HW # 19.

8-18 (a)

$$V_c(t) = [\text{Final Value}] + ([\text{Initial Value}] - [\text{Final Value}])e^{-\frac{\text{elapsed time}}{\tau}}$$

Initial Value : 0V ($V_c(0) = 0V$)

Final Value : 20V ($V_c(\infty) = 20V$)

$$\tau = RC = 10 \times 10^3 \times 0.4 \times 10^{-3} = 4(s)$$

$$\therefore V_c(t) = 20 - 20e^{-\frac{t}{4}} = \underline{20\left(1 - e^{-\frac{t}{4}}\right)\ (V)}$$

(b)

Initial Value : 10V ($V_c(0) = 10V$)

Final Value : 0V ($V_c(\infty) = 0$)

$$\therefore V_c(t) = \underline{10e^{-\frac{t}{4}}\ (V)}$$

8-19. (a)

$$i_L(t) = [\text{Final Value}] + ([\text{Initial value}] - [\text{Final Value}])e^{-\frac{\text{elapsed time}}{\tau}}$$

$$\tau = \frac{L}{R} = \frac{0.2}{100} = 2 \times 10^{-3}(s) = 2(ms)$$

Initial Value : 0 A ($i_L(0) = 0$)

Final Value : $\frac{20V}{100\Omega} = 0.2(A)$ $\left(i_L(\infty) = \frac{20V}{R}\right)$

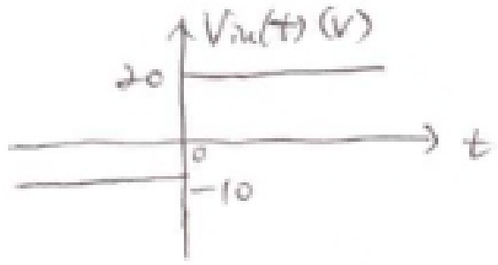
$$\therefore i_L(t) = 0.2 - 0.2e^{-\frac{t}{2\times10^{-3}}} = \underline{0.2\left(1 - e^{-500t}\right)\ (A)}$$

(b) Initial value : $-50mA = -0.05A$ $(i_L(0) = -50mA)$

Final value : $0A$ $\left(i_L(\infty) = \frac{0V}{R} = 0\right)$

$\therefore i_L(t) = -0.05 \times e^{-50t}$ (A)

8-20. (a) $V_{in}(t) = -10u(-t) + 20 \cdot u(t)$ (V)



At $t = 0^-$, there is no current through C.

$\therefore V_C(0^-) = V_{in}(0^-) \times \frac{R_2}{R_1+R_2} = -10 \times \frac{200}{200+50} = -8(V)$

By continuity property, $V_C(0^+) = V_C(0^-) = \boxed{-8V}$.

At $t = +\infty$, there is no current through C.

$\therefore V_C(\infty) = V_{in}(\infty) \times \frac{R_2}{R_1+R_2} = 20 \times \frac{200}{200+50} = 16(V)$

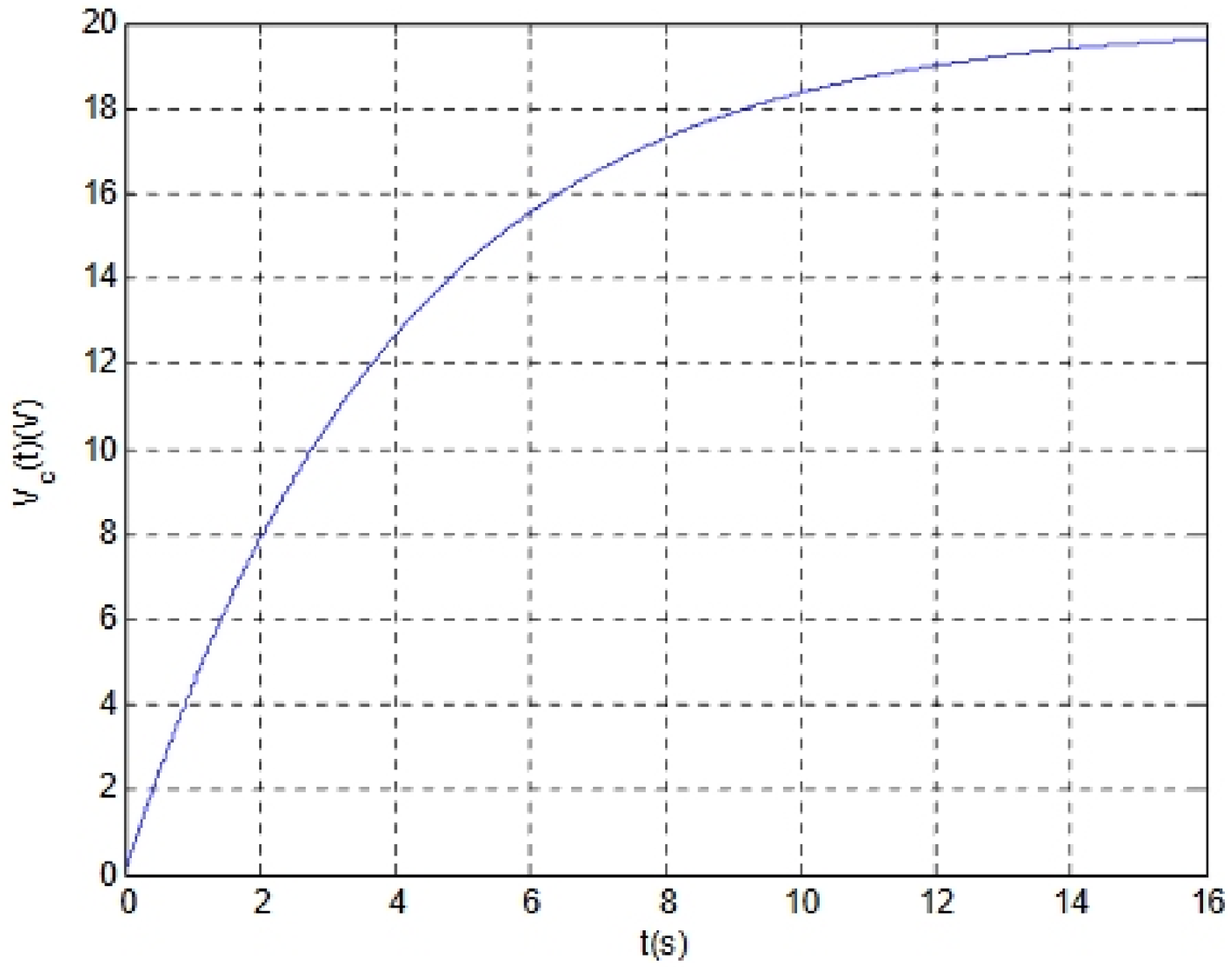
$V_C(t) = V_C(\infty) + [V_C(0^+) - V_C(\infty)]e^{-\frac{t}{\tau}}$ $(t>0)$

$\tau = (R_1 // R_2) \times C = (50 // 200) \times 2.5 \times 10^{-3} = 0.1(s)$

$\therefore V_C(t) = 16 + (-8-16)e^{-10t}$

$= 16 - 24e^{-10t}$ $(t>0)$

8-18(a)


20
18
16
14
12
10
8
6
4
2
0
0
2
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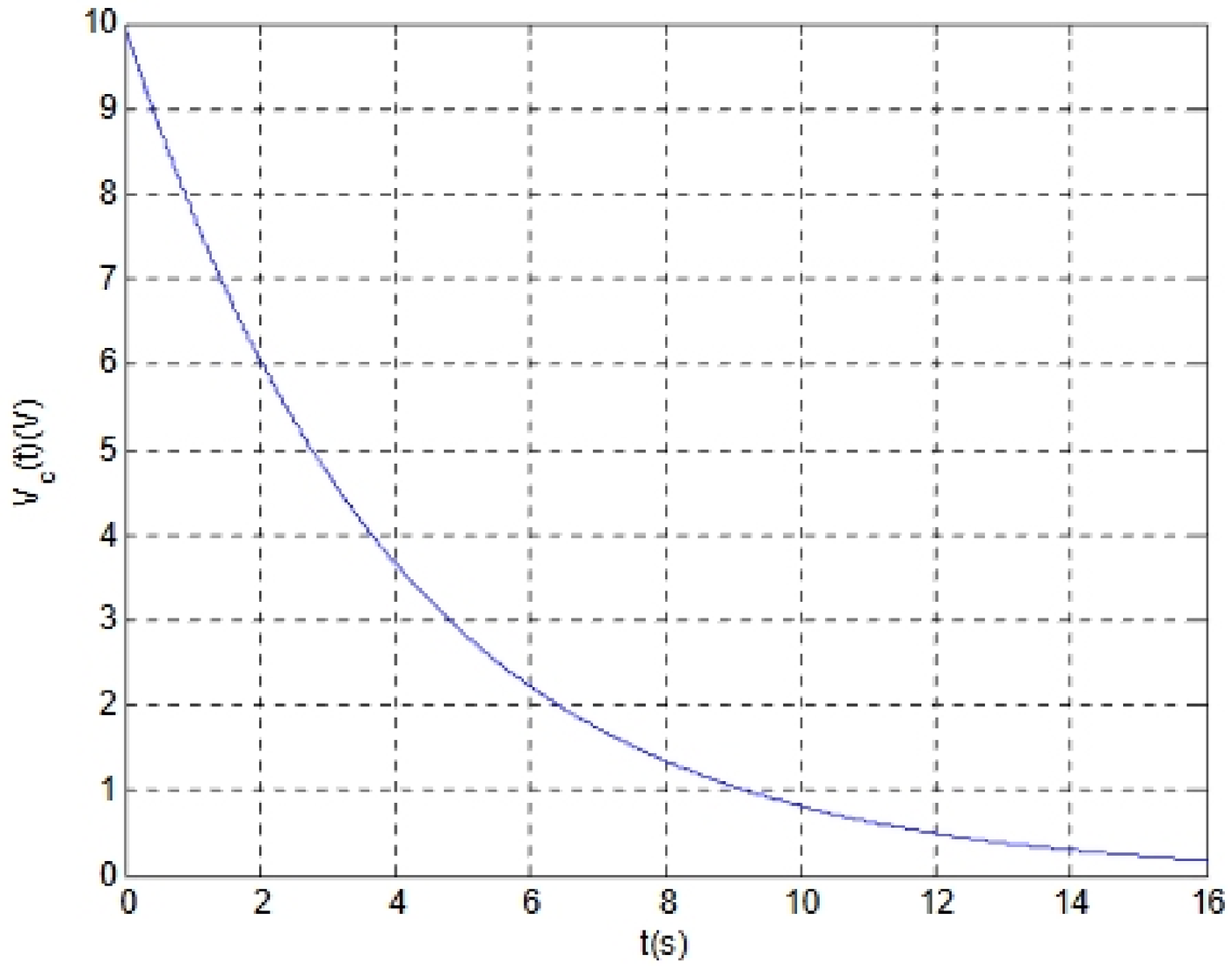
6
8
10
12
14
16
t(s)
$V_c(t)(V)$

8-18(b)


10
9
8
7
6
5
4
3
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1
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0
2
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10
12
14
16
t(s)
$V_c(t)(V)$