Name: ______________________________ date: _____________ period: _____

ch. 14 kinetics test 65 points ngss chemistry

In problems involving any calculation, show your work in an organized manner, include (i) any relevant equation (or formula), (ii) conversion factor(s), (iii) put the proper units in your calculations and answer, and (iv) have the proper number of significant figures in your answer.

1. Fill-in the below table (units = mM / second) in regards to the reaction: $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$

Rate	$\frac{\Delta [C_2H_6]}{\Delta t}$	$\frac{\Delta [O_2]}{\Delta t}$	$\frac{\Delta [CO_2]}{\Delta t}$	$\frac{\Delta [H_2O]}{\Delta t}$
a. 6	b. -12	don't fill	c. 24	36
12	-12	don't fill	24	d. 36
10	-20	e. -70	40	60

1pt@

Show your work for the below parts; while need not show work for other empty table cells, still have to fill-in these empty table cells. [15 points]

2pt@

a. rate = $\frac{1}{6} \frac{\Delta H_2O}{\Delta t} = \frac{1}{6} \frac{36\ mM}{sec} = \frac{6\ mM}{sec}$

b. rate = $-\frac{1}{2} \frac{\Delta C_2H_6}{\Delta t}$

$\frac{6\ mM}{sec} = -\frac{1}{2} \frac{\Delta C_2H_6}{\Delta t} \rightarrow \frac{\Delta C_2H_6}{\Delta t} = -12\ mM/sec$

c. rate = $\frac{1}{4} \frac{\Delta CO_2}{\Delta t}$

$\frac{\Delta CO_2}{\Delta t} = 4 \cdot rate = 4 \cdot (6) = 24\ mM/sec$

d.

blah

e. blah

rate = $-\frac{1}{7} \frac{\Delta O_2}{\Delta t}$

$\frac{\Delta O_2}{\Delta t} = -7 \cdot rate = -7(10) = -\frac{70\ mM}{sec}$

2. Determine the rate law and include the numeric value and units of the rate constant regardin g the reaction

$CH_4 + O_2 \rightarrow CO_2 + H_2O$ rate = $k[CH_4]^x[O_2]^y$

based on the below hypothetical experimental data. [20 points]

Expt	Initial rate (mM / sec)	[CH_4]; mM	[O_2]; mM
1	10	1.0	1.0
2	30	1.0	3.0
3	90	3.0	1.0

i) $\frac{r2}{r1} = \frac{30\ mM/sec}{10\ mM/sec} = \left(\frac{[CH_4(2)]}{[CH_4(1)]}\right)^x \left(\frac{[O_2(2)]}{[O_2(1)]}\right)^y$

$3 = 1^x\ 3^y$; $y = 1$

ii) $\frac{r3}{r1} = \frac{90\ mM/sec}{10\ mM/sec} = \left(\frac{CH_4(3)}{CH_4(1)}\right)^x \left(\frac{O_2(3)}{O_2(1)}\right)^y$

$9 = 3^x\ 1^y$; $x = 2$

iii) $r1 = k[CH_4]^2[O_2]$

$10\frac{mM}{sec} = k\ 1\,mM\ (1\,mM)^2$

$k = 10\frac{mM}{sec}\ \frac{1}{mM^3} = \frac{10}{mM^2\ sec}$ (or $\left(\frac{10^3 mM}{M}\right)^2 = \frac{10^7}{M^2\ sec}$)

iv) rate = $10\frac{mM^{-2}}{sec}[CH_4]^2[O_2]$ or

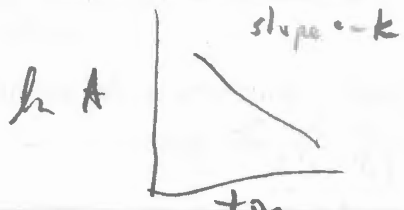
or

rate = $\frac{10^7}{M^2\ sec}[CH_4]^2[O_2]$

20 pts

3. Describe how to use graphical analysis to determine the rate law of the reaction: A → B if the reaction is a ___; sketch / label a graph and its basis / rationale. Need not derive any equations, but show the relevant equation(s). [15 points]

a. 1st order reaction

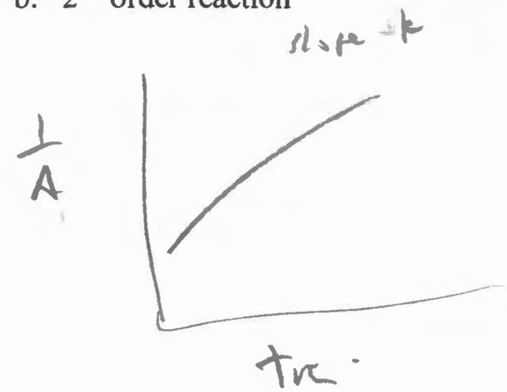


$\ln A = -kt + \ln A_0$

D+2pt Q

$rate = k[A]^1$

b. 2nd order reaction



$\frac{1}{A} = kt + \frac{1}{A_0}$

$rate = k[A]^2$

c. Zero order reaction

$A = -kt + A_0$

$rate = k$

4. In a hypothetical reaction: A → B, the initial [A] = 500 mM; what's the half life of the reaction ? [15 points]

a. The rate law: rate = {0.125 / minute} * [A]

1 pt i) 1st order Rx

1 pt ii) ln 2 = k t½

3 $t_{1/2} = \frac{\ln 2}{k} = \frac{\ln 2}{(0.125/\text{min})} = 5.5$ minutes

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b. The rate law: rate = {0.125 / mM * minute} * $[A]^2$

1 pt 2nd order Rx

1 $k[A]_0 t_{1/2} = 1$

3 $t_{1/2} = \frac{1}{k[A]_0} = \frac{1}{\left(\frac{0.125}{mM\ min}\ 500\ mM\right)} = 0.016$ min

c. The rate law: rate = {0.125 mM / minute} * $[A]^0$

1 pt 0th order Rx

1 $t_{1/2} = \frac{[A]_0}{2k} = \frac{500\ mM}{2\left(0.125\ \frac{mM}{min}\right)}$

3 $= 2000$ min

$A = A_0 - kt$

@ t½

$\frac{1}{2}A_0 = A_0 - k t_{1/2}$

$-\frac{1}{2}A_0 = -k t_{1/2}$