**Australian Islamic College 2018**

**ATAR Chemistry Units 3 and 4**

**Task 13 (Weighting: 3%)**

**Empirical Formula and Stoichiometry Test**

Test Time: 45 minutes

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| **First Name** | **Surname** |
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| **Teacher** |
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| **Mark / 39** | **Percentage** |
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Equipment allowed: Pens, pencils, erasers, whiteout, rulers and non-programmable calculators permitted by the Schools Curriculum and Standards Authority.

1. Carbon dioxide is prepared by reacting hydrochloric acid with marble chips (calcium carbonate).

If 3.125 g of marble chips were mixed with 20.0 mL of 2.00 mol L-1 HCl(aq)

(a) Write an equation for the reaction occurring.

[1 mark]

(b) Determine the limiting reagent and calculate the number of moles of the excess reagent remaining after the reaction is completed. [5 marks]

(c) What would be the volume of carbon dioxide produced at 25 oC and 1.00 atm?

[2 marks]

1. When solid ammonium sulfite ((NH4)2SO3) is heated strongly it decomposes to form the gases ammonia (NH3), sulfur dioxide (SO2), and water.

A 1.54 g sample of ammonium sulfite decomposed at 302 oC in a sealed gas vessel of volume 1.850 L.

1. Write a balanced chemical equation for the reaction. [1 mark]

1. Calculate the pressure inside the gas vessel when decomposition is complete.

[4 marks]

1. The gaseous products are passed through limewater, (Ca(OH)2 (*aq*)). What mass of calcium sulfite (CaSO3) would precipitate?

[2 marks]

1. An unknown organic compound X, which was known to contain hydrogen, carbon and chlorine was analysed to find its formula. A 10.15g sample was combusted in air and produced 4.40g of water.

A separate 5.48g of **X** underwent a substitution reaction to convert the chlorine atoms to chloride ions. On addition of excess silver nitrate solution to the resulting solution, 12.54g of silver chloride was precipitated.

A third 5.00g sample of X was vapourised and found to occupy 1.05 L at 200oC and 150 kPa.

(a) Calculate the empirical formula of **X**.

[8 marks]

(b) Calculate the molar mass of **X**, and hence work out the molecular formula.

[4 marks]

(c) Draw and name a possible structure for **X** that would react readily with aqueous bromine but would not form geometric *(cis/trans)* isomers

[2 marks]

1. The blue-green pigment Chrysocolla, is a hydrated salt that contains copper, silicon and oxygen:

Cu*w*Si*x*O*y*.*Z*H2O

A 10.00 g sample was carefully heated to remove water and the resulting solid had a mass of 7.21g.

To calculate the amount of silicon present, this 7.21g was roasted at high temperature in the presence of oxygen and 3.10g of SiO2 was produced.

In a separate analysis, it was found that the original hydrated salt was found to contain 32.8% copper.

(a) Determine the empirical formula of Chrysocolla by calculating the values of *w, x, y and Z.*

[9 marks]

(b) Based on the colour of the pigment, state the oxidation number of the copper, and calculate the oxidation state of silicon in the compound.

[1 mark]

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