**Australian Islamic College 2018**

**ATAR Chemistry Units 3 and 4**

**Task 4 (Weighting: 3%)**

**Acids and Bases Test**

Test Time: 45 minutes

Please do not turn this page until instructed to do so.

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| **First Name** | **Surname** |
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|  |
| --- |
| **Teacher** |
| **ANSWERS** |

|  |  |
| --- | --- |
| **Mark / 31** | **Percentage** |
|  | Final percentage rounded down |

Equipment allowed: Pens, pencils, erasers, whiteout, rulers and non-programmable calculators permitted by the Schools Curriculum and Standards Authority.

**Special condition**: 2 marks will be deducted for failing to write your full name on this test paper.

Teacher help: Your teacher can only help you during your test in one situation.

If you believe there is a mistake in a question show your teacher and your teacher will tell you whether or not there is a mistake in the question and if appropriate, how to fix that mistake.

Questions must be answered in this booklet, in the spaces provided.

Total marks: 31

1. Write an ionic equation and observations for the following reactions.
   1. Sulfuric acid is added to solid iron(II) sulfite.

Ionic equation:

(1 mark)

2H+(aq) + FeSO3(s) 🡪 SO2(g) + H2O(l) + Fe2+(aq)

Observations:

(2 marks; ½ each)

*A colourless liquid is added to a pale green solid. The pale green solid disappears, the liquid turns pale green and bubbles of a colourless gas with a choking odour are produced (any 4, ½ each).*

* 1. Ethanoic acid is added to solid copper(II) oxide.

Ionic equation:

(1 mark)

2CH3COOH(aq) + CuO(s) 🡪 Cu2+(aq) + 2CH3COO-(aq) + H2O(l)

Observations:

(2 marks; ½ each)

*A colourless solution with a vinegar-like odour is added to a black solid. The black solid disappears, the liquid becomes blue and the vinegar-like odour disappears.*

1. Complete this table by naming each acid and classifying it as strong or weak. The first one has been done as an example.

(3 marks, 1 mark per correct row, no half marks)

|  |  |  |
| --- | --- | --- |
| **Formula** | **Name** | **Strong or Weak Acid** |
| **HNO3** | **Nitric Acid** | **Strong** |
| **H3PO4** | ***Phosphoric Acid*** | ***Weak*** |
| **H2SO3** | ***Sulfurous acid*** | ***Weak*** |
| **H2C2O4** | ***Oxalic acid*** | ***Weak*** |

1. Give the formula of conjugate acid and conjugate base of the HS- ion.

(2 marks; 1 each)

* 1. Conjugate acid

H2S

* 1. Conjugate base

S2-

1. When dissolved in water, ammonia produces a basic solution.
   1. Explain why ammonia does not fit the Arrhenius definition of a base.

(1 mark)

*It does not contain hydroxide ions / OH / OH- (in its formula).*

* 1. Explain why ammonia does fit the Brønsted-Lowry definition of a base. State the reaction between ammonia and water to demonstrate this.

(2 marks)

*It acts as a proton acceptor. (1 mark)*

NH3(aq/g) + H2O(l) ⇌ NH4+(aq) + OH-(aq) *(1 mark)*

*Arrow must be correct.*

1. Pure water undergoes self-ionisation to a small extent.
   1. Write the reaction for the self-ionisation of water.

(1 mark)

H2O(l) + H2O(l) {or 2H2O(l)} ⇌ H3O+(aq) + OH-(aq)

*Arrow must be correct.*

* 1. Write the equilibrium expression for Kw, the equilibrium constant for the self-ionisation of water.

(1 mark)

Kw = [H3O+] [OH-]

* 1. The values of pH at two different temperatures are given below.

pH of pure water at 20oC = 7.083

pH of pure water at 100oC = 6.130

1. Determine [H3O+] at 20oC.

(2 marks)

[H3O+] = 10-pH

[H3O+] = 10-7.083 *(1 mark for either this or the above)*

[H3O+] = 8.260 x 10-8 mol L-1 *(1 mark. ½ off if no unit)*

1. Determine the percentage ionisation of pure water at 20oC.

(3 marks)

Water contains 1000 g in 1 L.

M(H2O) = 18.106

n(H2O) in 1 L = 1000 / 18.016 = 55.5062 mol

c(H2O) = 55.5062 mol L-1 (1)

% ionisation = 8.260 x 10-8 x 100 / 55.5062 (1)

= 1.488 x 10-7 % (1, ½ off for no/wrong unit)

* 1. Based on Le Chatelier’s Principle and the information provided, is the self-ionisation of water an exothermic or endothermic process?

(1 mark)

*Endothermic (1)*

1. List these pure substances in order of increasing pH.

(1 mark)

|  |  |
| --- | --- |
| **Substance** | **Ranking (1 to 7)** |
| 2 M KOH(aq) | *7* |
| H2O(l) | *5* |
| 2 M H2SO4(aq) | *1* |
| 1 M H2SO4(aq) | *2* |
| 1 M HCl(aq) | *3* |
| 0.5 M CH3COOH(aq) | *4* |
| 0.5 M NaOH(aq) | *6* |

1. Nitrous acid is a weak acid.
   1. The pH of a 0.100 M solution of nitrous acid (HNO2) is 2.200. Determine the Ka of nitrous acid.

(2 marks)

[H3O+] = 10-2.200 = 0.0063096 mol L-1 (1)

Ka = [H3O+]2 / [HNO2] = (0.0063096)2 / 0.1 = 3.98 x 10-4 (1)

1. Thymol blue is an acid-base indicator that is red in very acidic solution and yellow in basic solution. The Ka of thymol blue is 2 x 10-2. Determine the pH at which thymol blue changes colour from red to yellow. Show your working.

(3 marks)

HIn(aq) + H2O(l) ⇌ H3O+(aq) + In-(aq) (1)

Ka = [H3O+] [In-] / [HIn] (or 1)

Change of colour when [In-] / [HIn] = 1 (or 1)

Ka = 2 x 10-2 = [H3O+] (1)

pH = -log[H3O+] = 2 x 10-2

pH = 1.70 = 2 (1 sig. fig.) (1)

1. Some AlCl3 is dissolved in water.
   1. Describe the resulting solution.

(1 mark)

*Colourless.*

*(Accept some other answers at teacher’s discretion as question is ambiguous).*

* 1. Will the resulting solution be acidic, basic or neutral? Write a reaction to justify your response.

(2 marks)

*Acidic (1).*

*Al(H2O)63+(aq) + H2O(l)* ⇌ Al(H*2*O)*5*(OH)*2+(aq)* + H*3*O*+(aq) (1)*

END OF TEST