micro = 10^{-6}
milli = 10^{-3}
centi = 10^{-2}
kilo = 10^{3}
MEG = 10^{6}
Giga = 10^{9}
Tera = 10^{12}
Peta = 10^{15}

nano = 10^{-9}
pico = 10^{-12}
femto = 10^{-15}
atto = 10^{-18}

EE 220 Circuits 1

Lecture 14

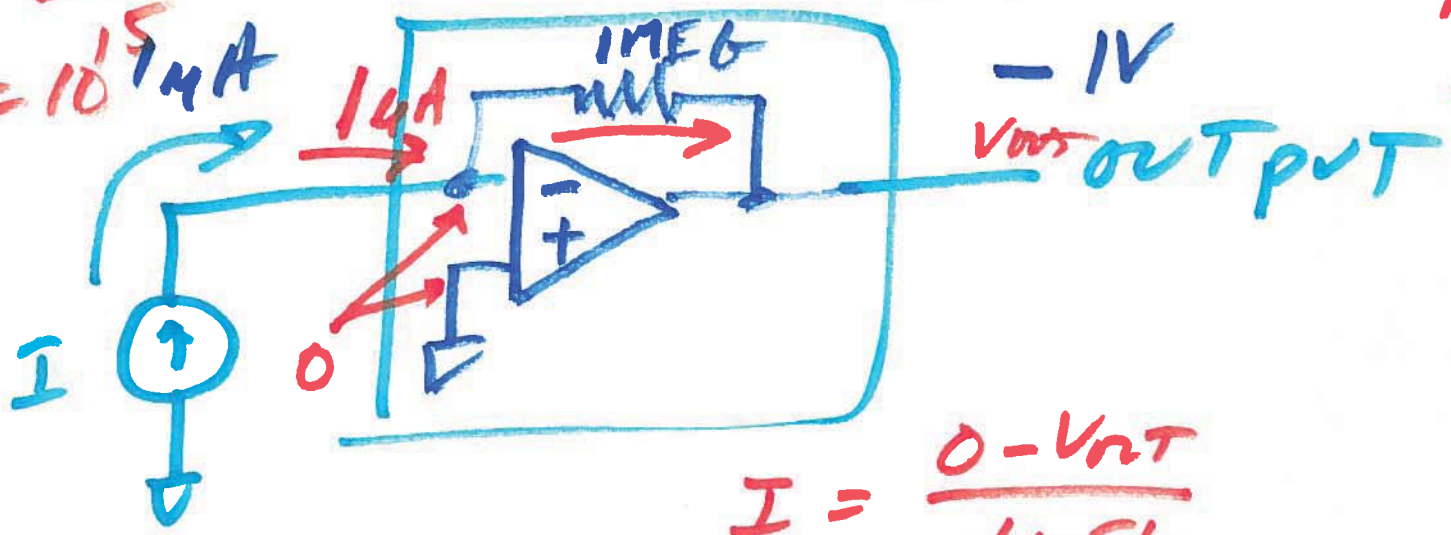
OCT. 18, 2017

$1m = 1milli$

$1m \neq 1MEG$

$1M\Omega$

$1m\Omega$



$$I = \frac{0 - V_{OUT}}{1MEG}$$

$$V_{OUT} = -I \cdot 1MEG$$

$$V_{OUT} = -1mA \cdot 1MEG$$

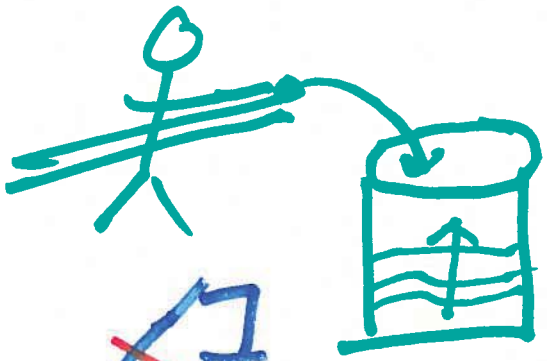
$$= -1V$$

capacitor

$$C = \frac{\epsilon \cdot A}{t}, \text{ FARADS}$$

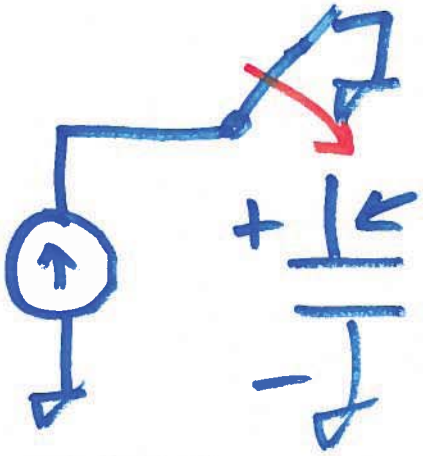
dielectric constant

ϵ ε $\mathcal{E}$

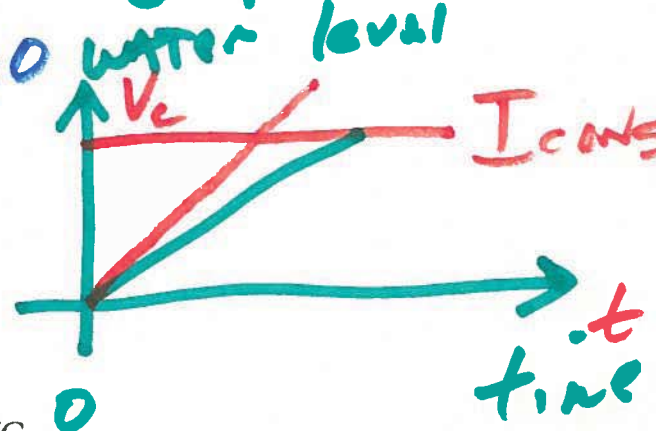


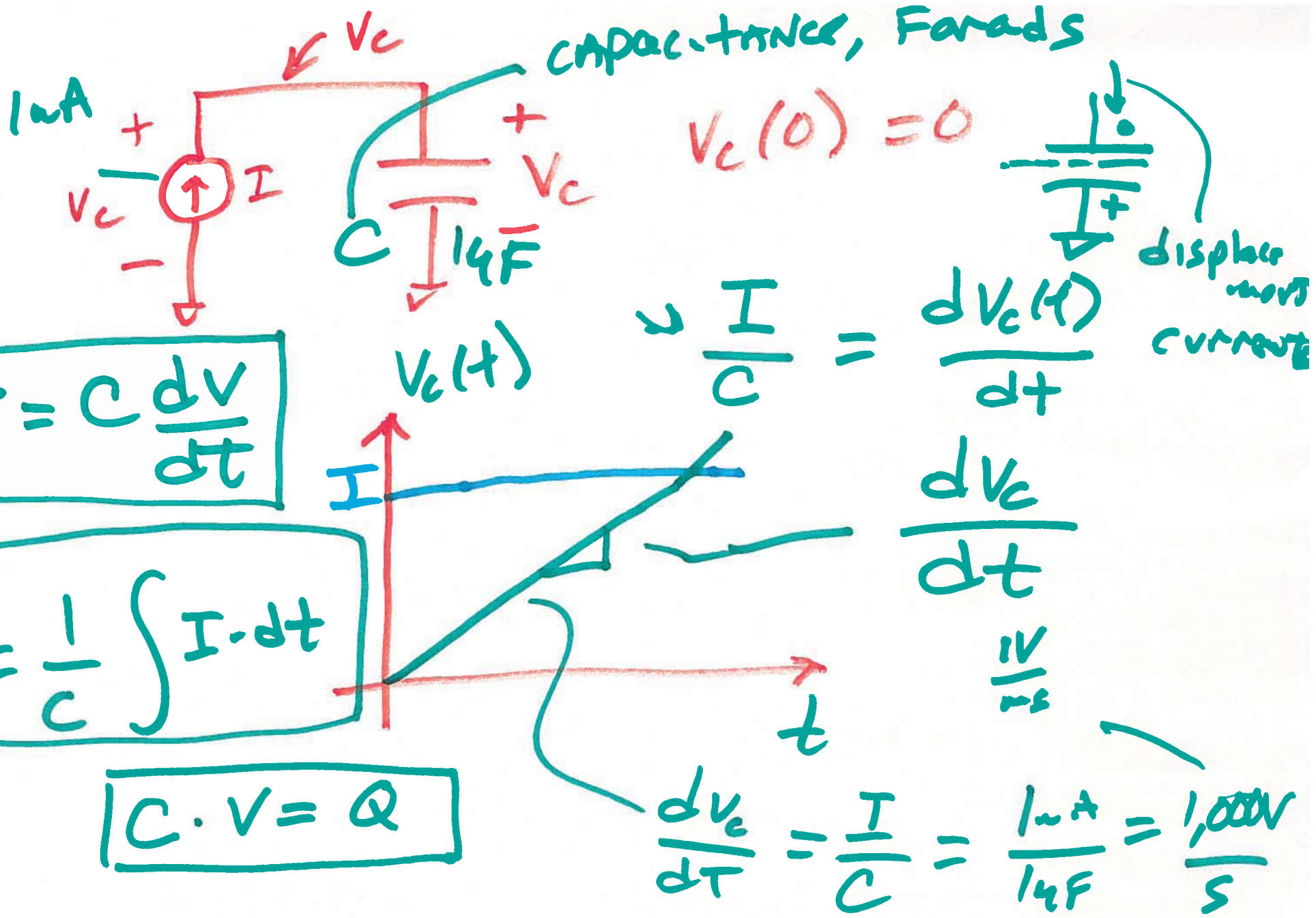
Bucket is empty

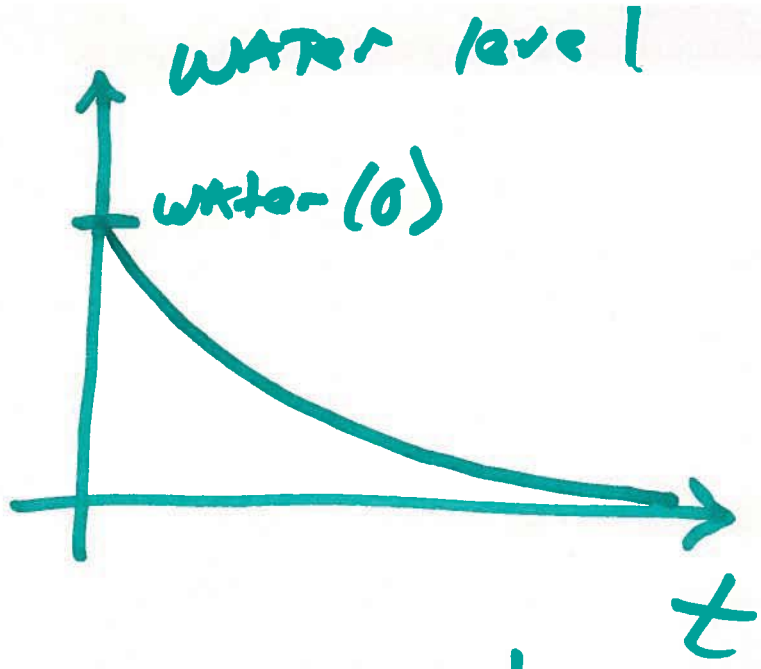
Capacitor is discharged



$V_c(0) = 0$




Vc
capacitance, Farads
1mA
+
Vc
−
I
+
Vc
C
1μF
Vc(0) = 0
displacement current
I = C dV/dt
Vc(t)
I
t
I/C = dVc(t)/dt
dVc/dt
1V/ms
V = 1/C ∫ I·dt
C · V = Q
dVc/dT = I/C = 1mA/1μF = 1,000V/s

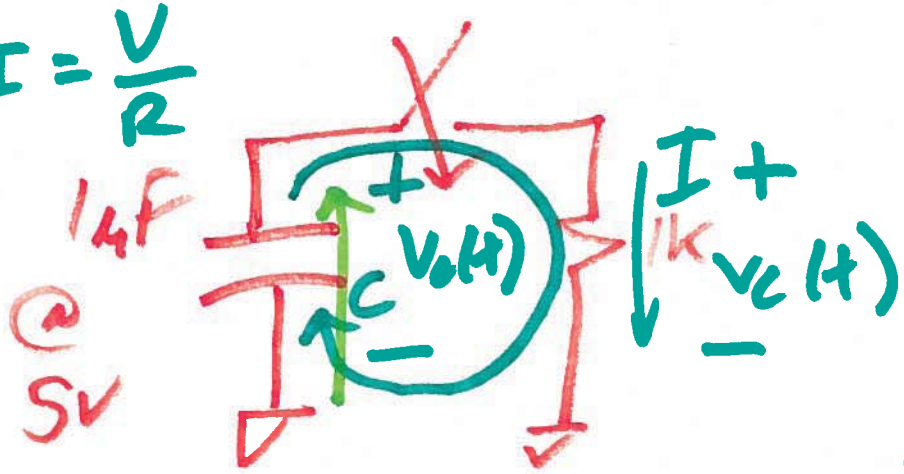


$V = IR$

$I = C\frac{dv}{dt}$

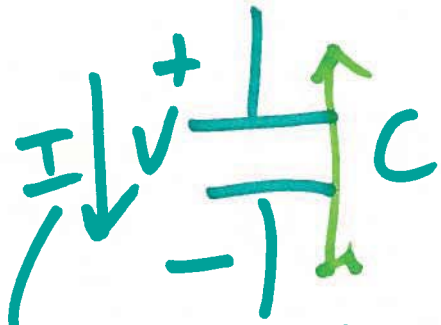
$t = 0$

$I = \frac{V}{R}$

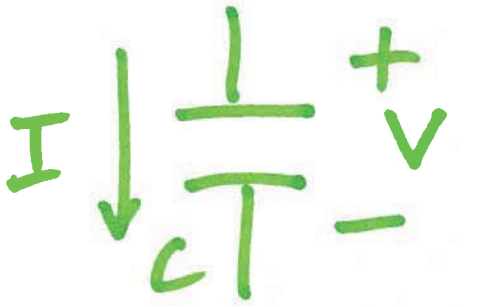


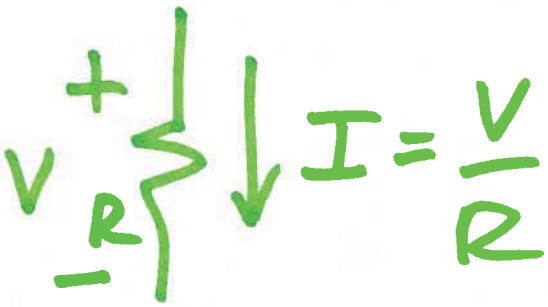
$\frac{V}{R} = -C\frac{dv}{dt}$

$Q = CV = 5\mu C$



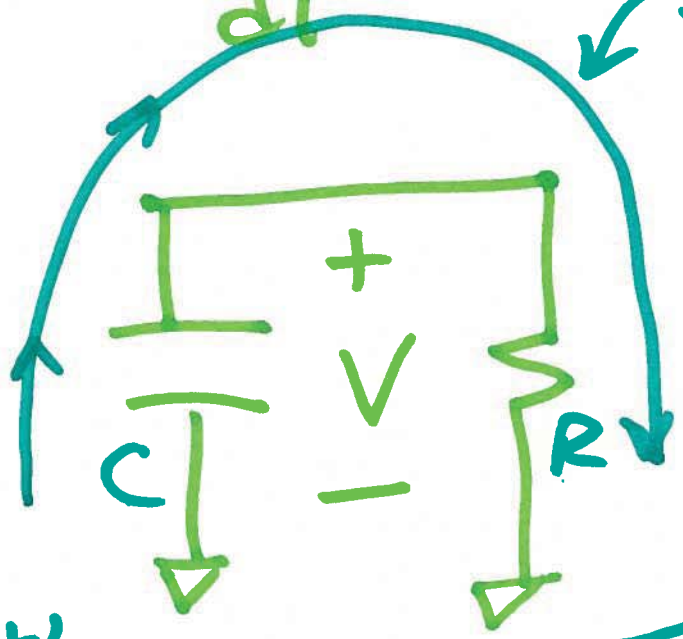
$I = -C\frac{dV}{dt}$





$$I = C\frac{dV}{dT}$$

$$I = -C\frac{dV}{dT}$$



$$I = \frac{V}{R}$$

$$\frac{V}{R} = -C\frac{dV}{dT}$$

Separation of variables

$$-\frac{1}{RC}\int_0^t dt = \int_{V_{init}}^{V_f}\frac{dV}{V}$$

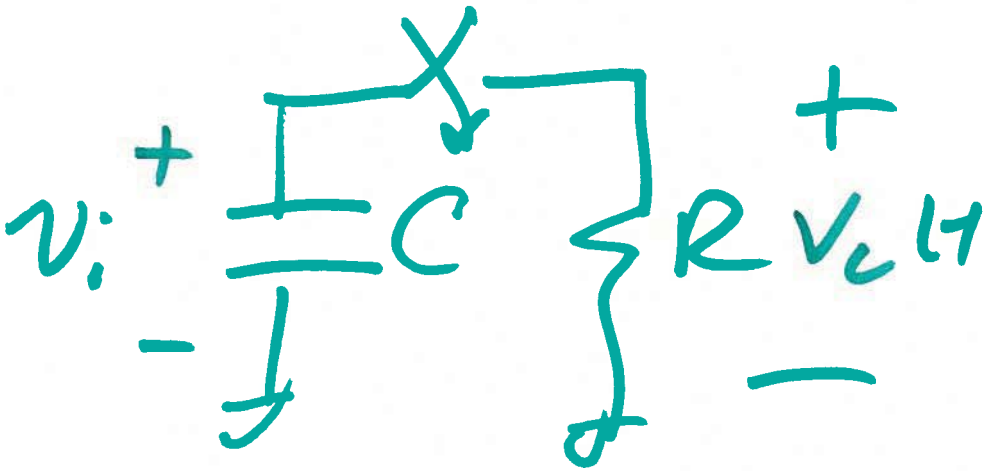
$$\rightarrow V_f(t) = V_{init}\, e^{-t/RC}$$

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

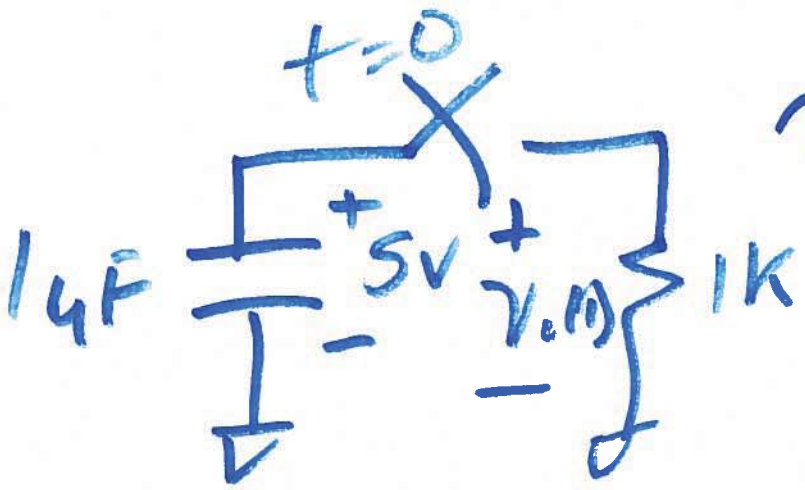
$$-\frac{t}{RC} = \ln V_f(t) - \ln V_{init}$$

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

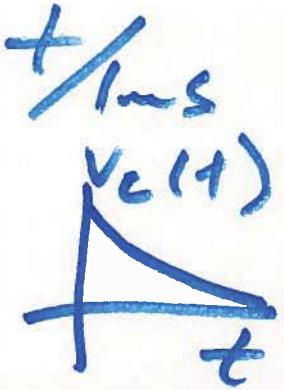
$$V_c(t) = v_f + (v_i - v_f)e^{-t/RC}$$



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



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



$$10^{-6}\,10^{3} = 10^{-3} = 1\text{ milli}$$

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

$\tau = RC$ (time constant)