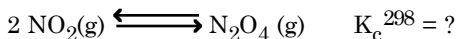




8. (5 pts) In class, we examined the equilibrium:



- (a)  $\text{N}_2\text{O}_4$  is colorless and  $\text{NO}_2$  is red-brown. Heating the mixture makes the contents become darker red-brown. This implies that the reaction, as written, is: [Circle: *endothermic* or *exothermic*.]  
 (b) Adding more  $\text{NO}_2$  to the equilibrium mixture will result in the reaction shifting [Circle: *left* or *right*] to re-attain equilibrium.  
 (c) At temperatures greater than 298,  $K_c$  would be [Circle: *< 0.36*; *= 0.36*; or *> 0.36*]  
 (d) If the volume of the container were reduced, all of the concentrations would increase due to the new smaller size. In order to re-attain equilibrium, the system has to shift [Circle: *left* or *right*].  
 (e) What is the value of  $K_c$  for the same equilibrium, but written as:



9. (2 pts) Which of the following is the **most** acidic?

- (a)  $\text{pOH} = 3.0$                       (b)  $[\text{H}_3\text{O}^+] = 1 \times 10^{-4} \text{ M}$   
 (c)  $\text{pH} = 9$                               (d)  $[\text{OH}^-] = 1 \times 10^{-1} \text{ M}$

10. (2 pts) Which of the following weak acids would give the **lowest** pH as a 1.0 M solution?

- (a) HA,  $K_a = 1 \times 10^{-3}$                       (b) HB,  $K_a = 1 \times 10^{-4}$   
 (c) HC,  $K_a = 1 \times 10^{-5}$                       (d) HD,  $K_a = 1 \times 10^{-6}$

11. (2 pts) Referring to Question 10, which of the following weak bases would give the **lowest** pH as a 1.0 M solution?

- (a) NaA    (b) NaB    (c) NaC    (d) NaD

12. (6 pts) Classify each of the following substances as strong acid (sa), weak acid (wa), neutral (n), weak base (wb) or strong base (sb).

- (a) HBr                      sa   wa   n   wb   sb  
 (b) NaBr                      sa   wa   n   wb   sb  
 (c) HF                      sa   wa   n   wb   sb  
 (d) KF                      sa   wa   n   wb   sb  
 (e) KOH                      sa   wa   n   wb   sb  
 (f)  $\text{NH}_4\text{NO}_3$                       sa   wa   n   wb   sb

13. (3 pts) What is the pH of a 0.00457 M KOH solution?

14. (3 pts) What is the pH of a 0.40 M solution of hypochlorous acid, HOCl? [Given:  $K_a = 3.5 \times 10^{-8}$ ]

15. (4 pts) Complete the following table matching the conjugate weak acid and weak base.

Weak acid	Conjugate weak base
HF	
	$\text{CN}^-$
$\text{H}_2\text{CO}_3$	
	$\text{SO}_3^{-2}$

16. (3 pts) Determine if  $\text{Na}_2\text{HPO}_4$  is a better weak acid or weak base. Show all work! [Given: Phosphoric acid,  $\text{H}_3\text{PO}_4$ :  $K_{a1} = 7.5 \times 10^{-3}$ ;  $K_{a2} = 6.2 \times 10^{-8}$ ;  $K_{a3} = 4.8 \times 10^{-13}$ ]

**Conclusion:**

17. (BONUS 1 point) Print your name here:

**Your exam score (50 possible):** \_\_\_\_\_  
**PrenHall/Pop Quiz (0 — 5 max.):** \_\_\_\_\_  
**Adjusted exam score (50 max.):** \_\_\_\_\_

*Determine your grade:*  
 $A \geq 46.5$ ;  $B+ \geq 43.2$ ;  $B \geq 41.0$ ;  $C+ \geq 37.5$ ;  $C \geq 34.00$ ;  $D \geq 30.00$

Answers:

1.  $K_c = [\text{NH}_3]^2 / [\text{N}_2][\text{H}_2]^3$

2.  $K_p = (P_{\text{Xe}}) \times (P_{\text{O}_2})^2$

3.  $K_c = 104$

4.  $Q_c = 2.31$ , therefore it must shift right

5.  $[\text{H}_2] = [\text{I}_2] = 0.92 \text{ M}$ ;  $[\text{HI}] = 6.75 \text{ M}$

6a. 20 minutes

6b.

	0 min	10 min	20 min	30 min	40 min
$\text{O}_2$	0	1	2	2	2
$\text{N}_2$	0	1	2	2	2

6c.  $K_c = 0.25$

7. a

8. (a) endo; (b) left; (c)  $> 0.36$ ; (d) left; (e)  $K_c = 2.78$

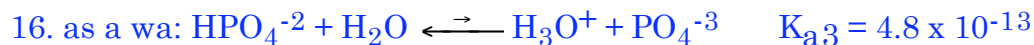
9. b;            10. a;            11. a

12. sa, n, wa, wb, sb, wa

13. 11.66;            14. 3.93

15.

Weak acid	Conjugate weak base
HF	$\text{F}^-$
HCN	$\text{CN}^-$
$\text{H}_2\text{CO}_3$	$\text{HCO}_3^-$
$\text{HSO}_3^-$	$\text{SO}_3^{2-}$



Therefore,  $\text{HPO}_4^{-2}$  is a better base.