Name: ______________________________

Chemistry 30

Unit 2: Chemical Kinetics

Assignment 1: 1-1 to 1-3 MAX: 10

Each question is worth 2 marks

1. During the combustion of methane, CH_4, shown by the reaction

$$CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$$

the concentration of methane was measured at various time intervals and the following results were obtained:

Time (s)	$[CH_4]$ ($mol \cdot l^{-1}$)
10	2.40
20	1.20
30	0.80
40	0.60

Calculate the average rate of loss of methane during the 10 to 40 second time period.

$$Rate = \frac{\Delta[CH_4]}{\Delta time} = \frac{0.60 - 2.40}{40 - 10} = \frac{-1.8}{30} = -0.06 mol \cdot L^{-1} \cdot s^{-1} or \ \frac{0.06M}{s}$$

We are usually not concerned with the sign for rate (positive or negative)

2. Consider the following reaction: $N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$

If the rate of decomposition of $N_2(g)$ is 0.03 $mol \cdot L^{-1} \cdot s^{-1}$, what is the rate of formation of $NH_3(g)$?

Because the ratio of moles of NH_3 to N_2 is 2:1 (from the balanced equation shown above), the rate of NH_3 production will be twice the rate of loss of N_2:

Rate NH_3 = 2 $\times$ 0.03 $mol \cdot L^{-1} \cdot s^{-1}$ ***= 0.06 $mol \cdot L^{-1} \cdot s^{-1}$***

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3. Measurements taken during the reaction $CO(g) + NO_2(g) \rightarrow CO_2(g) + NO(g)$

showed a concentration of carbon monoxide of 0.019 mol at 27 min and of 0.013 mol at 45 min. Calculate the average rate, in $\cdot L^{-1} \cdot min^{-1}$, over this 18 min period, of each of the following:

a) the loss of carbon monoxide, CO

$$Rate = \frac{\Delta[CO]}{\Delta time} = \frac{0.019 - 0.013}{27 - 45} = \frac{0.006}{18} = 3.3 \times 10^{-4}\ mol \cdot L^{-1} \cdot \min^{-1}$$

b) the gain of carbon dioxide, CO_2

The balanced equation indicates a 1:1 ratio between CO and CO_2

Therefore the rate of gain of CO_2 will equal the rate of loss of CO

$$Rate\ gain\ CO_2 = 3.3 \times 10^{-4}\ mol \cdot L^{-1} \cdot min^{-1}\ or\ \frac{3.3 \times 10^{-4}\,\text{mol}}{\text{L} \cdot \text{min}}$$

4. In the following reaction the average rate of loss of carbon monoxide, over a set period, is 0.15 mol $\cdot L^{-1} \cdot s^{-1}$.

$$2\ CO(g) \rightarrow CO_2(g) + C(s)$$

What is the average rate of production of carbon dioxide during the same period.

. *The ratio between CO_2 and CO is 1: 2 (1 CO_2 for 2 CO)*

Thus the rate of CO_2 production is ½ the rate of loss of CO:

$$Rate = ½\ (0.15\ mol \cdot L^{-1} \cdot s^{-1}.) = 7.5 \times 10^{-2}\ mol \cdot L^{-1} \cdot s^{-1}$$

$$(0.075\ mol \cdot L^{-1} \cdot s^{-1}\ or\ \frac{0.075M}{s})$$