

## Self Assessment A (Chemistry by Rymond Chang)

- $\text{C}_3\text{H}_8(\text{g})$ ,  $\text{C}_2\text{H}_4(\text{g})$ ,  $\text{ZnS}(\text{s})$ , and  $\text{H}_2\text{O}(\text{l})$ .

- 3.** Determine  $\Delta S^\circ$  for the reaction  $\text{SO}_3(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{SO}_4(\text{l})$ .

	$S^\circ(\text{J/K}\cdot\text{mol})$
$\text{SO}_3$	256.2
$\text{H}_2\text{O}$	69.9
$\text{H}_2\text{SO}_4$	156.9

- A. 169.2 J/K·mol                      B. 1343.2 J/K·mol                      C. -169.2 J/K·mol  
D. -29.4 J/K·mol                      E. 29.4 J/K·mol

4. A negative sign for  $\Delta G$  indicates that, at constant T and P,
- A. the reaction is exothermic.
  - B. the reaction is endothermic.
  - C. the reaction is fast.
  - D. the reaction is spontaneous.
  - E.  $\Delta S$  must be  $> 0$ .

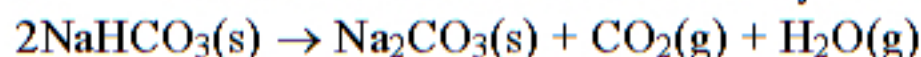
5. Ozone ( $\text{O}_3$ ) in the atmosphere can reaction with nitric oxide (NO):



Calculate the  $\Delta G^\circ$  for this reaction at  $25^\circ\text{C}$ . ( $\Delta H^\circ = -199 \text{ kJ/mol}$ ,  $\Delta S^\circ = -4.1 \text{ J/K}\cdot\text{mol}$ )

- A.  $1020 \text{ kJ/mol}$                       B.  $-1.22 \times 10^3 \text{ kJ/mol}$                       C.  $2.00 \times 10^3 \text{ kJ/mol}$   
D.  $-1.42 \times 10^3 \text{ kJ/mol}$                       E.  $-198 \text{ kJ/mol}$

6. Sodium carbonate can be made by heating sodium bicarbonate:



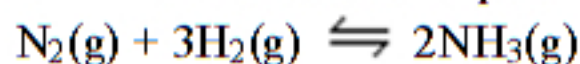
Given that  $\Delta H^\circ = 128.9 \text{ kJ/mol}$  and  $\Delta G^\circ = 33.1 \text{ kJ/mol}$  at  $25^\circ\text{C}$ , above what minimum temperature will the reaction become spontaneous under standard state conditions?

- A.  $0.4 \text{ K}$     B.  $3.9 \text{ K}$     C.  $321 \text{ K}$     D.  $401 \text{ K}$     E.  $525 \text{ K}$

7. For the reaction  $\text{H}_2(\text{g}) + \text{S}(\text{s}) \rightarrow \text{H}_2\text{S}(\text{g})$ ,  $\Delta H^\circ = -20.2 \text{ kJ/mol}$  and  $\Delta S^\circ = +43.1 \text{ J/K}\cdot\text{mol}$ . Which of the following statements is *true*?

- A. The reaction is only spontaneous at low temperatures.  
B. The reaction is spontaneous at all temperatures.  
C.  $\Delta G^\circ$  becomes less favorable as temperature increases.  
D. The reaction is spontaneous only at high temperatures.  
E. The reaction is at equilibrium at  $25^\circ\text{C}$  under standard conditions.

8. Determine the equilibrium constant  $K_p$  at  $25^\circ\text{C}$  for the reaction



$$(\Delta G^\circ_f(\text{NH}_3(\text{g})) = -16.6 \text{ kJ/mol})$$

- A.  $1.52 \times 10^{-6}$                       B.  $6.60 \times 10^5$                       C.  $8.28 \times 10^{-2}$                       D.  $2.60$                       E.  $13.4$

9. For the reaction  $2\text{C}(\text{graphite}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_2(\text{g})$ ,  $\Delta G^\circ = +209.2 \text{ kJ/mol}$  at  $25^\circ\text{C}$ . If  $P(\text{H}_2) = 100. \text{ atm}$ , and  $P(\text{C}_2\text{H}_2) = 0.10 \text{ atm}$ , calculate  $\Delta G$  for this reaction.

- A.  $+207.8 \text{ kJ/mol}$                       B.  $+226.3 \text{ kJ/mol}$                       C.  $+192.1 \text{ kJ/mol}$                       D.  $+17.3 \text{ kJ/mol}$   
E.  $-16.9 \text{ kJ/mol}$ .

10. The reaction rates of many spontaneous reactions are actually very slow. Which of the following is the best explanation for this observation?
- A.  $K_p$  for the reaction is less than one.
  - B. The activation energy of the reaction is large.
  - C.  $\Delta G^\circ$  for the reaction is positive.
  - D. Such reactions are endothermic.
  - E. The entropy change is negative.