Question 38 **(15 marks)**

Doxylamine succinate is an antihistamine, which is used to treat hay fever, and, as one of its side-effects is drowsiness, it is also used as a sleep aid. Doxylamine succinate contains carbon, hydrogen, oxygen and nitrogen.

(a) A 2.500 g sample of the compound was combusted, and 5.94 g of carbon dioxide and 1.63 g of water were produced. All of the nitrogen from a second 2.500 g sample was converted to ammonia and reacted with a 0.823 mol L^{-1} solution of hydrochloric acid. 15.6 mL of the acid was required to react completely with the ammonia.

Determine the empirical formula for doxylamine succinate. (11 marks)

(b) Doxylamine succinate is also a weak base. A 19.42 mg sample of doxylamine succinate required 1.00 mL of a 0.100 mol L^{-1} $HC\ell O_4$ acid solution for neutralisation.

Using a calculation, identify how many protons (hydrogen ions) a doxylamine succinate molecule can accept. The molar mass of doxylamine succinate is 388.46 g mol^{-1}.

(4 marks)