a) $\tilde{X} = XA$

$H = X(X'X)^{-1}X'$

After transformation:

$$\tilde{H} = \tilde{X}(\tilde{X}'\tilde{X})^{-1}\tilde{X}'$$
$$= XA(A'X'XA)^{-1}A'X'$$
$$= XAA^{-1}(X'X)^{-1}(A')^{-1}A'X'$$
$$= X(X'X)^{-1}X' = H$$

$$\hat{\tilde{y}} = \tilde{H}y = Hy = \hat{y}$$
$$\tilde{e} = \tilde{M}y = (\underline{I} - \tilde{H})y = (\underline{I} - H)y = My = e$$
$$\tilde{s}^2 = \tilde{e}'\tilde{e}/(n-k) = e'e/(n-k) = s^2$$
$$\tilde{R}^2 = (\mathrm{corr}(y, \hat{\tilde{y}}))^2 = (\mathrm{corr}(y, \hat{y}))^2 = R^2$$

b) $\tilde{b} = (\tilde{X}'\tilde{X})^{-1}\tilde{X}'y = (A'X'XA)^{-1}A'X'y$

$= A^{-1}(X'X)^{-1}(A')^{-1}A'X'y = A^{-1}(X'X)^{-1}X'y$

$= A^{-1}b$

$y = X\beta + \varepsilon = XAA^{-1}\beta + \varepsilon = \tilde{X}\cdot(A^{-1}\beta) + \varepsilon$

$\beta \rightarrow A^{-1}\beta$

$b \rightarrow A^{-1}b$