**Part B Written task – Investigation Analytical Chemistry /30**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write balanced **ionic** equations and give a detailed description of the observations you would expect to make for any reactions that occur in the following situations.

If no reaction occurs, write "no reaction".

1. A solution of silver nitrate is added to a solution of ammonium chloride. (4 marks)

Equation: **Ag+(aq) + Cℓ-(aq) à AgCℓ(s)**

|  |  |
| --- | --- |
| **Description** | **Marks** |
| correct species | 1 |
| balanced equation | 1 |
| **Total** | **2** |

Observations:

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Two colourless solution mixed** | 1 |
| **White precipitate formed** | 1 |
| **Total** | **2** |

(b) Dilute hydrochloric acid is added to solid copper (II) carbonate. (4 marks)

Equation: **2 H+(aq) + CuCO3(s) → Cu2+(aq) + CO2(g) + H2O(ℓ)**

|  |  |
| --- | --- |
| **Description** | **Marks** |
| correct species | 1 |
| balanced equation | 1 |
| **Total** | **2** |

Observations:

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Green solid added to colourless solution** | 1 |
| **Bubbling/Fizzing occurs**  **Or**  **Green solid dissolves and solution turns blue** | 1 |
| **Total** | **2** |

(c) Dilute hydrobromic acid is added to a solution of potassium sulfide. (4 marks)

Equation: **2H+(aq) + S2-(aq) à H2S (g)**

|  |  |
| --- | --- |
| **Description** | **Marks** |
| correct species | 1 |
| balanced equation | 1 |
| **Total** | **2** |

Observations:

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Two colourless solution mixed** | 1 |
| **Bubbling/fizzed and ‘rotten egg’ smell** | 1 |
| **Total** | **2** |

(d) Dilute ethanoic acid is added to solid nickel (II) oxide. (4 marks)

Equation: **2CH3COOH (aq) + NiO (s) à Ni(CH3COO)2 (aq) + H2O (l)**

**OR**

**2CH3COOH (aq) + NiO (s) à Ni2+(aq) + 2CH3COO- (aq) + H2O (l)**

|  |  |
| --- | --- |
| **Description** | **Marks** |
| correct species | 1 |
| balanced equation | 1 |
| **Total** | **2** |

Observations:

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Colourless solution mixed with green solid** | 1 |
| **Solid dissolves and solution turns green** | 1 |
| **Total** | **2** |

2. When dilute sulfuric acid is added to substance A (a solid), there is a vigorous effervescence and the gas explodes when ignited in air. When the remaining solution is evaporated, white crystals remain. A confused student is told that these crystals are either magnesium oxide, zinc sulfate, copper sulfate or calcium oxide.

(a) What are the crystals? (1 mark)

**Zinc sulfate**

(b) Identify substance A (1 mark)

**Zinc**

(c) Write an ionic equation to show the reaction of A with dilute sulfuric acid. (2 marks)

**2H+(aq) + Zn (s) à Zn2+ (aq) + H2(g)**

|  |  |
| --- | --- |
| **Description** | **Marks** |
| correct species | 1 |
| balanced equation | 1 |
| **Total** | **2** |

3. The equation below represents the reaction between solid iron (Fe) and hypochlorous acid (HCℓO).

6 HCℓO(aq) + 6 H+(aq) + 2 Fe(s) ® 3 Cℓ2(g) + 6 H2O(ℓ) + 2 Fe3+(aq)

A piece of iron was placed in a solution of 1.53 mol L-1 hypochlorous acid. The reaction was allowed

to go to completion, that is all the solid iron had reacted and 1.48 L of Cℓ2 was produced at STP.

(a) Calculate the volume of HCℓO that would have been required for the reaction to take place. (3 marks)

**n(Cl2) = V / 22.71 = 1.48 / 22.71 = 0.0651695 mol (1)**

**n(HClO) = 2 x n(Cl2) = 2 x 0.0651695 = 0.130339 mol (1)**

**V(HClO) = n / c = 0.130339 / 1.53 = 0.0851889 L (85.2 mL) (1)**

(b) Calculate the mass of the piece of iron that was reacted with the hypochlorous acid. (2 marks)

**n(Fe) = n(Cl2) x 2/3 = 0.0651695 x 2/3 = 0.04344635 mol (1)**

**m(Fe) = nM = 0.04344635 x 55.85 = 2.42648 g (1)**

4. Phosphoric acid can be prepared by reaction of sulfuric acid with "phosphate rock" according to the

equation:

Ca5(PO4)3OH + 5 H2SO4 à 3 H3PO4 + 5 CaSO4 + H2O

If 2.5 kg of “phosphate rock” was reacted with excess sulfuric acid, calculate the mass of phosphoric

acid produced. (5 marks)

**m(Ca5(PO4)3OH) = 2.5 kg = 2.5 x 10-3 g (1)**

**M(Ca5(PO4)3OH) = 502.318 g mol-1 (1)**

**n(Ca5(PO4)3OH) = m / M = 2500 / 502.318 = 4.977 mol (1)**

**n(H3PO4) = 3/1 x n(Ca5(PO4)3OH) = 3 x 4.977 = 14.93 mol (1)**

**m(H3PO4) = n x M = 14.93 x 97.994 = 1463 g (1.5 kg) (1)**

**End of Assessment**