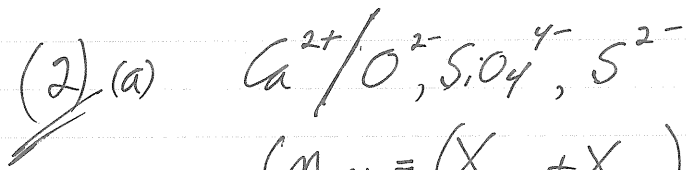


## 2005 Control II #2



$$M_{\text{Ca}^{2+}} = (X_{\text{CaO}} + X_{\text{CaS}})$$

$$M_{\text{S}^{2-}} = X_{\text{CaS}}$$

$$M_{\text{SiO}_4^{4-}} = X_{\text{SiO}_2}$$

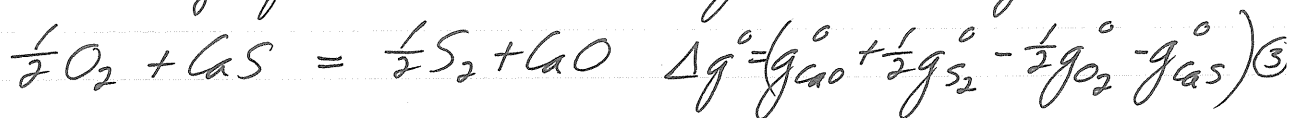
$$M_{\text{O}^{2-}} = X_{\text{CaO}} - 2X_{\text{SiO}_2}$$

$$\begin{cases} X_{\text{Ca}^{2+}} = 1 \\ X_{\text{O}^{2-}} = \frac{X_{\text{CaO}} - 2X_{\text{SiO}_2}}{X_{\text{CaO}} - X_{\text{SiO}_2} + X_{\text{CaS}}} \\ X_{\text{S}^{2-}} = \frac{X_{\text{CaS}}}{X_{\text{CaO}} - X_{\text{SiO}_2} + X_{\text{CaS}}} \end{cases}$$

$$a_{\text{CaO}} = X_{\text{Ca}^{2+}} X_{\text{O}^{2-}} = \frac{X_{\text{CaO}} - 2X_{\text{SiO}_2}}{X_{\text{CaO}} - X_{\text{SiO}_2} + X_{\text{CaS}}} \quad (1)$$

$$a_{\text{CaS}} = X_{\text{Ca}^{2+}} X_{\text{S}^{2-}} = \frac{X_{\text{CaS}}}{X_{\text{CaO}} - X_{\text{SiO}_2} + X_{\text{CaS}}} \quad (2)$$

(b) Exchange of O and S between gas and slag



$$\Delta g^\circ = -RT \ln K \quad (4)$$

$$K = \left(\frac{P_{\text{S}_2}}{P_{\text{O}_2}}\right)^{1/2} \cdot \frac{a_{\text{CaO}}}{a_{\text{CaS}}} = \left(\frac{P_{\text{S}_2}}{P_{\text{O}_2}}\right)^{1/2} \frac{(X_{\text{CaO}} - 2X_{\text{SiO}_2})}{X_{\text{CaS}}}$$

Substitute Eqs. (1), (2), (3), (4) to give  $X_{\text{CaS}}$  as a function of

$$\Delta g^\circ, P_{\text{O}_2}, P_{\text{S}_2}, T, X_{\text{CaO}}, X_{\text{SiO}_2}$$