{I}^- \rightarrow \text{I}_2 + \text{OH}^-$ (fast) $2\text{OH}^- + 2\text{H}_3\text{O}^+ \rightarrow 4 \text{H}_2\text{O}$ (fast)	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 $\text{A} + \text{B} \rightarrow \text{C}$, 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	
$\ln\left(\frac{k_2}{k_1}\right) = \frac{E_A}{R} \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$	

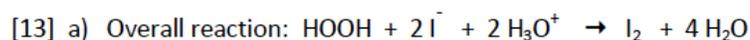
Answers [1-14]:

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

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

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

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



b) Intermediates: OH^- and HOI

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

d) Overall order: 2nd order

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