Unit Test

Introduction to Acids and Bases

Chemistry 12

11 pages

50 marks total & bonus 12 marks

1 hour 40 minutes

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*True/False. Select ONE best answer for each question. (1 mark each)*

1) Arrhenius bases release OH- ions into aqueous solutions.

|  |  |
| --- | --- |
| A) True | B) False |

2) PO43- is amphiprotic in water.

|  |  |
| --- | --- |
| A) True | B) False |

3) HSO4- is amphiprotic in water.

|  |  |
| --- | --- |
| A) True | B) False |

4) CO32- is the conjugate **acid** of HCO3-.

|  |  |
| --- | --- |
| A) True | B) False |

5) H3BO3 is a stronger acid than HCN.

|  |  |
| --- | --- |
| A) True | B) False |

*Multiple Choice. Select ONE best answer for each question. (1 mark each)*

6) Which of the following is the weakest base?

|  |  |
| --- | --- |
| A) HC2 O4 − | B) H2 PO4 − |
| C) HCOO− | D) CH3COO− |
| E) HIO3 |  |

7) Which of the following is the conjugate base of C6 H5COOH

|  |  |
| --- | --- |
| A) OH − | B) C6 H5COO− |
| C) C6 H5COOH2+ | D) H3O+ |
| E) H2 O |  |

8) Given the below equilibrium constant expression, this is the

|  |  |
| --- | --- |
| A) | Ka of HNO2 |
| B) | Kb of HNO2 − |
| C) | Ka of NO2 − |
| D) | Kb of NO2 − |

9) Consider the below equilibrium.

0.31

Which one is the strongest acid?

|  |  |
| --- | --- |
| A) |  |
| B) |  |
| C) |  |
| D) |  |

10) The correct acid dissociation equilibrium for H3C6 H5O7 in an aqueous solution is:

|  |  |
| --- | --- |
| A) |  |
| B) |  |
| C) |  |
| D) |  |

11) The pH of a 0.0001M solution of NaOH is

|  |  |
| --- | --- |
| A) 10 | B) 4 |
| C) 1.0 | D) 10.0 |
| E) 4.0 |  |

12) You will never find HNO3 molecules in water because

|  |  |
| --- | --- |
| A) | Of the leveling effect. |
| B) | Strong acids would completely ionize in aqueous solution. |
| C) | The strongest acid in water is H3O+ |
| D) | A and C |
| E) | All of the above |

13) If the following reaction favors the reactant's side, which one is the stronger acid?

|  |  |
| --- | --- |
| A) | B) |
| C) | D) |

14) The Kb of HC2O4- is

|  |  |
| --- | --- |
| A) | 1.7x10-13 |
| B) | 1.6x10-10 |
| C) | 6.4x10-5 |
| D) | 5.9x10-2 |

15) In which of the following is water H2O(l) acting as a base in the forward reaction?

|  |  |
| --- | --- |
| A) |  |
| B) |  |
| C) |  |
| D) |  |

16) At 30°C, the pH of pure water is roughly 6.9. What can we say about this water's neutrality?

|  |
| --- |
| A) Its pH is 6.9, which means the water is acidic. |
| B) Its pOH is also 6.9, so the water must be basic. |
| C) Its pOH would be 7.1 so the water must be basic. |
| D) Its pOH would be 7.1 so the water must be acidic. |
| E) In pure water, [H3O+] and [OH-] are equal, so the water is neutral. |

17) As a solution's pOH increases, its

|  |  |
| --- | --- |
| A) pH increases and its [H3O+] increases. | B) pH decreases and its [H3O+] increases |
| C) pH increases and its [H3O+] decreases. | D) pH decreases and its [H3O+] decreases. |

18) Which of the following properties are common in acid AND base aqueous solutions?

|  |  |  |  |
| --- | --- | --- | --- |
| A) | Sour taste | B) | Has electric conductivity |
| C) | Turns litmus blue | D) | Reacts with magnesium metal |
| E) | Releases gases |  |  |

19) Consider the following equilibria.

The strengths of the acids from **weakest to strongest** is

|  |  |
| --- | --- |
| A) , , , | B) , , , |
| C) , , , | D) , , , |
| E) , ,, |  |

20) In your titration lab, you added the phenolphthalien in your unknown solution. Choose the **best** reason from below.

|  |
| --- |
| A) To neutralize the unknown acid |
| B) To neutralize the base being added |
| C) To turn your unknown acid solution pink |
| D) To know the pH of the reaction |
| E) To find the equivalence point of the neutralization reaction |

*End of Multiple Choice section.*

*\*\*You can do it!! Keep going!\*\**

*Written Section. Show ALL your work. (30 marks)*

21) a) Write the Brönsted-Lowry acid-base equation for the reaction between HCN(aq) and NH3(aq). (2 marks)

b) Write the two conjugate acid-base pairs from the equation above. (2 marks)

22) a) Write the equilibrium of SO42-'s dissociation in an aqueous solution. (2 marks)

b) Write the Kb expression constant for SO42-. (2 marks)

c) Find the Kb value of SO42-. (2 marks)

23) A sample of a weak acid was found to conduct an electric current better than a sample of a strong acid. Explain these results in terms of ion concentration. (2 marks)

24) A 25mL solution of 0.020M KOH was mixed with a 40mL solution of 0.015M HNO3. Find the pOH of the mixture. (5 marks)

25) The pH of a 0.1M solution of is 4.8. Find the Ka value of . (3 marks)

26) In three separate trials, 10.00mL samples of **H2SO4** were titrated with 0.40M NaOH. The results are tabulated below:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Trial 1 | Trial 2 | Trial 3 |
| Final NaOH reading (mL) | 28.32 | 36.86 | 32.87 |
| Initial NaOH reading (mL) | 3.51 | 11.56 | 7.47 |

Calculate the concentration of the H2SO4. (4 marks)

27) Calculate the pH of 1.0L, 0.45 M H2CO3. Start by writing the predominant equilibrium equation. State any assumptions that you've made. (6 marks)

*End of Written Section.*

*Bonus Questions. (12 marks)*

I) Let's say you have 2 amphiprotic species in an aqueous solution (ex. H2PO4-­ and HCO3-). How would you know which species is acting as the acid or the base? What is the predominant chemical reaction? Start with defining amphiprotic species. Use what you learned about relative acid strengths in equilibrium to help you explain this question. (3 marks)

II) You know that for a generic acid, HA. Given the log identities on the side to help you, derive . (4 marks)

Log identities:

You know:

pKa = -log(Ka)

pH = -log[H3O+]

III) Find the pH of a 0.1M Na2HPO4 salt solution. Justify why you decided HPO42- acted as an acid or a base. (Hint: would HPO42- want a proton more than it wants to lose one? How can you quantitatively show this?) (5 marks)

*End of Unit Test.*