

Equilibrium Practice Test

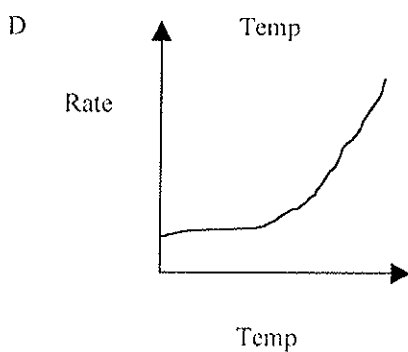
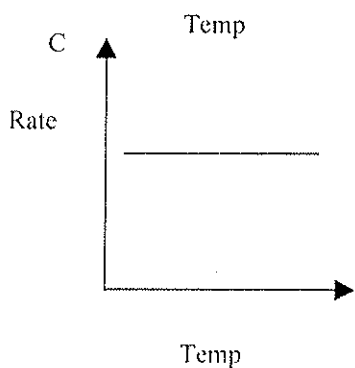
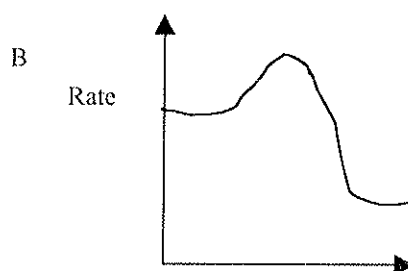
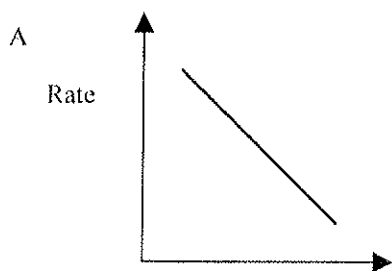
1) The slowest of the following reactions is:

- a) $\text{Ag}^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})} \rightleftharpoons \text{AgCl}_{(\text{s})}$
- b) $\text{H}^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})} \rightleftharpoons 2\text{H}_2\text{O}_{(\text{l})}$
- c) $3\text{Ba}^{2+}_{(\text{aq})} + 2\text{PO}_4^{3-}_{(\text{aq})} \rightleftharpoons \text{Ba}_3(\text{PO}_4)_2_{(\text{aq})}$
- d) $\text{Cu}_{(\text{s})} + 2\text{Ag}^+_{(\text{aq})} \rightleftharpoons \text{Cu}^{2+}_{(\text{aq})} + 2\text{Ag}_{(\text{s})}$

2) The rate of a chemical reaction is equal to the slope of the line with axes labelled

- | | x-axis | y-axis |
|----|---------------|---------------|
| a) | time | rate |
| b) | mass | time |
| c) | volume of gas | time |
| d) | time | concentration |

3) Consider the following reaction: $\text{CH}_4_{(\text{g})} + 2\text{O}_2_{(\text{g})} \rightleftharpoons \text{CO}_2_{(\text{g})} + 2\text{H}_2\text{O}_{(\text{g})} + \text{heat}$
The diagram that represents the relationship between rate and temperature is:



9) Chemical equilibrium is said to be dynamic because

- a) the reaction proceeds quickly
- b) the mass of the reactants is decreasing
- c) the macroscopic properties are constant
- d) both forward and reverse rates are occurring

10) Which equation has the largest value of K_{eq} ?

- a) $N_{2(g)} + O_{2(g)} \rightleftharpoons 2 NO_{(g)}$ $\Delta H = 21 \text{ kJ}$
- b) $C_2H_6(g) \rightleftharpoons 2C_{(s)} + 3 H_{2(g)}$ $\Delta H = 83 \text{ kJ}$
- c) $H_{2(g)} + 1/2 O_{2(g)} \rightleftharpoons H_2O_{(g)}$ $\Delta H = -240 \text{ kJ}$
- d) $Ca_{(s)} + 3 H_2O_{(l)} \rightleftharpoons Ca(OH)_{2(aq)} + H_{2(g)}$ $\Delta H = -240 \text{ kJ}$

11) The value of the K_{eq} can be changed by

- a) adding a catalyst
- b) changing the temperature
- c) changing the reactant concentration
- d) changing the volume of the container

12) Consider the following equilibrium: $PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$

When 0.40 mole of PCl_3 and 0.40 mole of Cl_2 are placed in a 1.00 L container and allowed to reach equilibrium, 0.244 mole of PCl_5 are present. From this information, the value of the K_{eq} is:

- a) 0.10
- b) 0.30
- c) 3.3
- d) 10

13) Consider the following equilibrium: $PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$ $K_{eq} = 2.30$

A 1.0 L container is filled with 0.05 mole PCl_5 , 1.0 mole PCl_3 , and 1.0 mole Cl_2 . The system proceeds to the

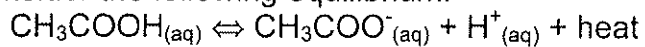
- a) left because the Trial $K_{eq} > K_{eq}$
- b) left because the Trial $K_{eq} < K_{eq}$
- c) right because the Trial $K_{eq} > K_{eq}$
- d) right because the Trial $K_{eq} < K_{eq}$

14) Given the following system: $2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(l)$

Which of the following chemicals, when added to the above system at equilibrium, would result in a decrease in $[Cr_2O_7^{2-}]$?

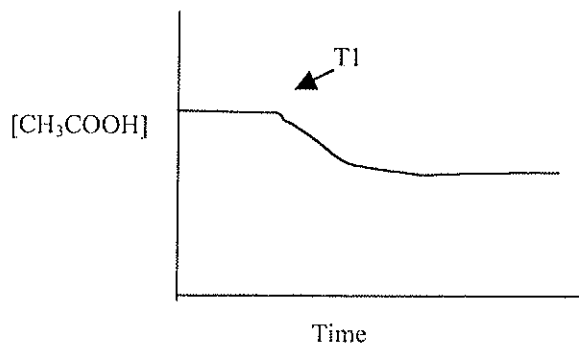
- a) NaOH
- b) HNO_3
- c) Na_2CrO_4
- d) $Na_2Cr_2O_7$

18) Consider the following equilibrium:



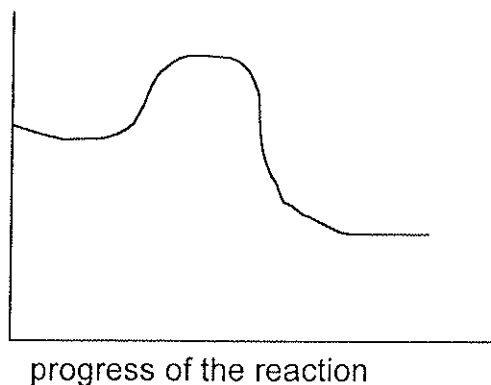
A stress was applied at time t_1 and the data plotted on the following graph:

The stress imposed at time t_1 is the result of



- a) the addition of HCl
- b) decreasing the temperature
- c) the addition of NaCH_3COO
- d) increasing the volume of the container

19) Consider the following potential energy diagram for an equilibrium system:



When the temperature of the system is increased, the equilibrium shifts to the

- a) left and the K_{eq} increases
- b) left and the K_{eq} decreases
- c) right and the K_{eq} increases
- d) right and the K_{eq} decreases

25) Consider the following equilibrium:



Which of the following will cause the equilibrium to shift to the left?

- a) adding $\text{H}_2\text{O}(\text{g})$
- b) removing some $\text{NO}(\text{g})$
- c) increasing the volume
- d) decreasing the temperature

26) A catalyst is added to a system already at equilibrium. How are the forward and reverse reaction rates affected by the addition of the catalyst.

- | Forward Rate | Reverse Rate |
|--------------|--------------|
| a) Increases | increases |
| b) increases | constant |
| c) constant | decreases |
| d) constant | constant |

27) Consider the following equilibrium: $2 \text{NOBr}(\text{g}) \rightleftharpoons 2 \text{NO}(\text{g}) + \text{Br}_2(\text{g})$ $K_{\text{eq}} = 0.064$

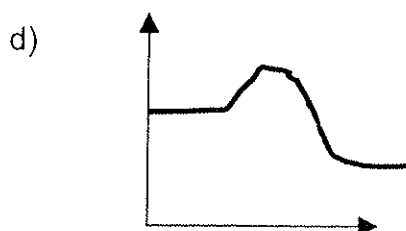
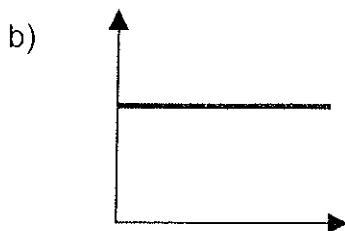
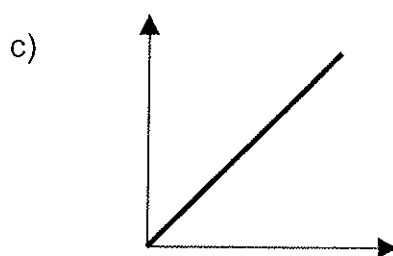
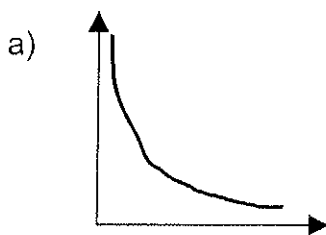
At equilibrium, a 1.00 L flask contains 0.030 mole NOBr and 0.030 mole NO. How many moles of Br_2 are present?

- a) 0.0019
- b) 0.064
- c) 0.030
- d) 0.47

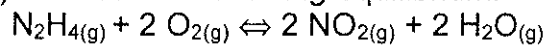
28) Which of the following does not apply to all chemical equilibrium systems?

- a) They are closed.
- b) The macroscopic properties are constant
- c) Forward and reverse rates are equal
- d) There are equal concentrations of reactants and products

29) The relationship between E_a and reaction rate is best represented as
x axis = E_a , y axis = rate



34) Consider the following equilibrium:



More oxygen is added to the above equilibrium. After the system re-establishes equilibrium, identify the substance(s), if any, that have a net

a) increase in concentration

b) decrease in concentration

35) Given the following equilibrium: $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2 \text{HI}(\text{g})$

Initially, 0.200 mole H_2 and 0.200 mole I_2 were placed into a 1.0 L container. At equilibrium, the $[\text{I}_2]$ is 0.040 M. Calculate the K_{eq} .

36) Consider the following equilibrium: $2 \text{CrO}_4^{2-}(\text{aq}) + 2 \text{H}^+(\text{aq}) \rightleftharpoons \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

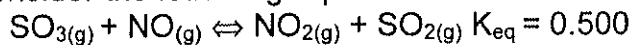
yellow

orange

When HCl is added, the solution turns orange. Explain why this colour change occurs.

38. Consider the following equilibrium $2 \text{NO}_{(g)} + \text{O}_{2(g)} \rightleftharpoons 2 \text{NO}_{2(g)}$ $K_{\text{eq}} = 1.5$
0.800 mole NO, 0.600 moles O_2 , and 0.400 moles NO_2 are placed in a vessel that 2.0 L. Show by calculation that the reaction is not at equilibrium? What will happen to $[\text{O}_2]$ as equilibrium is approached?

39. Consider the following equilibrium:



Exactly 0.100 mole SO_3 and 0.100 mole NO were placed in a 1.00 L flask and allowed to go to equilibrium. Calculate the equilibrium concentration of SO_2 .