Question 35 **(14 marks)**

The Ostwald process is used in the conversion of ammonia to nitric acid according to the equations below.

Equation 1: $4\ NH_3(g) + 5\ O_2(g) \rightarrow 4\ NO(g) + 6\ H_2O(g) \quad \Delta H = -905.2\ kJ\ mol^{-1}$

Equation 2: $2\ NO(g) + O_2(g) \leftrightharpoons 2\ NO_2(g) \quad \Delta H = -114.0\ kJ\ mol^{-1}$

Equation 3: $3\ NO_2(g) + H_2O(\ell) \rightarrow 2\ HNO_3(aq) + NO(g) \quad \Delta H = -117.0\ kJ\ mol^{-1}$

(a) The reaction in Equation 1 is carried out with a platinum-rhodium catalyst at approximately 850.0 °C and 1500 kPa. Using collision theory, account for these conditions. (8 marks)

(b) A nitric acid plant requires a production of 1095 tonnes of nitric acid by means of the Ostwald process each day. If the conversion of ammonia to nitric acid is 77.65% efficient, calculate the volume of ammonia at standard temperature and pressure (STP) that must be fed into the process each day. Give your answer to the appropriate number of significant figures. (6 marks)