Appendix Table A-14. Verify the result by using the general equation for finding enthalpies of reaction from enthalpies of formation.

a. $C_2H_6(g) + O_2(g) \longrightarrow$

b. $C_6H_6(l) + O_2(g) \longrightarrow$

18. The enthalpy of formation of ethanol, C_2H_5OH, is –277.0 kJ/mol at 298.15 K. Calculate the enthalpy of combustion of one mole of ethanol, assuming that the products are $CO_2(g)$ and $H_2O(l)$. (Hint: See Sample Problem C.)

Driving Force of Reactions

SECTION 2 REVIEW

19. Would entropy increase or decrease for changes in state in which the reactant is a gas or liquid and the product is a solid? What sign would the entropy change have?

20. How does an increase in temperature affect the entropy of a system?

21. What combination of ΔH and ΔS values always produces a negative free-energy change?

22. Explain the relationship between temperature and the tendency for reactions to occur spontaneously.

PRACTICE PROBLEMS

23. A reaction has $\Delta H = -356$ kJ and $\Delta S = -36$ J/K. Calculate ΔG at 25°C to confirm that the reaction is spontaneous.

24. A reaction has $\Delta H = 98$ kJ and $\Delta S = 292$ J/K. Investigate the spontaneity of the reaction at room temperature. Would increasing the temperature have any effect on the spontaneity of the reaction?

25. A reaction has $\Delta H = -76$ kJ and $\Delta S = -117$ J/K. Calculate ΔG for the reaction at 298.15 K. Is the reaction spontaneous?

26. The gas-phase reaction of H_2 with CO_2 to produce H_2O and CO has $\Delta H = 11$ kJ and $\Delta S = 41$ J/K. Is the reaction spontaneous at 298.15 K? What is ΔG?

27. Based on the following values, compute ΔG values for each reaction and predict whether the reaction will occur spontaneously. (Hint: See Sample Problem D.)

a. $\Delta H = +125$ kJ, T = 293 K, $\Delta S = 0.0350$ kJ/K

b. $\Delta H = -85.2$ kJ, T = 127°C, $\Delta S = 0.125$ kJ/K

c. $\Delta H = -275$kJ, T = 773 K, $\Delta S = 0.450$ kJ/K

28. The ΔS^0 for the reaction shown, at 298.15 K, is 0.003 00 kJ/(mol•K). Calculate the ΔG^0 for this reaction, and determine whether it will occur spontaneously at 298.15 K.

$C(s) + O_2(g) \longrightarrow CO_2(g) + 393.51$ kJ

MIXED REVIEW

29. When graphite reacts with hydrogen at 300 K, ΔH is –74.8 kJ and ΔS is –0.0809 kJ/K. Will this reaction occur spontaneously?

30. How might you change reaction conditions to induce an endothermic reaction that does not occur naturally?

31. The diagram below represents an interpretation of Hess's law for the following reaction.

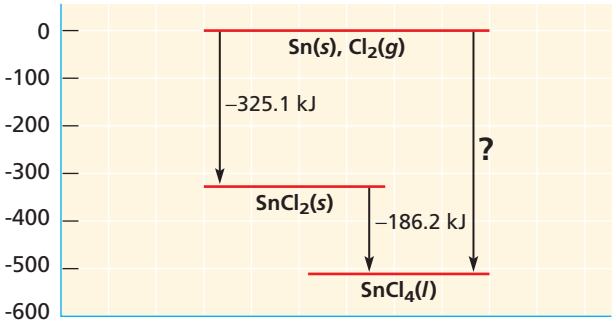
$Sn(s) + 2Cl_2(g) \longrightarrow SnCl_4(l)$

Use the diagram to determine ΔH for each step and the net reaction.

$Sn(s) + Cl_2(g) \longrightarrow SnCl_2(s)$ $\Delta H = ?$

$SnCl_2(l) + Cl_2(g) \longrightarrow SnCl_4(s)$ $\Delta H = ?$

$Sn(s) + 2Cl_2(g) \longrightarrow SnCl_4(l)$ $\Delta H = ?$



32. The standard enthalpy of formation for sulfur dioxide gas is –296.8 kJ/mol. Calculate the amount of energy given off in kJ when 30.0 g of $SO_2(g)$ is formed from its elements.