① $\overset{x_2}{\boxed{y}} = -2\overset{x_1}{\boxed{x}} + 10$

$H = \{ (x_1, x_2) \mid x_2 + 2x_1 - 10 = 0 \}$

$H = \{ (x_1, x_2) \mid \boxed{w^T} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + b = 0 \}$

$\begin{pmatrix} w_1 \\ w_2 \end{pmatrix} =$

$\therefore \quad x_2 + 2x_1 - 10 = w_1 x_1 + w_2 x_2 + b$

$\Rightarrow \quad w_1 = 1$

$\quad w_2 = 2$

$\quad b = -10$

$\underline{Sol}: \vec{w} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \quad b = -10$

② $\underline{Sol}: sign\left(\vec{w}^T \begin{pmatrix} 2 \\ 3 \end{pmatrix} + b\right) = sign\left((1 \quad 2) \begin{pmatrix} 2 \\ 3 \end{pmatrix} + (-10) \right)$

$\qquad = sign\left(2 + 6 + (-10) \right) = sign(-2) = -1$

③ $2\underset{X_1}{\textcircled{x}} + 4\underset{X_2}{\textcircled{y}} - 5\underset{X_3}{\textcircled{z}} = -10$

$$H = \left\{ (X_1, X_2, X_3) \mid 2X_1 + 4X_2 - 5X_3 + 10 = 0 \right\}$$

$$H = \left\{ (X_1, X_2, X_3) \mid \overset{= \begin{pmatrix} W_1 \\ W_2 \\ W_3 \end{pmatrix}}{\textcircled{W^T}} \begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} + b = 0 \right\}$$

$\therefore \quad 2X_1 + 4X_2 - 5X_3 + 10 = W_1 X_1 + W_2 X_2 + W_3 X_3 + b$

$\Rightarrow \quad W_1 = 2$

$\quad W_2 = 4$

$\quad W_3 = -5$

$\quad b = 10$

Sol: $\vec{W} \begin{pmatrix} 2 \\ 4 \\ -5 \end{pmatrix}, \quad b = 10$

④ $\text{sign}(\vec{W}^T \vec{X} + b)$

$= \text{sign}\left((2 \ 4 \ -5) \begin{pmatrix} -5 \\ -25 \\ -2 \end{pmatrix} + 10 \right)$

$= \text{sign}(-10 - 100 + 10 + 10)$

$= \text{sign}(-90) = -1$