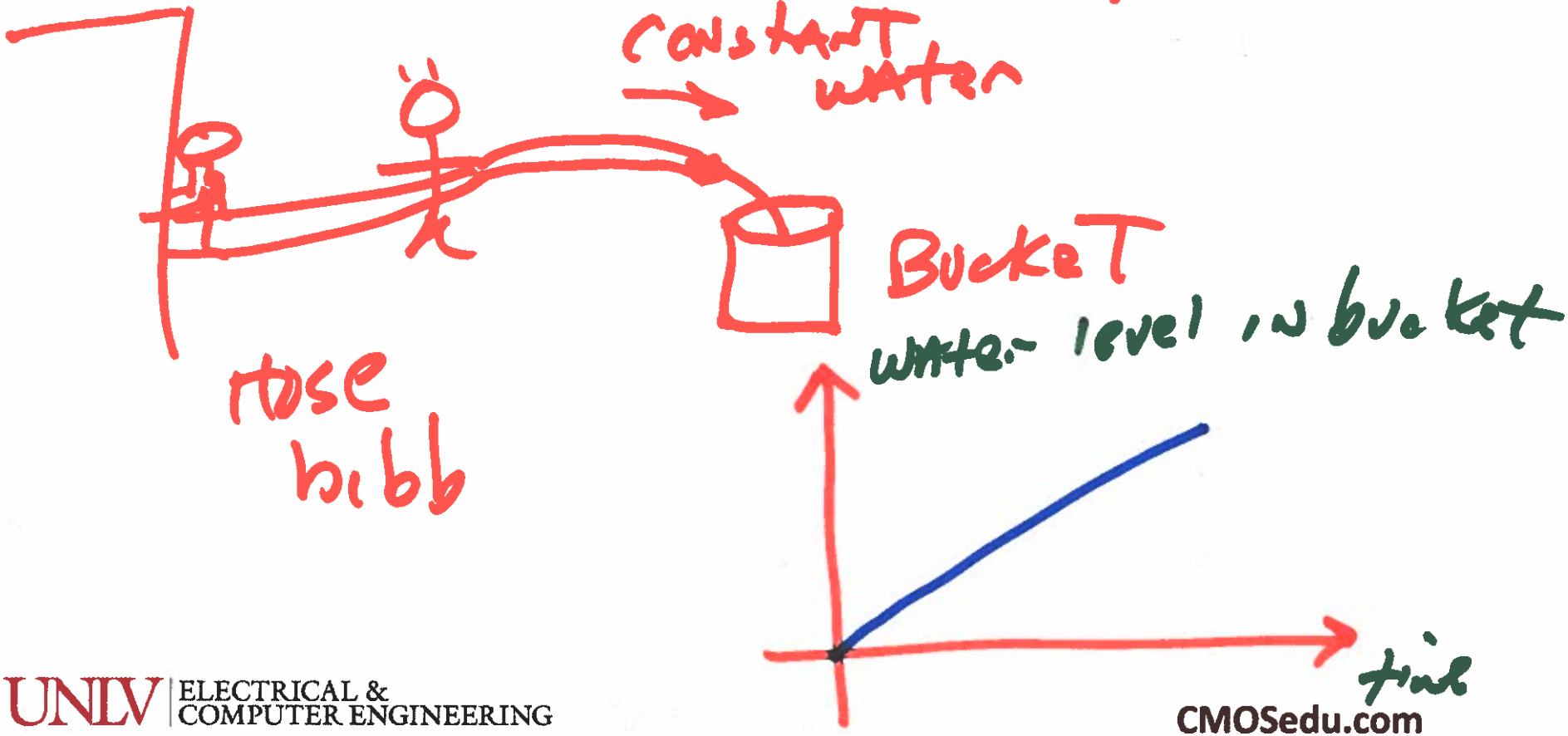
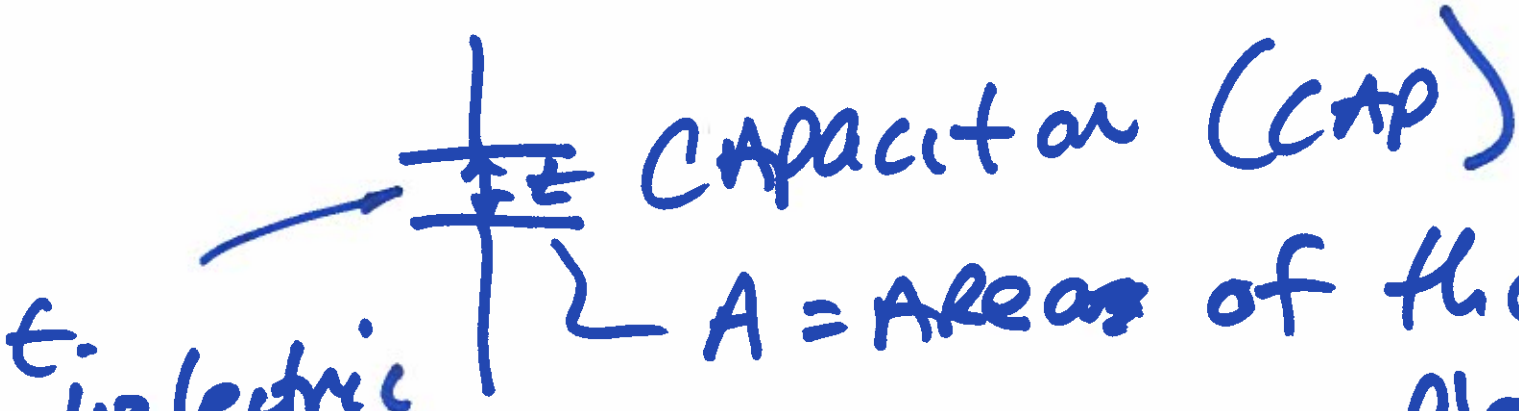
EE 220 Circuits 1

Lecture 14

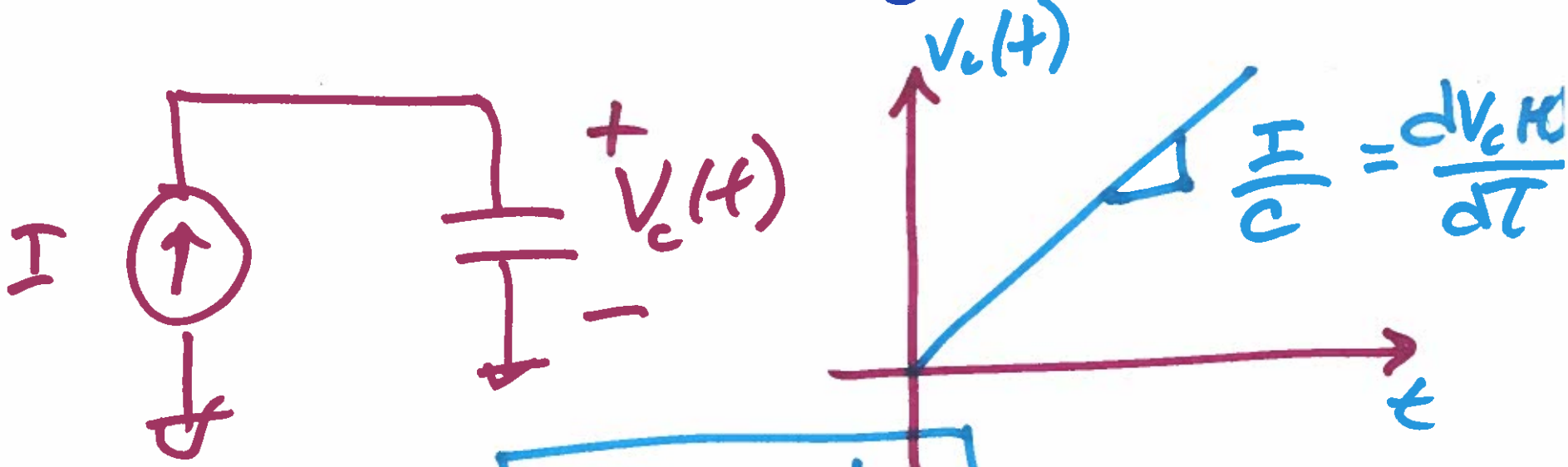
OCT. 16, 2019

Capacitors





$$C = \frac{\epsilon \cdot A}{t} \quad \text{(FARADS)}$$



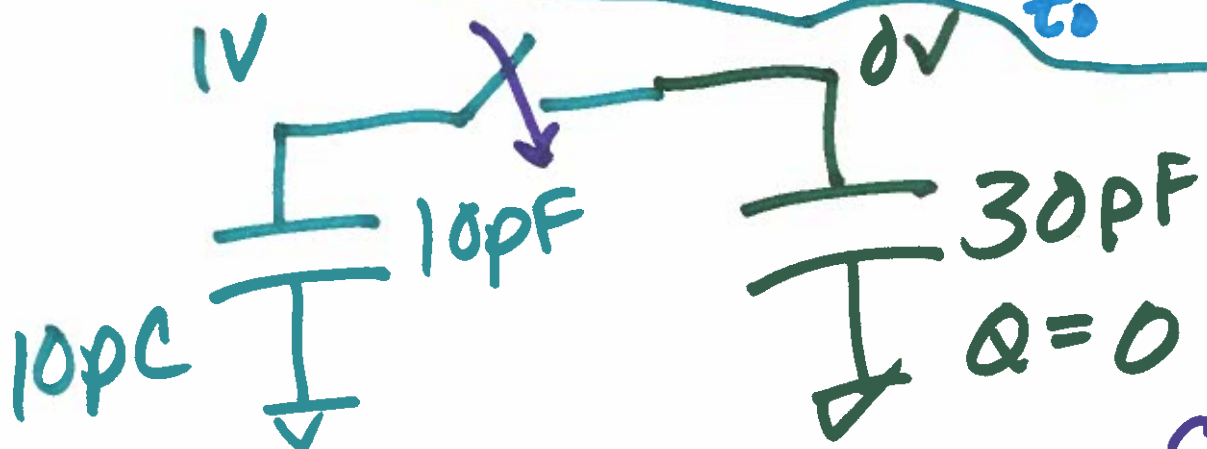
$$I = C\frac{dV_c}{dt}$$

Capacitance = Charge · Voltage

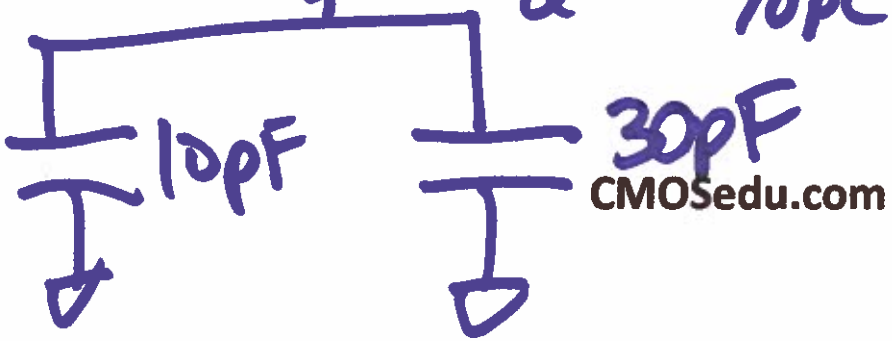
Coulombs

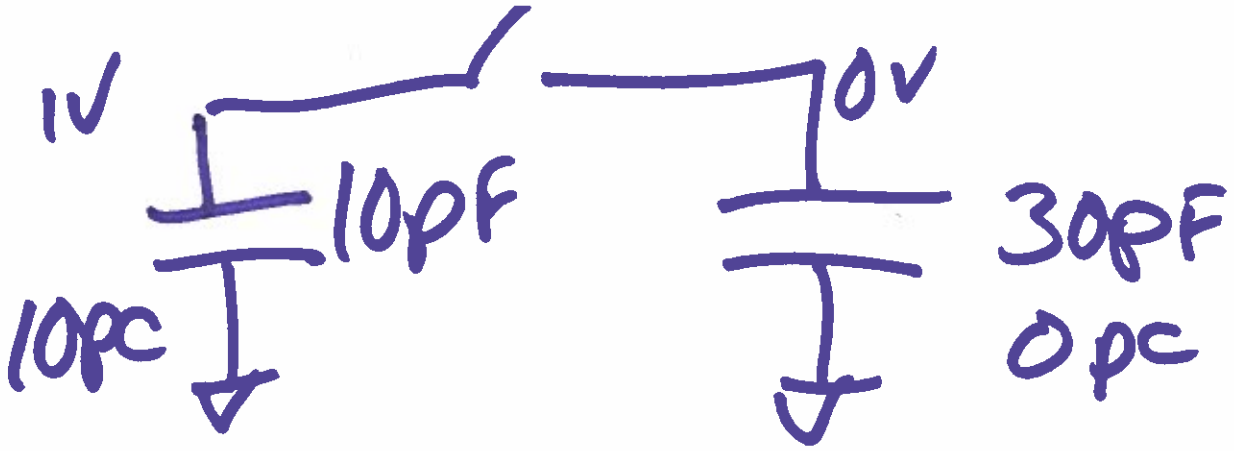
$$C = Q \cdot V$$

$$V_c(t) = \frac{1}{C}\int_{t_0}^{t} i(t)\cdot dt + V_c(t_0)$$

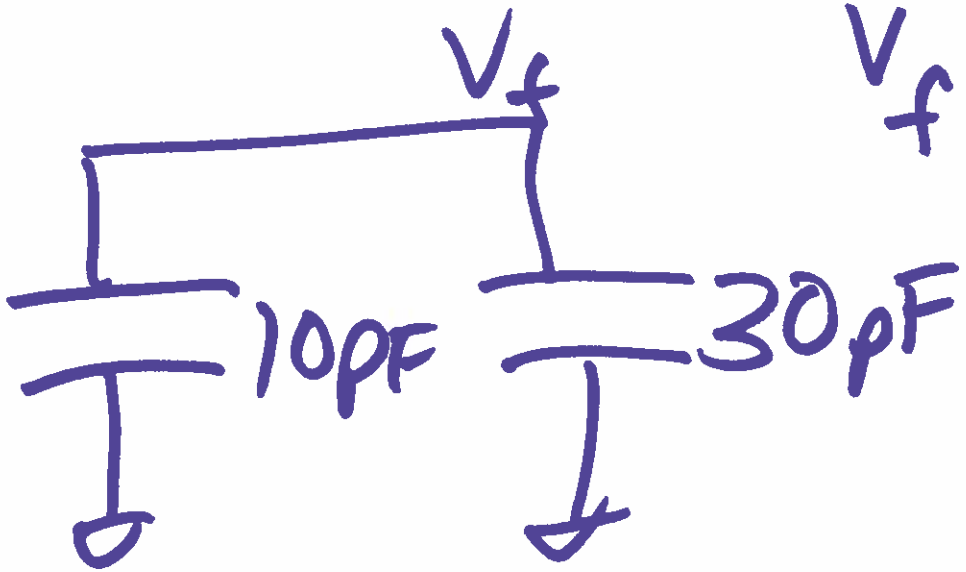


$$V_f = \frac{C}{Q} = \frac{40pF}{10pC} = 4$$



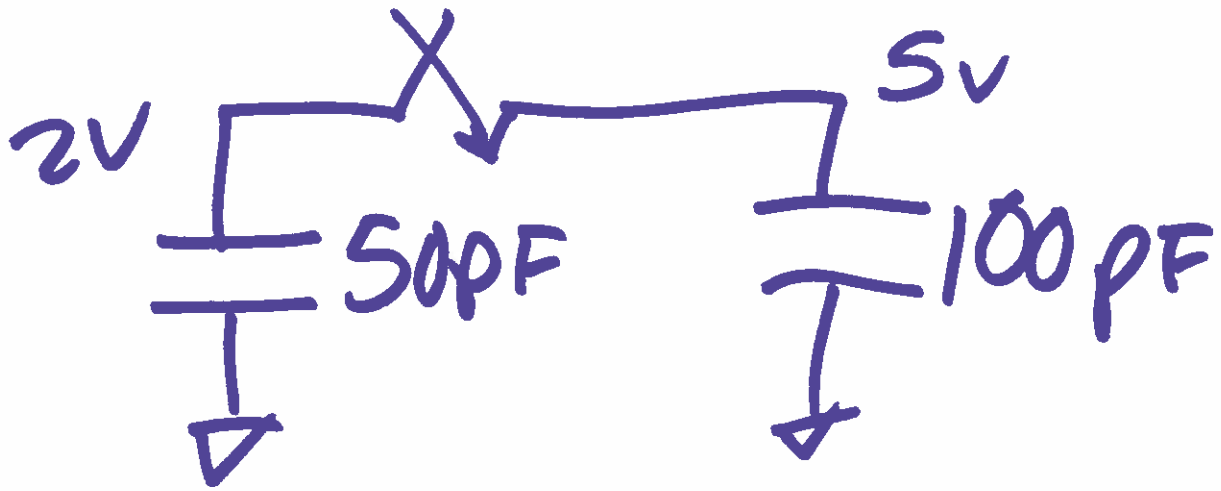


$$Q_{before} = 10pC + 0pC = 10pC$$



$$V_f \cdot 40pF = 10pC$$

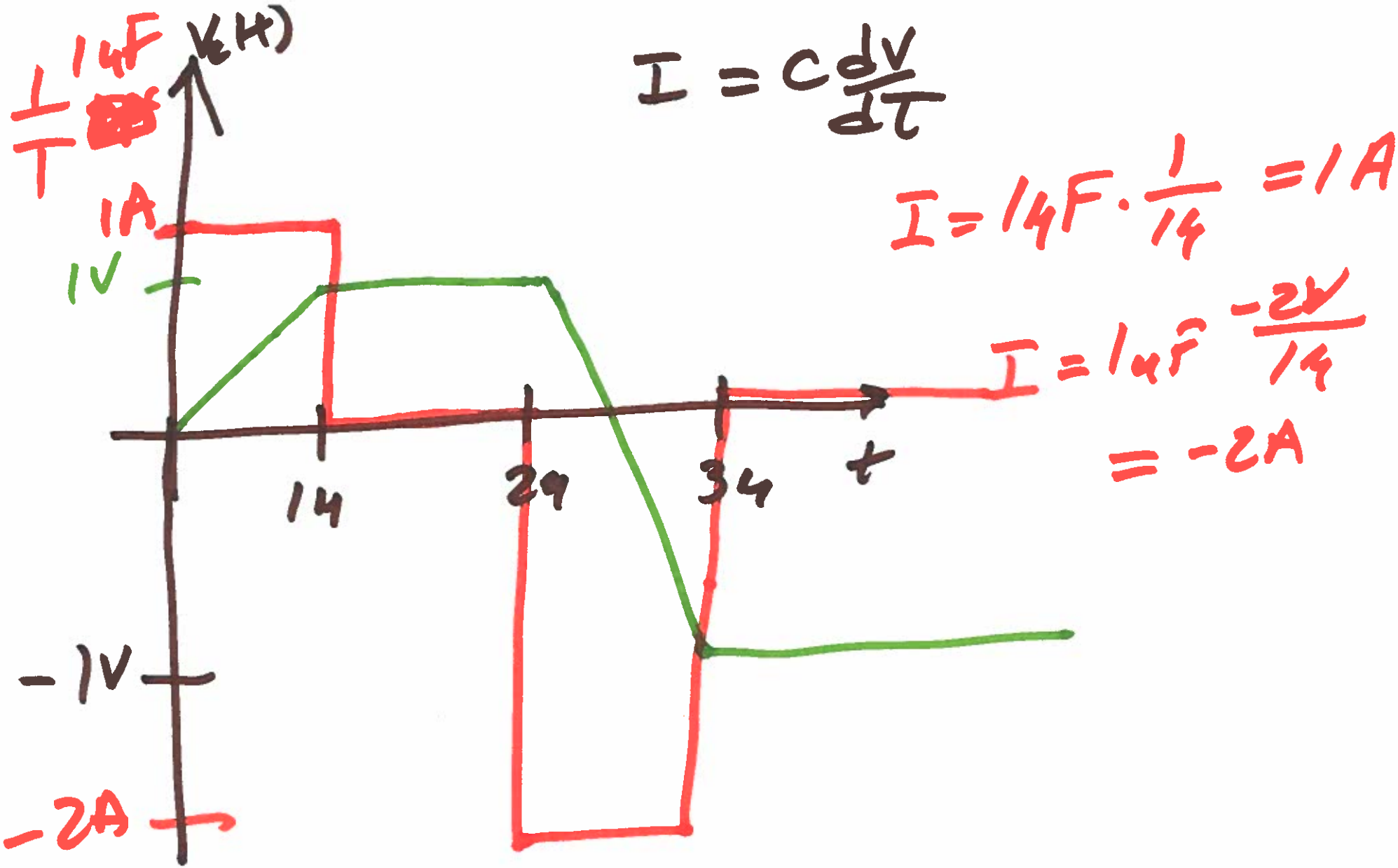
$$V_f = 0.25V$$

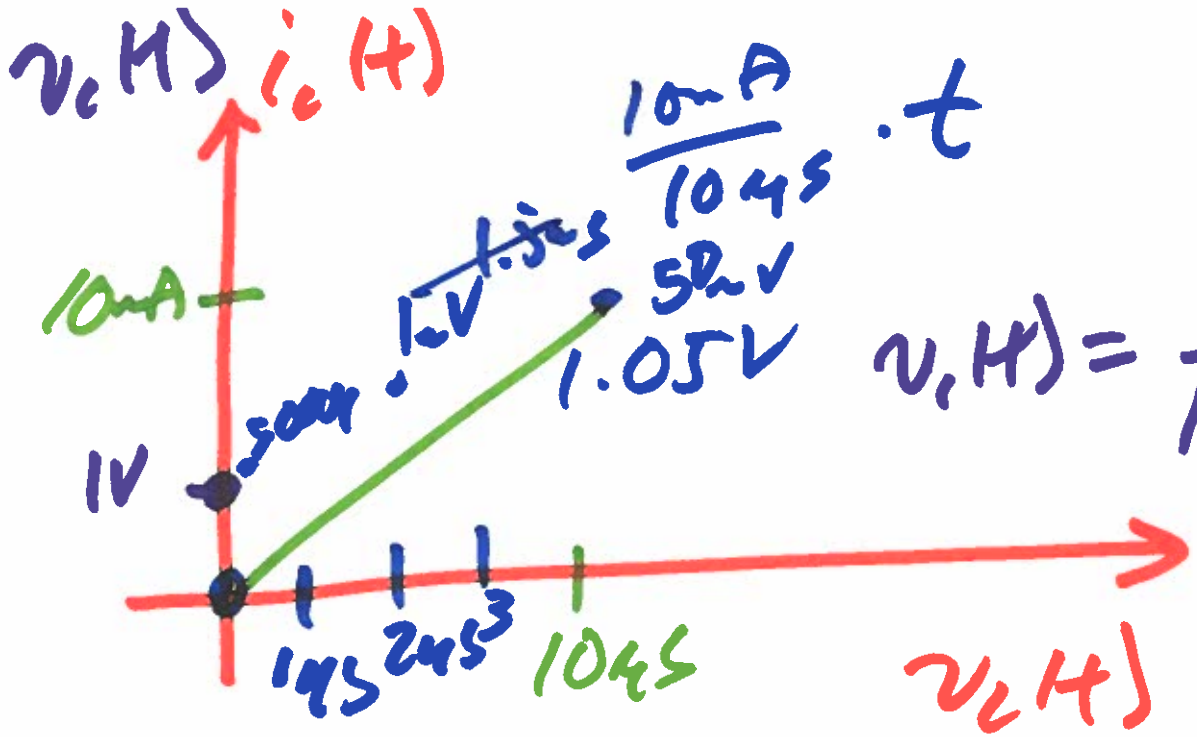


$p = 10^{-12}$
$n = 10^{-9}$
$f = 10^{-15}$
$\mu = 10^{-6}$

$$\underbrace{2 \cdot 50pF + 5 \cdot 100pF}_{\text{Before}} = \underbrace{V_f (150pF)}_{\text{Charge after}}$$

$$V_f = \frac{600}{150} = \boxed{4V = V_f}$$


1/T 1F
I(A)
1A
1V
-1V
-2A
14
29
34
t
I = C dV/dt
I = 1F · 1/1 = 1A
I = 1F -2V/1
= -2A



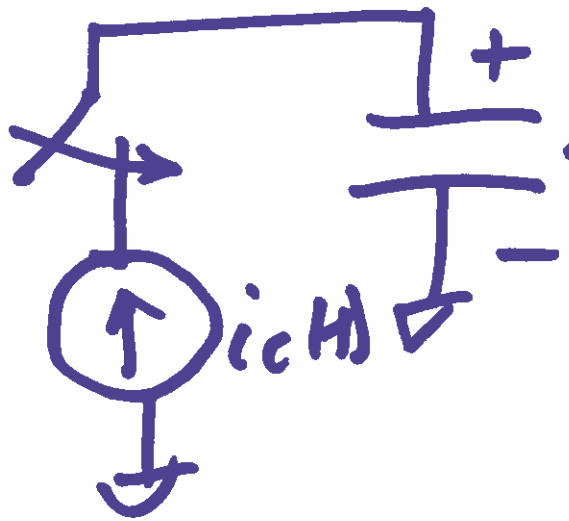
$$\frac{10\text{mA}}{10\mu\text{s}} \cdot t \qquad 1\mu\text{F}$$

$$v_c(t) = \frac{1}{1\mu\text{F}} \int_0^{10\mu\text{s}} 10\text{mA}\, t\, dt + 1\text{V}$$

$$\frac{10^3 t^2}{2}$$

$$v_c(t) = \frac{10\text{mA}}{2 \cdot 10^{-6}} \cdot t^2 \Big|_0^{10\mu\text{s}} + 1$$

$500 \cdot t^2$



initially charged to 1V

$$i_c(t) = \frac{10\,mA}{10\,\mu s} \cdot t = \frac{10^{-2}}{10^{-5}} \cdot t = 10^3 t$$

$$v_c(t) = \frac{1}{1\,\mu F} \int_0^{10\,\mu s} 10^3 \cdot t \cdot dt + 1$$

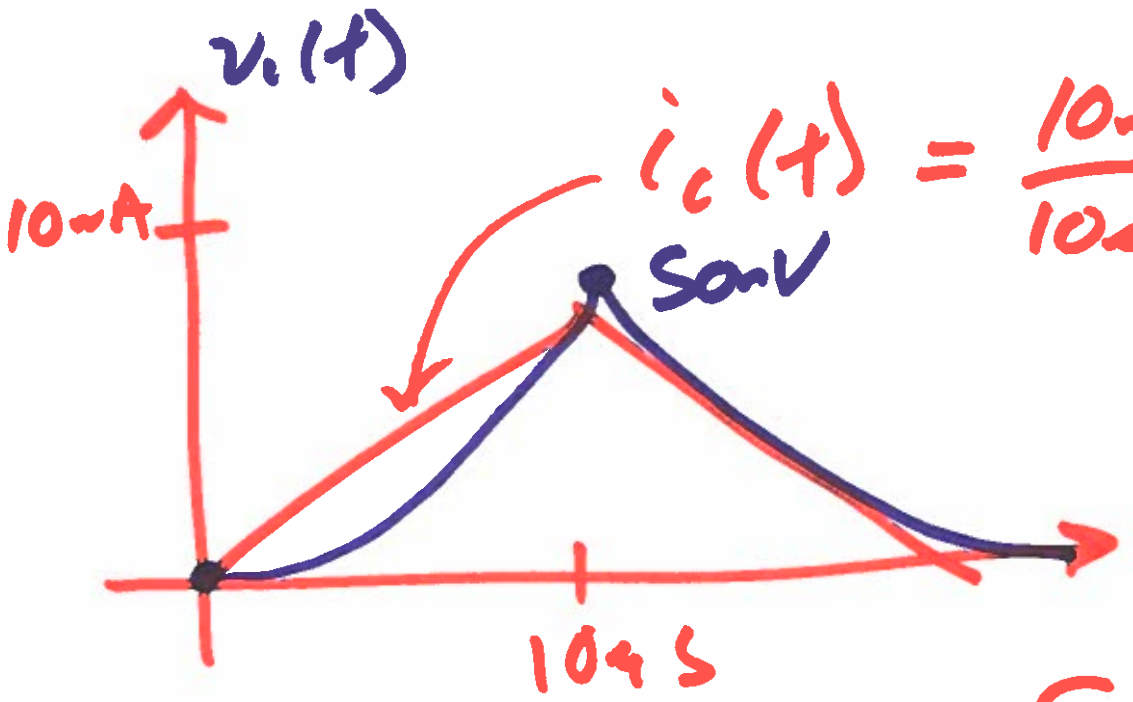
$$= 10^6 \cdot 10^3 \cdot \frac{1}{2} t^2 + 1$$

$$v_c(t) = \frac{10^9}{2} \cdot t^2 + 1$$

$t = 10\,\mu s$ $= \dfrac{10^9 \cdot 10^{-12}}{2} + 1$

$t = 10\,\mu s$ $= \dfrac{10^9 \cdot 10^{-2} \cdot 100}{2} + 1$ $50\,mV$

$50\,mV$



$$i_c(t) = \frac{10\text{mA}}{10\mu s} \cdot t$$

$$v_c(t) = \frac{1}{1\mu F} \cdot \int_0^t \frac{10\text{mA}}{10\mu s} \cdot t \cdot dt$$

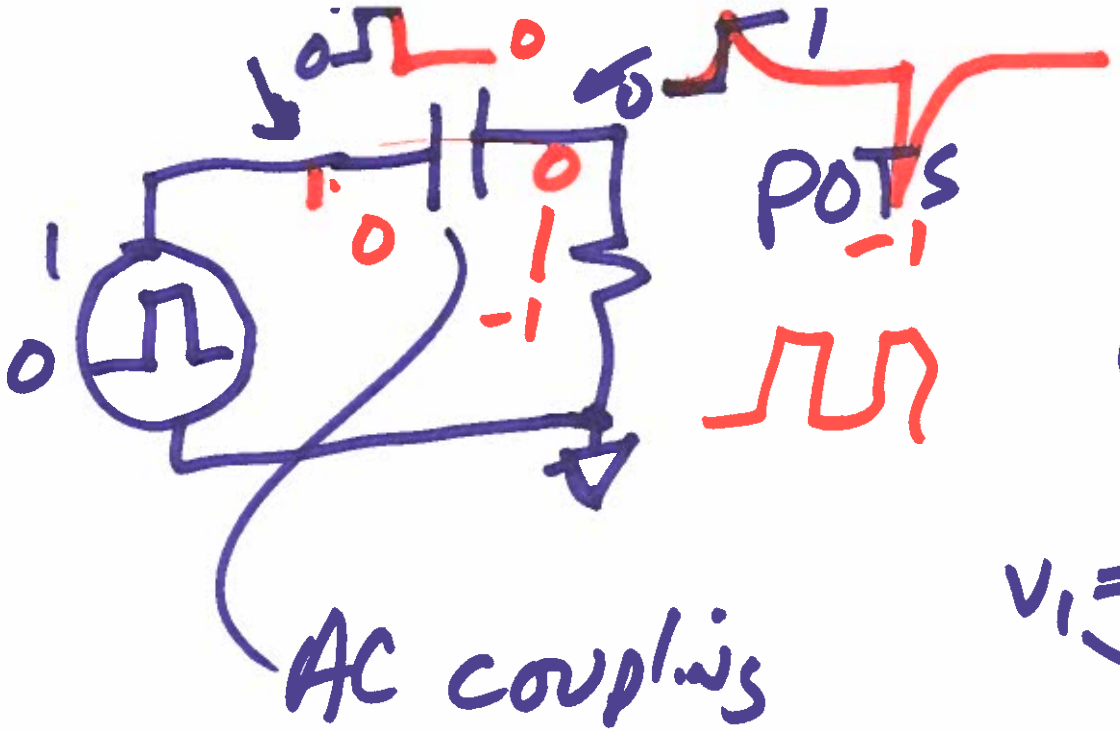
$$\frac{10^{-1}}{2} = \frac{0.1}{2} = 50\text{mV} = \frac{10 \cdot 10^{-3}}{10^{-5} \cdot 10 \cdot 10^{-6}} \cdot \frac{1}{2} t^2$$

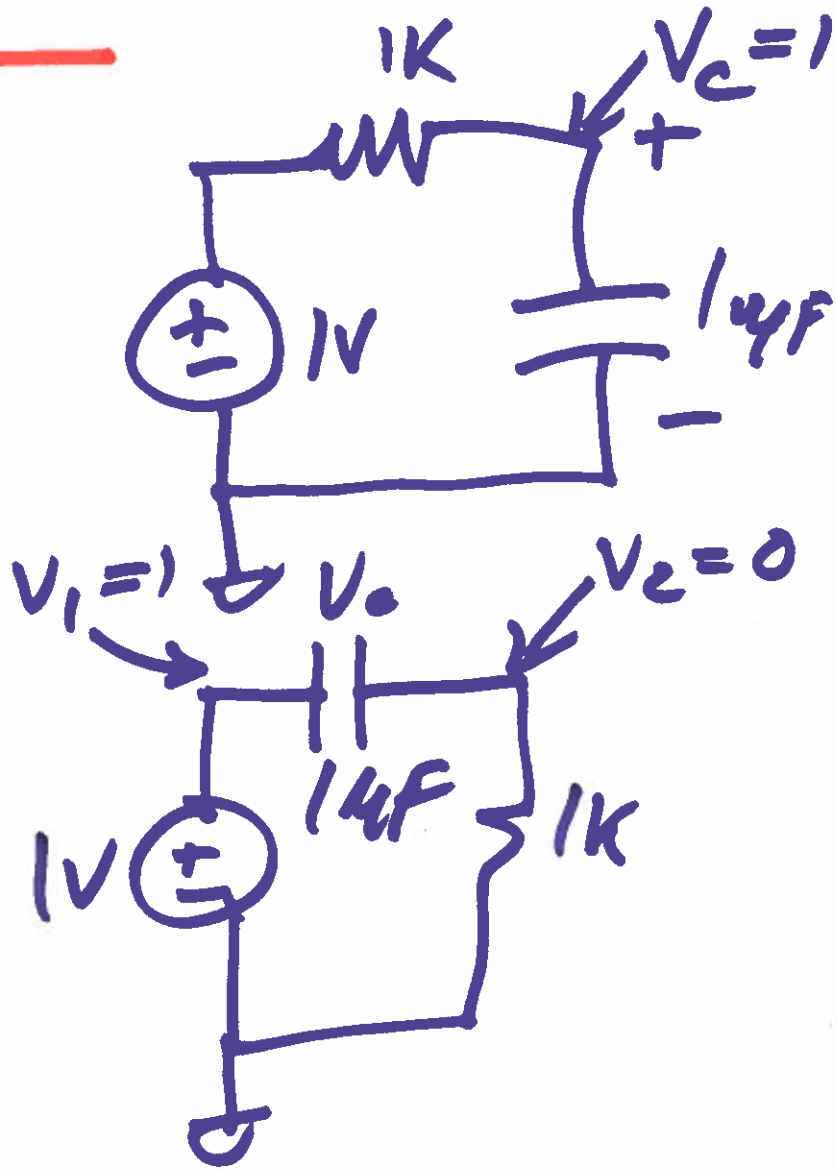
$$= \frac{10^9}{2} t^2$$

$t = 10\mu s$

$10^9 \cdot 10^{-1} \cdot 10^{-1} \cdot 10^{-1}$

2


1
0
1
0
1
0
1
0
-1
POTS
-1
AC coupling


1K
$V_c=1$
+
1V
1μF
−
$V_1=1$
V_o
$V_c=0$
1V
1μF
1K