Begin your response to **QUESTION 5** on this page.
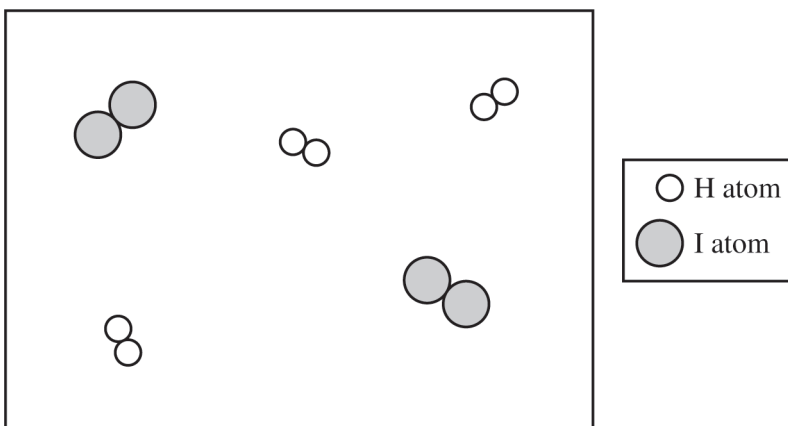
5. Hydrogen gas and iodine gas react to form hydrogen iodide at an elevated temperature, as represented by the following equation.

$$H_2(g) + I_2(g) \rightleftharpoons 2\,HI(g) \qquad \Delta H_{rxn} = -12.19 \text{ kJ / mol}_{rxn}$$

(a) Write the expression for the equilibrium constant, K_c, for this reaction.

(b) $H_2(g)$ and $I_2(g)$ are added to a previously evacuated container and allowed to react.
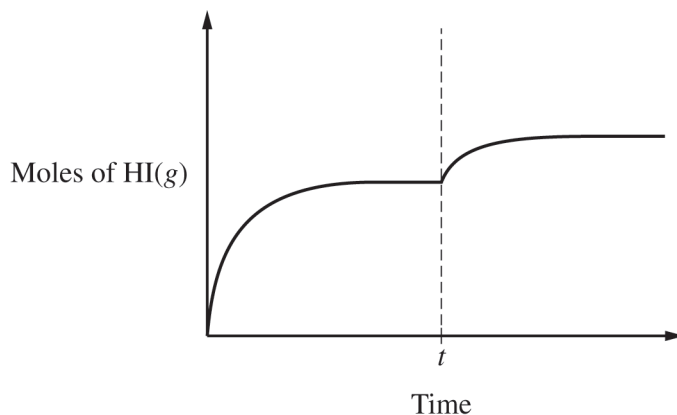
(i) At a certain time, the value of the reaction quotient, Q, is 0.67. The following particle diagram is an incomplete representation of the system at this time. The diagram shows the relative number of $H_2(g)$ and $I_2(g)$ molecules, but the $HI(g)$ molecules are not included. Draw the number of $HI(g)$ molecules needed to complete the diagram so that it accurately represents the system.

GO ON TO THE NEXT PAGE.

Continue your response to **QUESTION 5** on this page.

(ii) A student monitors the number of moles of $HI(g)$ over time. Hypothesize an experimental change that could have been applied to the system in the rigid container at time t to result in the change in the number of moles of $HI(g)$ shown in the graph. Assume that the student did not add more $HI(g)$ to the system.

(iii) After equilibrium is established, the mixture is transferred to a larger container at constant temperature. As a result, would the number of moles of $HI(g)$ increase, decrease, or remain the same? Justify your answer.

GO ON TO THE NEXT PAGE.

Question 5: Short Answer **4 points**
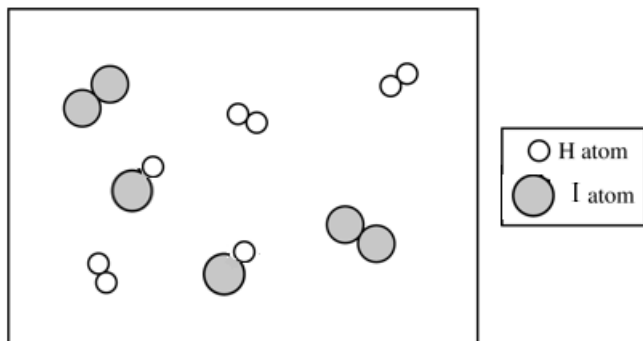
(a) For the correct expression: **1 point**

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

(b)(i) For the correct drawing consistent with part (a): **1 point**

(ii) For a valid hypothesis: **1 point**

Accept one of the following:

- *Decreased the temperature.*
- *Added more* H_2 *and/or* I_2 *to the reaction vessel.*

(iii) For the correct answer and a valid justification: **1 point**

Accept one of the following:

- *Remain unchanged. The number of moles in the numerator and denominator of Q (or K) are equal; changing the volume of the container would not alter the value of Q , which is still equal to K , so the number of moles of* HI *will remain the same.*
- *Remain unchanged. The increase in volume will decrease the concentration of reactants and products by an equal proportion. Because there are equal moles of gaseous reactants and products in the balanced chemical equation, there is no shift in the equilibrium position, and the number of moles of* HI *will remain the same.*

Total for part (b) **3 points**

Total for question 5 **4 points**