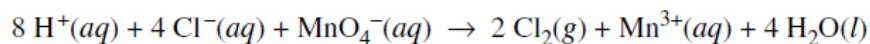


## Chemical Kinetics

### PRACTICE FRQ



$\text{Cl}_2(g)$  can be generated in the laboratory by reacting potassium permanganate with an acidified solution of sodium chloride. The net-ionic equation for the reaction is given above.

- (a) A 25.00 mL sample of 0.250 *M* NaCl reacts completely with excess  $\text{KMnO}_4(aq)$ . The  $\text{Cl}_2(g)$  produced is dried and stored in a sealed container. At 22°C the pressure of the  $\text{Cl}_2(g)$  in the container is 0.950 atm.
- Calculate the number of moles of  $\text{Cl}^-(aq)$  present before any reaction occurs.
  - Calculate the volume, in L, of the  $\text{Cl}_2(g)$  in the sealed container.

An initial-rate study was performed on the reaction system. Data for the experiment are given in the table below.

Trial	$[\text{Cl}^-]$	$[\text{MnO}_4^-]$	$[\text{H}^+]$	Rate of Disappearance of $\text{MnO}_4^-$ in $M \text{ s}^{-1}$
1	0.0104	0.00400	3.00	$2.25 \times 10^{-8}$
2	0.0312	0.00400	3.00	$2.03 \times 10^{-7}$
3	0.0312	0.00200	3.00	$1.02 \times 10^{-7}$

- (b) Using the information in the table, determine the order of the reaction with respect to each of the following. Justify your answers.
- $\text{Cl}^-$
  - $\text{MnO}_4^-$
- (c) The reaction is known to be third order with respect to  $\text{H}^+$ . Using this information and your answers to part (b) above, complete both of the following:
- Write the rate law for the reaction.
  - Calculate the value of the rate constant, *k*, for the reaction, including appropriate units.
- (d) Is it likely that the reaction occurs in a single elementary step? Justify your answer.