5.4 This exercise seems similar to Exercise 4.16.

Using cross entropy, we get:

$$-\ln p(\mathbf{t}|\mathbf{X},\mathbf{w}) = -\sum_{n=1}^{N}\{(t_n(1-\epsilon)+(1-t_n)\epsilon)\ln y(\mathbf{x}_n,\mathbf{w})$$
$$+((1-t_n)(1-\epsilon)+t_n\epsilon)\ln(1-y(\mathbf{x}_n,\mathbf{w}))\}$$

Note : The official solution manual is incorrect here. Let's assume that $\epsilon = 1/2$. In that case, according to the official solution, the cross entropy becomes:

$$E(\mathbf{w}) = -\sum_{n=1}^{N}\{t_n \ln[(1-\epsilon)y(\mathbf{x}_n,\mathbf{w})+\epsilon(1-y(\mathbf{x}_n,\mathbf{w}))]$$
$$+(1-t_n)\ln[1-(1-\epsilon)y(\mathbf{x}_n,\mathbf{w})-\epsilon(1-y(\mathbf{x}_n,\mathbf{w}))]\}$$

$$= -\sum_{n=1}^{N}\{t_n \ln[(1/2)y(\mathbf{x}_n,\mathbf{w})+(1/2)(1-y(\mathbf{x}_n,\mathbf{w}))]$$
$$+(1-t_n)\ln[1-(1/2)y(\mathbf{x}_n,\mathbf{w})-(1/2)(1-y(\mathbf{x}_n,\mathbf{w}))]\}$$

$$= -\sum_{n=1}^{N}\{t_n \ln[(1/2)y(\mathbf{x}_n,\mathbf{w})+(1/2)-(1/2)y(\mathbf{x}_n,\mathbf{w})]$$
$$+(1-t_n)\ln[1-(1/2)y(\mathbf{x}_n,\mathbf{w})-(1/2)+(1/2)y(\mathbf{x}_n,\mathbf{w})]\}$$

$$= -\sum_{n=1}^{N}\{t_n \ln[(1/2)]+(1-t_n)\ln[1/2]\}$$
$$= -\sum_{n=1}^{N}\{t_n \ln[(1/2)]+\ln[1/2]-t_n\ln[1/2]\}$$
$$= -\sum_{n=1}^{N}\{\ln[1/2]\}$$
$$= N\ln[2]$$

This would imply that for $\epsilon = 1/2$, the cross-entropy does not depend on the function $y(\mathbf{x}_n,\mathbf{w})$ at all. This is not correct.