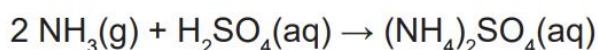


**Question 36****(17 marks)**

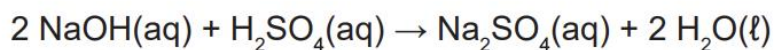
Glycoluril is an organic compound composed of carbon, hydrogen, nitrogen and oxygen atoms. It is used in paper making and water disinfection. A chemist was given the task of determining the empirical formula and also the molecular formula of glycoluril.

To do this, the chemist combusted 2.30 g of glycoluril in excess air, producing 2.85 g of carbon dioxide and 0.874 g of water.

The chemist then used the Kjeldahl Method to determine the nitrogen content of another 2.30 g sample of the compound. This involved converting all of the nitrogen atoms in the sample into ammonia with the ammonia then distilled into 25.0 mL of 1.35 mol L<sup>-1</sup> sulfuric acid, which was in excess. The reaction between ammonia and sulfuric acid is:



The excess sulfuric acid needed 15.40 mL of 0.186 mol L<sup>-1</sup> sodium hydroxide for complete reaction. The reaction equation is:



- (a) Determine the empirical formula of glycoluril. (12 marks)

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- (b) Another 2.30 g sample of glycoluril was vapourised at 242.0 kPa and 865.0 °C. The total volume of the resulting gas was 633.0 mL. Determine the molecular formula of glycoluril.  
(5 marks)

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