32. a. The combustion of gasoline releases heat, so this is an exothermic process.

b. The reaction is very exothermic (heat is released), and SO_{2}(g) will get very hot and possibly boil, as opposed to cooling the mixture. This means of removing heat since the reaction is at equilibrium.

c. The system loses 2 mol of SO_{2}(g) and 1 mol of H_{2}O(l) as a result of the reaction, so the system is at equilibrium.

d. The system releases 2 mol of H_{2}(g) and 1 mol of O_{2}(g) as a result of the reaction, so the system is at equilibrium.

e. The system releases 2 mol of CO_{2}(g) and 1 mol of H_{2}O(l) as a result of the reaction, so the system is at equilibrium.

33. a. The system releases 2 mol of CO_{2}(g) and 1 mol of H_{2}O(l) as a result of the reaction, so the system is at equilibrium.

b. The system releases 2 mol of CO_{2}(g) and 1 mol of H_{2}O(l) as a result of the reaction, so the system is at equilibrium.

c. The system releases 2 mol of CO_{2}(g) and 1 mol of H_{2}O(l) as a result of the reaction, so the system is at equilibrium.

d. The system releases 2 mol of CO_{2}(g) and 1 mol of H_{2}O(l) as a result of the reaction, so the system is at equilibrium.

e. The system releases 2 mol of CO_{2}(g) and 1 mol of H_{2}O(l) as a result of the reaction, so the system is at equilibrium.
...
Heat loss = 5.0 KJ (which is the heat evolved (exothermic reaction) by the combustion of 0.1964 g of gasoline) per liter of solution.

Heat gained by calorimeter = \( \frac{327\text{ C} \times 5.0\text{ KJ}}{156\text{ mL}} = \text{ AV}_\text{ calorimeter} \)

\[ \text{AV} = \frac{327\text{ C}}{156\text{ mL}} \times 5.0\text{ KJ} = 1.017 \text{ KJ} \]

Heat gained by solution = \( 2.95 \times 10^{-1} \times 4.18 \text{ J} \times 2.68 \times 327 \text{ C} \)

Heat lost by solution = \( 2.95 \times 10^{-1} \times 4.18 \text{ J} \times 268 \times 327 \text{ C} \)

Heat lost by water = \( \frac{0.1964 \times 0.973 \times 156 \text{ mL} \times 4.18 \text{ J}}{156 \text{ mL}} = \text{ AV}_\text{ water} \)

\[ \text{AV} = \frac{0.1964 \times 0.973 \times 4.18 \text{ J} \times 156 \text{ mL}}{156 \text{ mL}} = 0.930 \text{ KJ} \]

Heat gained by water = \( 0.926 \text{ KJ} \times 10^{-1} \times 4.18 \text{ J} \times 2.68 \times 327 \text{ C} \)

Heat gained by solution = \( 2.95 \times 10^{-1} \times 4.18 \text{ J} \times 2.68 \times 327 \text{ C} \)

Heat loss by solution = \( 2.95 \times 10^{-1} \times 4.18 \text{ J} \times 268 \times 327 \text{ C} \)

so it is an endothermic process (AV is positive).

Here, since the reaction decreases AH, NO₃⁻ dissolves here but is absorbed as NH₄NO₃ dissolves. To help eliminate sign errors, we will keep all quantities positive (b) and (c), then deduce the correct sign for AH at the end of the problem. To help eliminate sign errors, we will eliminate sign errors. Therefore:

A common error in chemical problems are sign errors. Keeping all quantities positive helps

Heat gained by water = \( \frac{0.926 \times 10^{-1} \times 4.18 \text{ J} \times 2.68 \times 327 \text{ C}}{156 \text{ mL}} = \text{ AV}_\text{ water} \)

Heat gained by solution = \( 2.95 \times 10^{-1} \times 4.18 \text{ J} \times 2.68 \times 327 \text{ C} \)

Heat lost by solution = \( 2.95 \times 10^{-1} \times 4.18 \text{ J} \times 268 \times 327 \text{ C} \)