In the feedback system displayed in (1), an input (1/s) is applied, and so V_{out}(s) takes the raw form: (1).

Figure 1: Modified system with feedback gain

$$V_{out}(s) = \frac{1}{s}\frac{\frac{kC_1}{C_2s+1}}{1+\frac{0.1kC_1}{C_2s+1}} \tag{1}$$

With some manipulation, this turns into (2).

$$V_{out}(s) = \frac{kC_1/C_2}{s}\frac{1}{s+\frac{1+0.1kC_1}{C_2}} \tag{2}$$

With an inverse Laplace transform, this turns into (3).

$$V_{out}(t) = \frac{kC_1/C_2}{\frac{1+0.1kC_1}{C_2}}(1-\mathrm{e}^{-(\frac{1+0.1kC_1}{C2})t}) \tag{3}$$

Finally, this simplifies to (4).

$$V_{out}(t) = \frac{kC_1}{1+0.1kC_1}(1-\mathrm{e}^{-(\frac{1+0.1kC_1}{C2})t}) \tag{4}$$

This implies that the steady state value is $\frac{kC_1}{1+0.1kC_1}$, and the time constant is $\frac{C2}{1+0.1kC_1}$.