Will shift to counteract the imposed stress. When a stress is applied to a system at equilibrium, the equilibrium will shift right, which will produce more N2 gas. This is shown as a flash will show a darker color.

Heating causes the equilibrium to shift right. 

\[
\text{Caution: } \text{No heat added} \rightarrow \text{No reaction} \\
\text{Explanation: } \text{No heat added, No reaction} \\
\text{will get darker when heated. Use the equation: N}_2\text{O}_4\text{ }\xrightleftharpoons{}^{(2)}{}\text{N}_2\text{O}_2 + \text{O}_2 \text{ will shift right.} \\
\]

4. Explain why a flash filled with N2O4 and NO2 will get darker when heated. Use the equation.

\[
\text{N}_2\text{O}_4 \xrightleftharpoons{}^{(2)}{}\text{N}_2\text{O}_2 + \text{O}_2 \\
\]

5. State the Chemist's Principle. Show a darker color.

10 mg 

Answer Right 

\[
\text{N}_2\text{O}_4 \xrightleftharpoons{}^{(2)}{}\text{N}_2\text{O}_2 + \text{O}_2 \\
\]

3. Which way will the following equilibrium shift if the total pressure on the system is increased? (Note: Some may have no shift.)

\[
\text{N}_2\text{O}_4 \xrightleftharpoons{}^{(2)}{}\text{N}_2\text{O}_2 + \text{O}_2 \\
\]

2. Predict which way the following equilibrium systems will shift when the total pressure is increased:

\[
\text{N}_2 + \text{O}_2 \xrightleftharpoons{}^{(2)}{}\text{N}_2\text{O}_4 \\
\]

Add up the moles of gaseous (m.o.g.) on both sides.
Worksheet 2.4 - Le Chatelier's Principle

**Chemistry 12**

### 5. Slightly greater than old equilibrium.

[\( \text{H}_2 \text{O}_2 \text{(aq)} \rarr \text{H}_2 \text{O} + \text{O}_2 \text{(g)} \)]

Time when \( \text{H}_2 \) was added. Note: Compared to the

\[ \text{H}_2 \]

and a slightly lower concentration of \( \text{H}_2 \) and \( \text{O}_2 \) since the new equilibrium will have a slightly higher concentration of forward reaction. For a while, greater than the rate of the new equilibrium. When the rate of the reverse reaction once again becomes equal to the rate of the

\[ \text{O}_2 \rarr 2\text{H}_2 \text{O} \]

**Answer:** False increases

(e) As \( [\text{H}_2] \) is increased, what will happen to the rate of the reverse reaction?

**Answer:** \( [\text{H}_2] \) increases

(b) If, for a while, the rate of the forward reaction is greater than the rate of the reverse reaction, what will happen to the \([\text{H}_2] \)?

**Answer:** Increases False

(a) Addition of more \( \text{H}_2 \) gas to the container will do what to the rate of the forward reaction?

\[ (\text{g}) \]

\( \text{H}_2 \rarr 2\text{H} \)

Consider the following reaction at equilibrium:

**Answer:** No shift.

(e) Add \( \text{H}_2 \) as a catalyst.

**Answer:** Shifts left.

(d) Decrease the temperature.

**Answer:** Shifts right.

(c) Decrease the total pressure.

(b) Decrease the \([\text{O}_2] \).

**Answer:** Shifts right.

(a) Increase the \([\text{H}_2] \).

Predict the direction of equilibrium shift by each of the following imposed changes:

\[ \text{H}_2 + \text{O}_2 \rarr 2\text{H}_2\text{O} \text{ (g)} \]

\[ \Delta H = -196 \text{ kJ} \]

\[ \text{H}_2\text{O}_2 \rarr \text{H}_2\text{O} + \text{O}_2 \text{ (g)} \]
9. a) The total pressure of the system is increased.
   Answer: Incorrect
   b) The temperature is increased.
   Answer: Incorrect
   c) CO gas is added to the container.
   Answer: Incorrect
   d) CH₃OH (g) \rightleftharpoons CH₃O + H₂ (g)
   \[ \text{Pressure of CH₃OH gas when each of the following changes are made:} \]
   Using the following equilibrium, state what would happen to the equilibrium partial
   volume has not changed.
   e) Helium gas is added to increase the total pressure.
   Answer: No shift
   f) The total pressure is decreased.
   Answer: No shift
   g) The temperature is increased.
   Answer: Down
   h) The volume of the container is decreased.
   Answer: Right
   i) H₂ gas is added.
   Answer: Right
   j) CO₂ gas is removed.
   Answer: Right
   k) CH₄ gas is added.
   Answer: Right

8. Consider the following equilibrium and state which way (towards or away) the equilibrium shifts.

\[ \text{Sketch a graph of the resulting concentration of each species as the process outlined in} \]
Chemistry 12 Chemical Equilibrium

\[ H₂ + I₂ \rightleftharpoons 2HI \]
Worksheet 2 - LeChatelier's Principle

At high temps, the reaction shifts right. At lower sides, the reaction shifts left. This run is not spontaneous. No favoring results, as the question form.

Molecular compositions change when an autonomic or during a limiting factor.

Explain why the oxide (NO) does not generally form in the atmosphere. The process is formed in the following equation:

\[ \text{NO}_2 \xrightleftharpoons{\text{heat}} \text{NO} + \text{O}_2 \]

Use this equilibrium:

13. Explain why the shift is added:

- No change in volume
- No change in pressure

1. Answer

Right

(e) O_2 gas is added to the system.

2. Answer

Left

(d) The total pressure is increased.

3. Answer

Right

(c) CO_2 is added to the container.

4. Answer

Left

(b) The temperature is decreased.

5. Answer

\[ \text{The volume of the container is halved} \]

(b) \[ \text{The volume of the container is halved} \]

12. Given the following equilibrium system, state why the reaction will shift when:

Chemistry 12 - Chemical Equilibrium
15. Explain why a flask containing NO₂ will get lighter in colour when put into ice water. Use the equation:

\[ \text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g}) \]

16. Given the following graph showing the concentrations of species A, B, and C, state what changes in concentration or composition are responsible for each of the shifts shown on the graph. The equilibrium equation is:

\[ \text{(3)} \text{B} \rightleftharpoons \text{(3)} \text{A} + \text{(3)} \text{C} \]

17. Explain why a flask containing NO₂ will get lighter in colour when put into ice water. Use the equation:

\[ \text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g}) \]

18. Explain why a flask containing NO₂ will get lighter in colour when put into ice water. Use the equation:

\[ \text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g}) \]
Exercise 2.2 - Le Chatelier's Principle

For each of the following reactions, predict whether the entropy increases or decreases.

(a) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(b) \( \text{CaCO}_3 + \text{H}_2\text{O} \rightarrow \text{Ca}^{2+} + \text{CO}_3^{2-} + \text{H}_2\text{O} \)

(c) \( \text{CaCO}_3 + \text{H}_2\text{O} \rightarrow \text{Ca}^{2+} + \text{CO}_3^{2-} + \text{H}_2\text{O} \)

(d) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(e) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(f) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(g) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(h) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(i) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(j) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(k) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(l) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(m) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(n) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(o) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(p) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(q) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(r) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(s) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(t) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(u) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(v) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(w) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(x) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(y) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

(z) \( \text{Mg}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}^2\text{OH}^+ + \text{CO}_3^{2-} \)

Given the equilibrium equation:

\( \text{(3) X + (3) X} \) → heat + (3) X

\( \text{Initial} \) X = 3.0 M, the [X] = 3.0 M and the [X] = 6.0 M, draw a graph similar to the one in question 16 showing qualitatively what happens to the concentrations of each species as the following changes are made to the system:

Time I - The temperature is increased.

Time II - Some X is added to the system.

Time III - Some X is removed from the system.

Time IV - The temperature is decreased.

Chemistry 12 - Chemical Equilibrium
Worksheet 2.2 - Le Chatelier's Principle

19. On the basis of enthalpy and entropy, predict whether each of the following reactions would be spontaneous as written or not at room temperature.

(a) \( \text{N}_2(g) + 3 \text{H}_2(g) \rightleftharpoons 2 \text{NH}_3(g) \) at 677°C.

(b) \( \text{CaO}(s) + \text{H}_2 \text{O}(l) \rightleftharpoons \text{Ca} \text{(OH)}_2(s) \) at 110°F.

(c) \( \text{2Pb} + \text{5O}_2(g) \rightleftharpoons \text{2PbO}_5(s) \) at 97°C.

(d) \( \text{C}_6 \text{H}_5 \text{NO}_2(s) \rightleftharpoons \text{C}_6 \text{H}_5 \text{NO}_2(aq) \) at 20°C.

(e) \( \text{2NO}_2(g) \rightleftharpoons \text{2N}_2(g) + 2 \text{O}_2(g) \) at 297°C.

(f) \( \text{Fe} + \text{H}_2 \text{O}(g) \rightleftharpoons \text{FeO} + \text{H}_2 \) at 1500°C.

Would be spontaneous as written

Would not be spontaneous as written

Maximum entropy favors (reaction products)

Minimum entropy favors (reaction products)

Sporaneous as written

Answer