G12 Chemistry: Class 9 Homework

1. Cyclopropane, C_3H_6 is used in the synthesis of organic compounds and as a fast-acting anaesthetic. It undergoes rearrangement to form propene, C_3H_6. If cyclopropane disappears at a rate of 0.25 mol/ L•s, at what rate is propene being produced? **[1 mark]**

2. Ammonia NH_3 reacts with oxygen to produce nitric oxide, NO, and water vapour.

   $$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

   At a specific time in the reaction, ammonia is disappearing at rate of 0.068mol/L•s. What is the corresponding rate of production of water? **[2 marks]**

3. Hydrogen bromide reacts with oxygen to produce bromine and water vapour.

   $$4HBr(g) + O_2(g) \rightarrow 2Br_2(g) + 2H_2O(g)$$

   How does the rate of decomposition of HBr (in mol/ L•s) compare with the rate of formation of Br_2 (also in mol/ L•s)? Express your answer as an equation. **[1 mark]**

4. Magnesium metal reacts with hydrochloric acid to produce magnesium chloride and hydrogen gas. Over an interval of 1.00s, the mass of Mg(s) changes by −0.011 g.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

a) What is the corresponding rate of consumption of HCl(aq) (in mol/s)? **[3 marks]**

b) Calculate the corresponding rate of production of $H_2(g)$ (in L/s) at 20°C and 101 kPa. **[3 marks]**

5. When heated, ethylene oxide decomposes to produce methane and carbon monoxide.

$$C_2H_4O(g) \rightarrow CH_4(g) + CO(g)$$

At 415°C, the following initial rate data were recorded. Determine the rate law equation and the rate constant at 415°C. **[4 marks]**

Experiment	**$[C_2H_4O]_0$ (mol/L)**	**Initial Rate (mol/ L•s)**
1	0.00285	5.84×10^{-7}
2	0.00428	8.76×10^{-7}
3	0.00570	1.17×10^{-6}

6. Iodine chloride reacts with hydrogen to produce iodine and hydrogen chloride.

$$2ICl + H_2 \rightarrow I_2 + 2HCl$$

At temperature T, the following initial rate data were recorded. Determine the rate law equation and the rate constant at temperature T. **[5 marks]**

Experiment	$[ICl]_0$ (mol/L)	$[H_2]_0$ (mol/L)	Initial Rate (mol/ L•s)
1	0.20	0.050	0.0015
2	0.40	0.050	0.0030
3	0.20	0.200	0.0060

6. Sulfuryl chloride, SO_2Cl_2 is used in a variety of applications, including the synthesis of pharmaceuticals, rubber-based plastics, dyestuff and rayon. At a certain temperature, the rate of decomposition of sulfuryl chloride was studied. **[4 marks]**

$$SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$$

Experiment	$[SO_2Cl_2]$ (mol/L)	Initial rate (mol/ L•s)
1	0.150	3.3×10^{-6}
2	0.300	6.6×10^{-6}
3	0.450	9.9×10^{-6}

a) Write the rate law equation for the decomposition of sulfuryl chloride.
b) Determine the rate constant, k, for the reaction with the appropriate units.