Q3:

$$\frac{\partial}{\partial b}\mathcal{L}\left(\underline{\mathbf{w}}, b\right) \overset{a}{=} \frac{\partial}{\partial b}\frac{1}{m}\sum_{i=1}^{m}\left(\underline{w}^{\top}\underline{x}_i - b - y_i\right)^2 \overset{b}{=} \frac{1}{m}\frac{\partial}{\partial b}\sum_{i=1}^{m}\left(\underline{w}^{\top}\underline{x}_i - b - y_i\right)^2 \overset{c}{=} \frac{1}{m}\sum_{i=1}^{m}\frac{\partial}{\partial b}\left(\underline{w}^{\top}\underline{x}_i - b - y_i\right)^2 \overset{d}{=}$$

$$\overset{d}{=} \frac{1}{m}\sum_{i=1}^{m}2\left(\underline{w}^{\top}\underline{x}_i - b - y_i\right)\cdot(-1) \overset{e}{=} \frac{2}{m}\sum_{i=1}^{m}\left(b + y_i - \underline{w}^{\top}\underline{x}_i\right) \overset{f}{=} \frac{2}{m}\left[mb + \sum_{i=1}^{m}\left(y_i - \underline{w}^{\top}\underline{x}_i\right)\right] \overset{g}{=}$$

$$\overset{g}{=} 2b + \frac{2}{m}\sum_{i=1}^{m}\left(y_i - \underline{w}^{\top}\underline{x}_i\right) \Rightarrow \frac{\partial}{\partial b}\mathcal{L}\left(\underline{\mathbf{w}}, b\right) = 2b + \frac{2}{m}\sum_{i=1}^{m}\left(y_i - \underline{w}^{\top}\underline{x}_i\right)$$

a : Definition of $\mathcal{L}\left(\underline{\mathbf{w}}, b\right)$
b : $\frac{1}{m}$ is scalar
c : Derivative of a sum is the sum of derivatives
d : Derivative of $\left(\underline{w}^{\top}\underline{x}_i - b - y_i\right)^2$w.r.t b
e : 2 is scalar
f : sum of b
g : Removing b from the sum