CHM 130: Chapter 16 Practice Problems Key

1. Check all of the following changes that *increase* the **rate of a reaction**:
   - ☑ a. increasing temperature
   - ☐ b. decreasing temperature
   - ☑ c. increasing the concentration of reactants
   - ☐ d. decreasing the concentration of reactants
   - ☐ e. increasing the activation energy
   - ☑ f. decreasing the activation energy
   - ☑ g. adding a catalyst

   Increasing the temperature and the concentration of reactants both result in more collisions, and increasing collision frequency increases the likelihood of successful collisions that lead to a chemical reaction. Adding a catalyst essentially decreases the activation energy, so more reactants have the activation energy required for the reaction to occur, so more reactions occur.

2. Check all of the following that result from an *increase in temperature*:
   - ☑ a. The reaction rate increases.
   - ☐ b. The reaction rate decreases.
   - ☑ c. Molecules move faster.
   - ☐ d. Molecules move slower.
   - ☑ e. Reactant molecules collide more often.
   - ☐ f. Reactant molecules collide less often.
   - ☑ g. More reactants have the required activation energy.
   - ☐ h. More reactants have the correct collision geometry.
   - ☐ i. The activation energy decreases.

   Increasing the temperature results in faster molecules and more collisions. Increasing temperature also results in more reactants having the activation energy required for the reaction to occur. However, increasing the temperature has no effect on the collision geometry requirement or the activation energy for the reaction.

3. Check all of the following that are true for **an exothermic reaction**:
   - ☑ a. The energy of the reactants is higher than the energy of the products.
   - ☐ b. The energy of the products is higher than the energy of the reactants.
   - ☐ c. Energy is required for the reaction to occur, so heat can be shown as a reactant.
   - ☑ d. Energy is released when the reaction occurs, so heat can be shown as a product.
   - ☐ e. Since energy is absorbed by the reaction, the surroundings feel colder after the reaction.
   - ☑ f. Since energy is released by the reaction, the surroundings feel hotter after the reaction.

   In an exothermic reaction, the energy of the reactants is higher than the energy of the products, so the reaction releases the difference in energy in terms of heat. Since exothermic reactions give off heat, heat can be shown as a product in a chemical equation, and the surroundings feel hotter after the reaction occurs.

4. Check all of the following that are true for **an endothermic reaction**:
   - ☐ a. The energy of the reactants is higher than the energy of the products.
   - ☑ b. The energy of the products is higher than the energy of the reactants.
   - ☑ c. Energy is required for the reaction to occur, so heat can be shown as a reactant.
   - ☐ d. Energy is released when the reaction occurs, so heat can be shown as a product.
   - ☑ e. Since energy is absorbed by the reaction, the surroundings feel colder after the reaction.
   - ☐ f. Since energy is released by the reaction, the surroundings feel hotter after the reaction.

   In an endothermic reaction, the energy of the products is higher than the energy of the reactants, so the reaction must absorb the difference in energy in terms of heat. Since endothermic reactions must absorb heat from the surrounding, heat can be shown as a reactant in a chemical equation, and the surroundings feel colder after the reaction occurs since the surroundings lost heat to the reaction.

5. Check all of the following that are true about a **catalyst**:
   - ☑ a. Adding a catalyst increases the rate of a reaction.
   - ☐ b. Adding a catalyst decreases the rate of a reaction.
   - ☐ c. Adding a catalyst increases the activation energy for a reaction.
   - ☑ d. Adding a catalyst decreases the activation energy for a reaction.
   - ☐ e. Adding a catalyst will increase heat of a reaction (ΔH).
   - ☐ f. Adding a catalyst will decrease heat of a reaction (ΔH).
   - ☑ g. A catalyst is never consumed (i.e., used up) in a reaction.
   - ☐ h. A catalyst is always consumed (i.e., used up) in a reaction.
   - ☑ i. A catalyst eases the collision geometry requirement, so more reactants collide as needed.

   A catalyst increases the rate of a reaction by decreasing the activation energy for a reaction and easing the collision geometry requirement. A catalyst is never consumed in the reaction, so it can often be used again and again to catalyze a reaction (e.g. the catalytic converter in your car is used over and over again). A catalyst has no effect on the heat of a reaction (ΔH).

6. Check all of the following that are true for a system at **equilibrium**:
   - ☑ a. The rate of the forward reaction is equal to the rate of the reverse reaction.
   - ☑ b. Reactants are being produced and consumed at the same rate, so the concentration of reactants does not change.
   - ☑ c. Products are being produced and consumed at the same rate, so the concentration of products does not change.
   - ☑ d. The concentration of reactants and products are not changing.
   - ☐ e. The concentration of reactants must be equal to the concentration of products.
   - ☐ f. Since the concentration of reactants and products are not changing, everything has stopped.

   For a system at equilibrium, the rate of the forward reaction is equal to the rate of the reverse reaction. Since reactants and products are being produced and consumed at the same rate, the concentration of reactants and products do not change. However, the concentrations of reactants and products do not have to be equal to one another to remain constant. Finally, while concentrations are not changing, the reactions are still occurring. Nothing has stopped.