Some PS4 Solutions

1 (exercise 5.2)

$$QFT|0...0\rangle = \frac{1}{\sqrt{2^n}} \sum_{k=0...0}^{1...1} |k\rangle$$

2 (exercise 5.4)

Using method from book, pag. 181, apply $(Ph_1)(A_2)(C_2)(C_1NOT_2)(B_2)(C_1NOT_2)(C_2)$, where:

$$Ph = \begin{bmatrix} 1 & 0 \\ 0 & i\pi/2^k \end{bmatrix}$$

and $A = R_z(\pi/2^k)$, $B = R_z(-\pi/2^k)$, $C = I$.

3 (exercise 4.1)

Pairs of (θ, ϕ), for the eigenvalue 1 and -1 respectively:
σ_x: $(\pi/2, 0)$ and $(\pi/2, \pi)$
σ_y: $(\pi/2, \pi/2)$ and $(\pi/2, -\pi/2)$
σ_x: $(0,)$ and $(\pi,)$

4 (exercise 4.4)

$$H = 1/\sqrt{2}(\sigma_x + \sigma_z) = 1/\sqrt{2}(1 - i\sigma_y)\sigma_z = e^{-i\pi/4\sigma_y}\sigma_z$$

$$e^{-i\pi/4\sigma_y} = e^{-i\pi/2\sigma_z}e^{-i\pi/4\sigma_x}e^{i\pi/2\sigma_z}$$

$$H = PhR_z(\pi/2)R_x(\pi/2)R_z(\pi/2)$$

5 (exercise 4.16)

One is:

$$\begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & -1 & 0 \\ 0 & 1 & 0 & -1 \end{bmatrix}$$

And the other is:

$$\begin{bmatrix} 1 & 1 & 0 & 0 \\ 1 & -1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & -1 \end{bmatrix}$$

6 (exercise 4.17)

Check that $(C_1NOT_2) = (H_2)(C_1Z_2)(H_2)$

7 (exercise 4.19)

Permute the last 2 columns of ρ and then the last 2 rows.

8 (exercise 4.24)

Well... just do the algebra.