Name Answer key – STURMAN Date Class

18–2 Practice Problems

1. Write the equilibrium expression for the oxidation of hydrogen to form water vapor.
$2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$
$\frac{[H_2O]^2}{[H_2]^2[O_2]}$

2. Write the equilibrium expression for the formation of nitrosyl bromide.
$2NO(g) + Br_2(g) \rightleftharpoons 2NOBr(g)$

3. Write the equilibrium expression for the following reaction.
$NO(g) + O_3(g) \rightleftharpoons O_2(g) + NO_2(g)$
$\frac{[O_2][NO_2]}{[NO][O_3]}$

4. Write the equilibrium expression for the following reaction.
$CH_4(g) + Cl_2(g) \rightleftharpoons CH_3Cl(g) + HCl(g)$

5. Write the equilibrium expression for the following reaction.
$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$
$\frac{[CO][H_2]^3}{[CH_4][H_2O]}$

6. Write the equilibrium expression for the following reaction.
$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$

7. Write the equilibrium expression for the combustion of ethane at high temperature.
$2C_2H_6(g) + 7O_2(g) \rightleftharpoons 4CO_2(g) + 6H_2O(g)$
$\frac{[O_2]^4[H_2O]^6}{[C_2H_6]^2[CO_2]^7}$

8. Write the equilibrium expression for the decomposition of ethane.
$C_2H_6(g) \rightleftharpoons C_2H_4(g) + H_2(g)$

9. Write the equilibrium expression for the following reaction.
$Hg(g) + I_2(g) \rightleftharpoons HgI_2(g)$
$\frac{[HgI_2]}{[Hg][I_2]}$

10. Write the equilibrium expression for the following reaction.
$SnO_2(s) + 2CO(g) \rightleftharpoons Sn(s) + 2CO_2(g)$

11. Write the equilibrium expression for the following reaction.
$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$
$\frac{[CO]^2}{[CO_2]}$

12. Write the equilibrium expression for the following reaction.
$FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g)$

13. Write the equilibrium expression for the following reaction.
$KCl(l) + Na(l) \rightleftharpoons NaCl(l) + K(g)$
$[K]$

14. Write the equilibrium expression for the following reaction.
$NaCl(s) + H_2SO_4(l) \rightleftharpoons HCl(g) + NaHSO_4(s)$

15. Write the equilibrium expression for the following reaction.
$P_4(s) + 6NO(g) \rightleftharpoons P_4O_6(s) + 3N_2(g)$
$\frac{[N_2]^3}{[NO]^6}$

16. Write the equilibrium expression for the following reaction.
$2NO(g) + 2H_2(g) \rightleftharpoons N_2(g) + 2H_2O(l)$

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18–2 Practice Problems (continued)

17. Write the equilibrium expression for the following reaction.
$H_2CO_3(s) \rightleftharpoons H_2O(l) + CO_2(g)$
$[CO_2]$

18. Write the equilibrium expression for the following reaction.
$CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(l)$

19. At 740°C, K_{eq} = 0.0060 for the decomposition of calcium carbonate ($CaCO_3$), which is described by the equation
$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$
Find Q and predict how the reaction will proceed if $[CO_2]$ = 0.0004 M.
$[CO_2] = .0004$ proceed right

20. For the reaction
$CO(g) + H_2O(g) \rightleftharpoons H_2(g) + CO_2(g)$
K_{eq} = 5.10 at 527°C. If [CO] = 0.15 M, $[H_2O]$ = 0.25 M, $[H_2]$ = 0.42 M, and $[CO_2]$ = 0.37 M, calculate Q and determine how the reaction will proceed.

21. At 340°C, K_{eq} = 0.064 for the reaction
$Fe_2O_3(s) + 3H_2(g) \rightleftharpoons 2Fe(s) + 3H_2O(g)$
Given that $[H_2]$ = 0.45 M and $[H_2O]$ = 0.37 M, find Q and predict how the reaction will proceed.
$\frac{[H_2O]^3}{[H_2]^3} = \frac{.37^3}{.45^3} = .556 > .064$ shift left

22. At 2130°C, K_{eq} = 0.0025 for the reaction
$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$
If $[N_2]$ = 0.81 M, $[O_2]$ = 0.75 M, and [NO] = 0.030 M, find Q and determine the direction in which the reaction will proceed.

23. Ammonia is synthesized from nitrogen and hydrogen in the reaction
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
At 500°C, the equilibrium constant for this reaction is 0.080. Given that $[NH_3]$ = 0.0596 M, $[N_2]$ = 0.600 M, and $[H_2]$ = 0.420 M, find Q and predict how the reaction will proceed.
.080 = .080 at equilibr

24. The decomposition of antimony pentachloride ($SbCl_5$) is described by the equation
$SbCl_5(g) \rightleftharpoons SbCl_3(g) + Cl_2(g)$
At 448°C, the equilibrium constant for this reaction is 0.0251. What is the value of Q if $[SbCl_5]$ = 0.095 M, $[SbCl_3]$ = 0.020 M, and $[Cl_2]$ = 0.050 M? How will this reaction proceed?

25. At 1000°C, K_{eq} = 1.0 x 10^{-13} for the decomposition of hydrofluoric acid (HF), as described in the reaction
$2HF(g) \rightleftharpoons H_2(g) + F_2(g)$
If [HF] = 23.0 M, $[H_2]$ = 0.540 M, and $[F_2]$ = 0.380 M, determine the value of Q and predict how the reaction will proceed.
$\frac{[H_2][F_2]}{[HF]^2} = 3.8 \times 10^{-4} > 1.0 \times 10^{-13}$ left

26. At 1227°C, K_{eq} for the following reaction is 0.15.
$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
If $[SO_2]$ = 0.344 M, $[O_2]$ = 0.172 M, and $[SO_3]$ = 0.056 M, find Q and determine how the reaction will proceed.