Take $I_1(t') = 10^{-4} t'$

$$\boxed{V(t) = V(0)e^{-t/\tau} + \frac{1}{\tau}\int_0^t R I_1(t') e^{-(t-t')/\tau} dt'}$$

from posted lecture notes

For simplicity, let $V(0) = 0$.

$\tau = RC = 0.01$ (10 ms - from problem set)

Let $R = 10^4$, $C = 10^{-6}$ (can choose anything such that $R \cdot C = 0.01$)

$$V(t) = V(0)e^{-t/\tau} + \frac{1}{\tau}\int_0^t R I_1(t') e^{-(t-t')/\tau} dt'$$

$$= 0 + \frac{1}{\tau}\int_0^t R \cdot 10^{-4} t' e^{-(t-t')/\tau} dt'$$

$$= \frac{10^{-4}}{C}\int_0^t t' e^{-t/\tau} e^{t'/\tau} dt'$$

$$= \frac{10^{-4} e^{-t/\tau}}{C}\int_0^t t' e^{t'/\tau} dt'$$

(t is a constant, 30 ms, so we can pull $e^{-t/\tau}$ out of the integral)

integration by parts:

$\int u\,dv = uv - \int v\,du$

$u = t'$ $\quad v = \tau e^{t'/\tau}$

$du = 1$ $\quad dv = e^{t'/\tau}$

$$V(t) = \frac{10^{-4} e^{-t/\tau}}{C}\left[\tau t' e^{t'/\tau} - \tau\int_0^t e^{t'/\tau}\right]_0^t$$

$$V(t) = \frac{10^{-4} e^{-t/\tau}\tau}{C}\left[t' e^{t'/\tau} - \tau e^{t'/\tau}\right]_0^t$$

$$V(t) = \frac{10^{-4} e^{-t/\tau}\tau}{C}\left[t e^{t/\tau} - \tau e^{t/\tau} - (0 - \tau)\right]$$

$$V(t) = \frac{10^{-4}\tau}{C}\left[t - \tau + \tau e^{-t/\tau}\right]$$

Now plug in $t = 0.03$ s

$$V(0.03) = \frac{10^{-4}\tau}{C}\left[0.03 - \tau + \tau e^{-0.03/\tau}\right] \approx 0.0205 \text{ V}$$

Now find the constant current input (I_2) that gives $V(0.03) = 0.0205$ V

$$\boxed{V(t) = (V(0) - V_\infty)e^{-t/\tau} + V_\infty}$$ where $V_\infty = I_2 R$

from posted lecture notes

Remember we took $V(0) = 0$.

$$V(t) = -I_2 R e^{-t/\tau} + I_2 R$$

$$= I_2(-Re^{-t/\tau} + R) \Rightarrow I_2 = \frac{V(t)}{-Re^{-t/\tau} + R}$$

$$I_2 = \frac{0.0205}{-Re^{-0.03/\tau} + R} \approx 2.1574 \times 10^{-6} \text{ A}$$

We have:

$$I_1(t') = 10^{-4} t'$$

$$I_2(t') = 2.1574 \times 10^{-6}$$

Both of these current inputs give a voltage response of 0.0205 V at 30 msec.