**YEAR 12 CHEMISTRY – ATCHE**

**TEST 2 2018**

**Acids & Bases**

**/ 47**

**Recommended time: 55 Minutes**

Name: \_\_\_\_\_\_\_Mark Key\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Teacher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This test is in two parts.

**Part 1:** Multiple choice style consisting of (15) questions.

Each question is worth 1 mark.

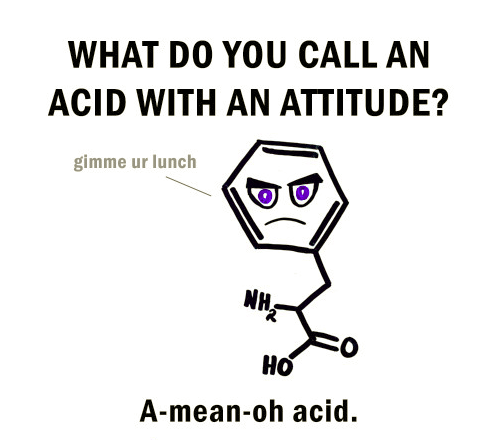
Write your answers in the table provided.

Attempt ALL Questions

**Part 2:** Short and/or Extended Answer questions worth 32 marks.

Write all answers in the spaces provided.

The marks allocated to each question are shown next to each question.



**Part 1: Multiple Choice section.**

Please write your answers in the boxes provided.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **B** | **C** | **B** | **C** | **C** | **C** | **B** | **A** | **A** | **B** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **11** | **12** | **13** | **14** | **15** |
| **B** | **C** | **D** | **C** | **D** |

**Part 2: Short Answer Section**

Question 16.   
(a) A buffer of carbonic acid (H2CO3)/hydrogencarbonate (HCO3**−**) is present in blood plasma to maintain a pH between 7.35 and 7.45. Write equations to show the relevant species acting as a buffer in a carbonic acid/hydrogencarbonate solution. (2 marks)

|  |
| --- |
| H2CO3 + OH- 🡨🡪 HCO3 - + H2O (1mark)  HCO3 - + H3O+ 🡨 🡪 H2CO3 + H2O (1 mark)  Note that hydrolysis reactions score no marks: a suitable eqn for a buffer must have acid and hydroxide. |

(b) Explain why 300.0 mL of 1.00 mol L–1 carbonic acid/hydrogencarbonate buffer does not change in pH significantly when 3 drops of 1.00 mol L–1 HCℓ are added to it, yet when 3 drops of 1.00 mol L–1 HCℓ are added to 300.0 mL of distilled water there is a significant change in pH? (4 marks)

1 When H3O+ from HCl solution is added, it reacts with HCO3 - to form water

|  |
| --- |
| 2 This prevents H3O+ / H+ concentration from changing significantly |
|  |
| 3) When HCl is added to pure water, the H3O+ don’t react with anything, and therefore the 4 H3O+ concentration increases significantly |
|  |
| Optionally: use LCP to say that LCP favours the consumption of H+ and the system returns towards its original equilibrium |
|  |

Question 17. Ammonium sulfate and calcium hydrogen phosphate are both salts which are added to soil. Explain, using appropriate equations, the effect of each of these on soil pH. (5 marks)

(NH4)2SO4 is added to lower soil pH (1 mark)

|  |
| --- |
| NH4+ ions hydrolyse water in the soil to produce H3O+ ions: |
| NH4+ + H2O 🡨 🡪 NH3 + H3O+  (1 mark) |
|  |
| CaHPO4 is added to raise pH in the soil (1 mark) it |
| HPO4 2- + H2O 🡨 🡪 H2PO4 - + OH- (1mark) |
| OH- reacts with H+ to lower [H+] and increase pH (1 mark) |

Question 18. Models and theories are contested and refined or replaced when new evidence challenges them. State two pieces of evidence that conflicted with the Arrhenius and Bronsted-Lowry theory of acids that led to the development of new theories. (2 marks)

Arrhenius: (i) any 1: NH3 is a base, no OH-

|  |
| --- |
| Gaseous HCl and NH3 undergo acid base reaction without OH- |
|  |
|  |
| Bronsted-Lowry (ii) any 1 |
| Doesn’t explain reactions between acidic and basic oxides eg CaO + CO2 🡪 CaCO3 |
| Doesn’t explain why AlCl3 behaves as an acid in certain organic reactioms |

Question 19. (11 marks)

A 20 ml solution of potassium hydroxide was standardised against a 0.040 mol L-1 solution of HCl.

1. Fill in the missing spaces in the table below and then answer the questions that follow:

STANDARDIZATION OF KOH SOLUTION:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | 1st trial | 2nd trial | 3rd trial |
| Final reading of acid buret |  | 24.6 ml | 25.0 ml | 26.5 ml |
| Initial reading of acid buret |  | 0.0 ml | 0.5 ml | 0.0 ml |
| Total volume of acid used |  | 24.6 ml | 24.5 ml | 26.5 ml |

(3 marks)

1. What is the molarity (concentration) of the base?. (Show all working for full marks) (3 marks)

Exclude trial 3 – not concordant

|  |
| --- |
| Avg vol = (24.6 + 24.5 )/2 = 24.55 ml (1 mark) |
|  |
| KOH + HCl 🡪 H2O + NaCl |
| Therefore n OH- = n(HCl)  =0.04 mol L-1 x 0.02455L = 9.82 x10-4 mol (1mark) |
|  |
| C= 9.82 x10-4 mol /0.020 = 0.0491 mol L-1 (1 mark) |
|  |
| If discordant not eliminated, they’ll get 0.0504 mol L-1 (give 2 marks) |
| If they discard trial 1, expecting it to be rough, they’ll get 0.051 mol L-1 (give 2 marks) |

1. What volume of the solution of KOH from part b) would be required to completely neutralise 20.0mL of a 0.150 mol L-1 solution of the triprotic acid citric acid? (Show all working for full marks) (3 marks)  
     
   3 KOH + H3-citrate 🡪 3H2O + K3 Citrate or

|  |
| --- |
| 3 KOH + H3A 🡪 3H2O + K3A OR RECOGNISE CORRECT 3:1 RATIO (1mark) |
|  |
| N(H3A) = 0.15 x 0.02 = 3.0x10-3 mol H3A |
| Therefore 3 x H3A = 9.0x10-3 mol (1 mark) |
| Therefore v = n/c = 9.0x10-3 / 0.0491 = 0.183 litres or 183 mL (1 mark) |
| Note: carry over marks are full if 179 ml or 176 ml |
|  |
|  |
|  |

1. From your answer to part (c), would you expect the final pH to be acidic, neutral, or basic? Give a reason for your answer. (2 marks)

|  |
| --- |
| Basic (1 mark) |
| Citric acid is a weaker acid than OH- is a strong base, therefore hydrolysis of water by citrate ion will occur |
| (1 mark) |
| Or eq’n that shows this |

1. Name a suitable indicator for this titration of KOH and citric acid. (1 mark)

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| --- |
| Phenolphthalein (don’t penalise spelling !) |

Question 20. The rivers upon which Perth and its surroundings are located are called the Swan and Canning rivers. Their combined volume is approximately 160 gigalitres. In winter, the average pH is 7.9.

1. Theoretically, how many 100 litre drums of 10 mol L-1 sodium hydroxide would it take to raise that volume of water to that pH? (show all working for full marks) (4 marks)

|  |
| --- |
| 160 GL = 1.60 x 1011 litres (1/2 mark) |
| n(OH-) =cv, c[OH-] = kw/H+ |
| C(pH7) = 1x 10 -7 mol L-1 ½ mark |
| C(pH 7.9) = 1x 10 -14/10-7.9  = 7.943 x 10-7 ½ mark |
| n(OH-) = (7.943 x 10-7 - 1x 10 -7) mol L-1 x 1.60 x 1011 litres = 1.11093 x 105 moles (1 mark) |
|  |
| 1 drum contains n=cxv = 100x10 moles = 1x 103 moles (1/2 mark) |
| Drums needed = 1.11093 x 105 moles / 1x 103 moles per drum = 111.09 (1 mark)  Carry over if error in gigalitre (ie lose only ½) |
|  |

Or: At pH 7, [OH-] = 10-7 mol L-1

n(OH-) at pH7 = 10-7 x 1.6 x1011 = 1.6 x104 mol

n(OH- ) before reaction = 7.943 x 10-7 x 1.6 x1011 = 1.271 x 105 mol

Moles to achieve pH7 = (1.271 – 0.16) x 105 mol = 1.111 x 105 mol.

1. In reality, it would probably take more sodium hydroxide than the amount you just calculated. State the most likely reason why this is so. Explain your answer using any relevant equations. (3 marks)

|  |
| --- |
| Buffering of the water due to dissolved substances (1mark) |
|  |
| Eg H2CO3 + OH- 🡪 HCO3- + H2O (1 mark for this or plausible acidic reaction) |
|  |
| Any weak acid dissolved in the water will consume added hydroxide, leading to extra OH being needed to reach the target pH (1 mark for explanation that states why extra hydroxide is needed) |
|  |
| Not allowed/rewarded answers (**most** likely reason) |
| Differences in temperature, errors in measuring pH, any ocean water effects |
| Other plausible answers may be considered. Marker to discuss prior to awarding marks |

END OF TEST