Problem 1:

$$I(x,y)' = aI(x,y) + b \quad \forall \text{ pixels } (x,y) \in \Lambda$$

$$S(I(W)) = \sum_{x,y \in W} \begin{bmatrix} I_x(x,y)^2 & I_x(x,y) I_y(x,y) \\ I_x(x,y) I_y(x,y) & I_y(x,y)^2 \end{bmatrix}$$

$$S(I(W)') = \sum_{x,y \in W} \begin{bmatrix} a^2 I_x(x,y)^2 & aI_x(x,y) aI_y(x,y) \\ aI_x(x,y) aI_y(x,y) & a^2 I_y(x,y)^2 \end{bmatrix}$$

$$= a^2 S(I(W))$$

Assume λ_{min}, λ_{max} is two eigenvalues of $S(I(W))$, then the eigenvalues of $S(I(W)')$ is $a^2\lambda_{min}$, $a^2\lambda_{max}$. where $a^2\lambda_{min} < a^2\lambda_{max}$

$R = \lambda_{min}$

$R' = a^2 \lambda_{min} = a^2 R$