Name: _____ date: _____ period: _____

Ch 14 kinetics test 50 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), and (iii) put the proper units in your calculations and answer.

1. In regards to the reaction: $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H2O$ [15 points; partial credit if work is shown]

   a. if the rate of consumption of oxygen is 28 mM / sec, then what is the rate of generation of water ?

2 pt / 3

$$-\frac{1}{7}\frac{\Delta O_2}{\Delta t} = \frac{1}{6}\frac{\Delta H_2O}{\Delta t}$$

$$\frac{\Delta H_2O}{\Delta t} = -\frac{6}{7}\frac{\Delta O_2}{\Delta t} = -\frac{6}{7}\left(-28\ \frac{mM}{sec}\right) = 24\ \frac{mM}{sec}$$

   b. if the rate of generation of carbon dioxide is 16 mM / sec, then what is $\frac{\Delta [O_2]}{\Delta t}$?

2 pt / 3

$$\frac{1}{4}\frac{\Delta CO_2}{\Delta t} = -\frac{1}{7}\frac{\Delta O_2}{\Delta t}$$

$$\frac{1}{4}\left(\frac{16\ mM}{sec}\right) = -\frac{1}{7}\frac{\Delta O_2}{\Delta t}$$

$$\frac{\Delta O_2}{\Delta t} = -28\ mM/sec$$

   c. if oxygen decreases at a rate of 56 mM / sec, then what is the rate of the reaction ?

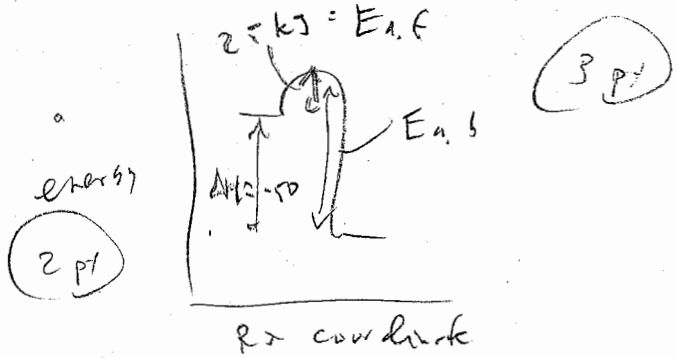
2 pt / 3

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

$$rate = -\frac{1}{7}\left(56\ \frac{mM}{sec}\right)$$

$$= -8\ \frac{mM}{sec}$$

2. Sketch a reaction energy profile for a reaction; label the axis and identify: $\Delta H = -50$ kJ; activation energy for the forward reaction = 25 kJ & the activation energy of the backward reaction. What is the numeric value of the activation energy of the backward reaction ? [10 points]



3 pt / 2 pt

2 pt / 3 pt

$$E_{a,f} - E_{a,b} = \Delta H$$

$$25\ kJ - E_{a,b} = -50\ kJ$$

$$E_{a,b} = 75\ kJ$$

rate = k [N_2]^x [H_2]^y

3. Based on the below hypothetical experimental data for the reaction: $N_2 + 3\ H_2 \rightarrow 2\ NH_3$

Expt	[N2] mM	[H2] mM	Rate (μM / sec)
1	2.0	2.0	25.0
2	4.0	2.0	50.0
3	8.0	8.0	200.0

determine the rate law of the reaction; units of k in M. [15 points]

(4 pts)

i) $\frac{r2}{r1} = \frac{50\ \mu M/sec}{25\ \mu M/sec} = 2^x$ (1)

$2 = 2^x$; $x = 1$

4 ii) $\frac{r3}{r1} = \frac{200\ \mu M/sec}{25\ \mu M/sec} = 4^x\ 4^y$ (1)

$8 = 4 \cdot 4^y$

$2 = 2^{2y}$; $y = \frac{1}{2}$

4 iii) $r1 = 25 \cdot 10^{-6}\ \frac{M}{sec} = k\ (2 \cdot 10^{-3} M)(2 \cdot 10^{-3} M)^{\frac{1}{2}}$

$k = \frac{25 \cdot 10^{-6} M}{sec\ 2\sqrt{2}\ M^{3/2}} = 8.84 \cdot 10^{-6}\ \frac{}{M^{\frac{1}{2}}\ sec}$

3 iv) rate: $\frac{8.84 \cdot 10^{-6}}{M^{\frac{1}{2}}\ sec}$ [N_2] [H_2]$^{\frac{1}{2}}$

4. Determine the exponents in the rate law for the following reaction (expressed as its net ionic equation):

$S_2O_3^{2-}{}_{(aq)} + H^+{}_{(aq)} \rightarrow S_{(s)} + SO_{2\,(g)} + H_2O_{(l)}$ rate = k [$S_2O_3^{2-}$]^x [H^+]^y

based on the below hypothetical experimental data. [10 points]

Expt	V($S_2O_3^{2-}$); μL	V(H^+); μL	V(H_2O); μL	Time (sec)
1	500	500	0	60
2	500	250	250	120
3	300	300	400	278

hint: $a = b^x \rightarrow x = \frac{\log(a)}{\log(b)} = \frac{\ln(a)}{\ln(b)}$

3 pts

i) $\frac{r1}{r2} = \frac{t2}{t1} = \frac{120}{60} = 1^x\ 2^y$ (2)

$2 = 2^y$; $y = 1$

3 ii) $\frac{r1}{r3} = \frac{t3}{t1} = \frac{278}{60} = \left(\frac{500}{300}\right)^x \left(\frac{500}{300}\right)^y$

$4.63 = (1.66)^x\ (1.66)$

$2.780 = (1.66)^x$

$x = \frac{\log 2.780}{} = \frac{0.444}{} = 2$