# AFCoKaRE Practice Problem 2.4

Purpose: This problem allows you to practice writing an expression for the heat of reaction as a function of temperature.

Problem Statement: Sodium chlorate is a solid at room temperature and melts at 533 K. Campbell and van der Kouwe[1] report that the heat capacity, in cal mol^{-1} K^{-1}, of the solid varies with temperature according to equation (1), where T is in K, and that the heat capacity of the liquid is constant and equal to 32 cal mol^{-1} K^{-1} up to ca. 575 K. They report the heat of fusion to be 5076 cal mol^{-1}, and Wikipedia lists its standard heat of formation to be -365.4 kJ mol^{-1}. In the presence of a catalyst, liquid phase sodium chlorate will decompose, producing solid sodium chloride and gaseous oxygen, reaction (2). Generate an expression for the heat of reaction (2) as a function of temperature in the range from 535 to 575 K. The heat of formation of NaCl may be taken to equal -411.1 kJ mol^{-1} and its heat capacity to be constant and equal to 36.79 J mol^{-1} K^{-1}. The heat capacity of oxygen, in J mol^{-1} K^{-1}, can be calculated using equation (3) where T is in K.

$$\hat{C}_{p,NaClO_3(s)} = 0.044T + 10.92 \tag{1}$$

$$2\ NaClO_3 \rightarrow 2\ NaCl + 3\ O_2 \tag{2}$$
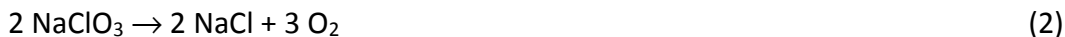
$$\hat{C}_{p,O_2} = 25.46 + 0.01519T - 7.15 \times 10^{-6}T^2 + 1.311 \times 10^{-9}T^3 \tag{3}$$

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[1] "Studies on the thermodynamics and conductances of molten salts and their mixtures. Part VI. Calorimetric studies of sodium chlorate and its mixtures with sodium nitrate" A. N. Campbell and E. T. van der Kouwe, *Can. J. Chem.* **46**, 1287-91 (1968).