Use the following reaction to answer all questions.

\[
\text{C}_2\text{H}_4(g) + \text{H}_2\text{O}(g) \rightleftharpoons \text{C}_2\text{H}_5\text{OH}(g) \quad \Delta H^\circ = -47.8 \text{ kJ/mol}
\]

\[K_c = 9 \times 10^3 \text{ at 600. K} \]

1. Write the expression for \(K_c\) and \(K_p\) (4 pt.)

2. Calculate the value of \(K_p\)? (4 pt.)

3. If \(Q = 0.506\), what must happen for the reaction to reach equilibrium? (Do more reactants have to be converted to products or products into reactants?) (4 pt.)

4. Are reactants or products more plentiful at equilibrium? (3 pt.)

5. What effect would the following have on the equilibrium. (10 pt.)
   a. Increase the volume \(\text{Shift left} \quad \text{No Change} \quad \text{Shift right}\)
   b. Increase the temperature \(\text{Shift left} \quad \text{No Change} \quad \text{Shift right}\)
   c. Adding \(\text{H}_2\text{O}(g)\) \(\text{Shift left} \quad \text{No Change} \quad \text{Shift right}\)
   d. Removing \(\text{C}_2\text{H}_5\text{OH}(g)\) \(\text{Shift left} \quad \text{No Change} \quad \text{Shift right}\)
   e. Add a catalyst \(\text{Shift left} \quad \text{No Change} \quad \text{Shift right}\)