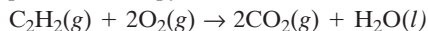
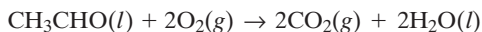


Use enthalpies of combustion for  $\text{C}_2\text{H}_2$  and  $\text{CH}_3\text{CHO}$  to compute the enthalpy of the above reaction.

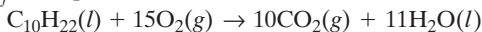


$$\Delta H = -1299.6 \text{ kJ/mol}$$

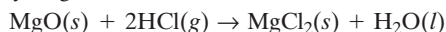


$$\Delta H = -1166.9 \text{ kJ/mol}$$

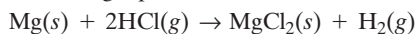
495. Calculate the enthalpy for the combustion of decane.  $\Delta H_f^\circ$  for liquid decane is  $-300.9 \text{ kJ/mol}$ .



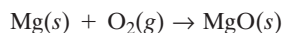
496. Find the enthalpy of the reaction of magnesium oxide with hydrogen chloride:



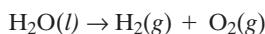
Use the following equations and data.



$$\Delta H = -456.9 \text{ kJ/mol}$$

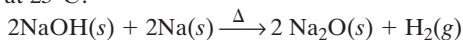


$$\Delta H = -601.6 \text{ kJ/mol}$$



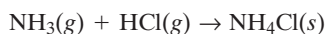
$$\Delta H = +285.8 \text{ kJ/mol}$$

497. What is the free energy change for the following reaction at  $25^\circ\text{C}$ ?



$$\Delta S = 10.6 \text{ J/mol}\cdot\text{K} \quad \Delta H_{f,\text{NaOH}}^\circ = -425.9 \text{ kJ/mol}$$

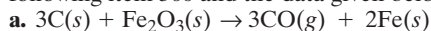
498. The following equation represents the reaction between gaseous  $\text{HCl}$  and gaseous ammonia to form solid ammonium chloride:



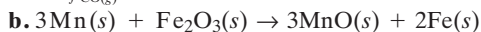
Calculate the entropy change in  $\text{J/mol}\cdot\text{K}$  for the reaction of hydrogen chloride and ammonia at  $25^\circ\text{C}$  using the following data and the table following item 500.

$$\Delta G = -91.2 \text{ kJ/mol}$$

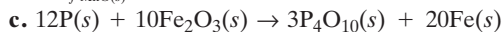
499. The production of steel from iron involves the removal of many impurities in the iron ore. The following equations show some of the purifying reactions. Calculate the enthalpy for each reaction. Use the table following item 500 and the data given below.



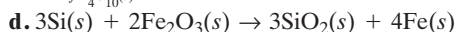
$$\Delta H_{f,\text{CO}(\text{g})}^\circ = -110.53 \text{ kJ/mol}$$



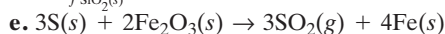
$$\Delta H_{f,\text{MnO}(\text{s})}^\circ = -384.9 \text{ kJ/mol}$$



$$\Delta H_{f,\text{P}_4\text{O}_{10}(\text{s})}^\circ = -3009.9 \text{ kJ/mol}$$

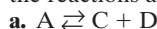


$$\Delta H_{f,\text{SiO}_2(\text{s})}^\circ = -910.9 \text{ kJ/mol}$$



## Equilibrium: Chap. 18, Sec. 1

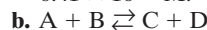
500. Calculate the equilibrium constants for the following hypothetical reactions. Assume that all components of the reactions are gaseous.



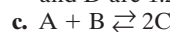
For problems 498–499

Substance	$\Delta H_f^\circ$ (kJ/mol)	Substance	$\Delta H_f^\circ$ (kJ/mol)
$\text{NH}_3(\text{g})$	-45.9	$\text{HF}(\text{g})$	-273.3
$\text{NH}_4\text{Cl}(\text{s})$	-314.4	$\text{H}_2\text{O}(\text{g})$	-241.82
$\text{NH}_4\text{F}(\text{s})$	-125	$\text{H}_2\text{O}(\text{l})$	-285.8
$\text{NH}_4\text{NO}_3(\text{s})$	-365.56	$\text{H}_2\text{O}_2(\text{l})$	-187.8
$\text{Br}_2(\text{l})$	0.00	$\text{H}_2\text{SO}_4(\text{l})$	-813.989
$\text{CaCO}_3(\text{s})$	-1207.6	$\text{FeO}(\text{s})$	-825.5
$\text{CaO}(\text{s})$	-634.9	$\text{Fe}_2\text{O}_3(\text{s})$	-1118.4
$\text{CH}_4(\text{g})$	-74.9	$\text{MnO}_2(\text{s})$	-520.0
$\text{C}_3\text{H}_8(\text{g})$	-104.7	$\text{N}_2\text{O}(\text{g})$	+82.1
$\text{CO}_2(\text{g})$	-393.5	$\text{O}_2(\text{g})$	0.00
$\text{F}_2(\text{g})$	0.00	$\text{Na}_2\text{O}(\text{s})$	-414.2
$\text{H}_2(\text{g})$	0.00	$\text{Na}_2\text{SO}_3(\text{s})$	-1101
$\text{HBr}(\text{g})$	-36.29	$\text{SO}_2(\text{g})$	-296.8
$\text{HCl}(\text{g})$	-92.3	$\text{SO}_3(\text{g})$	-395.7

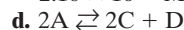
At equilibrium, the concentration of A is  $2.24 \times 10^{-2} \text{ M}$  and the concentrations of both C and D are  $6.41 \times 10^{-3} \text{ M}$ .



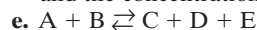
At equilibrium, the concentrations of both A and B are  $3.23 \times 10^{-5} \text{ M}$  and the concentrations of both C and D are  $1.27 \times 10^{-2} \text{ M}$ .



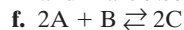
At equilibrium, the concentrations of both A and B are  $7.02 \times 10^{-3} \text{ M}$  and the concentration of C is  $2.16 \times 10^{-2} \text{ M}$ .



At equilibrium, the concentration of A is  $6.59 \times 10^{-4} \text{ M}$ . The concentration of C is  $4.06 \times 10^{-3} \text{ M}$ , and the concentration of D is  $2.03 \times 10^{-3} \text{ M}$ .



At equilibrium, the concentrations of both A and B are  $3.73 \times 10^{-4} \text{ M}$  and the concentrations of C, D, and E are  $9.35 \times 10^{-4} \text{ M}$ .



At equilibrium, the concentration of A is  $5.50 \times 10^{-3} \text{ M}$ , the concentration of B is  $2.25 \times 10^{-3}$ , and the concentration of C is  $1.02 \times 10^{-2} \text{ M}$ .

501. Calculate the concentration of product D in the following hypothetical reaction:



At equilibrium, the concentration of A is  $1.88 \times 10^{-1} \text{ M}$ , the concentration of C is  $6.56 \text{ M}$ , and the equilibrium constant is  $2.403 \times 10^2$ .

502. At a temperature of  $700 \text{ K}$ , the equilibrium constant is  $3.164 \times 10^3$  for the following reaction system for the hydrogenation of ethene,  $\text{C}_2\text{H}_4$ , to ethane,  $\text{C}_2\text{H}_6$ :

