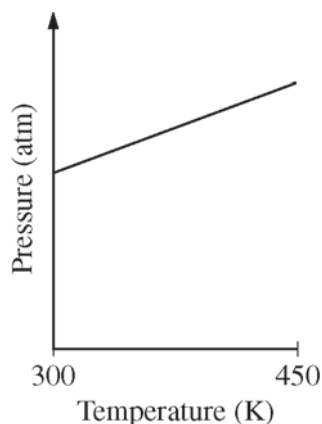


## 2013 AP<sup>®</sup> CHEMISTRY FREE-RESPONSE QUESTIONS

Answer Question 5 and Question 6. The Section II score weighting for these questions is 15 percent each.

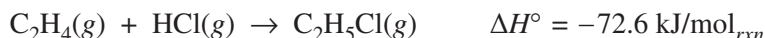
Your responses to these questions will be scored on the basis of the accuracy and relevance of the information cited. Explanations should be clear and well organized. Examples and equations may be included in your responses where appropriate. Specific answers are preferable to broad, diffuse responses.

5. A sample of  $C_2H_4(g)$  is placed in a previously evacuated, rigid 2.0 L container and heated from 300 K to 450 K. The pressure of the sample is measured and plotted in the graph below.



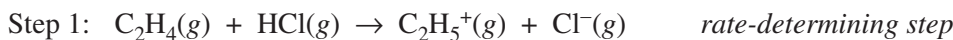
- (a) Describe TWO reasons why the pressure changes as the temperature of the  $C_2H_4(g)$  increases. Your descriptions must be in terms of what occurs at the molecular level.

$C_2H_4(g)$  reacts readily with  $HCl(g)$  to produce  $C_2H_5Cl(g)$ , as represented by the following equation.



- (b) When  $HCl(g)$  is injected into the container of  $C_2H_4(g)$  at 450 K, the total pressure increases. Then, as the reaction proceeds at 450 K, the total pressure decreases. Explain this decrease in total pressure in terms of what occurs at the molecular level.

It is proposed that the formation of  $C_2H_5Cl(g)$  proceeds via the following two-step reaction mechanism.



- (c) Write the rate law for the reaction that is consistent with the reaction mechanism above.
- (d) Identify an intermediate in the reaction mechanism above.