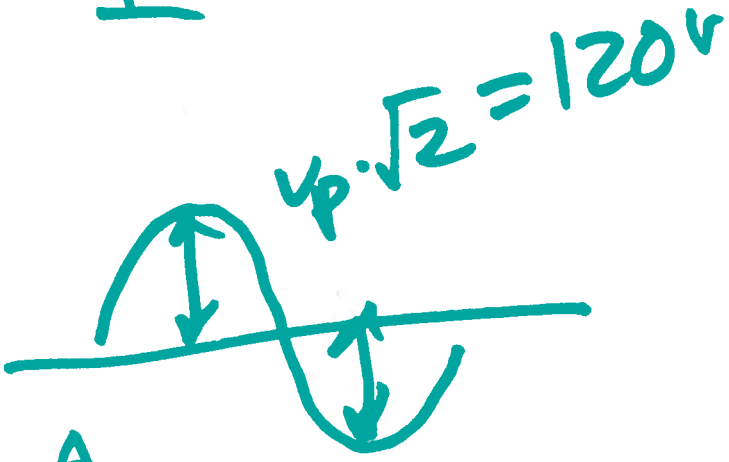
EE 220

Circuits I

Lecture 19



~ 5mA

$\frac{120V}{20X} = 6mA$

ideal capacitors & inductors don't dissipate power they store energy

$$\frac{1}{T}C$$

$$CV = Q$$

$$V = \frac{1}{C}\int i \cdot dt$$

$$p(t) = i(t) \cdot v(t)$$

$$i = C \cdot \frac{dv}{dt}$$

$$p(t) = v(t) \cdot C \cdot \frac{dv(t)}{dt}$$

$$\mathcal{E} = \int p(t) \cdot dt = C \int_0^V v(t)\, dv(t)$$

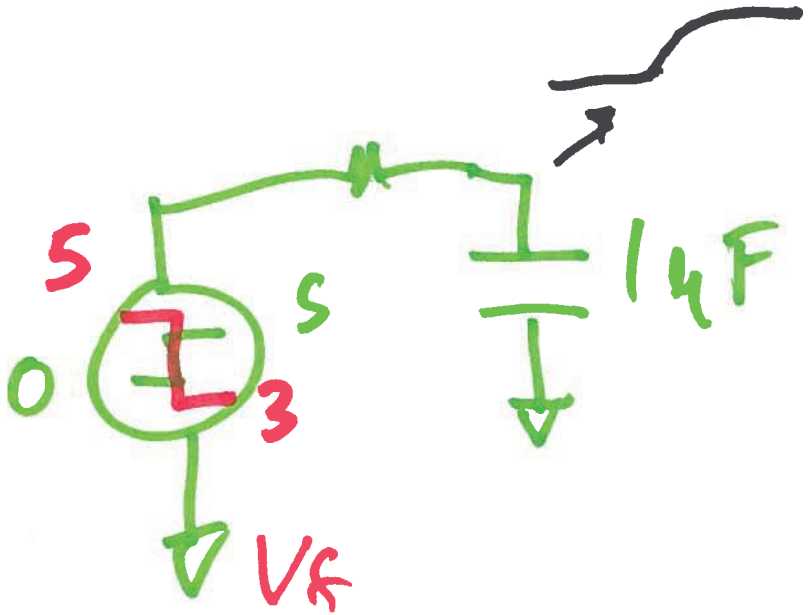
$$\text{Energy} = C \cdot \frac{1}{2}(V-0)^2$$

$$\mathcal{E} = \frac{1}{2}CV^2$$

$$\begin{cases} P = V \cdot I \\ = \frac{V^2}{R} \\ = I^2 \cdot R \end{cases}$$

$$\text{Power} = \text{Watts} = \frac{J}{s}$$

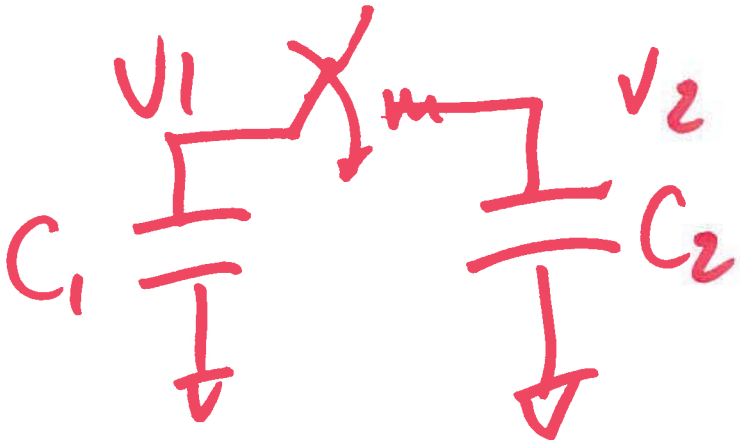
ENERGY = Joules



Calculate Energy stored in C

$$\mathcal{E} = \frac{1}{2} 1\mu F \cdot 5^2$$

$$= 12.5\,\mu J$$



$$\mathcal{E}_\downarrow = \frac{1}{2} 1\mu F \cdot 2^2$$

$$= 2\,\mu J$$

$$C_1 V_1 + V_2 C_2 = V_f (C_1 + C_2)$$

$$P \propto C_L V_{DD}^2 \cdot f$$

$$i(t) = \frac{1}{L}\int v(t)\,dt$$

$$p(t) = i(t)\cdot v(t)$$

$$v(t) = L\cdot\frac{di(t)}{dt}$$

$$p(t) = L\cdot i(t)\cdot\frac{di(t)}{dt}$$

$$\mathcal{E} = \int p(t)\cdot dt = L\cdot\int_0^I i(t)\cdot dt = \boxed{\frac{1}{2}LI^2 = \mathcal{E}}$$

$\mathcal{E}$ ← energy

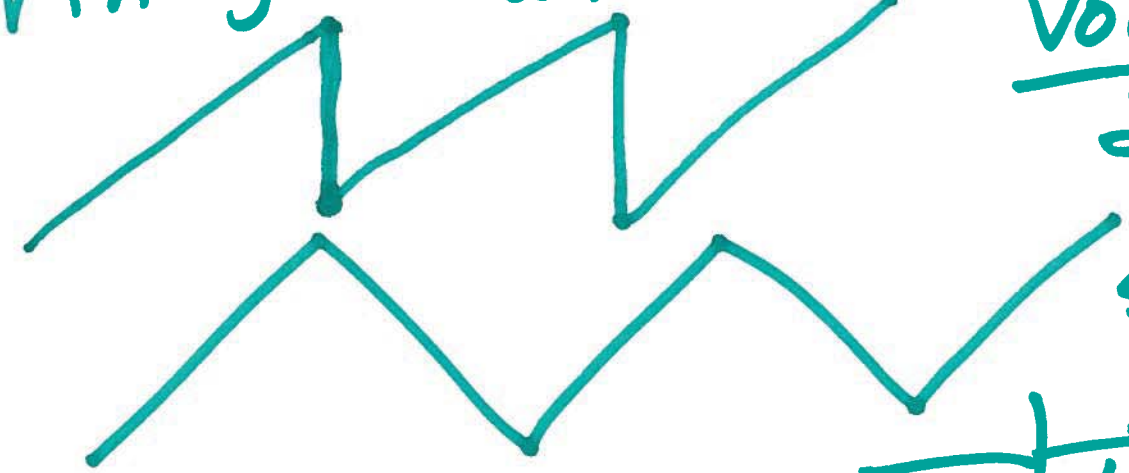
10A | 10μH

$$\mathcal{E} = \frac{1}{2} 10\mu (10mA)^2$$

$$= \frac{1}{2} \cdot 10^{1} \cdot 10^{-6} \cdot 10^{2} \cdot 10^{-6}$$

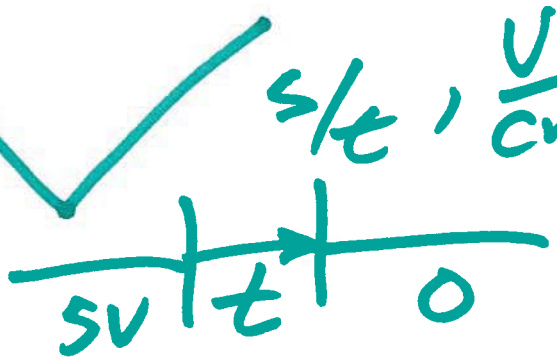
$$= \frac{1}{2} nJ = \frac{1}{2} \cdot 10^{-9} J$$

tr. Angle wave



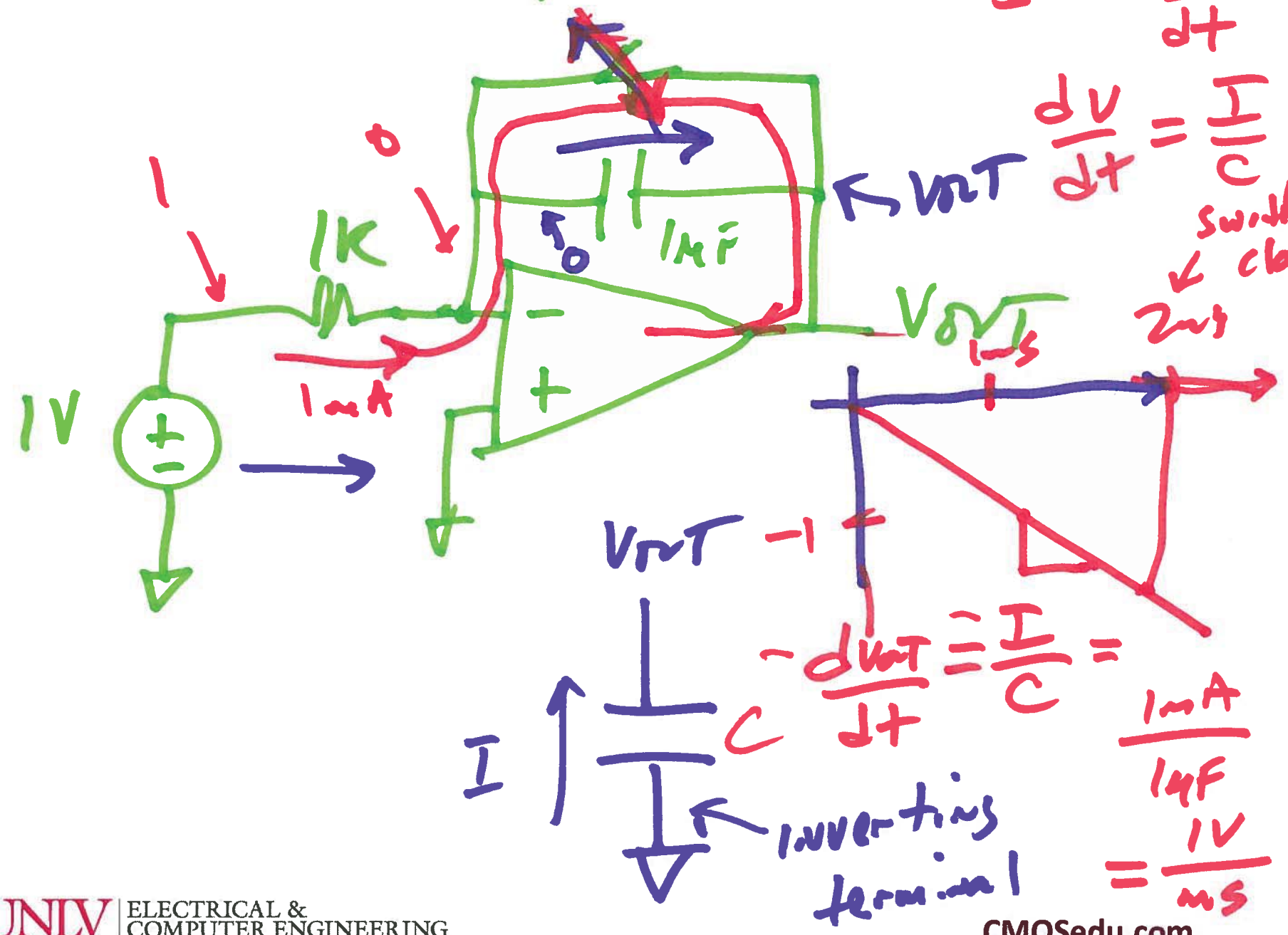
$$\frac{\text{Volts}}{\text{distance}} = \text{Electric field}$$

$$V = \int \mathcal{E} \cdot d\ell$$



V/t, V/cm

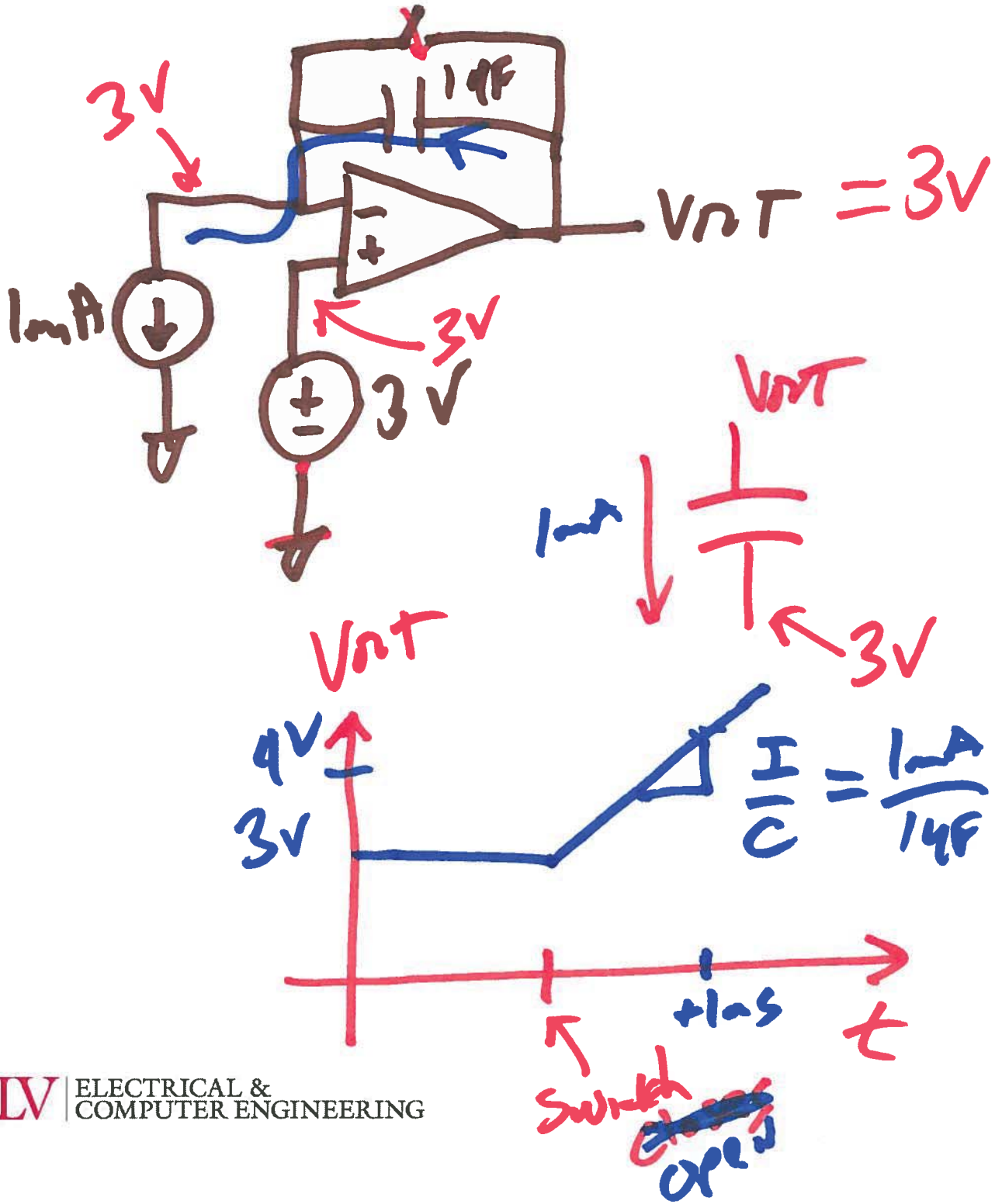
Integrators



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

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

$$-\frac{dV_{OUT}}{dt} = \frac{I}{C} = \frac{1mA}{1\mu F} = \frac{1V}{ms}$$


X
1pF
3V
VOUT = 3V
1mA
3V
3V
VOUT
1mA
3V
VOUT
4V
3V
I/C = 1mA/1pF = 1V/ns
+1ns
t
Switch
OPEN