44. The reaction between ammonia and oxygen is given: $2\ NH_3(g) + 2\ O_2(g) \rightarrow N_2O(g) + 3\ H_2O(l)$. We therefore know that which of the following reactions can also occur?

a) $4\ NH_3(g) + 5\ O_2(g) \rightarrow 4\ NO(g) + 6\ H_2O(g)$
b) $4\ NO(g) + 6\ H_2O(g) \rightarrow 4\ NH_3(g) + 5\ O_2(g)$
c) $N_2O(g) + 3\ H_2O(l) \rightarrow 2\ NH_3(g) + 2\ O_2(g)$
d) none of the above

45. The equilibrium constant, K_c, for the reaction $2\ CH_2Cl_2(g) \leftrightarrow CH_4(g) + CCl_4(g)$ is 2×10^2 at some specific temperature. Assuming that you start with only CH_2Cl_2, describe the relative abundance of each species present at equilibrium.

a) $[CH_4]$ and $[CCl_4]$ will be significantly smaller than $[CH_2Cl_2]$.
b) $[CH_4]$ and $[CCl_4]$ will be significantly larger than $[CH_2Cl_2]$.
c) $[CH_4]$ and $[CCl_4]$ will be approximately equal to $[CH_2Cl_2]$.
d) Can't tell without more information.

46. The equilibrium constant, K_c, for the reaction $2\ SO_3(g) \leftrightarrow 2\ SO_2(g) + O_2(g)$ is 6.34×10^{-2} at 1110 K. What is the value of K_c at this temperature for the related reaction $SO_3(g) \leftrightarrow SO_2(g) + 1/2\ O_2(g)$?

a) 6.34×10^{-2} b) 3.17×10^{-2} c) 4.02×10^{-3} d) 0.252

47. The equilibrium constant, K_c, for the reaction $NH_4Cl(s) \leftrightarrow NH_3(g) + HCl(g)$ is 5.10×10^{-6} at 298K. If an equilibrium mixture of the three compounds in a 7.41 L container at 298K contains 2.89 mol of $NH_4Cl(s)$ and 0.237 mol of NH_3, the number of moles of HCl present is:

a) 1.18×10^{-3} moles b) 1.59×10^{-4} moles c) 2.15×10^{-5} moles d) 6.22×10^{-5} moles

48. A student ran the reaction $2\ CH_2Cl_2(g) \leftrightarrow CH_4(g) + CCl_4(g)$ in the laboratory at 300 K. When she introduced 8.55×10^{-2} moles of $CH_2Cl_2(g)$ into a 1.00 Liter container, she found the equilibrium concentration of $CCl_4(g)$ to be 3.92×10^{-2} M. Calculate the K_c she obtained for this reaction.

a) 0.717 b) 30.5 c) 0.210 d) 0.458 e) 5.52

49. Consider the reaction $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$ where $K_p = 0.497$ at 500 K. If the three gases are mixed in a rigid container so that the partial pressure of each gas is initially 1.00 atm, which is true?

a) A reaction will occur in which more PCl_3 is produced.
b) Q is greater than K so the reaction will go forward.
c) The reaction is at equilibrium. No further reaction will occur.
d) A reaction will occur in which more $PCl_5(g)$ is produced.
e) K_p will decrease.

50. A student determines the value of the equilibrium constant for the reaction $CO(g) + 3\ H_2(g) \leftrightarrow CH_4(g) + H_2O(g)$ to be 1.56×10^{25}. Based on this value of K_{eq} the $\Delta G°$ for this reaction is expected to be:

a) greater than zero b) less than zero c) approximately equal to zero

51. NO_2 is a reddish brown gas while N_2O_4 is colorless. At high temperature the red color is strong. At low temperature the gas has less color. If the reaction is written $2\ NO_2(g) \leftrightarrow N_2O_4(g)$ we can conclude that this reaction is:

a) endothermic
b) exothermic
c) neither exothermic nor endothermic
d) more info is needed to answer this question

52. The equilibrium constant, K_c, for the reaction $2\ HI\ (g) \leftrightarrow H_2(g) + I_2(g)$ is 1.80×10^{-2} at 698 K. Calculate the equilibrium concentration of I_2 if 0.328 moles of HI is initially introduced into 1.00 L vessel at 698 K.

a) 0.259 M b) 0.328 c) 0.0347 M d) 0.0768

53. Consider the reaction $2\ SO_3(g) \leftrightarrow 2\ SO_2(g) + O_2(g)$ where $K_c = 2.90 \times 10^{-2}$ at 1150 K. A reaction mixture was found to contain 3.85×10^{-2} moles of $SO_3(g)$, 4.10×10^{-2} moles of $SO_2(g)$, and 4.52×10^{-2} moles of $O_2(g)$, in a 1.00 Liter container. Is the reaction at equilibrium, and if not, what direction must it run in order to reach equilibrium?

a) The reaction must run in the forward direction to reach equilibrium.
b) The reaction is at equilibrium.
c) Not enough information is available to make a prediction.
d) The reaction must run in the reverse direction to reach equilibrium.

54. Consider the following system at equilibrium where $\Delta H° = 18.8$ kJ, and $K_c = 9.52 \times 10^{-2}$, at 350 K:

$$CH_4(g) + CCl_4(g) \leftrightarrow 2\ CH_2Cl_2(g)$$

When 0.35 moles of $CH_2Cl_2(g)$ are added to an equilibrium system at constant temperature what happens?

a) The value of K_c increases.
b) The value of Q is greater than K.
c) The reaction must run in the forward direction to re-establish equilibrium.
d) The concentration of CCl_4 will decrease.

55. Consider the following system at equilibrium where $\Delta H° = 111$ kJ/mol, and $K_c = 6.30$, at 723 K:

$$2\ NH_3(g) \leftrightarrow N_2(g) + 3H_2(g)$$

If the VOLUME of the equilibrium system is suddenly decreased at constant temperature:

a) the value of K_c will increase.
b) the value of Q becomes less than K.
c) the reaction must run in the reverse direction to re-establish equilibrium.
d) the number of moles of H_2 will increase.

56. Consider the following system at equilibrium where $\Delta H° = 87.9$ kJ, and $K_c = 1.20 \times 10^{-2}$, at 500 K:

$$PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$$

If the temperature of a system at equilibrium is suddenly increased:

a) the value of K_c suddenly increases.
b) the value of Q suddenly becomes greater than K.
c) the reaction must remain the same - already at equilibrium.
d) the concentration of Cl_2 will start to decrease.

57. Consider the reaction $CO(g) + Cl_2(g) \leftrightarrow COCl_2(g)$ at equilibrium where $K_c = 77.5$ and $\Delta H° = -108$ kJ/mol at 600 K. The production of $COCl_2(g)$ is favored by:

a) increasing the temperature.
b) increasing the pressure (by changing the volume).
c) increasing the volume.
d) adding $COCl_2$.
e) removing Cl_2.

58. For the reaction $I_2(g) + Cl_2(g) \leftrightarrow 2\ ICl(g)$, $\Delta H° = -26.8$ kJ and $\Delta S° = 0.0114$ kJ/K. What is the equilibrium constant for this reaction at 324 K? Assume that $\Delta H°$ and $\Delta S°$ are independent of temperature.

a) 5.73×10^{-14} b) 30.5 c) 1.21×10^{-5} d) 1.74×10^{13} e) 8.25×10^{4}

59. Which version of the quiz do you have?

a) **Version A** b) Version B

KEY:

44)c 45)b 46)d 47)a 48)b 49)d 50)b 51)b 52)c 53)d 54)b 55)c 56)a 57)b 58)e 59)a