7.

a) $$\sum_{k=1}^{n}(x_k-\bar{x})^2=\sum_{k=1}^{n}\left(x_k^2-2x_k\bar{x}+\bar{x}^2\right)=\sum_{k=1}^{n}x_k^2-\sum_{k=1}^{n}\left(2x_k\bar{x}-\bar{x}^2\right)=$$

$$=\sum_{k=0}^{n}x_k^2-\bar{x}\sum_{k=1}^{n}\left(2x_k-\sum_{l=1}^{n}\frac{x_l}{n}\right)=\sum_{k=1}^{n}x_k^2-\bar{x}\left(\sum_{k=1}^{n}2x_k-\sum_{k=1}^{n}\sum_{l=1}^{n}\frac{x_l}{n}\right)=$$

$$=\sum_{k=1}^{n}x_k^2-\bar{x}\left(\sum_{k=1}^{n}2x_k-\cancel{n}\sum_{l=1}^{n}\frac{x_l}{\cancel{n}}\right)=\sum_{k=1}^{n}x_k^2-\bar{x}\sum_{k=1}^{n}(2x_k-x_k)=$$

$$=\sum_{k=1}^{n}x_k^2-\bar{x}(n\bar{x})=\sum_{k=1}^{n}x_k^2-n\bar{x}^2$$

b) $$\sum_{k=1}^{n}(x_k-\bar{x})(y_k-\bar{y})=\sum_{k=1}^{n}\left(x_ky_k-x_k\bar{y}-\bar{x}y_k+\bar{x}\bar{y}\right)=\sum_{k=1}^{n}x_ky_k-\sum_{k=1}^{n}\left(x_k\bar{y}+\bar{x}y_k-\bar{x}\bar{y}\right)=$$

$$=\sum_{k=1}^{n}x_ky_k-\sum_{k=1}^{n}\left(\bar{y}(x_k-\bar{x})+\bar{x}y_k\right)=\sum_{k=1}^{n}x_ky_k-\bar{y}\sum_{k=1}^{n}(x_k-\bar{x})-\sum_{k=1}^{n}\bar{x}y_k=$$

$$=\sum_{k=1}^{n}x_ky_k-\bar{y}\sum_{k=1}^{n}x_k+\bar{y}\sum_{k=1}^{n}\bar{x}-\bar{x}\sum_{k=1}^{n}y_k=\sum_{k=1}^{n}x_ky_k-\cancel{\bar{y}n\bar{x}}+\cancel{\bar{y}n\bar{x}}-\bar{x}n\bar{y}=$$

$$=\sum_{k=1}^{n}x_ky_k-n\bar{x}\bar{y}$$