Q2:

Trapezoid Method:

$$y_{k+1} = y_k + h_k \left(f(t_k, y_k) + f(t_{k+1}, y_{k+1}) \right) / 2$$

For $y' = \lambda y$:

$$y_{k+1} = y_k + \Delta t \left(\lambda y_k + \lambda y_{k+1} \right) / 2$$

$$y_{k+1} = \left(\frac{1 + \Delta t \lambda / 2}{1 - \Delta t \lambda / 2} \right) y_k$$

Growth factor: $G = \dfrac{1 + \frac{1}{2}\lambda \Delta t}{1 - \frac{1}{2}\lambda \Delta t}$

$$\lim_{\lambda \Delta t \to \infty} G = \lim_{\lambda \Delta t \to -\infty} \frac{1 + \frac{1}{2}\lambda \Delta t}{1 - \frac{1}{2}\lambda \Delta t} = \lim_{\lambda \Delta t \to -\infty} \frac{\frac{1}{\lambda \Delta t} + \frac{1}{2}}{\frac{1}{\lambda \Delta t} - \frac{1}{2}} = \frac{\frac{1}{2}}{-\frac{1}{2}} = -1$$

, not L-stable

For the analytical case:

$$G = e^{\lambda t}, \quad \lim_{\lambda t \to -\infty} e^{\lambda t} = 0$$