Q4

a)

Since $y = 10^{-3} r^2 + 4 \log(T+1) - 7$

$$y_1 = 10^{-3} r_1^2 + 4 \log(T_1 + 1) - 7$$

We can define,

$$x_1^T = [r_1^2 \quad \log(T_1+1) \quad 1]$$

or,

$$x_1 = \begin{bmatrix} r_1^2 \\ \log(T_1+1) \\ 1 \end{bmatrix}$$

and,

$$W = \begin{bmatrix} 10^{-3} \\ 4 \\ -7 \end{bmatrix}$$

Thus, $y_1 = x_1^T W$, where x_1 & W are as above.

b) Given, $y = \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = Xw$

we know, $y_1 = 10^{-3} r_1^2 + 4 \log(T_1 + 1) - 7$

$y_2 = 10^{-3} r_2^2 + 4 \log(T_2 + 1) - 7$

Thus, we can define X as,

$$X = \begin{bmatrix} r_1^2 & \log(T_1 + 1) & 1 \\ r_2^2 & \log(T_2 + 1) & 1 \end{bmatrix}$$

and w as $w = \begin{bmatrix} 10^{-3} \\ 4 \\ -7 \end{bmatrix}$

Thus, $y = Xw = \begin{bmatrix} r_1^2 & \log(T_1 + 1) & 1 \\ r_2^2 & \log(T_2 + 1) & 1 \end{bmatrix} \begin{bmatrix} 10^{-3} \\ 4 \\ -7 \end{bmatrix} = \begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$

gives us the required matrix y.