EE 221 Circuits II

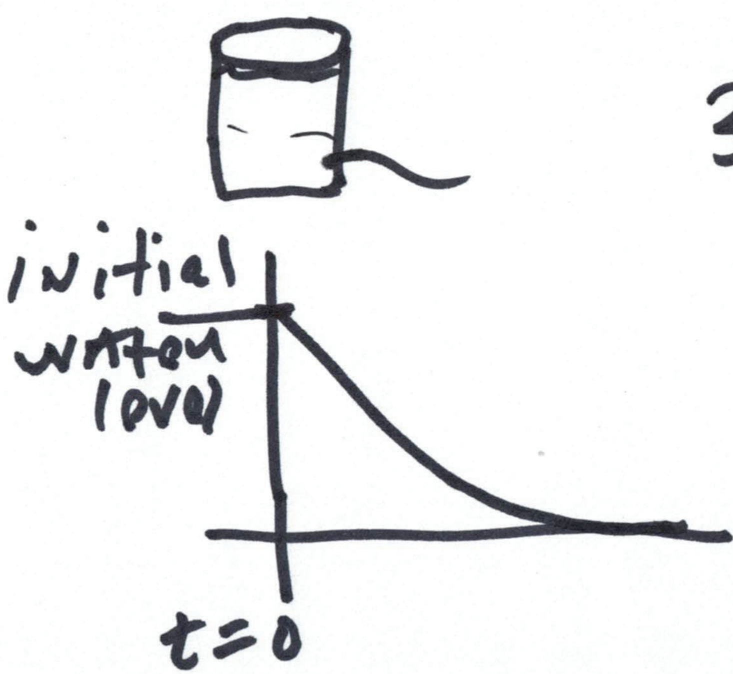
March 20, 2023

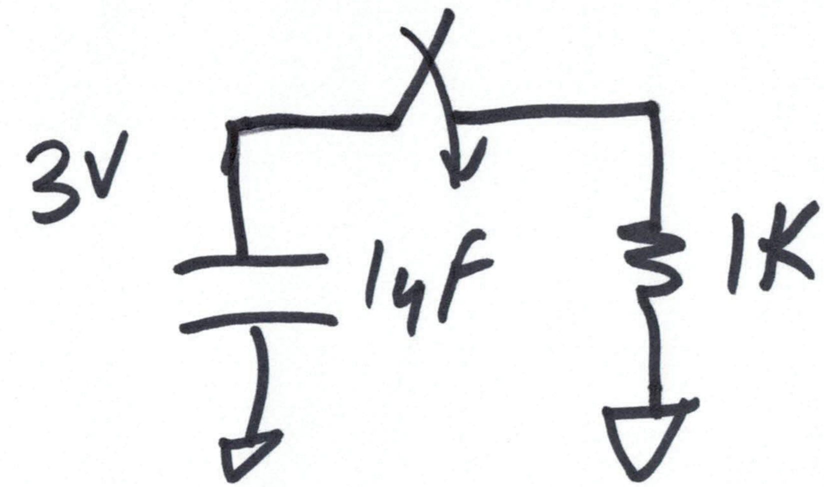
Lecture 14

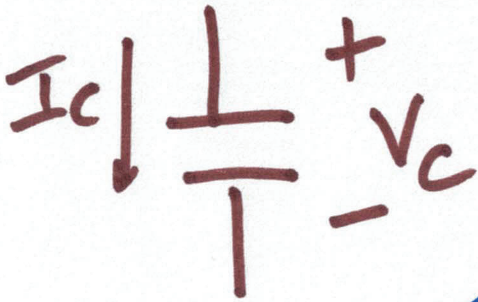
$CV = Q$

$1\mu F \cdot 3V = 3\mu C$

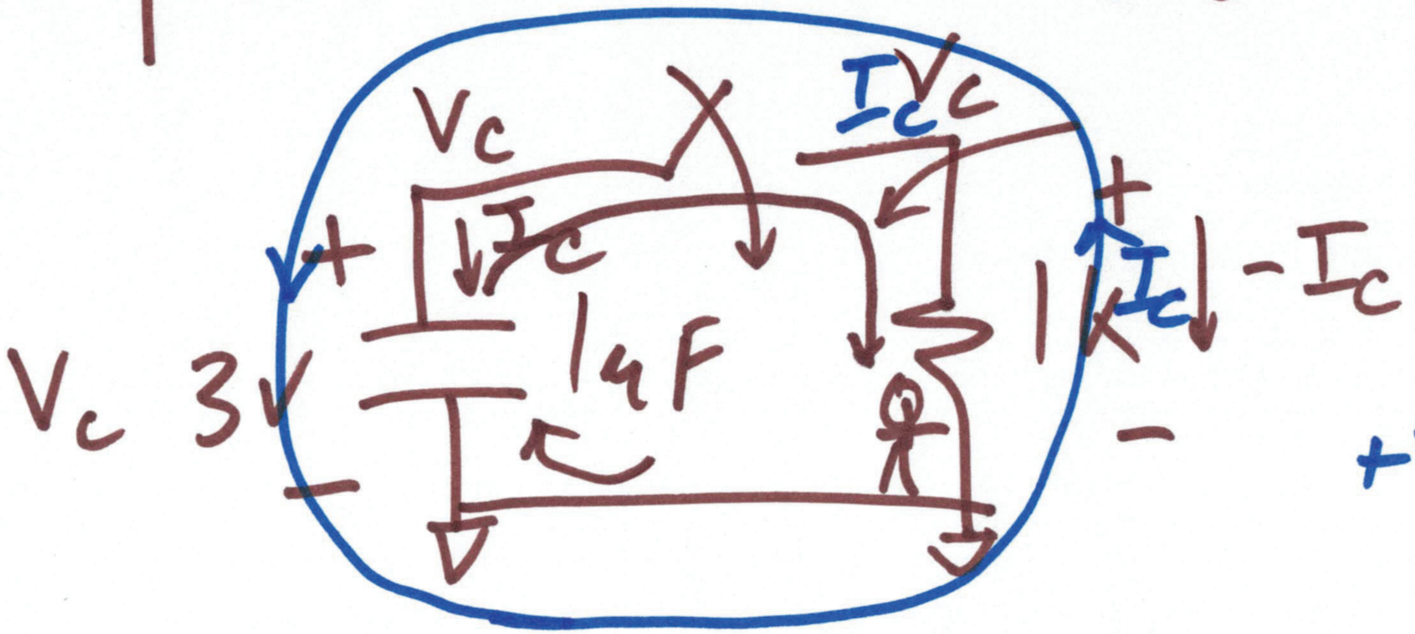
$-1.6 \times 10^{-19}\,C$

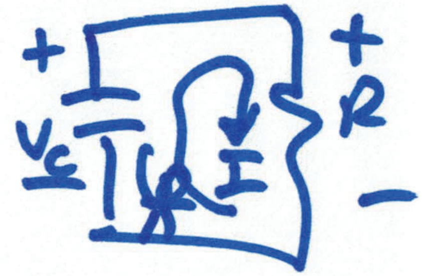






$$I_c = C\frac{dV_c}{dt}, \quad V_c = \frac{1}{C}\int_0^t I_c\,dt$$





$$+V_c - I\cdot R = 0$$

$$V_c - (-I_c)\cdot R = 0$$

$$V_c + I_c\cdot R = 0$$

$$V_c + I_c \cdot R = 0$$

$$\int \frac{d\,\text{logcabin}}{\text{logcabin}}$$

$$V_c = -I_c \cdot R$$

natural log cabin

$$V_c = -RC \cdot \frac{dV_c}{dt}$$

$$\int_0^t -\frac{dt}{RC} = \int_{V_{init}}^{v_c(t)} \frac{dV_c}{V_c}$$

$$-\frac{1}{RC} t \Big|_0^t = \ln V_c \Big|_{V_{init}}^{v_c}$$

$$-\frac{t}{RC} = \ln v_c - \ln V_{init}$$

$$e^{\frac{-t}{RC}} = e^{\ln \frac{v_c}{V_{init}}}$$

$$e^{-t/RC} = \frac{v_c}{V_{init}}$$

$$v_c(t) = V_{init}\, e^{-t/RC}$$

$$v_c(t) = 3e^{-t/1ms}$$

$$R \cdot C = 1K \cdot 1\mu F = 1ms$$

$$v_c(t) = 3e^{-(t-1ms)/1ms}$$

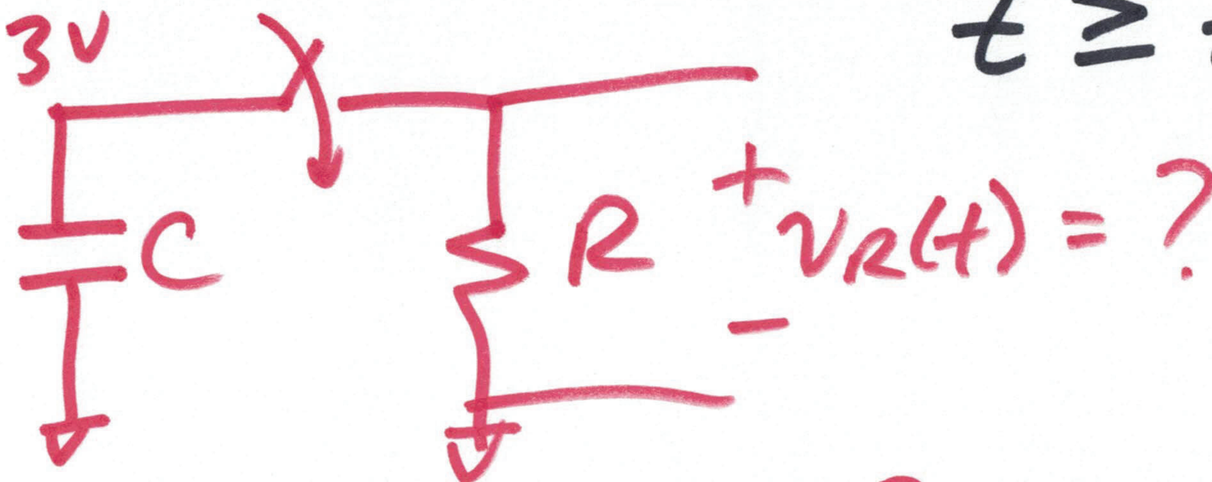
$$t \geq 1ms$$

$t)$

$$v_C(t) = v_f + (v_i - v_f)\, e^{-t/RC}$$

$$= v_f + (v_i - v_f)\, e^{-\frac{(t - t_{init})}{RC}}$$

$$t \geq t_{init}$$



$v_f = 0 \quad v_i = 3$

$$v_R(t) = 3\, e^{-t/RC}$$

$$v_c(t) = 3e^{-(t-1ms)/1ms}$$

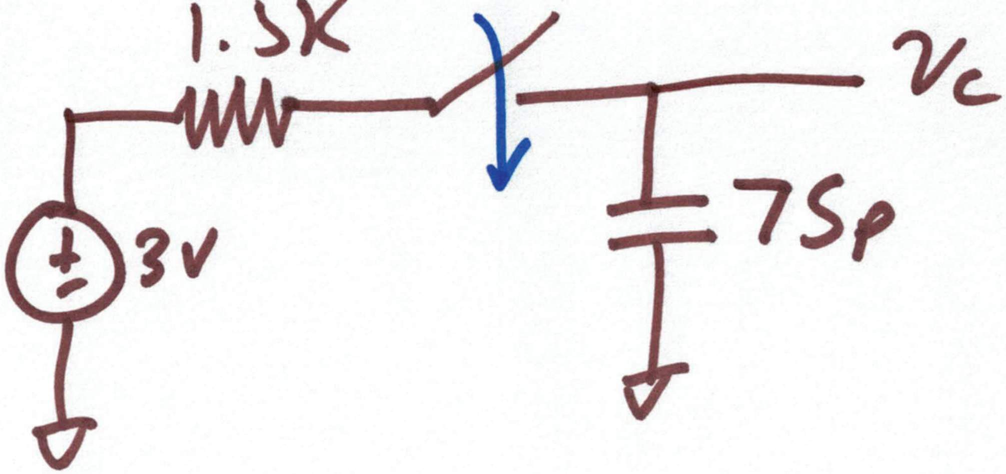
1 time constant @ 1ms after the switch closes (2ms)

$$3e^{-1} = 3 \cdot .37$$

1τ drops 63%

↓

1.89 37%



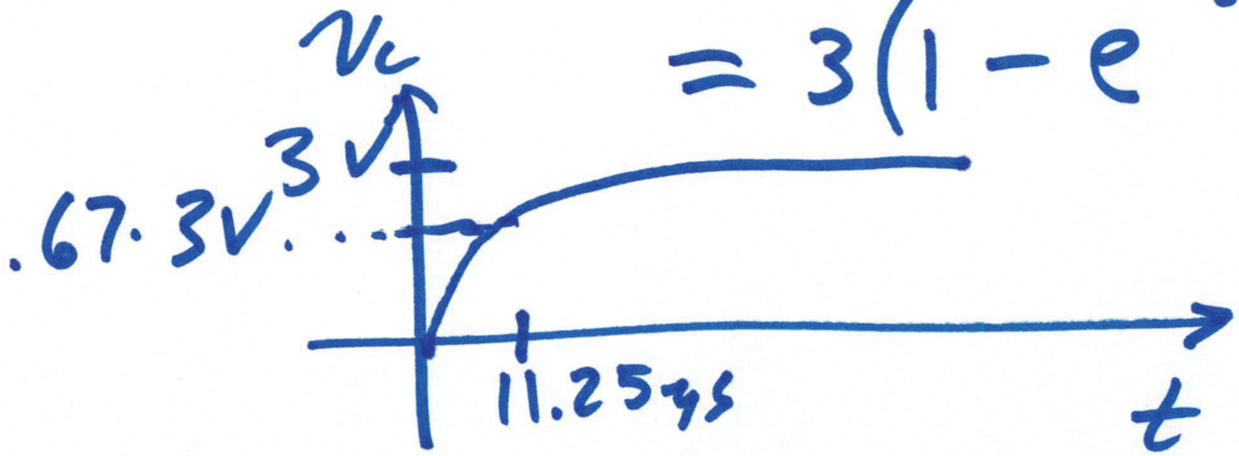
$$v_i = 0$$

$$v_f = 3V$$

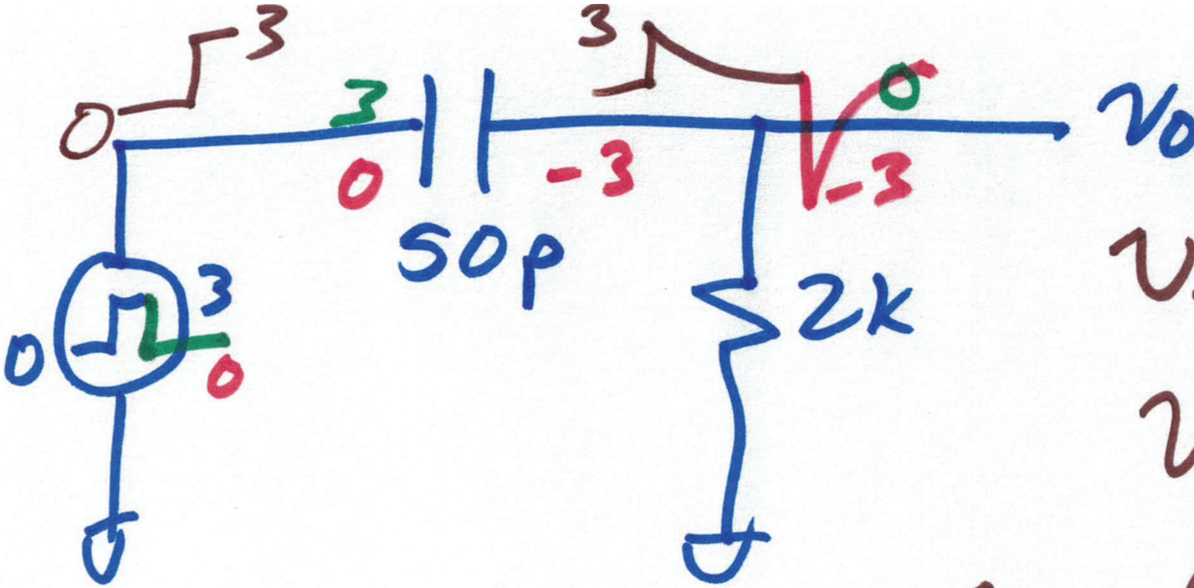
$$v_c(t) = 3 + (0-3)e^{-t/(1.5k\cdot 75p)}$$

$$= 3\left(1 - e^{-t/(1.5k\cdot 75p)}\right)$$

$$\tau = 11.25\,\mu s$$



b)



$$v_f = 0$$

$$v_i = 3$$

$$v_o = v_f + (v_i - v_f)e^{-t/RC}$$

$$= 3e^{-t/100ns}$$

$$t > 0$$

$$v_i = -3$$

$$v_f = 0$$

$$v_o = -3\left(1 - e^{-t/100n}\right)$$