Q3)

$$\frac{\text{maxmag}}{\text{minag}} = 10 = \text{maxmag}$$

$$\Rightarrow \text{minmag} = 1$$

Assuming A of form $\begin{bmatrix} \alpha & \beta \\ -\alpha & \beta \end{bmatrix}$

$$Ae_1 = \begin{bmatrix} \alpha \\ -\alpha \end{bmatrix}$$

Clearly

$$Ae_2 = \begin{bmatrix} \beta \\ \beta \end{bmatrix}$$

$\langle Ae_1, Ae_2 \rangle = 0$

$$\Rightarrow \sqrt{2\alpha^2} = 10$$

$$\Rightarrow \alpha = 5\sqrt{2}$$

$$\Rightarrow (Ae_2^T)\, e_1 = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \beta = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \sqrt{2\beta^2} = 1$$

$$\begin{bmatrix} 5\sqrt{2} & \frac{1}{\sqrt{2}} \\ -5\sqrt{2} & \frac{1}{\sqrt{2}} \end{bmatrix}$$