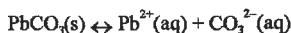


1. Which K_{sp} value indicates a salt with the greatest solubility in water?

- (1) 4.0×10^{-10} (3) 2.0×10^{-6}
 (2) 3.0×10^{-8} (4) 1.0×10^{-4}

2. Given the system at equilibrium:



How will the addition of $\text{Na}_2\text{CO}_3(\text{aq})$ affect $[\text{Pb}^{2+}](\text{aq})$ and the mass of $\text{PbCO}_3(\text{s})$?

- (1) $[\text{Pb}^{2+}](\text{aq})$ will increase and the mass of $\text{PbCO}_3(\text{s})$ will increase.
 (2) $[\text{Pb}^{2+}](\text{aq})$ will increase and the mass of $\text{PbCO}_3(\text{s})$ will decrease.
 (3) $[\text{Pb}^{2+}](\text{aq})$ will decrease and the mass of $\text{PbCO}_3(\text{s})$ will increase.
 (4) $[\text{Pb}^{2+}](\text{aq})$ will decrease and the mass of $\text{PbCO}_3(\text{s})$ will decrease.

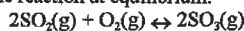
3. Given the reaction:



Which change would cause an immediate increase in the rate of the forward reaction?

- (1) decreasing the reaction temperature
 (2) decreasing the reaction pressure
 (3) increasing the concentration of $\text{NO}(\text{g})$
 (4) increasing the concentration of $\text{N}_2(\text{g})$

4. Given the reaction at equilibrium:



Which is the correct equilibrium constant expression for the reaction?

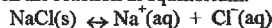
(1)
$$K_{eq} = \frac{[2\text{SO}_3]}{[2\text{SO}_2] + [\text{O}_2]}$$

(2)
$$K_{eq} = \frac{[\text{SO}_3]}{[\text{SO}_2][\text{O}_2]}$$

(3)
$$K_{eq} = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$$

(4)
$$K_{eq} = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 + [\text{O}_2]}$$

5. Given the reaction at equilibrium:



The addition of KCl to this system will cause a shift in the equilibrium to the

- (1) left, and the concentration of the $\text{Na}^+(\text{aq})$ ions will increase
 (2) right, and the concentration of the $\text{Na}^+(\text{aq})$ ions will increase
 (3) left, and the concentration of the $\text{Na}^+(\text{aq})$ ions will decrease
 (4) right, and the concentration of the $\text{Na}^+(\text{aq})$ ions will decrease

6. Which equilibrium constant indicates an equilibrium mixture that consists largely of products?

- (1) $K = 1 \times 10^0$ (3) $K = 3 \times 10^{-14}$
 (2) $K = 2 \times 10^{10}$ (4) $K = 4 \times 10^{-23}$

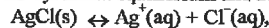
7. The value of the equilibrium constant of a chemical reaction will change when there is an increase in the

- (1) concentration of the products (3) pressure
 (2) concentration of the reactants (4) temperature

8. A chemical reaction has reached equilibrium when

- (1) the reverse reaction begins
 (2) the forward reaction ceases
 (3) the concentrations of the reactants and products become equal
 (4) the concentrations of the reactants and products become constant

9. Given the system at equilibrium and 25°C :



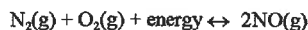
Which change will affect the value of the solubility product, K_{sp} for $\text{AgCl}(\text{s})$?

- (1) increasing the temperature of the AgCl solution
 (2) increasing the amount of $\text{AgCl}(\text{s})$
 (3) decreasing the concentration of $\text{Cl}^-(\text{aq})$
 (4) decreasing the concentration of $\text{Ag}^+(\text{aq})$

10. Which factors must be equal in a reversible chemical reaction at equilibrium?

- (1) the activation energies of the forward and reverse reactions
 (2) the rates of reaction of the forward and reverse reactions
 (3) the concentrations of the reactants and products
 (4) the potential energies of the reactants and products

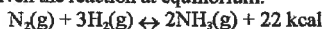
11. Given the reaction at equilibrium:



Which change will result in a decrease in the amount of $\text{NO}(\text{g})$ formed?

- (1) increasing the temperature
 (2) increasing the concentration of $\text{O}_2(\text{g})$
 (3) decreasing the concentration of $\text{N}_2(\text{g})$
 (4) decreasing the pressure

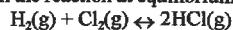
12. Given the reaction at equilibrium:



Which stress would cause the equilibrium to shift to the left?

- (1) increasing the pressure (3) adding $\text{H}_2(\text{g})$ to the system
 (2) increasing the temperature (4) adding $\text{N}_2(\text{g})$ to the system

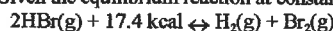
13. Given the reaction at equilibrium:



As the pressure increases at constant temperature, the number of moles of HCl

- (1) decreases (3) remains the same
 (2) increases

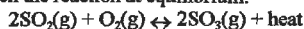
14. Given the equilibrium reaction at constant pressure:



When the temperature is increased, the equilibrium will shift to the

- (1) left, and the concentration of $\text{HBr}(\text{g})$ will decrease
 (2) left, and the concentration of $\text{HBr}(\text{g})$ will increase
 (3) right, and the concentration of $\text{HBr}(\text{g})$ will decrease
 (4) right, and the concentration of $\text{HBr}(\text{g})$ will increase

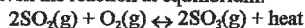
15. Given the reaction at equilibrium:



Which change will shift the equilibrium to the right?

- (1) decreasing the pressure (3) increasing the temperature
 (2) decreasing $[\text{SO}_2]$ (4) increasing $[\text{O}_2]$

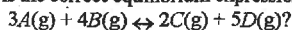
16. Given the reaction at equilibrium:



Which change will shift the equilibrium to the right?

- (1) increasing the pressure (3) decreasing the amount of $\text{O}_2(\text{g})$
 (2) increasing the temperature (4) decreasing the amount of $\text{SO}_2(\text{g})$

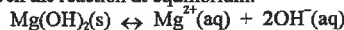
17. Which is the correct equilibrium expression for the reaction



$$(1) K_{eq} = \frac{[C]^2[D]^5}{[A]^3[B]^4} \quad (3) K_{eq} = \frac{[A]^3[B]^4}{[C]^2[D]^5}$$

$$(2) K_{eq} = \frac{[B]^4[D]^5}{[A]^3[C]^2} \quad (4) K_{eq} = \frac{[A]^3[C]^2}{[B]^4[D]^5}$$

18. Given the reaction at equilibrium:

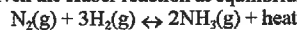


The solubility product constant for this reaction is correctly written as

$$(1) K_{sp} = [Mg^{2+}][OH^-]^2 \quad (3) K_{sp} = [Mg^{2+}][2OH^-]$$

$$(2) K_{sp} = [Mg^{2+}] + [OH^-]^2 \quad (4) K_{sp} = [Mg^{2+}] + [2OH^-]$$

19. Given the Haber reaction at equilibrium:



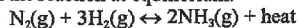
Which stress on the system will decrease the production of $NH_3(g)$?

- (1) decreasing the temperature on the system
- (2) decreasing the concentration of $H_2(g)$
- (3) increasing the pressure on the system
- (4) increasing the concentration of $N_2(g)$

20. Which of the following salts is most soluble at 25°C?

- (1) zinc oxalate, $K_{sp} = 1.40 \times 10^{-9}$
- (2) lead (II) oxalate, $K_{sp} = 8.55 \times 10^{-10}$
- (3) cadmium oxalate, $K_{sp} = 1.44 \times 10^{-8}$
- (4) manganese (II) oxalate, $K_{sp} = 1.72 \times 10^{-7}$

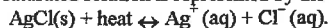
21. Given the reaction at equilibrium:



At constant temperature, which changes would produce a greater yield of $NH_3(g)$?

- (1) increasing the pressure and decreasing the concentration of $N_2(g)$
- (2) increasing the pressure and increasing the concentration of $N_2(g)$
- (3) decreasing the pressure and decreasing the concentration of $N_2(g)$
- (4) decreasing the pressure and increasing the concentration of $N_2(g)$

22. A saturated solution is represented by the equation



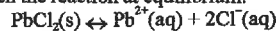
Which change will cause an increase in the amount of $AgCl(s)$?

- (1) an increase in the concentration of $Cl^-(aq)$
- (2) a decrease in the concentration of $Ag^+(aq)$
- (3) an increase in temperature
- (4) a decrease in pressure

23. One mole of each of the salts below is added to a liter of water. Which salt will produce the highest concentration of carbonate ions (CO_3^{2-})?

- (1) $BaCO_3$, $K_{sp} = 2.6 \times 10^{-9}$
- (2) $ZnCO_3$, $K_{sp} = 1.4 \times 10^{-11}$
- (3) $MgCO_3$, $K_{sp} = 1.2 \times 10^{-5}$
- (4) $CaCO_3$, $K_{sp} = 5.0 \times 10^{-9}$

24. Given the reaction at equilibrium:

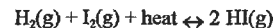


Which is the correct solubility product constant expression for the reaction?

$$(1) K_{sp} = [Pb^{2+}][Cl^-]^2 \quad (3) K_{sp} = \frac{[Cl^-]^2}{[Pb^{2+}]}$$

$$(2) K_{sp} = [Pb^{2+}][Cl^-] \quad (4) K_{sp} = \frac{[Cl^-]}{[Pb^{2+}]}$$

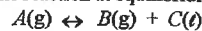
25. Given the equilibrium reaction in a closed system:



What will be the result of an increase in temperature?

- (1) The equilibrium will shift to the left and $[H_2]$ will decrease.
- (2) The equilibrium will shift to the left and $[H_2]$ will increase.
- (3) The equilibrium will shift to the right and $[HI]$ will decrease.
- (4) The equilibrium will shift to the right and $[HI]$ will increase.

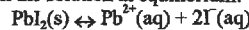
26. Given the reaction at equilibrium:



Which equilibrium constant indicates an equilibrium mixture with the smallest concentration of $B(g)$?

- (1) $K_{eq} = 1.0 \times 10^{-10}$
- (2) $K_{eq} = 1.0 \times 10^0$
- (3) $K_{eq} = 1.0 \times 10^1$
- (4) $K_{eq} = 1.0 \times 10^{10}$

27. Given the solution at equilibrium:



The addition of which nitrate salt will cause a decrease in the concentration of $I^-(aq)$?

- (1) KNO_3
- (2) $LiNO_3$
- (3) $Ca(NO_3)_2$
- (4) $Pb(NO_3)_2$