Week 2 Workshop Example Solutions

Example 6:

The initial voltage at t = 0 across the capacitor is v(0) = 10 V×4 kΩ/10 kΩ = 4 V.

For $0 \le t \le 0.5$ ms, $\tau = R_2C = 4000 \times 0.25 \times 10^{-6} = 1$ ms, $1/\tau = 1000$. $v(t) = 4\exp(-1000t)\,u(t)$ V.

At t = 0.5 ms, $V_1 = v(0.5\text{ ms}) = 4\exp(-0.5) = 2.4261$ V

For 0.5 ms ≤ t, the final value is $v(\infty) = 20\text{ V} \times 4\,\text{k}\Omega/10\,\text{k}\Omega = 8$ V. $R_{eq} = R_2 \,||\, R_3 = 2.4\,\text{k}\Omega$

For 0.5 ms ≤ t, $\tau = R_{eq}C = 2400 \times 0.25 \times 10^{-6} = 0.6$ ms, $1/\tau = 1666.6667$ (1/s).

For 0.5 ms ≤ t,

$v(t) = [8 + (2.4261 - 8)\exp(-1666.6667(t - 0.0005))] = [8 - 5.5739\exp(-1666.6667(t - 0.0005))]\,u(t)$ V