Name _____

AP Chemistry: Thermodynamics (II) ΔS and ΔG
Multiple Choice

	Energy	Entropy
(A)	Remains constant	Remains constant
(B)	Remains constant	Decreases
(C)	Remains constant	Increases
(D)	Decreases	Increases
(E)	Increases	Decreases

56. A cube of ice is added to some hot water in a rigid, insulated container, which is then sealed. There is no heat exchange with the surroundings. What has happened to the total energy and the total entropy when the system reaches equilibrium?

41. Which of the following reactions has the largest positive value of ΔS per mole of Cl_2 ?

(A) $H_{2(g)} + Cl_{2(g)} \rightarrow 2\ HCl_{(g)}$ (B) $Cl_{2(g)} + 1/2\ O_{2(g)} \rightarrow Cl_2O_{(g)}$ (C) $Mg_{(s)} + Cl_{2(g)} \rightarrow MgCl_{2(s)}$

(D) $2\ NH_4Cl_{(s)} \rightarrow N_{2(g)} + 4\ H_{2(g)} + Cl_{2(g)}$ (E) $Cl_{2(g)} \rightarrow 2\ Cl_{(g)}$

53. Which of the following must be true for a reaction that proceeds spontaneously from initial standard state conditions?

(A) $\Delta G° > 0$ and $K_{eq} > 1$ (B) $\Delta G° > 0$ and $K_{eq} < 1$ (C) $\Delta G° < 0$ and $K_{eq} > 1$

(D) $\Delta G° < 0$ and $K_{eq} < 1$ (E) $\Delta G° = 0$ and $K_{eq} = 1$

70. $H_2O_{(s)} \rightarrow H_2O_{(l)}$

When ice melts at its normal melting point, 273.16 K and 1 atmosphere, which of the following is true for the process shown above?

(A) $\Delta H < 0, \Delta S > 0, \Delta V > 0$ (B) $\Delta H < 0, \Delta S < 0, \Delta V > 0$ (C) $\Delta H > 0, \Delta S < 0, \Delta V < 0$

(D) $\Delta H > 0, \Delta S > 0, \Delta V > 0$ (E) $\Delta H > 0, \Delta S > 0, \Delta V < 0$

35. For which of the following processes would ΔS have a negative value?

I. $2\ Fe_2O_{3(s)} \rightarrow 4\ Fe_{(s)} + 3\ O_{2(g)}$

II. $Mg^{2+} + 2\ OH^- \rightarrow Mg(OH)_{2(s)}$

III. $H_{2(g)} + C_2H_{4(g)} \rightarrow 3\ C2H6_{(g)}$

(A) I only (B) I and II only (C) I and III only (D) II only (E) I, II, and III

58. $N_2(g) + 3\ H_{2(g)} \rightarrow 2\ NH_{3(g)}$

The reaction indicated above is thermodynamically spontaneous at 298 K, but becomes nonspontaneous at higher temperatures. Which of the following is true at 298 K?

(A) ΔG, ΔH, and ΔS are all positive. (B) ΔG, ΔH, and ΔS are all negative.

(C) ΔG and ΔH are negative, but ΔS is positive. (D) ΔG and ΔS are negative, but ΔH is positive.

(E) ΔG and ΔH are positive, but ΔS is negative.

	ΔH	ΔS
(A)	Positive	Positive
(B)	Positive	Negative
(C)	Positive	Equal to zero
(D)	Negative	Positive
(E)	Negative	Negative

66. When solid ammonium chloride, $NH_4Cl_{(s)}$ is added to water at 25 °C, it dissolves and the temperature of the solution decreases. Which of the following is true for the values of ΔH and ΔS for the dissolving process?

22. Of the following reaction, which involves the largest decrease in entropy?

(A) $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$ (B) $2\ CO_{(g)} + O_{2(g)} \rightarrow 2\ CO_{2(g)}$

(C) $Pb(NO_3)_{3(aq)} + 2\ KI_{(aq)} \rightarrow PbI_{2(s)} + 2\ KNO_{3(aq)}$ (D) $C_3H_{8(g)} + O_{2(g)} \rightarrow 3\ CO_{2(g)} + 4\ H_2O_{(g)}$

(E) $4\ La_{(s)} + 3\ O_{2(g)} \rightarrow 2\ La_2O_{3(s)}$

41. When solid NH_4SCN is mixed with solid $Ba(OH)_2$ in a closed container, the temperature drops and a gas is produced. Which of the following indicates the correct signs for ΔG, ΔH, and ΔS for the process?

	ΔG	ΔH	ΔS
(A)	−	−	−
(B)	−	+	−
(C)	−	+	+
(D)	+	−	+
(E)	+	−	−

73. $X_{(s)} \rightleftarrows X_{(l)}$

Which of the following is true for any substance undergoing the process represented above at its normal melting point?

(A) $\Delta S < 0$ (B) $\Delta H = 0$ (C) $\Delta H = T\Delta G$ (D) $T\Delta S = 0$ (E) $\Delta H = T\Delta S$