$$J_{MSE}(\theta) = \frac{1}{2m} \sum_{i=1}^{m} \left(y^{(i)} - \left(\overbrace{\sum_{k=1}^{n} w_{2,k}\, \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right) + b_2}^{h(x^{(i)})} \right) \right)^2$$

$$\frac{\delta J_{MSE}}{\delta w_{1,k}} = \frac{1}{2m} \cdot \sum_{i=1}^{m} \frac{\delta}{\delta w_{1,k}} \left(y^{(i)} - h(x^{(i)}) \right)^2$$

$$= \frac{1}{\cancel{2}m} \cdot \sum_{i=1}^{m} \cancel{2}\left(y^{(i)} - h(x^{(i)})\right) \cdot \frac{\delta}{\delta w_{1,k}} \left(y^{(i)} - h(x^{(i)})\right)$$

$$= -\frac{w_{2,k}}{m} \sum_{i=1}^{m} \left(y^{(i)} - h(x^{(i)})\right) \cdot \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right) \cdot \left(1 - \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right)\right) \cdot x^{(i)}$$

$$\frac{\delta h(x^{(i)})}{\delta w_{1,k}} = w_{2,k} \cdot \frac{\delta}{\delta w_{1,k}} \left(\sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right) \right)$$

$$= w_{2,k} \cdot \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right) \cdot \left(1 - \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right)\right) \cdot x^{(i)}$$

$$\frac{\delta J_{MSE}}{\delta w_{2,k}} = \frac{1}{2m} \cdot \sum_{i=1}^{m} \frac{\delta}{\delta w_{2,k}} \left(y^{(i)} - h(x^{(i)}) \right)^2$$

$$= \frac{1}{\cancel{2}m} \cdot \sum_{i=1}^{m} \cancel{2}\left(y^{(i)} - h(x^{(i)})\right) \cdot \frac{\delta}{\delta w_{2,k}} \left(y^{(i)} - h(x^{(i)})\right)$$

$$= \frac{-1}{m} \sum_{i=1}^{m} \left(y^{(i)} - h(x^{(i)})\right) \cdot \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right)$$

$$\frac{\delta h(x^{(i)})}{\delta w_{2,k}} = \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right)$$

$$\frac{\delta J_{MSE}}{\delta b_{1,k}} = \frac{1}{2m} \cdot \sum_{i=1}^{m} \frac{\delta}{\delta b_{1,k}} \left(y^{(i)} - h(x^{(i)}) \right)^2$$

$$= \frac{1}{\cancel{2}m} \cdot \sum_{i=1}^{m} \cancel{2}\left(y^{(i)} - h(x^{(i)})\right) \cdot \frac{\delta}{\delta b_{1,k}} \left(y^{(i)} - h(x^{(i)})\right)$$

$$= -\frac{w_{2,k}}{m} \sum_{i=1}^{m} \left(y^{(i)} - h(x^{(i)})\right) \cdot \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right) \cdot \left(1 - \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right)\right)$$

$$\frac{\delta h(x^{(i)})}{\delta b_{1,k}} = w_{2,k} \cdot \frac{\delta}{\delta b_{1,k}} \left(\sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right) \right)$$

$$= w_{2,k} \cdot \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right) \cdot \left(1 - \sigma\left(w_{1,k} \cdot x^{(i)} + b_{1,k}\right)\right)$$

$$\frac{\delta J_{MSE}}{\delta b_2} = \frac{1}{2m} \cdot \sum_{i=1}^{m} \frac{\delta}{\delta b_2} \left(y^{(i)} - h(x^{(i)}) \right)^2$$

$$= \frac{1}{\cancel{2}m} \cdot \sum_{i=1}^{m} \cancel{2}\left(y^{(i)} - h(x^{(i)})\right) \cdot \frac{\delta}{\delta b_2} \left(y^{(i)} - h(x^{(i)})\right)$$

$$= \frac{-1}{m} \cdot \sum_{i=1}^{m} \left(y^{(i)} - h(x^{(i)})\right)$$