

1. A 1.0 L flask contains a mixture of hydrogen (8.0 atm), oxygen (4.0 atm) and neon (2.0 atm) at the stated partial pressures at a temperature of 40 °C. What is the total pressure inside the flask at 40 °C after the mixture is ignited. Ignore the vapour pressure of water.  
a) 14.0 atm      b) 10.0 atm      c) 6.0 atm      d) 2.0 atm      e) 0.0 atm
2. Assuming ideal behaviour, what is the boiling point of a solution of sodium hydroxide (150.0 g) in water (900.0 g)? The boiling point elevation constant,  $K_b$ , for water is 0.51 K kg mol<sup>-1</sup>.  
a) 106.4 °C      b) 104.3 °C      c) 102.1 °C      d) 97.9 °C      e) 95.8 °C
3. Which one of the following is **not** an example of a conjugate acid-base pair?  
a) NH<sub>4</sub><sup>+</sup>, NH<sub>3</sub>  
b) HI, I<sup>-</sup>  
c) CH<sub>3</sub>CH<sub>2</sub>OH<sub>2</sub><sup>+</sup>, CH<sub>3</sub>CH<sub>2</sub>O<sup>-</sup>  
d) HSO<sub>3</sub><sup>-</sup>, SO<sub>3</sub><sup>2-</sup>  
e) H<sub>2</sub>O, OH<sup>-</sup>
4. Which one of the following sets of 0.1 M solutions is arranged in order of increasing boiling point?  
a) glucose < NaCl < NH<sub>3</sub> < Na<sub>2</sub>SO<sub>4</sub>  
b) glucose < HBr < Na<sub>3</sub>PO<sub>4</sub> < Na<sub>2</sub>SO<sub>4</sub>  
c) Na<sub>2</sub>SO<sub>4</sub> < Na<sub>3</sub>PO<sub>4</sub> < HBr < glucose  
d) glucose < HBr < Na<sub>2</sub>SO<sub>4</sub> < Na<sub>3</sub>PO<sub>4</sub>  
e) HBr < Na<sub>2</sub>SO<sub>4</sub> < Na<sub>3</sub>PO<sub>4</sub> < glucose
5. What is the pH of a 0.20 M solution of boric acid? The pK<sub>a</sub> of boric acid is 9.24.  
a) 0.70      b) 2.73      c) 4.97      d) 5.12      e) 5.87

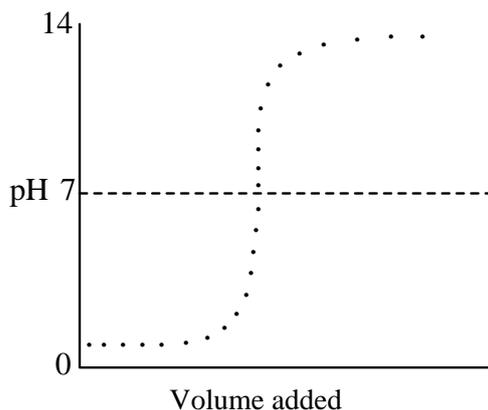
6. What is the pH of a 0.045 M solution of KBr? The  $pK_a$  of HOBr is 8.63.

- a) 4.74                      b) 4.99                      c) 8.25                      d) 9.01                      e) 10.64

7. A buffered solution is 0.0500 M  $CH_3COOH$  and 0.0400 M  $NaCH_3CO_2$ . If 0.0100 mol of gaseous HCl is added to 1.00 L of the buffered solution, what is the final pH of the solution? For acetic acid,  $pK_a = 4.76$

- a) 4.76                      b) 4.46                      c) 4.66                      d) 4.86                      e) 4.54

8. In each of the following titrations, the first solution is in the burette and the second solution is in the titration flask. For which titration would the curve illustrated be typical?



- a)  $Na_2CO_3$  (0.05 M) / HCl (0.1 M)  
 b) NaOH (0.1 M) / HI (0.1 M)  
 c) NaOH (0.1 M) /  $CH_3COOH$  (0.1 M)  
 d)  $NH_3$  (0.1 M) /  $CH_3COOH$  (0.1 M)  
 e)  $NH_3$  (0.1 M) / HCl (0.1 M)

9. Given the initial rate data below, what is the rate law for the following reaction?



$[ClO_2]$ (mol L <sup>-1</sup> )	$[OH^-]$ (mol L <sup>-1</sup> )	Initial rate (mol L <sup>-1</sup> s <sup>-1</sup> )
0.100	0.100	0.23
0.200	0.050	0.46
0.200	0.100	0.92

- a) rate =  $k[ClO_2][OH^-]^2$                       b) rate =  $k[ClO_2]^2[OH^-]$                       c) rate =  $k[ClO_2]^2[OH^-]^2$   
 d) rate =  $k[ClO_2][OH^-]$                       e) rate =  $k[ClO_2]^3$

10. How long does it take for the activity a sample of  $^{131}I$  to drop to 95% of its initial value? The half-life of  $^{131}I$  is 8.02 days.

- a) 0.59 days                      b) 0.26 days                      c) 1.37 days                      d) 0.41 days                      e) 5.2 days

Correct answers:                      1D, 2B, 3C, 4D, 5C, 6E, 7B, 8B, 9B, 10A

1. A 1.0 L flask contains a mixture of hydrogen (8.0 atm), oxygen (4.0 atm) and neon (2.0 atm) at the stated partial pressures at a temperature of 200 °C. What is the total pressure inside the flask at 200 °C after the mixture is ignited.  
a) 14.0 atm      b) 10.0 atm      c) 8.0 atm      d) 4.0 atm      e) 2.0 atm
2. Assuming ideal behaviour, what is the freezing point of a solution of sodium hydroxide (95.0 g) in water (600.0 g)? The freezing point depression constant,  $K_f$ , for water is 1.86 K kg mol<sup>-1</sup>.  
a) -14.7 °C      b) -7.36 °C      c) 0 °C      d) 7.36 °C      e) 14.7 °C
3. Which of the following is **not** an example of a conjugate acid-base pair?  
a) O, OH<sup>-</sup>  
b) HSO<sub>3</sub><sup>-</sup>, SO<sub>3</sub><sup>2-</sup>  
c) HCN, CN<sup>-</sup>  
d) H<sub>3</sub>PO<sub>4</sub>, H<sub>2</sub>PO<sub>4</sub><sup>-</sup>  
e) H<sub>3</sub>O<sup>+</sup>, H<sub>2</sub>O
4. Which one of the following sets of 0.1 M solutions is arranged in order of increasing boiling point?  
a) sucrose < NaCl < CH<sub>3</sub>COOH < Na<sub>2</sub>SO<sub>4</sub>  
b) sucrose < HCl < Na<sub>3</sub>PO<sub>4</sub> < K<sub>2</sub>SO<sub>4</sub>  
c) sucrose < CH<sub>3</sub>COOH < MgCl<sub>2</sub> < K<sub>3</sub>PO<sub>4</sub>  
d) HBr < Na<sub>2</sub>SO<sub>4</sub> < Na<sub>3</sub>PO<sub>4</sub> < sucrose  
e) Na<sub>2</sub>SO<sub>4</sub> < K<sub>3</sub>PO<sub>4</sub> < HBr < sucrose
5. What is the pH of a 2.00 M solution of hydrazoic acid, HN<sub>3</sub>? The pK<sub>a</sub> of HN<sub>3</sub> is 4.65.  
a) -0.30      b) 0.48      c) 2.00      d) 2.17      e) 4.35

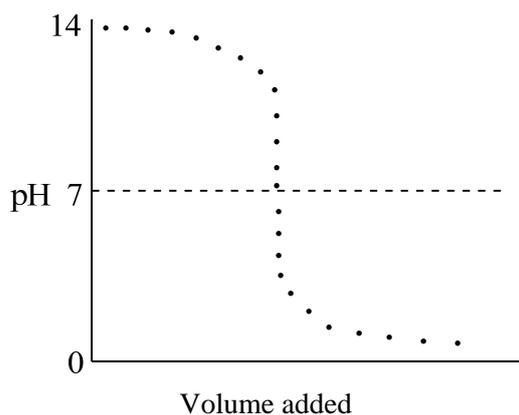
6. What is the pH of a 0.42 M solution of sodium azide,  $\text{NaN}_3$ ? The  $\text{p}K_a$  of  $\text{HN}_3$  is 4.65.

- a) 4.74                      b) 8.25                      c) 9.14                      d) 9.73                      e) 13.62

7. A buffered solution is 0.0600 M  $\text{CH}_3\text{COOH}$  and 0.0300 M  $\text{NaCH}_3\text{CO}_2$ . If 0.0200 mol of solid  $\text{NaOH}$  is added to 1.00 L of the buffered solution, what is the final pH of the solution? For acetic acid,  $\text{p}K_a = 4.76$

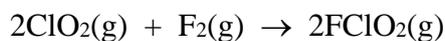
- a) 4.76                      b) 4.46                      c) 4.66                      d) 4.86                      e) 4.54

8. In each of the following titrations, the first solution is in the burette and the second solution is in the titration flask. For which titration would the curve illustrated be typical?



- a)  $\text{HCl}$  (0.1 M) /  $\text{Na}_2\text{CO}_3$  (0.05 M)  
 b)  $\text{HCl}$  (0.1 M) /  $\text{NH}_3$  (0.1 M)  
 c)  $\text{CH}_3\text{COOH}$  /  $\text{NaOH}$  (0.1 M) (0.1 M)  
 d)  $\text{CH}_3\text{COOH}$  (0.1 M) /  $\text{NH}_3$  (0.1 M)  
 e)  $\text{HI}$  (0.1 M) /  $\text{NaOH}$  (0.1 M)

9. Given the initial rate data below, what is the rate law for the following reaction?



$[\text{ClO}_2]$ ( $\text{mol L}^{-1}$ )	$[\text{F}_2]$ ( $\text{mol L}^{-1}$ )	Initial rate ( $\text{mol L}^{-1} \text{ s}^{-1}$ )
0.010	0.10	$1.2 \times 10^{-3}$
0.040	0.10	$4.8 \times 10^{-3}$
0.010	0.20	$2.4 \times 10^{-3}$

- a) rate =  $k[\text{ClO}_2][\text{F}_2]^2$                       b) rate =  $k[\text{ClO}_2]^2[\text{F}_2]$                       c) rate =  $k[\text{ClO}_2]^2[\text{F}_2]^2$   
 d) rate =  $k[\text{ClO}_2][\text{F}_2]$                       e) rate =  $k[\text{ClO}_2]^2$

10. How long does it take for the activity a sample of  $^{14}\text{C}$  to drop to 55% of its initial value? The half-life of  $^{14}\text{C}$  is 5730 years.

- a) 2100 years                      b) 11000 years                      c) 3400 years                      d) 4900 years                      e) 8800 years

Correct answers:                      1B, 2A, 3A, 4C, 5D, 6C, 7D, 8E, 9D, 10D