c) $x = \frac{1}{2}\left(r \pm \sqrt{4h + r^2}\right)$

$h_c(r) = -\frac{r^2}{4}$

$\Rightarrow \begin{bmatrix} h_c(r) \\ r \end{bmatrix} = \begin{bmatrix} -\frac{r^2}{4} \\ r \end{bmatrix}$

d) $h = r = 0$ transcritical in $r$-direction of $[h_c(r), r]$

$\Rightarrow \frac{d}{dr}\begin{bmatrix} h_c(r) \\ r \end{bmatrix} = \begin{bmatrix} -\frac{r}{2} \\ 1 \end{bmatrix} = \mathbb{v}$

Normalize:

$\mathbb{v}_{norm} = \frac{\mathbb{v}}{\|\mathbb{v}\|}$

$\|\mathbb{v}\| = \sqrt{\left(-\frac{r}{2}\right)^2 + 1^2} = \sqrt{\frac{r^2}{4} + 1}$ or $\frac{\sqrt{4 + r^2}}{2}$

$\mathbb{v}_{norm} = \frac{[-r;\ 2]}{\sqrt{4 + r^2}}$