Exercise 10.1

Let $|\psi\rangle = a|0\rangle + b|1\rangle$ and the initial state be $|\psi_0\rangle = a|000\rangle + b|100\rangle$.
Applying a CNOT to the first two qubits we get,
$|\psi_1\rangle = a|000\rangle + b|110\rangle$
Applying a CNOT to the first and last qubits we get,
$|\psi_2\rangle = a|000\rangle + b|111\rangle$

Exercise 10.2

$P_\pm = \frac{1}{2}(|0\rangle \pm |1\rangle)(\langle 0| \pm \langle 1|) = \frac{1}{2}(|0\rangle\langle 0| + |1\rangle\langle 1| \pm |1\rangle\langle 0| \pm |0\rangle\langle 1|) = \frac{1}{2}(I \pm X)$
Therefore,
$\mathcal{E}(\rho) = (1-2p)\rho + 2pP_+\rho P_+ + 2pP_-\rho P_- = (1-2p)\rho + \frac{1}{2}p(I+X)\rho(I+X) + \frac{1}{2}p(I-X)\rho(I-X) = (1-2p)\rho + p\rho + pX\rho X = (1-p)\rho + pX\rho X$

Exercise 10.3

$Z_2Z_3Z_1Z_2 = [I \otimes (|00\rangle\langle 00| + |11\rangle\langle 11|) - I \otimes (|01\rangle\langle 01| + |10\rangle\langle 10|)][(|00\rangle\langle 00| + |11\rangle\langle 11|) \otimes I - (|01\rangle\langle 01| + |10\rangle\langle 10|) \otimes I] = \underbrace{|000\rangle\langle 000| + |111\rangle\langle 111|}_{P_0} - (\underbrace{|100\rangle\langle 100| + |011\rangle\langle 011|}_{P_1})$
$+ \underbrace{|010\rangle\langle 010| + |101\rangle\langle 101|}_{P_2} - (\underbrace{|001\rangle\langle 001| + |110\rangle\langle 110|}_{P_3})$

Exercise 10.4

Exercise 10.5

Exercise 10.6

Exercise 10.7

Exercise 10.8

Exercise 10.9

Exercise 10.10

Exercise 10.11

Exercise 10.12

Exercise 10.13

Exercise 10.14

Exercise 10.15

Exercise 10.16

Exercise 10.17

Exercise 10.18

Exercise 10.19

Exercise 10.20

Exercise 10.21

Exercise 10.22

Exercise 10.23

Exercise 10.24

Exercise 10.25

Exercise 10.26