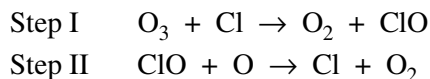


## 2002 AP<sup>®</sup> CHEMISTRY FREE-RESPONSE QUESTIONS

6. Use the principles of atomic structure and/or chemical bonding to explain each of the following. In each part, your answer must include references to both substances.
- (a) The atomic radius of Li is larger than that of Be.
  - (b) The second ionization energy of K is greater than the second ionization energy of Ca.
  - (c) The carbon-to-carbon bond energy in C<sub>2</sub>H<sub>4</sub> is greater than it is in C<sub>2</sub>H<sub>6</sub>.
  - (d) The boiling point of Cl<sub>2</sub> is lower than the boiling point of Br<sub>2</sub>.

Answer EITHER Question 7 below OR Question 8 printed on page 12. Only one of these two questions will be graded. If you start both questions, be sure to cross out the question you do not want graded. The Section II score weighting for the question you choose is 15 percent.

7. An environmental concern is the depletion of O<sub>3</sub> in Earth's upper atmosphere, where O<sub>3</sub> is normally in equilibrium with O<sub>2</sub> and O. A proposed mechanism for the depletion of O<sub>3</sub> in the upper atmosphere is shown below.



- (a) Write a balanced equation for the overall reaction represented by Step I and Step II above.
- (b) Clearly identify the catalyst in the mechanism above. Justify your answer.
- (c) Clearly identify the intermediate in the mechanism above. Justify your answer.
- (d) If the rate law for the overall reaction is found to be  $\text{rate} = k[\text{O}_3][\text{Cl}]$ , determine the following.
  - (i) The overall order of the reaction
  - (ii) Appropriate units for the rate constant,  $k$
  - (iii) The rate-determining step of the reaction, along with justification for your answer