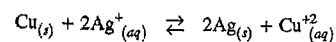


Chem 12 Unit 2 Review

1. In which of the following will entropy and enthalpy factors favour the establishment of an equilibrium?

- A. $\text{CaCO}_3(s) + 178 \text{ kJ} \rightleftharpoons \text{CaO}(s) + \text{CO}_2(g)$
 B. $\text{Mg}(s) + 2\text{HCl}(aq) \rightleftharpoons \text{MgCl}_2(aq) + \text{H}_2(g) + 425 \text{ kJ}$
 C. $2\text{C}(s) + 2\text{H}_2(g) \rightleftharpoons \text{C}_2\text{H}_4(g) \quad \Delta H = +52.3 \text{ kJ}$
 D. $2\text{C}_2\text{H}_6(g) + 7\text{O}_2(g) \rightleftharpoons 4\text{CO}_2(g) + 6\text{H}_2\text{O}(g) \quad \Delta H = -1560 \text{ kJ}$

2. For the equilibrium system below:



We would know the system is at equilibrium because

- A. $[\text{Cu}^{2+}] = [\text{Ag}^+]$
 B. $2[\text{Cu}^{2+}] = [\text{Ag}^+]$
 C. the mass of $\text{Cu}(s)$ remains constant.
 D. the mass of the entire system remains constant.

3. Which of the factors below is **not** a condition necessary for equilibrium?

- A. a closed system
 B. a constant temperature
 C. equal forward and reverse reaction rates
 D. equal concentrations of reactants and products

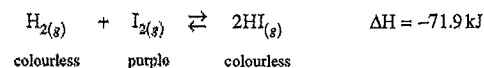
4. In order for a chemical reaction to go to completion, how must the entropy and enthalpy change?

	Entropy	Enthalpy
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	decreases	decreases

5. What is true for reacting systems that spontaneously go to completion?

- A. They are exothermic and their entropy increases.
 B. They are exothermic and their entropy decreases.
 C. They are endothermic and their entropy increases.
 D. They are endothermic and their entropy decreases.

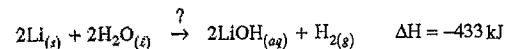
6. Consider the following equilibrium:



Which of the following would allow you to conclude that the system has reached equilibrium?

- A. The pressure remains constant.
 B. The reaction rates become zero.
 C. The colour intensity remains constant.
 D. The system shifts completely to the right.

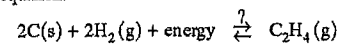
7. For the reacting system:



What will entropy and enthalpy factors favour?

	Entropy	Enthalpy
A.	products	reactants
B.	products	products
C.	reactants	reactants
D.	reactants	products

8. Consider the following equation:



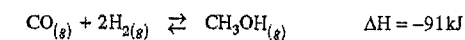
Which of the following occurs when C and H_2 are combined?

	Enthalpy Change	Entropy Change	Result
A.	increasing	decreasing	no reaction
B.	increasing	decreasing	reacts completely
C.	increasing	increasing	equilibrium
D.	decreasing	decreasing	no reaction

9. Which of the following forward reactions demonstrates decreasing enthalpy and increasing entropy?

- A. $\text{Hg}(l) + \frac{1}{2}\text{O}_2(g) \rightleftharpoons \text{HgO}(s) \quad \Delta H = -91 \text{ kJ}$
 B. $2\text{HCl}(g) \rightleftharpoons \text{H}_2(g) + \text{Cl}_2(g) \quad \Delta H = +185 \text{ kJ}$
 C. $2\text{HgO}(s) \rightleftharpoons 2\text{Hg}(l) + \text{O}_2(g) \quad \Delta H = +182 \text{ kJ}$
 D. $2\text{SO}_3(g) \rightleftharpoons 2\text{SO}_2(g) + \text{O}_2(g) \quad \Delta H = -200 \text{ kJ}$

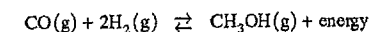
10. Consider the following equilibrium:



Which of the factors below would increase the concentration of CH_3OH at equilibrium?

- A. an addition of CO
 B. an increase in the volume
 C. a decrease in the pressure
 D. an increase in the temperature

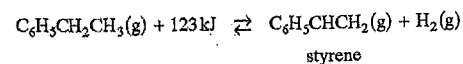
11. Methanol (CH_3OH) is produced according to the following equilibrium equation:



Which conditions would favour a high yield of methanol?

	Temperature	Pressure
A.	low	low
B.	low	high
C.	high	low
D.	high	high

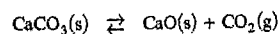
12. Styrene is manufactured as follows:



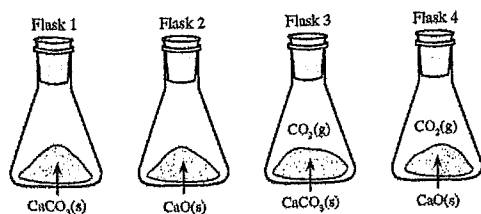
Which of the following describes the temperature and pressure needed for the maximum yield of styrene?

	Temperature	Pressure
A.	low	low
B.	low	high
C.	high	low
D.	high	high

13. Consider the following equilibrium:

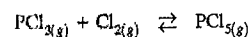


In which of the flasks will this equilibrium be established?



- A. 1, 2, 3 only
 B. 1, 2, 4 only
 C. 1, 3, 4 only
 D. 3, 4 only

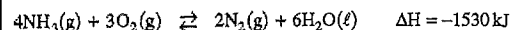
14. Consider the following equilibrium:



If the volume of the system is decreased, how will the reaction rates in the new equilibrium compare with the rates in the original equilibrium?

	Forward Rate	Reverse Rate
A.	increases	increases
B.	increases	decreases
C.	decreases	decreases
D.	decreases	increases

Use the following equilibrium system to answer questions 15 to 17



15. Which of the following would cause the amount of NH_3 at equilibrium to increase?

- A. an increase in $[\text{O}_2]$
 B. a decrease in volume
 C. a decrease in temperature
 D. an increase in temperature

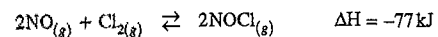
16. What happens when O_2 is added to the above system?

	Equilibrium	$[\text{N}_2]$
A.	no shift	unchanged
B.	shifts right	decreases
C.	shifts right	increases
D.	shifts left	increases

17. If some O_2 is injected into the system, what happens to the forward and reverse reaction rates during the shift to re-establish equilibrium?

	Forward Reaction Rate	Reverse Reaction Rate
A.	increases	decreases
B.	decreases	decreases
C.	increases	increases
D.	decreases	increases

18. Consider the following equilibrium system:



In which direction will the equilibrium shift and what happens to the value of K_{eq} when the temperature of the system is increased?

	Shift	K_{eq}
A.	right	increases
B.	right	decreases
C.	left	increases
D.	left	decreases

19. Consider the following equilibrium:

$$\text{N}_{2(\text{g})} + 3\text{H}_{2(\text{g})} \rightleftharpoons 2\text{NH}_{3(\text{g})}$$

If some Ne gas is added at a constant volume then how will $[\text{N}_2]$, $[\text{H}_2]$ and K_{eq} be affected?

	$[\text{N}_2]$	$[\text{H}_2]$	K_{eq}
A.	increases	increases	decreases
B.	decreases	decreases	increases
C.	decreases	increases	does not change
D.	does not change	does not change	does not change

20. What is the effect of adding a catalyst to an equilibrium system?

- A. The value of E_a increases.
 B. The value of K_{eq} increases.
 C. Forward and reverse rates increase.
 D. The concentration of products increases.

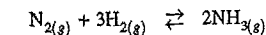
21. Consider the following equilibrium system:

$$2\text{SO}_{2(\text{g})} + \text{O}_{2(\text{g})} \rightleftharpoons 2\text{SO}_{3(\text{g})} \quad K_{eq} = 1.2 \times 10^4$$

If additional SO_2 is added to the system, what happens to the equilibrium and the value of K_{eq} ?

	Equilibrium	K_{eq}
A.	shifts left	decreases
B.	shifts right	increases
C.	shifts right	no change
D.	no change	no change

22. Consider the following equilibrium system:

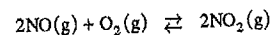


Determine the changes in reaction rates as a catalyst is added.

	Forward Rate	Reverse Rate
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	decreases	decreases

23.

Consider the following equilibrium system:

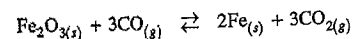


An equilibrium mixture of $\text{NO}(\text{g})$, $\text{O}_2(\text{g})$ and $\text{NO}_2(\text{g})$ is transferred from a 1.0 L container to a 2.0 L container. Which reaction is favoured and what happens to the $[\text{NO}_2]$?

	Reaction Favoured	$[\text{NO}_2]$
A.	reverse	increases
B.	reverse	decreases
C.	forward	increases
D.	forward	decreases

24.

Consider the following equilibrium:



Identify the equilibrium constant expression.

A. $K_{eq} = \frac{[\text{CO}_2]^3}{[\text{CO}]^3}$

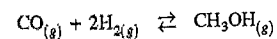
B. $K_{eq} = \frac{[\text{CO}_2]}{[\text{CO}]}$

C. $K_{eq} = \frac{[\text{CO}_2]^3 [\text{Fe}]^2}{[\text{Fe}_2\text{O}_3] [\text{CO}]^3}$

D. $K_{eq} = \frac{[\text{Fe}_2\text{O}_3] [\text{CO}]^3}{[\text{CO}_2]^3 [\text{Fe}]^2}$

25.

Consider the following equilibrium:

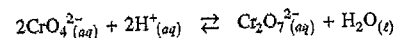


At equilibrium it was found that $[\text{CO}] = 0.105 \text{ mol/L}$, $[\text{H}_2] = 0.250 \text{ mol/L}$ and $[\text{CH}_3\text{OH}] = 0.00261 \text{ mol/L}$. Which of the following is the equilibrium constant value?

- A. 9.94×10^{-2}
 B. 0.398
 C. 2.51
 D. 10.0

26.

Consider the following equilibrium:

What is the K_{eq} expression?

A. $\frac{[\text{CrO}_4^{2-}]^2 [\text{H}^+]^2}{[\text{Cr}_2\text{O}_7^{2-}]}$

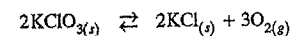
B. $\frac{[\text{Cr}_2\text{O}_7^{2-}]}{[\text{CrO}_4^{2-}]^2 [\text{H}^+]^2}$

C. $\frac{[\text{Cr}_2\text{O}_7^{2-}]}{2[\text{CrO}_4^{2-}] [2\text{H}^+]}$

D. $\frac{[\text{Cr}_2\text{O}_7^{2-}] [\text{H}_2\text{O}]}{[\text{CrO}_4^{2-}]^2 [\text{H}^+]^2}$

27.

Consider the following equilibrium system:



Which of the following is the equilibrium constant expression?

A. $K_{eq} = [\text{O}_2]^3$

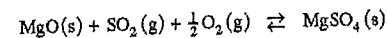
B. $K_{eq} = \frac{1}{[\text{O}_2]^3}$

C. $K_{eq} = \frac{[\text{KClO}_3]^2}{[\text{KCl}]^2 [\text{O}_2]^3}$

D. $K_{eq} = \frac{[\text{KCl}]^2 [\text{O}_2]^3}{[\text{KClO}_3]^2}$

28.

Consider the following equilibrium equation:

Which expression represents the $[\text{O}_2]$ at equilibrium?

A. $[\text{O}_2] = \frac{1}{K_{eq} [\text{SO}_2]}$

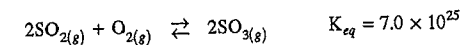
B. $[\text{O}_2] = (K_{eq} [\text{SO}_2])^2$

C. $[\text{O}_2] = \left(\frac{1}{K_{eq} [\text{SO}_2]} \right)^2$

D. $[\text{O}_2] = \frac{[\text{MgSO}_4]}{K_{eq} [\text{MgO}] [\text{SO}_2]}$

29.

A container is initially filled with pure SO_3 . After a period of time, the following equilibrium is established:

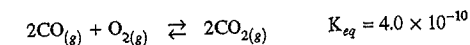


What does this equilibrium mixture contain?

- A. mostly products
 B. mostly reactants
 C. $\frac{3}{5}$ reactants and $\frac{2}{5}$ products
 D. equal amounts of reactants and products

30.

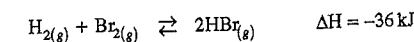
Consider the following equilibrium:

What is the value of K_{eq} for $2\text{CO}_2(\text{g}) \rightleftharpoons 2\text{CO}(\text{g}) + \text{O}_2(\text{g})$?

- A. 4.0×10^{-10}
 B. 2.0×10^{-5}
 C. 5.0×10^4
 D. 2.5×10^9

31.

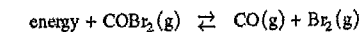
Consider the following equilibrium:

How could the value of K_{eq} be increased?

- A. add H_2
 B. add HBr
 C. increase the pressure
 D. reduce the temperature

32.

Consider the following equilibrium system:

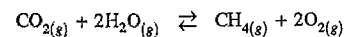


Which of the following statements is true?

- A. Decreasing $[\text{CO}]$ will increase K_{eq} .
 B. Increasing $[\text{COBr}_2]$ will increase K_{eq} .
 C. Increasing the temperature will decrease K_{eq} .
 D. Decreasing the temperature will decrease K_{eq} .

33.

Consider the following equilibrium:

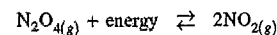


Which of the options below indicates that the reactants are favoured?

- A. K_{eq} is zero.
 B. K_{eq} is very large.
 C. K_{eq} is slightly less than 1.
 D. K_{eq} is slightly greater than 1.

34.

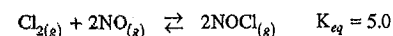
Consider the following equilibrium:

How are K_{eq} and $[\text{N}_2\text{O}_4]$ affected by the addition of Ne (an inert gas) into the container at constant volume.

	K_{eq}	$[\text{N}_2\text{O}_4]$
A.	no change	no change
B.	no change	increases
C.	increases	decreases
D.	decreases	increases

35.

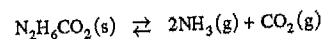
Consider the following equilibrium:

At equilibrium, $[\text{Cl}_2] = 1.0 \text{ M}$ and $[\text{NO}] = 2.0 \text{ M}$. What is the $[\text{NOCl}]$ at equilibrium?

- A. 0.80 M
 B. 0.89 M
 C. 4.5 M
 D. 10 M

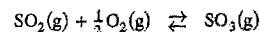
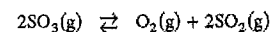
36.

Consider the following equilibrium equation:

Initially, 0.245 mol $\text{N}_2\text{H}_6\text{CO}_2$ is placed in a 1.0L container. At equilibrium, $[\text{CO}_2] = 0.18 \text{ M}$. What is the value of K_{eq} ?

- A. 5.8×10^{-3}
 B. 2.3×10^{-2}
 C. 3.2×10^{-2}
 D. 6.5×10^{-2}

37.

Consider the equilibrium expression K_{eq1} for reaction 1:and the equilibrium expression K_{eq2} for reaction 2:How is K_{eq2} related to K_{eq1} ?

- A. $K_{eq2} = K_{eq1}$
 B. $K_{eq2} = (K_{eq1})^2$
 C. $K_{eq2} = \left(\frac{1}{K_{eq1}}\right)$
 D. $K_{eq2} = \left(\frac{1}{K_{eq1}}\right)^2$

38.

Which of the following describes how a K_{eq} value is related to the relative concentrations of reactants and products?

	K_{eq} value	Relative Concentration
I.	large	$[\text{products}] > [\text{reactants}]$
II.	large	$[\text{reactants}] > [\text{products}]$
III.	small	$[\text{products}] > [\text{reactants}]$
IV.	small	$[\text{reactants}] > [\text{products}]$

- A. I only
 B. IV only
 C. I and IV only
 D. II and III only

39.

Consider the following reactions:

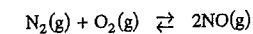
I	$\text{Na}_2\text{O}(s) \rightleftharpoons 2\text{Na}(l) + \frac{1}{2}\text{O}_2(g)$	$K_{eq} = 2 \times 10^{-25}$
II	$\text{Na}_2\text{O}_2(s) \rightleftharpoons 2\text{Na}(l) + \text{O}_2(g)$	$K_{eq} = 5 \times 10^{-29}$
III	$2\text{Na}_2\text{O}(s) \rightleftharpoons 4\text{Na}(l) + \text{O}_2(g)$	$K_{eq} = 3 \times 10^{-14}$

Which of the following lists the reactions in order, from the greatest $[\text{O}_2]$ at equilibrium, to the least $[\text{O}_2]$ at equilibrium?

- A. I, II, III
 B. I, III, II
 C. III, I, II
 D. III, II, I

40.

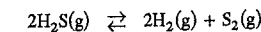
Consider the following equilibrium system:

Under certain conditions, $K_{eq} = 1.0 \times 10^{-30}$. When conditions are changed, K_{eq} becomes 0.10. Which of the following could account for this?

- A. $[\text{N}_2]$ was changed.
 B. A catalyst was added.
 C. Pressure was changed.
 D. Temperature was changed.

41.

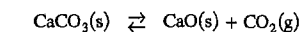
Consider the following equilibrium system:

At equilibrium, a 2.0L reaction vessel contained 1.2×10^{-3} mol H_2S , 7.2×10^{-6} mol H_2 and 6.0×10^{-2} mol S_2 . What is the value of K_{eq} ?

- A. 6.5×10^{-10}
 B. 1.1×10^{-6}
 C. 2.2×10^{-6}
 D. 9.3×10^5

42.

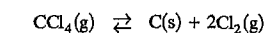
Consider the equilibrium:

In a 5.0L container at equilibrium there are 2.42 g CO_2 , 1.00 g CaCO_3 and 1.00 g CaO . Which of the following is the value of K_{eq} ?

- A. 0.055
 B. 0.011
 C. 0.020
 D. 91

43.

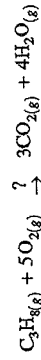
Consider the following equilibrium:

Initially, 0.31 mol CCl_4 was placed in a 1.0L container. At equilibrium, $[\text{Cl}_2] = 0.060 \text{ M}$. Which of the following is the value of K_{eq} ?

- A. 3.9×10^{-4}
 B. 1.3×10^{-2}
 C. 1.4×10^{-2}
 D. 7.8×10^1

1.

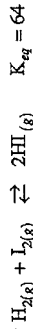
Consider the following exothermic reaction:



Explain, in terms of increasing or decreasing entropy and enthalpy, whether or not the reaction will reach equilibrium.

2.

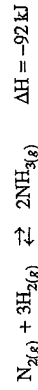
Given the reacting system:



Equal moles of H_2 , I_2 and HI are placed in a 1.0 L container. Use calculations to determine the direction the reaction will proceed in order to reach equilibrium.

3.

Consider the following reaction for the Haber Process for ammonia production:



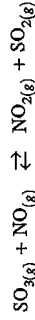
The system is normally maintained at a temperature of approximately 500°C .

a) Explain why 1000°C is not used.

b) Explain why 100°C is not used.

4.

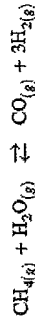
Consider the following equilibrium:



In an experiment, 0.100 moles of SO_3 and 0.100 moles of NO are placed in a 1.00 L container. When equilibrium is achieved, $[\text{NO}_2] = 0.0414 \text{ mol/L}$. Calculate the K_{eq} value.

5.

Consider the following equilibrium:

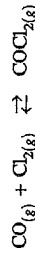


K_{eq}	Temperature
1.78×10^{-3}	800°C
4.68×10^{-2}	1000°C

Is the forward reaction in this equilibrium exothermic or endothermic? Explain your answer.

6.

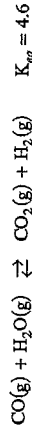
Consider the following equilibrium:



At equilibrium, the system contains 2.00 mol CO , 1.00 mol Cl_2 and 0.200 mol COCl_2 in a 2.0 L container. Calculate the value of K_{eq} .

7.

Consider the following equilibrium:



Initially, 0.50 mol CO , 0.50 mol H_2O , 0.62 mol CO_2 and 0.62 mol H_2 are placed in a 1.0 L container, and the reaction proceeds towards products. Calculate the equilibrium $[\text{H}_2]$.

8.

Consider the equilibrium: $\text{CO}_2(\text{g}) + \text{H}_2(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \quad K_{\text{eq}} = 1.60$

Initially, 8.2 mol of CO and 8.2 mol of H_2O are placed in a 2.0 L container and allowed to react. Calculate the equilibrium concentrations of CO_2 and CO .