Multiple Choice

1. For the reaction:

$$BrO_3^- + 5Br^- + 6H+ \rightarrow 3Br_2 + 3H_2O$$

The value of $-\Delta[Br^-]/\Delta t = 7.5\times10^{-2}$ mol L^{-1} s^{-1} at a particular time. What will be the value of $\Delta[Br_2]/\Delta t$ at the same instant (in mol L^{-1} s^{-1})?

A) 1.25×10^{-2} B) 1.5×10^{-2} C) 4.5×10^{-2} D) 1.25×10^{-1}

2. Nitric oxide reacts with chlorine to form nitrosyl chloride.

$$NO + 1/2Cl_2 \rightarrow NOCl$$

Use the following data to determine the rate law (rate equation) for this reaction:

Experiment	[NO]	$[Cl_2]$	Initial rate
1	0.22	0.064	0.96 mol L^{-1} min^{-1}
2	0.66	0.064	8.64 mol L^{-1} min^{-1}
3	0.22	0.032	0.48 mol L^{-1} min^{-1}

A) Rate = $k\,[NO]^2\,[Cl_2]^2$ B) Rate = $k\,[NO]^2\,[Cl_2]^{1/2}$
C) Rate = $k\,[NO]\,[Cl_2]^{1/2}$ D) Rate = $k\,[NO]^2\,[Cl_2]$

3. At 25°C, the rate constant for the first order decomposition of a pesticide solution is 6.4×10^{-3} min^{-1}. If the starting concentration of pesticide is 0.0314 mol L^{-1}. What concentration (in mol L^{-1}) will remain after 62.0 min at 25°C?

A) 0.011 B) 0.0131 C) 0.0191 D) 0.0211

4. The reaction $2A \rightarrow B$ is first order in A with a rate constant of 2.8×10^{-2} s^{-1}. How long (in seconds) will it take for A to decrease from 0.88 mol L^{-1} to 0.14 mol L^{-1}?

A) 59.5 B) 65.7 C) 74.8 D) 88.6

5. Which of the following would alter the value of the rate constant (k) for the reaction?

$$2A + B \rightarrow \text{products}$$

A) Increasing the concentration of A only.
B) Increasing the concentration of B only.
C) Increasing the concentration of both A and B.
D) Increasing the temperature.

6. Which is the correct equilibrium constant expression for the following reaction?

$$Fe_2O_3(s) + 3H_2(g) \rightleftharpoons 2Fe(s) + 3H_2O(g)$$

A) $K_c = [H_2O]^3 / [H_2]^3$ B) $K_c = [Fe]^2\,[H_2O]^3 / [Fe_2O_3]\,[H_2]^3$
C) $K_c = [Fe_2O_3]\,[H_2]^3 / [Fe]^2\,[H_2O]^3$ D) $K_c = [H_2O] / [H_2]$

7. Consider the following equilibria:

$$SO_2(g) + 1/2O_2(g) \rightleftharpoons SO_3(g) \qquad K_1$$

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g) \qquad K_2$$

The values of the equilibrium constants K_1 and K_2 are related by:

A) $K_2 = (K_1)^2$ B) $(K_2)^2 = K_1$ C) $K_2 = (K_1)^{-2}$ D) $K_2 = (K_1)^{-1}$

8. For the following reaction $K_c = 1.2\times10^{-4}$ at 295.0 K.

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

Calculate (in atm) the partial pressure of NH_3 gas at equilibrium.

A) 0.117 B) 0.265 C) 0.344 D) 0.424

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9. Consider the following reaction at equilibrium:

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $\Delta Hr\times n = -198$ kJ

Which of the following statements could be true?

1) K_p increases with decreasing temperature.
2) K_p increases with increasing temperature.
3) K_p increases with decreasing total pressure.
4) K_p increases with increasing total pressure.

A) 1 only B) 1 and 4 C) 2 only D) 2 and 3

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10. The isomerization of cyclopropane follows first order kinetics. The rate constant at 700 K is 6.2×10^{-4} min^{-1}, and the half life at 760 K is 29.0 min. Calculate (in kJ/mol) the activation energy for this reaction.

A) 269.2 B) 250.6 C) 240.8 D) 283.4

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11. The unit for a third order reaction rate constant is:

A) s^{-1} B) $mol^{-2}\ L^2\ s^{-1}$ C) $mol^2\ L^{-2}\ s^{-1}$ D) $mol^3\ L^{-3}\ s^{-1}$

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12. 4.21 moles of S_2Cl_4 gas are introduced in 2.0 L vessel. The reaction

$$S_2Cl_4(g) \rightleftharpoons 2SCl_2(g)$$

Comes to equilibrium and 1.25 moles of S_2Cl_4 are found in the reaction vessel. Calculate K_c for the reaction.

A) 14.0 B) 17.0 C) 19.5 D) 21.5

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13. At 700 K, the reaction

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

has an equilibrium constant $K_c = 4.3\times10^6$, and the following concentrations are present: $[SO_2] = 0.01$ M; $[SO_3] = 10.0$ M and $[O_2] = 0.10$ M

Therefore:

A) The reaction mixture is at equilibrium.
B) The reaction must proceed to the right to reach equilibrium.
C) The reaction must proceed to the left to reach equilibrium.
D) There is not enough information to answer.

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14. What is the pH of 1.0 L buffer solution that is 0.12 M lactic acid, $HC_3H_5O_3$, and 0.10 M sodium lactate, $NaC_3H_5O_3$, after the addition of 0.01 mole of gaseous HCl (assuming that this will not change the volume of the solution)? For lactic acid: $K_a = 1.4\times10^{-4}$.

A) 3.27 B) 3.45 C) 3.69 D) 3.95

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15. The conjugated acid of NH_2^- is:

A) HNO_3 B) HNO_2 C) NH_4^+ D) NH_3

16. The pOH of 2.5×10^{-3} M $Ba(OH)_2$ solution is:

A) 5.0 B) 2.5 C) 2.3 D) 2.1

17. The pH of 100 ml of 0.002 M HCl solution is:

A) 0.27 B) 2.0 C) 0.2 D) 2.7

18. The pH of 1.6 M KOH solution is:

A) 13.8 B) 14.2 C) 12.4 D) 1.6

19. The pH of 0.05 M acetic acid ($K_a = 1.8\times10^{-5}$) solution is:

A) 3 B) 4 C) 5 D) 6

20. The pH of 0.1 M ammonia ($K_b = 1.8\times10^{-5}$) solution is:

A) 2.87 B) 11.13 C) 8.94 D) 12.56