Honour Chemistry: Unit 6 Practice Test: Acids and Bases

Name: ______________________________ Date: ____________________ Block: _______

Total: 40 marks

Part A: Multiple Choice and Numerical Response **(1 mark each for Multiple Choice)**
(2 marks each for Numerical Response)

1. The list of substances containing only acids is

A. soda pop, grapefruit juice, household ammonia.
B. household ammonia, vinegar, soda pop.
C. milk of magnesia, eggs, sea water.
D. vinegar, lemon juice, soda pop.

2. The equation which represents the acid dissociation of $HS^{-}{}_{(aq)}$ is

A. $HS^{-}{}_{(aq)} + H_2O_{(l)} \rightleftharpoons H_2S_{(aq)} + OH^{-}{}_{(aq)}$
B. $HS^{-}{}_{(aq)} + H_3O^{+}{}_{(aq)} \rightarrow H_2S_{(aq)} + H_2O_{(l)}$
C. $HS^{-}{}_{(aq)} + H_2O_{(l)} \rightleftharpoons S^{2-}{}_{(aq)} + H_3O^{+}{}_{(aq)}$
D. $HS^{-}{}_{(aq)} + H_2O_{(l)} \rightleftharpoons H_{2\,(g)} + S^{2-}{}_{(aq)} + OH^{-}{}_{(aq)}$

3. In an experiment, 20.0 mL of 0.10 mol/L $HCl_{(aq)}$ was titrated with 20.0 mL of 0.10 mol/L $KOH_{(aq)}$ to the equivalence point. The pH at the equivalence point would be

A. 1.00 **B.** 3.0 **C.** 7.00 **D.** 12.00

Numerical Response

1. To the nearest tenth, the pH of a basic solution that has an $[OH^{-}{}_{(aq)}]$ of 6.40×10^{-3} mol/L is __________ .

Use the following observations to answer the next question.

Solution	**Observation**
Solution I	has a large pH, conducts electricity
Solution II	turns litmus blue, forms an aqueous solution having no conductivity
Solution III	conducts electricity; reacts with $Zn_{(s)}$ to form $H_{2\,(g)}$
Solution IV	has a large pH; turns pink when phenolphthalein is added

4. A student made one error in recording observations on four unknown solutions. For which solution did the error occur?

A. I **B.** II **C.** III **D.** IV

---

5. When a small amount of either an acid or a base is added to the buffered solution, the buffer will

A. be consumed in the reaction to change the pH of the solution.
B. act in the same way as the inflection area of a titration curve.
C. cause a dramatic change in pH of the solution.
D. resist a change in pH of the solution.

Numerical Response

2. To the nearest tenth, the volume of 2.00 mol/L H_2SO_4 solution would be needed to react completely with 4.20 g of solid Na_2CO_3 is _______________ mL.

Use the following information to answer the next question.

A standard solution of $KOH_{(aq)}$ was used to titrate an unknown solid acid sample (HA) until the endpoint was reached. The following data were obtained:

Mass of acid in sample	0.25 g
Concentration of standard $KOH_{(aq)}$	0.100 mol/L
Initial buret reading $KOH_{(aq)}$	0.50 mL
Final buret reading $KOH_{(aq)}$	29.64 mL

6. The molar mass of the unknown acid is

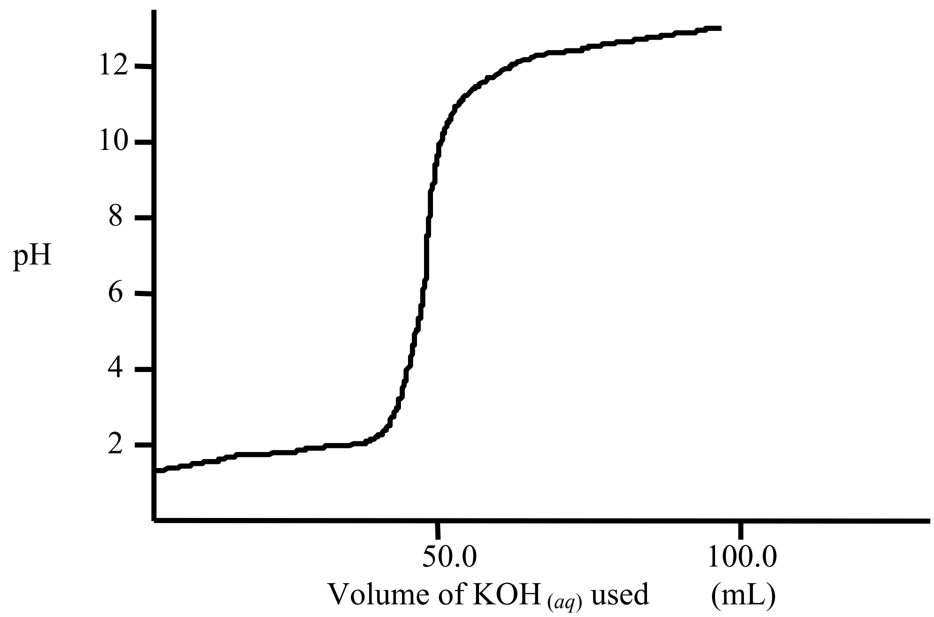
A. 83 g/mol **B.** 86 g/mol **C.** 2.5×10^2 g/mol **D.** 8.6×10^3 g/mol

---

Use the following information to answer the next question.

The concentration of an acid, HA, was determined by titrating 25.0 mL with a solution of 0.050 mol/L potassium hydroxide.

The variation of pH with volume of potassium hydroxide is shown in the graph.



7. The concentration of the acid, HA, is

A. 0.10 mol/L **B.** 0.050 mol/L **C.** 0.025 mol/L **D.** 0.010 mol/L

Numerical Response

3. To the nearest hundredth, the pH of a solution with a pOH of 6.95 is ________________________.

Use the following information to answer the next two questions.

Chromium(VI) oxide is used to form the highly acidic "dichromic acid" in chromium plating solution. Production of "dichromic acid" is $2\ CrO_{3\,(aq)} + H_2O_{\,(l)} \rightarrow H_2Cr_2O_{7\,(aq)}$. The "dichromic acid" ionizes 100% in water as $H_2Cr_2O_{7\,(aq)} + H_2O_{\,(l)} \rightarrow H_3O^+_{\,(aq)} + HCr_2O_7^-{}_{(aq)}$.

8. What is the pH in a chromium plating solution in a 1000 L tank when 240.0 g/L of $CrO_{3\,(s)}$ is dissolved?

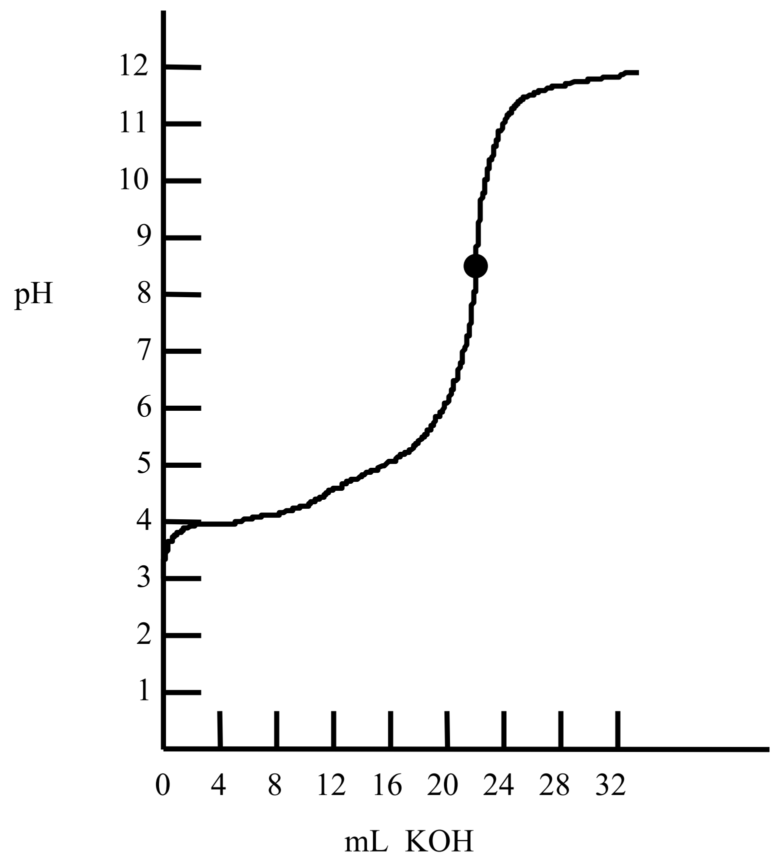
A. −0.0792 **B.** −0.3802 **C.** 2.620 **D.** 2.921

9. Barium carbonate is used to modify the pH in chromium plating solutions. The addition of solid barium carbonate

A. decreases the pH and decreases the $[H_3O^+_{\,(aq)}]$
B. decreases the pH and increases the $[H_3O^+_{\,(aq)}]$
C. increases the pH and increases the $[H_3O^+_{\,(aq)}]$
D. increases the pH and decreases the $[H_3O^+_{\,(aq)}]$

Use the following information to answer the next question.

The graph below represents results from the titration of an acetic acid sample with a potassium hydroxide solution.



10. At the pH indicated by the point on the graph, the most abundant chemical species would be

A. $H_3O^+_{\,(aq)}$, $OH^-_{\,(aq)}$, $H_2O_{\,(l)}$
B. $CH_3COO^-_{\,(aq)}$, $K^+_{\,(aq)}$, $H_2O_{\,(l)}$
C. $CH_3COOH_{\,(aq)}$, $KOH_{\,(aq)}$, $H_2O_{\,(l)}$
D. $CH_3COOH_{\,(aq)}$, $OH^-_{\,(aq)}$, $K^+_{\,(aq)}$, $H_2O_{\,(l)}$

---

11. In industry, some of the empirical properties of a substance are selected as safe and efficient diagnostic tests. In the electroplating industry, the **safest** and **most efficient** diagnostic test for acids is the one where

A. acids react with active metals to produce hydrogen gas
B. acids taste sour
C. acids react with carbonates to produce carbon dioxide gas
D. blue litmus turns red in acid solution

12. A 0.100 mol/L propanoic acid solution, $C_2H_5COOH_{(aq)}$, has a pH of 2.95. From these data, the K_b for the propanoate ion, $C_2H_5COO^-_{(aq)}$, is

A. 1.1×10^{-3}
B. 1.3×10^{-5}
C. 7.9×10^{-10}
D. 8.7×10^{-12}

The Haber process uses hydrogen and nitrogen to produce ammonia for use as a feedstock for other processes or as a fertilizer. In industry, the goal of manufacturing is to obtain the highest yield of product for the lowest cost.

13. Ammonia could also be produced industrially, by reacting ammonium ion with hydrogen sulfate ion according to the equation

$$NH_4^+{}_{(aq)} + HSO_4^-{}_{(aq)} \rightleftharpoons NH_{3\,(aq)} + H_2SO_{4\,(aq)}$$

A conjugate acid base pair is

A. $NH_4^+{}_{(aq)}$ and $HSO_4^-{}_{(aq)}$
B. $HSO_4^-{}_{(aq)}$ and $NH_{3\,(aq)}$
C. $H_2SO_{4\,(aq)}$ and $HSO_4^-{}_{(aq)}$
D. $H_2SO_4^-{}_{(aq)}$ and $NH_4^+{}_{(aq)}$

14. Fertilizer can then be produced by reacting aqueous ammonia with nitric acid. The correct net ionic equation for this process is

A. $NH_{3\,(aq)} + H_3O^+{}_{(aq)} \rightarrow NH_4^+{}_{(aq)} + H_2O_{(l)}$
B. $NH_{3\,(aq)} + H_2O_{(l)} \rightarrow NH_2^-{}_{(aq)} + H_3O^+{}_{(aq)}$
C. $NH_{3\,(aq)} + HNO_{3\,(aq)} \rightarrow NH_4^+{}_{(aq)} + NO_3^-{}_{(aq)}$
D. $H_3O^+{}_{(aq)} + NO_3^-{}_{(aq)} \rightarrow HNO_{3\,(aq)} + H_3O^+{}_{(aq)} + NH_4^+{}_{(aq)}$

15. A drop of chlorophenol red is added to a 0.10 mol/L $HCl_{(aq)}$ sample. The colour of the indicator is

A. yellow because the pH of the solution is less than 5.2
B. yellow because the pH of the solution is greater than 5.2
C. red because the pH of the solution is less than 6.8
D. red because the pH of the solution is greater than 6.8

16. Which of the following species is able to react as either an acid or a base?

A. $CO_3^{2-}{}_{(aq)}$
B. $CH_3OH_{(aq)}$
C. $HS^-{}_{(aq)}$
D. $NH_{3\,(aq)}$

17. A buffer system of $CH_3COOH_{(aq)}$ / $NaCH_3COO_{(aq)}$ works best if

A. the solution to be buffered has a pH greater than 7
B. the amount of $CH_3COOH_{(aq)}$ and $CH_3COO^-{}_{(aq)}$ are large compared to the amount of acid or base added
C. large amounts of acid or base are added to the buffered system
D. the concentration of $CH_3COO^-{}_{(aq)}$ is small compared to the concentration of $CH_3COOH_{(aq)}$

Use the following acid-base equations and key to answer the next two questions.

Equations

Equation	
$HOCN_{(aq)} + C_3H_5O_3^-{}_{(aq)} \rightleftharpoons OCN^-{}_{(aq)} + HC_3H_5O_{3\,(aq)}$	Products favoured
$HC_3H_5O_{3\,(aq)} + C_6H_5COO^-{}_{(aq)} \rightleftharpoons C_3H_5O_3^-{}_{(aq)} + C_6H_5COOH_{(aq)}$	Products favoured
$HOCN_{(aq)} + IO_3^-{}_{(aq)} \rightleftharpoons OCN^-{}_{(aq)} + HIO_{3\,(aq)}$	Reactants favoured

Key

1	$C_6H_5COOH_{(aq)}$	**4**	$OCN^-{}_{(aq)}$	**7**	$HC_3H_5O_{3\,(aq)}$
2	$C_6H_5COO^-{}_{(aq)}$	**5**	$HIO_{3\,(aq)}$	**8**	$C_3H_5O_3^-{}_{(aq)}$
3	$HOCN_{(aq)}$	**6**	$IO_3^-{}_{(aq)}$		

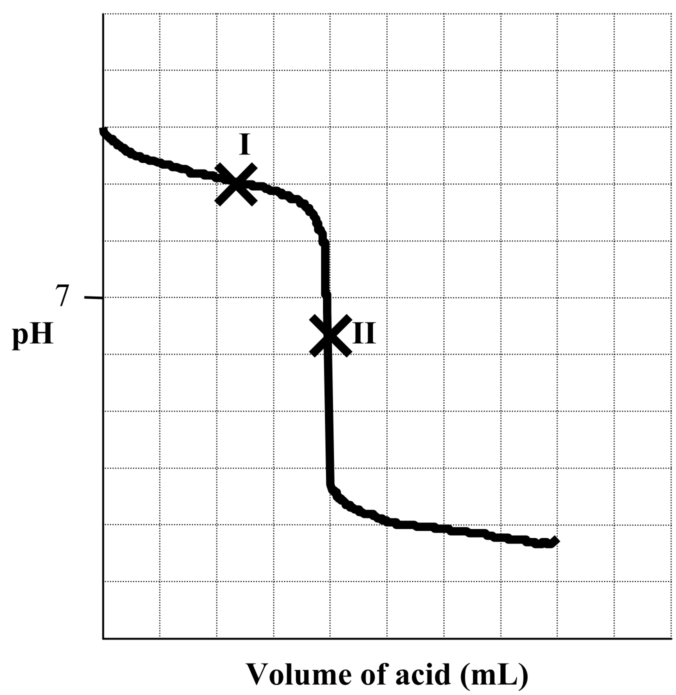
Numerical Response

4. The bases, listed in any order, are ________________.

Numerical Response

5. The acids, ordered from strongest to weakest, are ______________.

Use the following information to answer the next question.



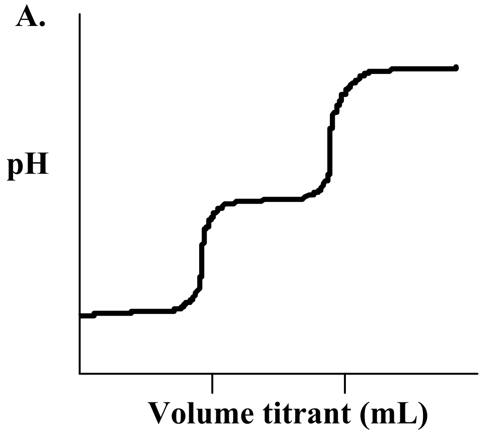
18. On the pH curve showing the titration of a weak base with a strong acid, it can be seen that the pH changes very gradually at I compared to II. The reason for this is that

A. the acid is not as strong at I as at II
B. the solution at I is a buffer solution
C. all the base reacted at I
D. pH always changes rapidly around pH = 7

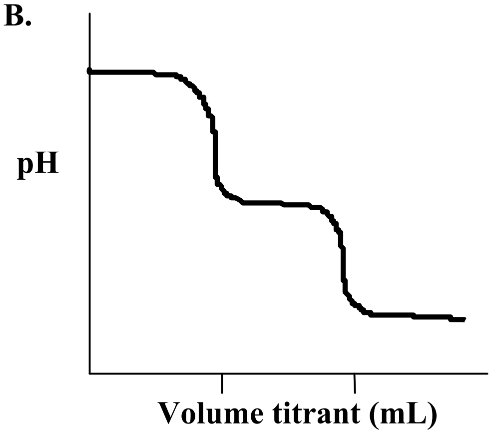
---

19. Which of the following graphs **best** represents the neutralization of a diprotic acid by the continuous addition of 0.10 mol/L $NaOH_{(aq)}$?

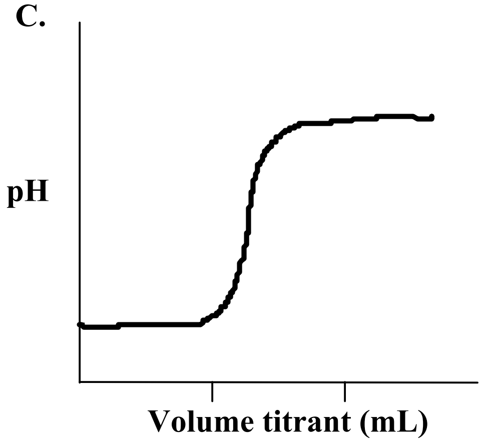
A.



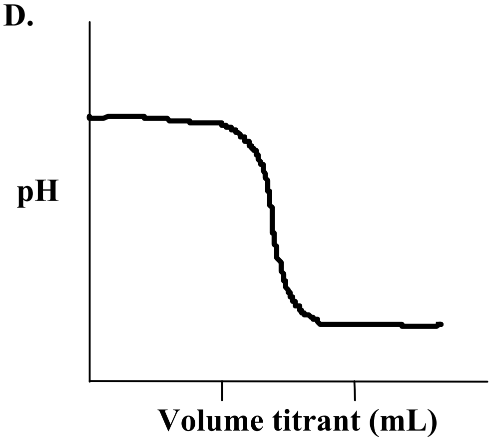
B.



C.



D.



Use the following information to answer the next question.

A student is asked to determine the molar concentration of acetic acid in a sample of vinegar. A standardized sodium hydroxide solution is available. From the list below, **select the four procedures** you would most likely perform to solve this problem.

1	measure and record the initial mass of the vinegar sample
2	measure and record the volume of the vinegar sample
3	add phenolphthalein to the vinegar sample
4	fill a buret with standardized sodium hydroxide solution
5	measure and record the final mass of the vinegar sample
6	measure and record the initial and final volumes from the buret

Numerical Response

6. The order in which these procedures must be performed is ___________.

---

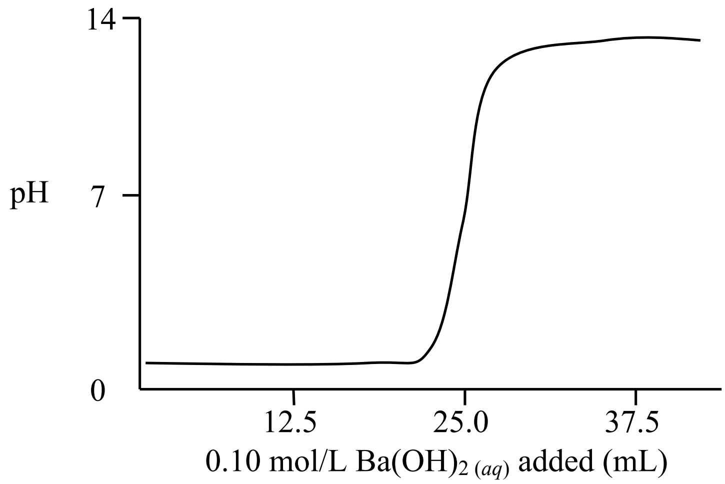
20. Which of the following is **not** associated with a 0.10 mol/L solution of a weak acid?

A. $[H_3O^+_{(aq)}] < 0.10$ mol/L
B. A relatively strong conjugate base
C. A small K_a value
D. pH = 1.00

Part B: Written Response **(8 marks)**

Use the following information to answer the next question.

A student titrated 45.0 mL of an unknown monoprotic acid ($HA_{(aq)}$) with a 0.100 mol/L barium hydroxide solution. A pH meter was used to obtained the following curve:



1. a. Based on the results shown on the graph, write a balanced chemical equation and calculate the initial concentration of the unknown acid.

b. 0.315 g of acid was dissolved in water to make the 45.0 mL of unknown solution. Calculate the molar mass of this acid.

c. What can you tell about the strength of this acid? Explain.

d. Identify the unknown acid using the Chemistry Data Booklet and the results from part **b.** and **c.**

Part A: Multiple Choice and Numerical Response

1.	D	**2.**	C	**3.**	C	**4.**	B	**5.**	D	**6.**	B	**7.**	A	**8.**	A	**9.**	D	**10.**	B
11.	D	**12.**	C	**13.**	C	**14.**	A	**15.**	A	**16.**	C	**17.**	B	**18.**	B	**19.**	A	**20.**	D

Numerical Response

1. 11.8 **2.** 19.8 **3.** 7.05 **4.** 2468 **5.** 5371 **6.** 2346 or 2436 or 4236

Part B: Written Response

1. a. [HA] = 0.111 mol/L = 111 mmol/L

b. M = 63.0 g/mol

c. HA would be a strong acid because:
Equivalence point has a pH of 7 with a strong base.

d. HNO_3 = 63.02 g/mol