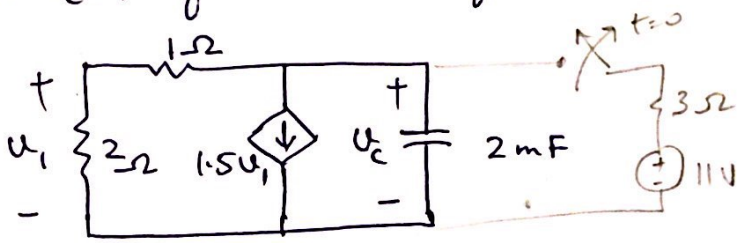
(MUST)

(Pdf)

Pract 8.7 General RC Circuit

(PP 282 8th Ed HKD)

Determine $v_c(t)$ for $t > 0$ if $v_c(0) = 11$ volts.



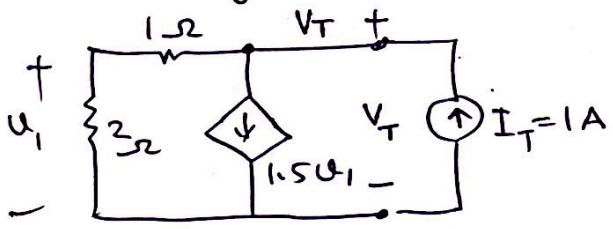
Solution: The circuit is identified as a source-free RC circuit.

— Its response will be of the form

$$v_c(t) = V_{co}\, e^{-t/\tau} \quad V$$

where $\tau = R_{eq} C_{eq}$

— To calculate R_{eq}?



— and $R_{eq} = \dfrac{V_T}{I_T}$

— Writing KCL at node V_T:

$$\frac{V_T - v_1}{1} + 1.5 v_1 = 1$$

or $V_T + 0.5 v_1 = 1$ ——— (1)

——— contd

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—contd (282)

Also $v_1 = (1 - 1.5v_1) \times 2$ (KCL at top node)

$v_1 = 2 - 3v_1$

$4v_1 = 2$

$v_1 = 0.5$ ——— (2)

— Putting in (1)

$V_T + 0.5 \times 0.5 = 1$

$V_T = 1 - 0.25 = 0.75$

$V_T = 0.75$

— Hence $R_{eq} = \frac{0.75}{1} = 0.75\,\Omega$.

— So $\tau = R_{eq}C = 0.75 \times 2 \times 10^{-3}$

$\tau = 1.5 \times 10^{-3}$ s

— Thus $v_c(t) = V_0 e^{-t/\tau}$ V

$v_c(t) = 11\, e^{-\frac{t}{1.5 \times 10^{-3}}}$

$v_c(t) = 11\, e^{-\frac{10}{15} \times 10^3 t}$

$v_c(t) = 11\, e^{-2/3 \times 10^3 t}$ V , $t > 0$

Note: NOW voltage across 2 Ω and 1 Ω can be found by voltage division rule.

So $v_1(t) = \frac{2}{3} \times 11 e^{-2/3 \times 10^3 t}$

and $v_2(t) = \frac{1}{3} \times 11 e^{-2/3 \times 10^3 t}$ Volts.