Dougherty Valley HS AP Chemistry
Kinetics – More Kinetics Practice

WORKSHEET #5

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 $N_2O_5(g) \rightarrow NO_2(g) + NO_3(g)$ proceeds as a first order reaction with a half-life of 30.0 seconds at a certain temperature. If the initial concentration $[N_2O_5]_0 = 0.400$ 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) 2.31×10^{-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 N_2O_5 versus time in Problem #2?

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

$b)\ [N_2O_5] = kt$

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

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

[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:

$CH_2CH_2CH_2 \rightarrow CH_2{=}CHCH_3$

by first-order kinetics. The rate constant is k = 2.74 x 10-3 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 x 10^{-1} M	
d) 7.94 x 10^{-2} M	

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

$3\,A + 2\,B \rightarrow 4\,C$

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

$NO\,(g) + NO_2\,(g) + O_2\,(g) \rightarrow N_2O_5\,(g)$

Run	$[NO]_0$, M	$[NO_2]_0$, M	$[O_2]_0$, 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 isotope will remain after 2.00 hours?

The mechanism of a reaction is shown below.

$HOOH + I^- \rightarrow HOI + OH^-$ (slow)
$HOI + I^- \rightarrow I_2 + OH^-$ (fast)
$2OH^- + 2H_3O^+ \rightarrow 4\,H_2O$ (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 A + B → C, the rate constant at 215°C is 5.0 x10^{-3} and the rate constant at 452°C is 1.2 x 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] $-\frac{1}{3}\frac{\Delta[A]}{\Delta t} = -\frac{1}{2}\frac{\Delta[B]}{\Delta t} = \frac{1}{4}\frac{\Delta[C]}{\Delta t}$

[11] Rate = $k[NO]\,[NO_2]$ $k = 2.1\ M^{-1}s^{-1}$

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

[13] a) Overall reaction: $HOOH + 2\,I^- + 2\,H_3O^+ \rightarrow I_2 + 4\,H_2O$

b) Intermediates: OH^- and HOI

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

d) Overall order: 2nd order

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