Acids and bases test

Chemistry IB12

Name:
Date:

Useful information

Acid	Abreviation	K_a or pK_a	Base	Abreviation	K_b or pK_b
AH		$K_a = 2.6 \cdot 10^{-6}$	COH		$K_b = 9.5 \cdot 10^{-5}$
BH		$K_a = 6.5 \cdot 10^{-7}$	Methylamine	$MeNH_2$	$K_b = 4.37 \cdot 10^{-4}$
Acetic	AcH	pKa = 4.76	Aniline	$PhNH_2$	$K_b = 4.17 \cdot 10^{-10}$
Benzoic	PhH	$K_a = 6.44 \cdot 10^{-5}$			
Hydrofluoric	HF	$K_a = 5.62 \cdot 10^{-4}$			
Hydrocyanic	HCN	$K_a = 3.98 \cdot 10^{-10}$			

1. The acid AH is an acid according to the Brønsted definition.
   a) Write its reaction [1]

   b) Write the definition of an acid according to Brønsted.[1]

2. Write the Lewis definition of acids and bases and give an example of each. (HL) [2]

3. A popular trick to scare away ducks from rice fields is mixing in an empty soda bottle some aluminium foil and hydrochloric acid. The pressure built up by the ensuing reaction inflates the bottle until it breaks like a balloon, making a loud noise.
Write the reaction that takes place.[2]

4. Complete and balance these reactions: [1 each]

a) $Ca(OH)_2 + HCl \rightarrow$

b) $Ag + HNO_3 \rightarrow$

c) $CO_2 + H_2O \rightarrow$

5. a) Explain the difference between a strong acid and a weak acid. Explain as well why strong acids don't have K_a [3]

b) Explain why a 10^{-4} M solution of HCl has a pH of 4, but a 10^{-8} M solution of HCl doesn't have a pH of 8. [2]

c) Which acid is stronger, AH or BH. Motivate your answer. [2]

6. Calculate:

a) The pH of a 0.025 M solution of BH (HL) [3]

b) The pH of a 0.03 M solution of COH (HL) [3]

c) The pH of a 0.007 M solution of H_2SO_4 [2]

7. Two hypothetical acids, DH and EH are weak acids. When dissolving 0.01 mol of NaD in water, the pH of the resulting solution is 8.6, and when dissolving the same number of moles of NaE in water the resulting solution has a pOH of 4.2.
State and explain which acid is stronger. [3]

Bonus question: calculate the K_a of DH [2]

8. a) Which three oxides cause most of the acid deposition? Write one reaction pertaining each of them. [3]

b) Outline two major problems associated with acid deposition. [2]

c) Mention four possible measures that may help reducing acid deposition. [2]

9. (HL) a) Calculate the pH of a 0.16M Acetic acid [3]

b) Calculate the pH of a 0.044 M solution of sodium benzoate [4]

10. (HL) a) Sketch the curve of a titration of HF (approximately 0.01M) using a strong base of the same concentration. Draw the relevant points and calculate the pH at them. [4]

b) Pick an appropriate indicator for this titration from this list. State why you have chosen it, which colour change will take place and when you will stop the titration. [4]

Indicator	pH range	Acid colour	Alkali colour
methyl orange	3.1–4.4	red	yellow
bromophenol blue	2.9–4.6	yellow	blue
bromocresol green	3.8–5.4	yellow	blue
methyl red	4.2–6.3	red	yellow
bromothymol blue	6.0–7.6	yellow	blue
phenol red	6.8–8.4	yellow	red
phenolphthalein	8.2–10.0	colourless	pink

11. (HL)a) Describe how you would prepare a pH 10 buffer solution using the acids and bases mentioned anywhere in the exam and any amount of HCl or NaOH you may need. [4]

b) The solution you have prepared would withstand better the addition of acid or base? Explain why. [2]