33. The thermite reaction used in some welding applications has the following enthalpy and entropy changes at 298.15 K. Assuming ΔS and ΔH are constant, calculate ΔG at 448 K.

$Fe_2O_3 + 2Al(s) \longrightarrow 2Fe(s) + Al_2O_3(s)$

$\Delta H^0 = -851.5$ kJ $\Delta S^0 = -38.5$ J/K

34. Rewrite each equation below with the ΔH value included in either the reactants or products, and identify the reaction as endothermic or exothermic.

a. $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$; $\Delta H = -197.8$ kJ

b. $2NO_2(g) \longrightarrow 2NO(g) + O_2(g)$; $\Delta H = +114.2$ kJ

c. $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l)$; $\Delta H = -1411.0$ kJ

35. Calculate the change in enthalpy for the following reaction.

$$4FeO(s) + O_2(g) \longrightarrow 2Fe_2O_3(s)$$

Use the enthalpy-of-formation data listed in Appendix Table A-14.

36. The reaction to synthesize methanol (CH_3OH) industrially is

$$CO(g) + 2H_2(g) \longrightarrow CH_3OH(g).$$

The $\Delta H^0_{reaction} = -90.7$ kJ and the $\Delta S^0_{reaction} = -220.8$ J/K. At what temperatures is the reaction nonspontaneous?

37. What is the main characteristic of a calorimeter in a bomb calorimeter experiment, and why is this characteristic essential?

CRITICAL THINKING

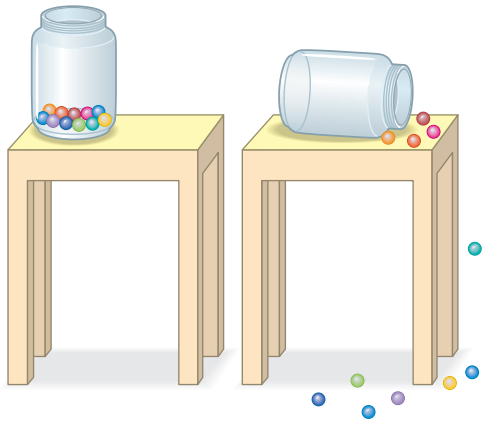
38. Relating Ideas Given the entropy change for the first two reactions below, calculate the entropy change for the third reaction below.

$S_8(s) + 8O_2(s) \longrightarrow 8SO_2(g)$ $\Delta S = 89$ J/K

$2SO_2(s) + O_2(s) \longrightarrow 2SO_3(g)$ $\Delta S = -188$ J/K

$S_8(s) + 12O_2(s) \longrightarrow 8SO_3(g)$ $\Delta S = ?$

39. Interpreting Concepts Look at the two pictures below. Which picture appears to have more order? Why? Are there any similarities between the amount of order the marbles have and the entropy of particles?



(a) (b)

40. Inferring Conclusions A reaction is endothermic and has a $\Delta H = 8$ kJ. This reaction occurs spontaneously at 25°C. What must be true about the entropy change?

41. Inferring Conclusions If both ΔH and ΔS are negative, how does temperature affect spontaneity?

42. Inferring Relationships If the reaction $X \longrightarrow Y$ is spontaneous, what can be said about the reaction $Y \longrightarrow X$?

43. Interpreting Concepts Absolute enthalpy cannot be determined; only change in energy can be measured. However, absolute entropy can be determined. Explain why an absolute entropy can be determined.