9) Eigenvalues $\lambda = \frac{-b \pm \sqrt{b^2 - 4 \cdot 2 \cdot 2}}{4}$ should be real if

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the system is overdamped. So $b^2 - 16 > 0$, or $\boxed{b > 4}$

10) $\begin{bmatrix} -7-\lambda & -3 \\ 36 & 14-\lambda \end{bmatrix}$ $(-7-\lambda)(14-\lambda) + 108$

$= (\lambda+7)(\lambda-14) + 108$

$= \lambda^2 - 7\lambda + 10$

$= (\lambda - 2)(\lambda - 5)$

3, 2 $\boxed{\lambda_1 = 2}$ $\begin{bmatrix} -9 & -3 \\ 36 & 12 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$ $\boxed{v_1 = \begin{bmatrix} 1 \\ -3 \end{bmatrix}}$

$-9x = 3y$

3, 2 $\boxed{\lambda_2 = 5}$ $\begin{bmatrix} -12 & -3 \\ 36 & 9 \end{bmatrix}$ $-12x = 3y$ $\boxed{v_2 = \begin{bmatrix} 1 \\ -4 \end{bmatrix}}$

11(a) $\boxed{Y = c_1 e^{2t}\begin{bmatrix} 1 \\ -3 \end{bmatrix} + c_2 e^{5t}\begin{bmatrix} 1 \\ -4 \end{bmatrix}}$

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(b) $c_1\begin{bmatrix} 1 \\ -3 \end{bmatrix} + c_2\begin{bmatrix} 1 \\ -4 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \Rightarrow \begin{matrix} c_1 + c_2 = 0 \\ -3c_1 - 4c_2 = 1 \end{matrix}$

$-c_2 = 1 \qquad c_1 = +1$

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$\boxed{Y = +e^{2t}\begin{bmatrix} 1 \\ -3 \end{bmatrix} - e^{5t}\begin{bmatrix} 1 \\ -4 \end{bmatrix}}$

(c) e^{5t} dominates as $t \to \infty$ so

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$\boxed{\begin{matrix} x \to -\infty \\ y \to \infty \\ y/x \to -4 \end{matrix}}$