

**G12 Chemistry: Class 10 Homework**

1. Cyclopropane,  $C_3H_6$  has a three-membered hydrocarbon ring structure. It undergoes rearrangement to propene. At  $1000^\circ C$ , the first-order rate constant for the decomposition of cyclopropane is  $9.2s^{-1}$ . **[3 marks]**
  - a) Determine the half-life of the reaction.
  - b) What percent of the original concentration of cyclopropane will remain after 4 half-lives?
  
2. Peroxyacetyl nitrate (PAN),  $H_2CCO_2ONO_2$  is a constituent of photochemical smog. It undergoes a first-order decomposition reaction with  $t_{1/2} = 32 \text{ min}$ . **[4 marks]**
  - a) Calculate the rate constant in  $s^{-1}$  for the first-order decomposition of PAN.
  - b) 128min. after a sample of PAN began to decompose, the concentration of PAN in the air is  $3.1 \times 10^{13}$  molecules/L. What was the concentration of PAN when the decomposition began?
  
3. In general, a reaction is essentially over after 10 half-lives. Prove that this generalization is reasonable. **[2 marks]**

4. The following reaction is exothermic:  $2\text{ClO}(\text{g}) \rightarrow \text{Cl}_2(\text{g}) + \text{O}_2(\text{g})$

Draw and label a potential energy diagram for the reaction. Propose a reasonable activated complex. **[5 marks]**

5. A researcher is investigating the following overall reaction.

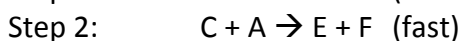
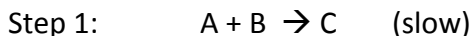


The researcher claims that the rate law equation for the reaction is written as follows:

$$\text{Rate} = k[\text{C}][\text{D}] \quad \mathbf{[3 \text{ marks}]}$$

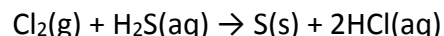
- Is the rate law equation possible for the given reaction?
- If so, suggest a mechanism that would match the rate law. If not, explain why or why not.

6. A chemist proposes the following reaction mechanism for a certain reaction. **[3 marks]**



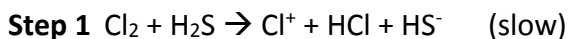
- Write the equation for the chemical reaction that is described by this mechanism.
- Write a rate law equation that is consistent with the proposed mechanism.

7. Chlorine gas reacts with aqueous hydrogen sulfide (also known as hydrosulfuric acid) to form elemental sulfur and hydrochloric acid.



The experimentally obtained rate law equation is written as follows:  $\text{Rate} = k[\text{Cl}_2][\text{H}_2\text{S}]$ . Which of the following mechanisms is consistent with this information? Explain your answer. **[2 marks]**

*Mechanism A*



*Mechanism B*



8. In each process, does the entropy of the system increase or decrease? **[5 marks]**

- a) Ice melting
- b) Water vapour condensing
- c) Sugar dissolving in water
- d)  $\text{HCl}(\text{g}) + \text{NH}_3(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$
- e)  $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

9. What is the sign of the entropy change in each chemical reaction? **[5 marks]**

- a)  $\text{N}_2\text{O}_4(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
- b)  $\text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{PCl}_5(\text{g})$
- c)  $2\text{Al}(\text{s}) + 3/2\text{O}_2(\text{g}) \rightarrow \text{Al}_2\text{O}_3(\text{s})$
- d)  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- e)  $\text{S}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{SO}_2(\text{g})$

10. Which of the following reactions would be spontaneous at 25°C? If either of the reactions is nonspontaneous, at what temperature might it become spontaneous? **[5 marks]**

a)  $\Delta H = -10.5 \text{ kJ/mol}$   
 $\Delta S = 30 \text{ J/Kmol}$

b)  $\Delta H = 1.8 \text{ kJ/mol}$   
 $\Delta S = -113 \text{ J/Kmol}$

11. Find the temperatures at which reactions with the following  $\Delta H$  and  $\Delta S$  values would become spontaneous: **[4 marks]**

a)  $\Delta H = -126 \text{ kJ/mol}$   
 $\Delta S = 84 \text{ J/Kmol}$

b)  $\Delta H = -11.7 \text{ kJ/mol}$   
 $\Delta S = -105 \text{ J/Kmol}$