

c) i) To find the barrier lines for the flow, first find the eigenvalues of A.

$$\det \begin{pmatrix} 5-\lambda & -2 \\ 7 & -4-\lambda \end{pmatrix} = (5-\lambda)(-4-\lambda) + 14 = 0$$

$$= -20 - 5\lambda + 4\lambda + \lambda^2 + 14 = 0$$

$$= \lambda^2 - \lambda - 6 = 0$$

$$= (\lambda - 3)(\lambda + 2) = 0$$

$$\lambda = 3 \text{ or } \lambda = -2$$

$$\text{for } \lambda = 3, \begin{pmatrix} 5-\lambda & -2 \\ 7 & -4-\lambda \end{pmatrix} = \begin{pmatrix} 2 & -2 \\ 7 & -7 \end{pmatrix}$$

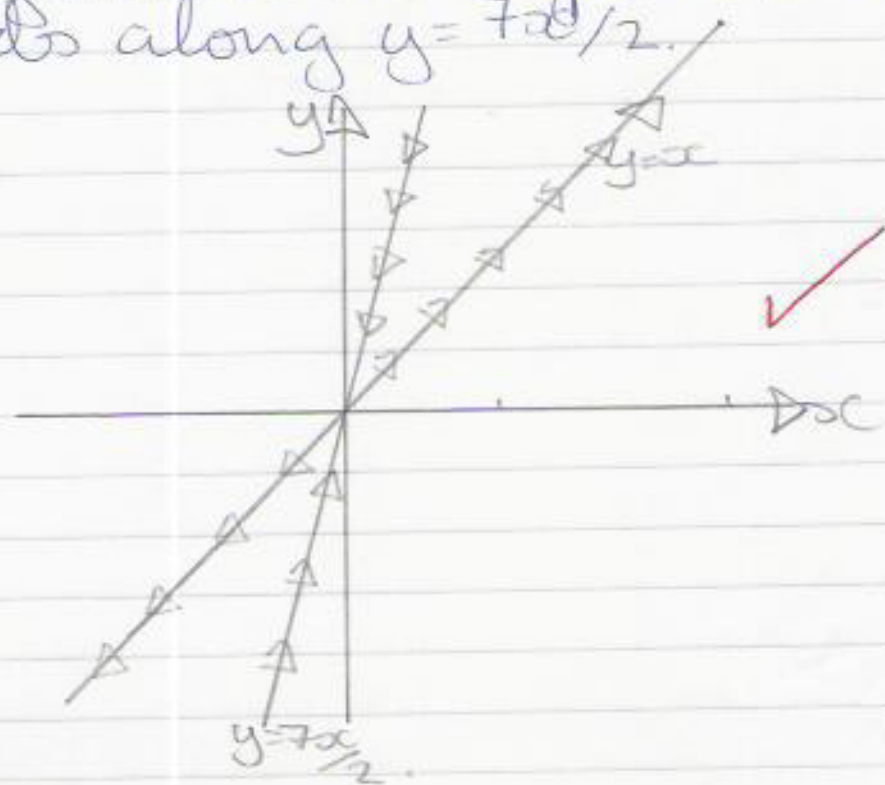
A barrier line is the line $x=y=0$ or $x=y$.
The eigenvalue is positive, so the flow is outwards along $y=x$.

$$\text{for } \lambda = -2, \begin{pmatrix} 5-\lambda & -2 \\ 7 & -4-\lambda \end{pmatrix} = \begin{pmatrix} 7 & -2 \\ 7 & -2 \end{pmatrix}$$

A barrier line is the line $7x - 2y = 0$ or $y = 7x/2$.

The eigenvalue is negative, so the flow is inwards along $y = 7x/2$.

ii)



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