

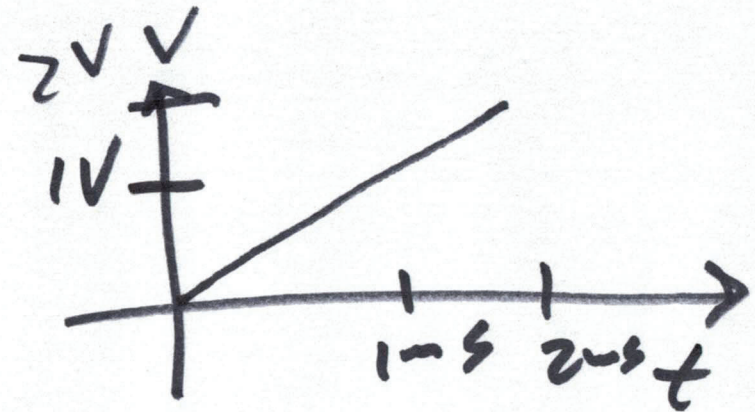
EE 220 CIRCUITS I

Lecture ~~15~~ 15

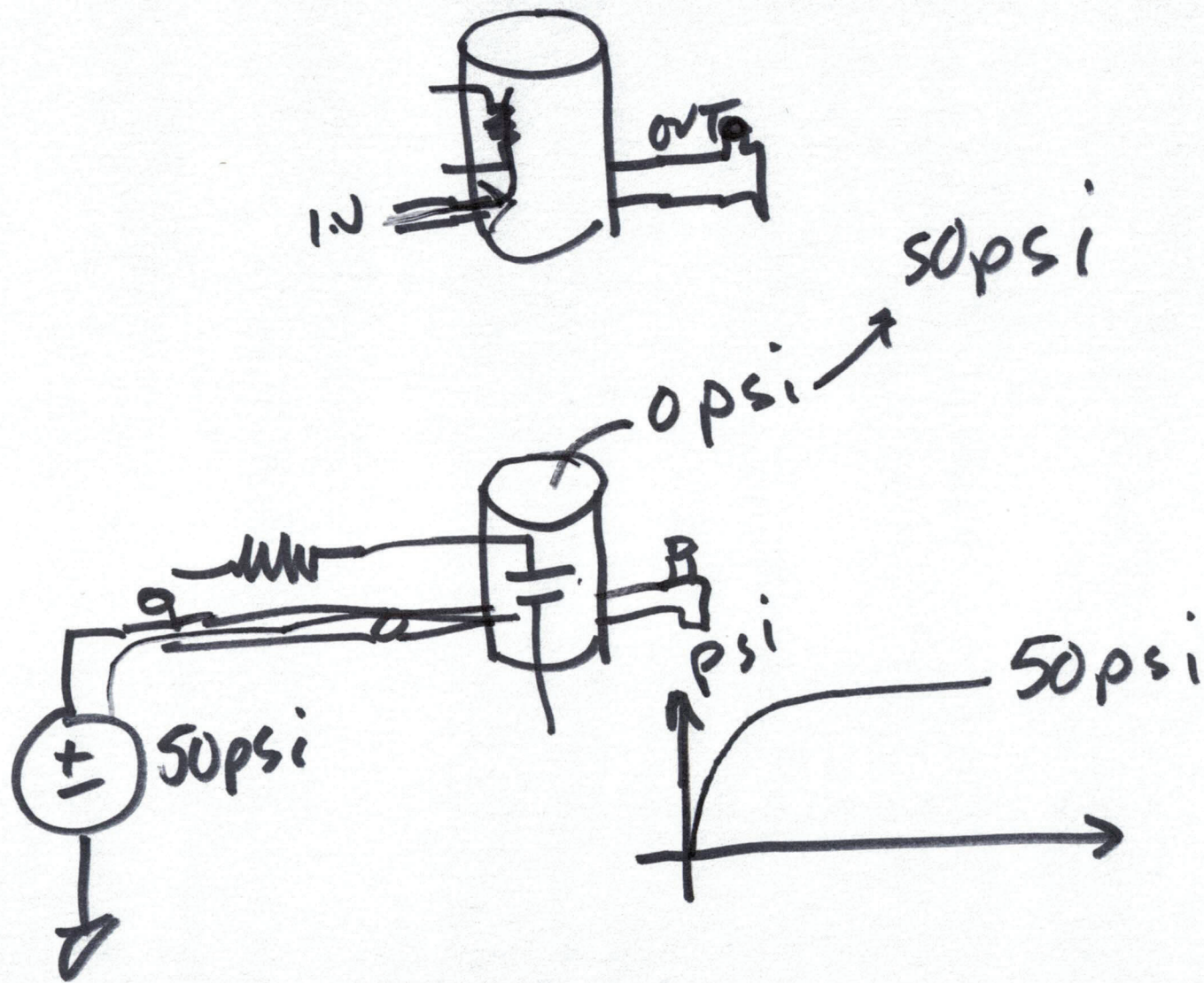
OCTOBER 24, 2022

$$CV = Q$$
$$1\mu\text{F} \cdot 5\text{V} = Q$$

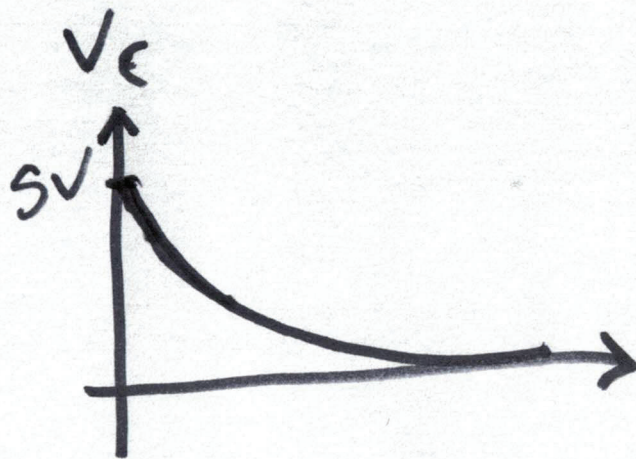
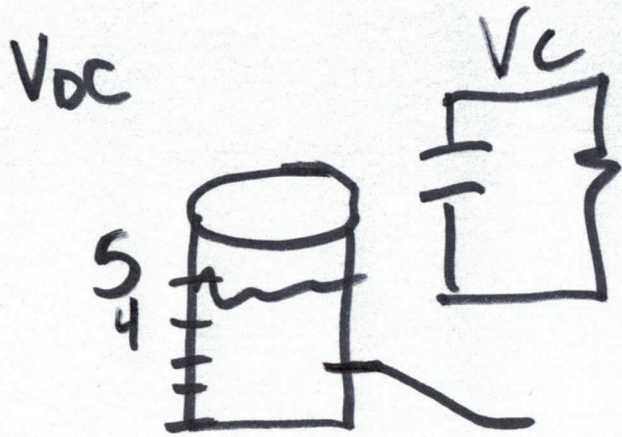
$$Q = 5\mu\text{C}$$



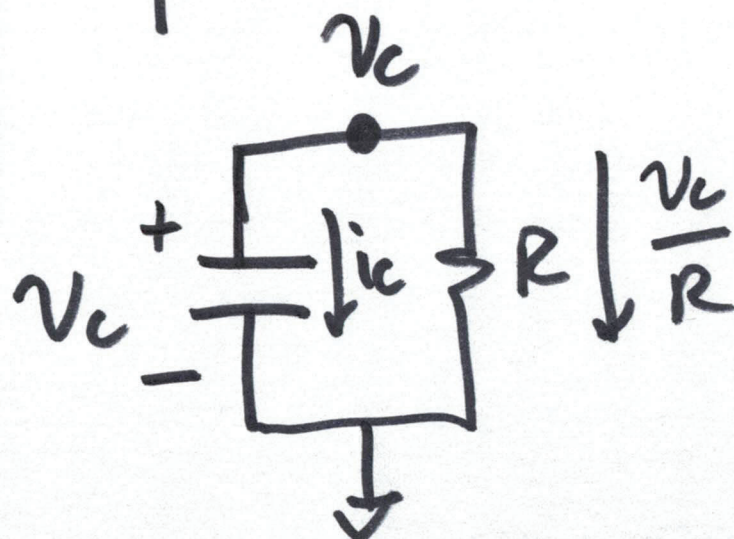
$$I = C \frac{dV}{dt} = 1\mu\text{A} = 1\mu\text{F} \cdot \frac{dV}{dt}$$
$$\frac{1\text{V}}{\mu\text{s}} = \frac{dV}{dt} = \frac{10^{-3}}{10^{-6}} = \frac{1}{10^{-3}}$$



2)



$i_c \downarrow$ $\frac{+}{-} V_c$ $i_c = C \frac{dV_c}{dt}$ $t=0$ knife into the bucket



$\frac{V_c}{R} + i_c = 0 = \frac{V_c}{R} + C \frac{dV_c}{dt}$

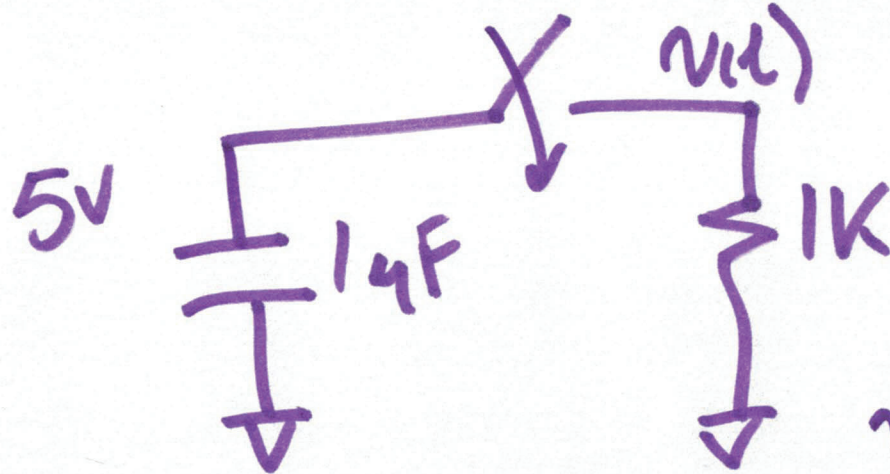
$C \frac{dV_c}{dt} = -\frac{V_c}{R}$

3)

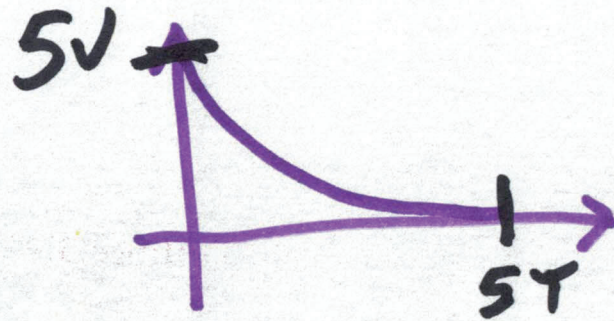
$$\frac{v(t)}{v_{init}} = e^{-\frac{t}{RC}} \quad t \geq 0$$

$$v(t) = v_{init} e^{-\frac{t}{RC}} \quad t \geq 0$$

$\tau = RC = \text{time constant}$



$$v(t) = 5e^{-\frac{t}{1\mu s}} \quad t \geq 0$$



5)

$$\int_{V_{init}}^{v(t)} \frac{dv_c}{v_c} = \int_0^t -\frac{1}{RC} \cdot dt$$

$$\ln x \Big|_{V_{init}}^{v(t)} = -\frac{1}{RC} t \Big|_0^t$$

$$\ln v(t) - \ln V_{init} = -\frac{t}{RC} - \frac{0}{RC}$$

$$\ln a - \ln b = \ln \frac{a}{b}$$

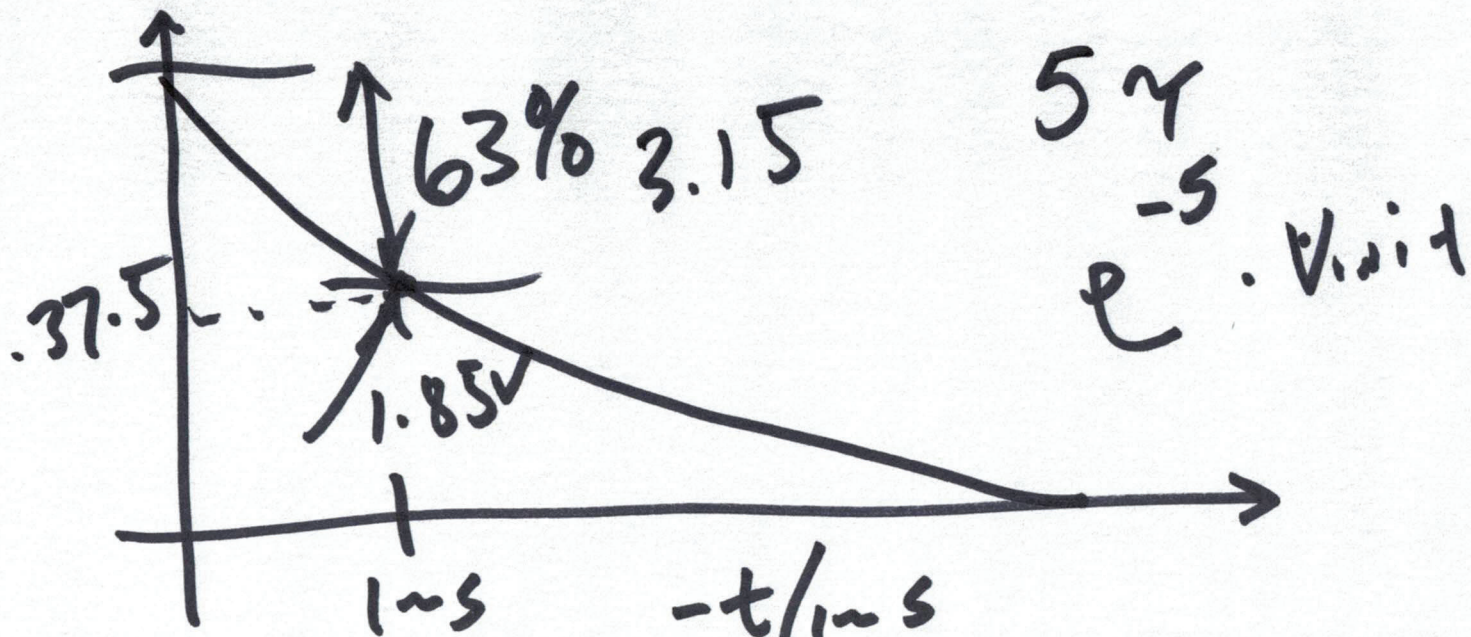
$$\exp\left(\ln \frac{v(t)}{V_{init}}\right) = \exp\left(-\frac{t}{RC}\right)$$

$$\int_{V_{init}}^{v_H) \frac{dv_C}{v_C} = \int_{t_{init}}^+ -\frac{1}{RC} \cdot dt$$

$$v(t) = V_{init} e^{-\frac{(t-t_{init})}{RC}} \quad t \geq t_{init}$$

$$v(t) = \overset{5}{\cancel{V_{init}}} e^{-\frac{(t-1\mu s)}{1\mu s}} \quad t \geq 1\mu s$$

5)



$$V(t) = 5e^{-t/1\text{ms}}$$

τ = time constant

at 1 time constant τ

$$V(t) = 5e^{-1} = \frac{5}{e} = 37.5$$

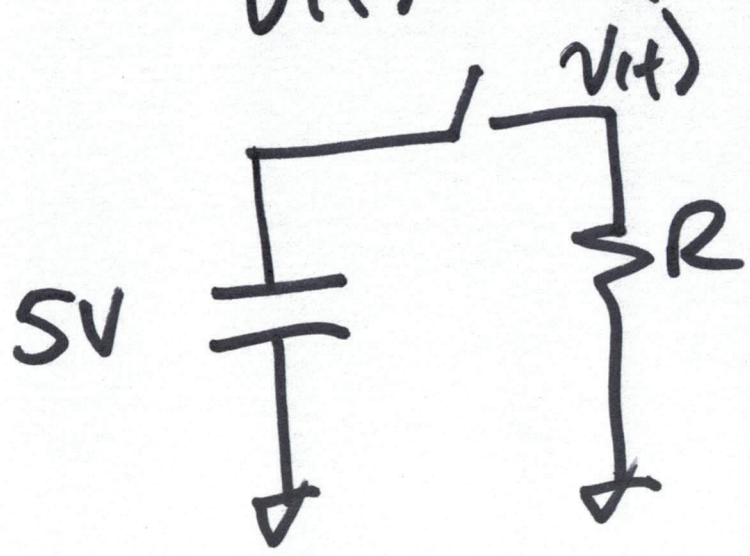
five

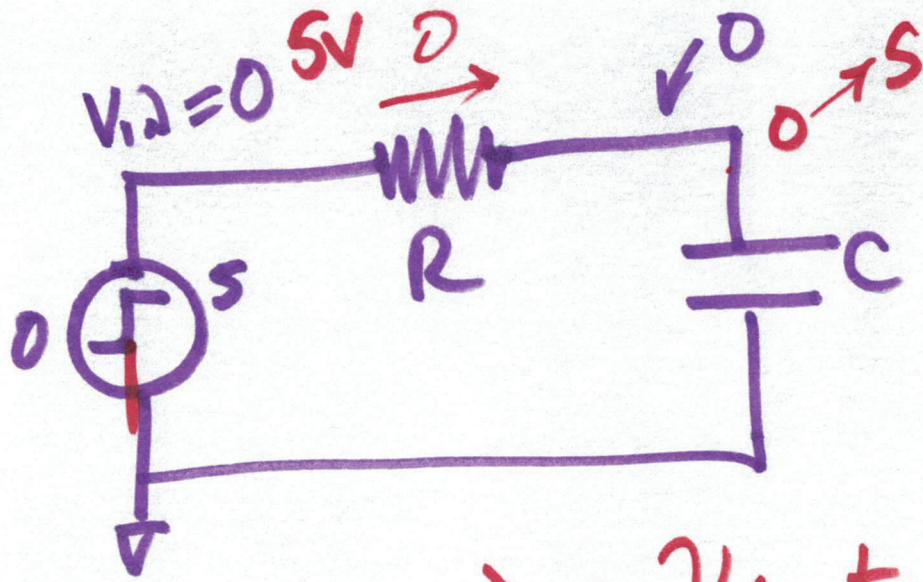
$$v(t) = v_f + (v_i - v_f) e^{-t/\tau}$$

$$v_i = 5$$

$$v_f = 0$$

$$v(t) = 5e^{-t/\tau}$$





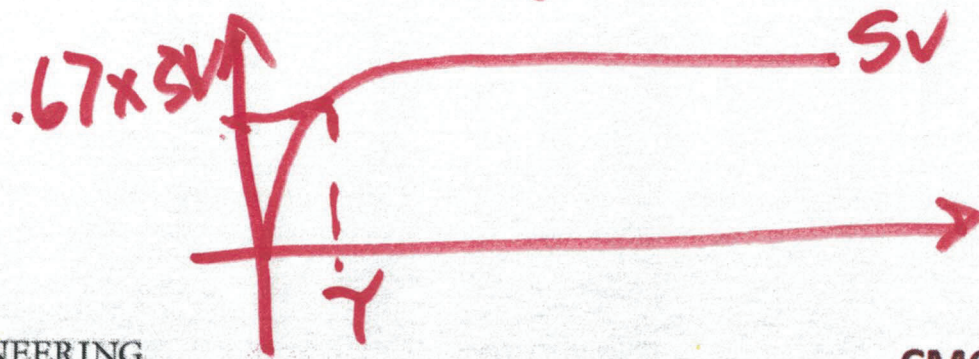
$$v_i = 0$$

$$v_f = 5$$

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

$$= 5 - 5e^{-t/RC}$$

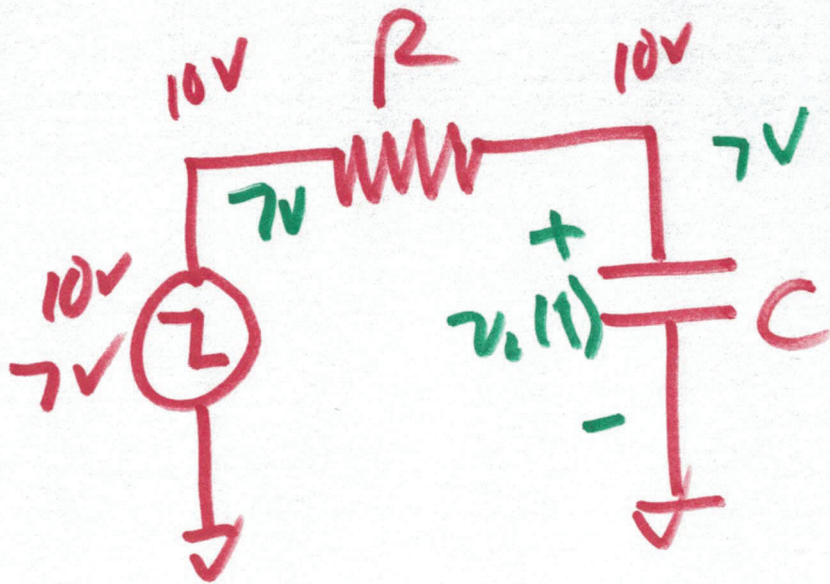
$$= 5(1 - e^{-t/RC})$$



$$v_f = 0$$

$$v_i = 5$$

$$v_c(t) = v_f + (v_i - v_f)e^{-\frac{(t-t_i)}{1\text{ms}}}$$
$$= +5e^{-\frac{(t-8\text{ms})}{1\text{ms}}} \quad t \geq 8\text{-s}$$



$$v_i = 10V$$

$$v_f = 7V$$

$$10 - 7 \quad -t/RC$$

$$v_c(t) = 7 + (10 - 7)e^{-t/RC}$$

$$v_c(t) = 7 + 3e^{-t/RC}$$