

**G12 Chemistry: Class 9 Homework**

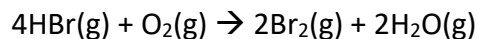
1. Cyclopropane,  $C_3H_6$  is used in the synthesis of organic compounds and as a fast-acting anaesthetic. It undergoes rearrangement to form propene,  $C_3H_6$ . If cyclopropane disappears at a rate of  $0.25 \text{ mol/L}\cdot\text{s}$ , at what rate is propene being produced? **[1 mark]**

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



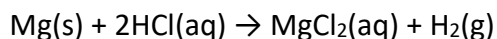
At a specific time in the reaction, ammonia is disappearing at rate of  $0.068 \text{ mol/L}\cdot\text{s}$ . What is the corresponding rate of production of water? **[2 marks]**

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



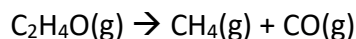
How does the rate of decomposition of  $HBr$  (in  $\text{mol/L}\cdot\text{s}$ ) compare with the rate of formation of  $Br_2$  (also in  $\text{mol/L}\cdot\text{s}$ )? Express your answer as an equation. **[1 mark]**

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.



- 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<sub>2</sub>(g) (in L/s) at 20°C and 101 kPa. **[3 marks]**

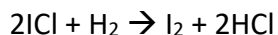
5. When heated, ethylene oxide decomposes to produce methane and carbon monoxide.



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 <sub>2</sub> H <sub>4</sub> O] <sub>0</sub> (mol/L)	Initial Rate (mol/ L•s)
1	0.00285	5.84 x 10 <sup>-7</sup>
2	0.00428	8.76 x 10 <sup>-7</sup>
3	0.00570	1.17 x 10 <sup>-6</sup>

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



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

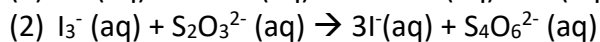
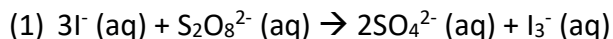
Experiment	[ICl] <sub>0</sub> (mol/L)	[H <sub>2</sub> ] <sub>0</sub> (mol/L)	Initial Rate (mol/ L•s)
1	0.20	0.050	0.0015
2	0.40	0.050	0.0030
3	0.20	0.200	0.0060

6. The reaction of nitric oxide with hydrogen at 1280°C is:  $2\text{NO}(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$

Experiment	[NO] (mol/L)	[H <sub>2</sub> ] (mol/L)	Initial rate (mol/ L•s)
1	$5.0 \times 10^{-3}$	$2.0 \times 10^{-3}$	$1.3 \times 10^{-5}$
2	$10.0 \times 10^{-3}$	$2.0 \times 10^{-3}$	$5.0 \times 10^{-5}$
3	$10.0 \times 10^{-3}$	$4.0 \times 10^{-3}$	$10.0 \times 10^{-5}$

- a) From the data collected above, determine the rate law and the rate constant. **[5 marks]**  
 b) Determine the rate of reaction when [NO] =  $12.0 \times 10^{-3}$  M and [H<sub>2</sub>] =  $6.0 \times 10^{-3}$  M. **[1 mark]**

7. The iodine clock reaction is a common laboratory procedure to measure the rate of reaction. It involves a series of chemical reactions:



When the  $\text{I}_3^-$  from Reaction (1) comes in contact with starch from Reaction (3), it produces a characteristic blue/black colour. However, before that can happen,  $\text{S}_2\text{O}_3^{2-}$  reacts with the  $\text{I}_3^-$  in Reaction (2) to produce colourless products. Since Reaction (2) is much faster than Reaction (3), Reaction (3) will not take place until all of the  $\text{S}_2\text{O}_3^{2-}$  is used up. Once this occurs, the solution changes to a blue/black colour.

The table below shows the time it took for the reaction to change to a blue/black colour at various concentrations of  $\text{I}^-$  and  $\text{S}_2\text{O}_8^{2-}$ . Water was added to each trial to obtain a final volume of 100mL.

Trial	1.0M KI (aq)	0.1M $(\text{NH}_4)_2\text{S}_2\text{O}_8$ (aq)	Time (s) at 25°C	Time (s) at 45°C
1	12 mL	30 mL	17	3
2	6 mL	30 mL	36	7
3	12 mL	15 mL	36	7

- a) From the data above, calculate the missing values below using  $C_1V_1 = C_2V_2$  for the concentrations and  $(\text{time})^{-1}$  for the average rates of reaction. **[12 marks]**

Trial	$[\text{I}^-]$	$[\text{S}_2\text{O}_8^{2-}]$	Avg Rate at 25°C	Avg Rate at 45°C
1				
2				
3				

- b) Calculate the rate law and the rate constant using the values above at 25°C. **[5 marks]**  
 c) How does temperature affect the rate of a chemical reaction? **[1 mark]**