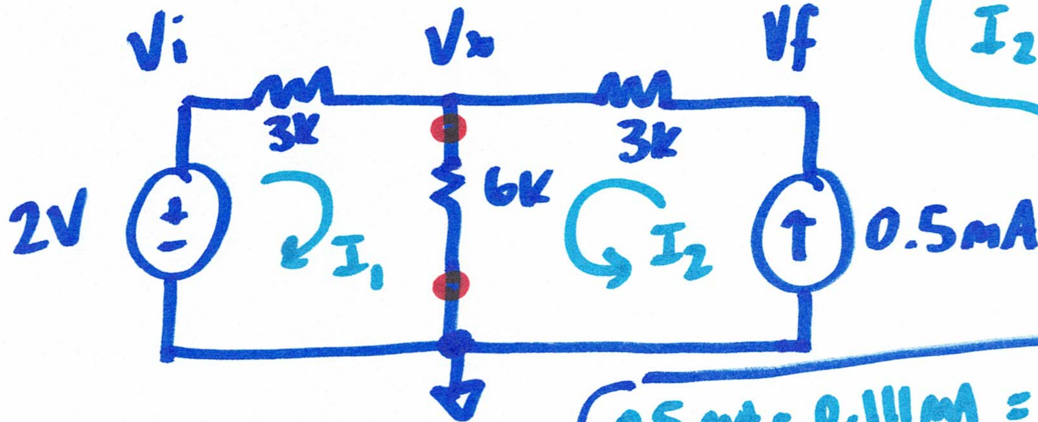
EE 220: Circuits I [Exam Review 1]

- Thevenin & Norton examples ✓
- mesh analysis / superposition ✓
- AC steady state analysis (phasor problems)
- Dependent sources ✓
- charge sharing ✓
- caps (DC open) & inductors (DC short) ✓
- AC signals (sinusoids)
- power dissipation ✓

UNLV | HOWARD R. HUGHES COLLEGE OF ENGINEERING

QB



I_1: $2V - I_1 \cdot 3K - (I_1 + 0.5mA) \cdot 6K = 0$

$I_2 = 0.5mA$

$2V - I_1 \cdot 9K - 3V = 0$

$-1V = +I_1 \cdot 9K$

$I_1 = \frac{1V}{9K} = -0.111mA$

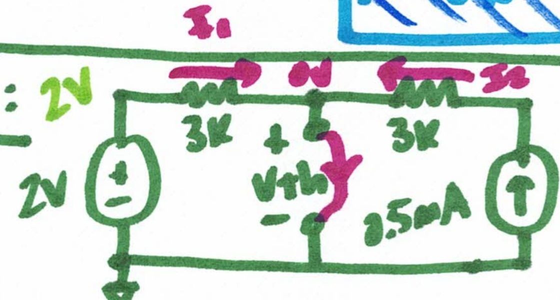
$0.5mA - 0.111mA = 0.389mA$

$Vx = (I_1 + I_2) \cdot 6K =$ ~~0.111mA~~ $\cdot 6K$

~~∴ Vx = 3.0? V~~ ✓ wrong!! use spice!!

$Vx = 2.33V$

Finding Vth: 2V



$-1.5V +$

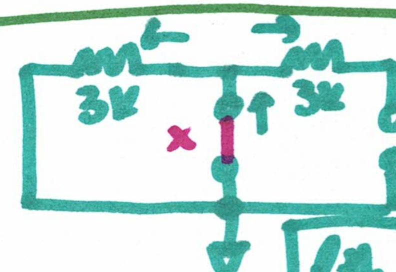
2V —3K— Vth

← 0.5mA

$Vth = 3.5V$

$I_1 + I_2 = I_{sc} = I_N$

Finding Rth:



$Rth = 3K$

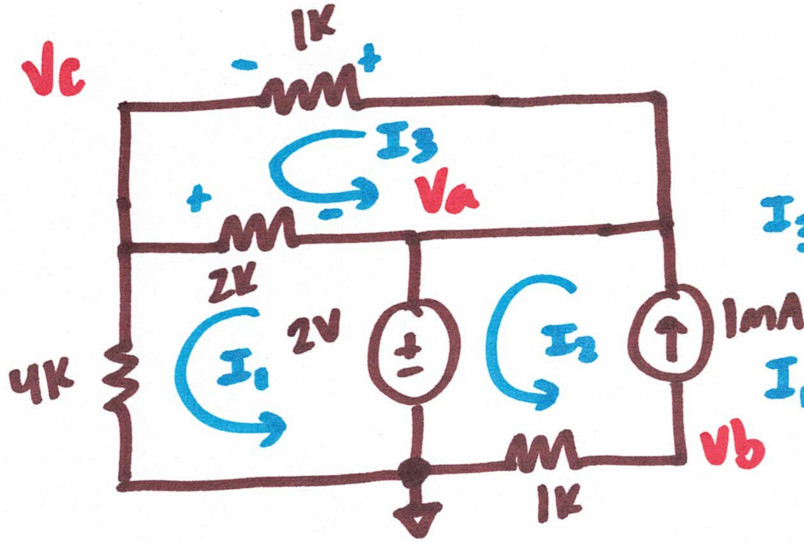
Finding IN:

$$I_N = \frac{Vth}{Rth} = \frac{3.5V}{3K} = 1.166mA = I_N$$

UNLV | HOWARD R. HUGHES COLLEGE OF ENGINEERING

MT_P3

$V_{c1} + V_{c2} = V_c$



$$I_2 = 1mA$$

$I_3: \; -I_3 \cdot 1K - (I_3 - I_1) \cdot 2K = 0$

$I_1: \; 2V - (I_1 - I_3) \cdot 2K - I_1 \cdot 4K = 0$

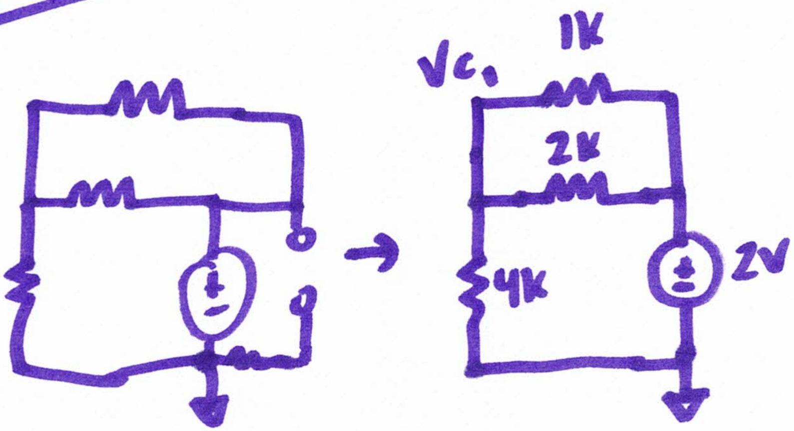
⋮

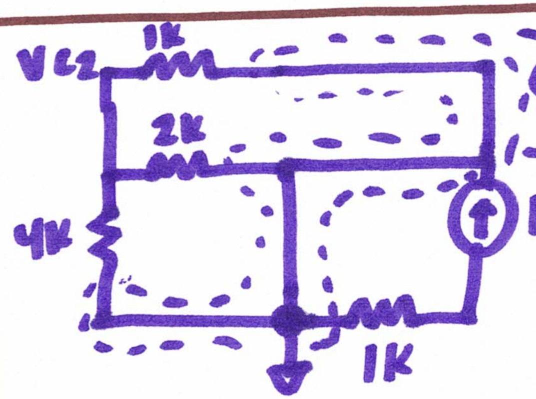
$I_1 = \text{something} \cdot I_3$

Mesh

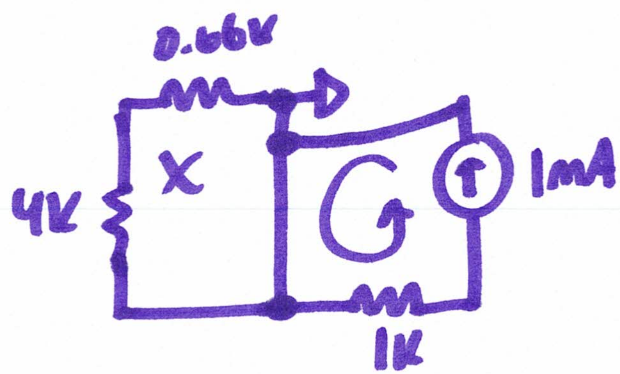
Superposition

$2V\left(\frac{4K}{0.66K + 4K}\right) = V_{c1}$

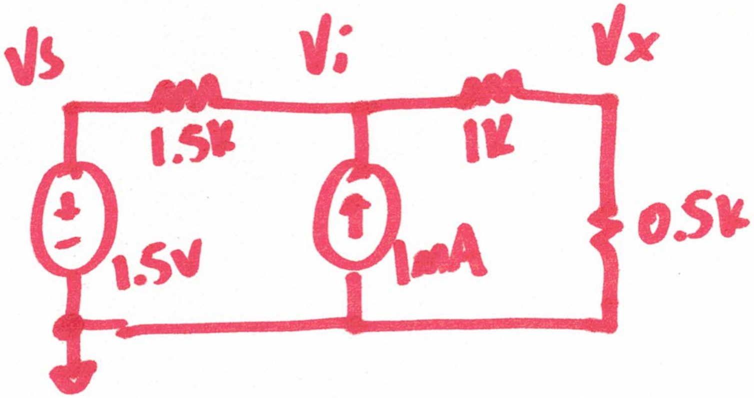




→ 0.66K



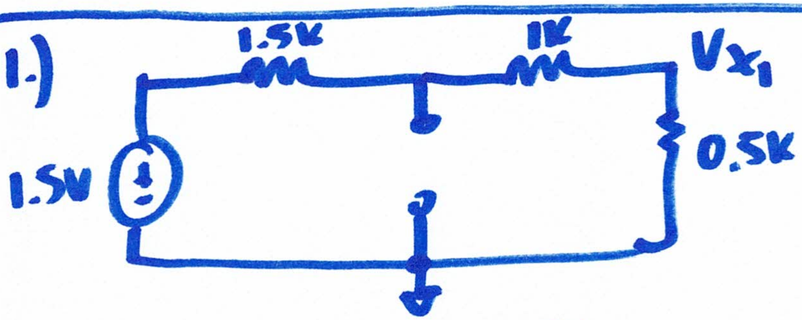
Baker F17 MT P.2



$V_x = V_{x_1} + V_{x_2}$

$V_x = \underline{0.25} + \underline{0.25} = 0.5V$

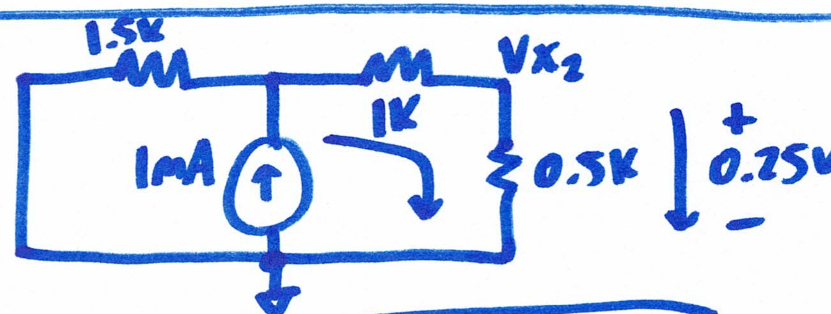
1.)



$V_{x_1} = 1.5V\left(\frac{0.5K}{2.5K + 0.5K}\right) = 1.5V\left(\frac{1}{6}\right)$

$V_{x_1} = 0.25V$

2.)



$V_{x_2} = 0.25V$

$V_x = 0.25 + 0.25 = 0.5V$

Dependent Sources

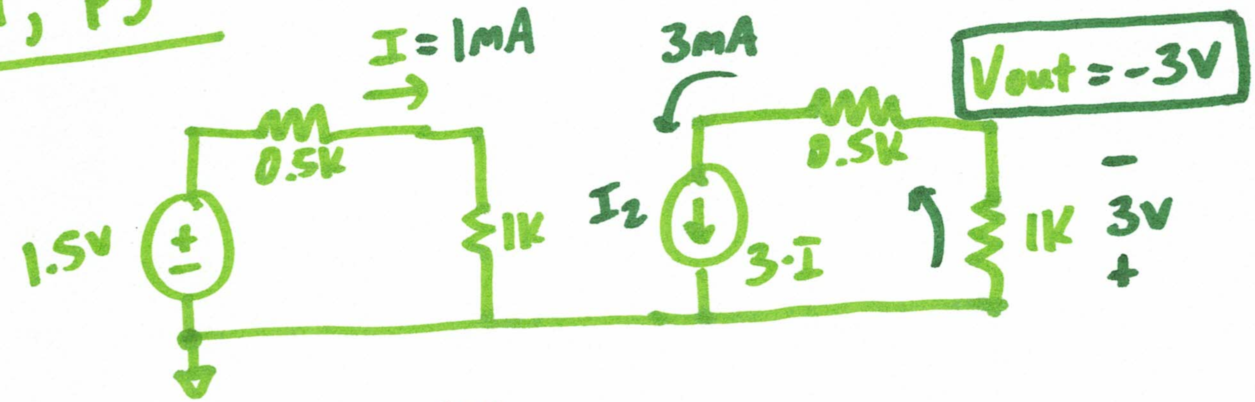
CCVS → current controlled voltage source

CCCS → current controlled current source

VCVS → voltage controlled voltage source

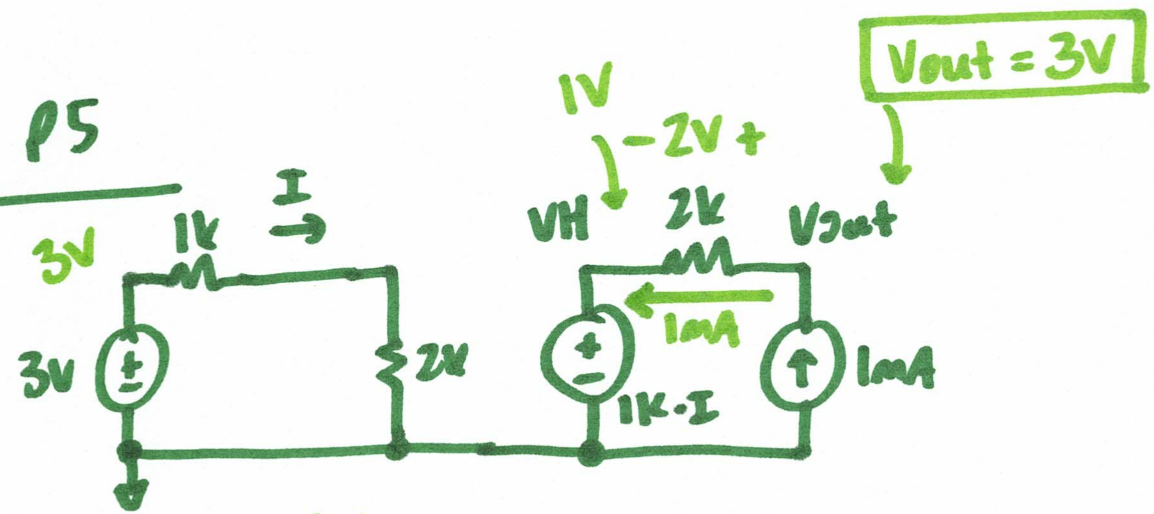
VCCS → voltage controlled current source

Baker F17 MT, P5



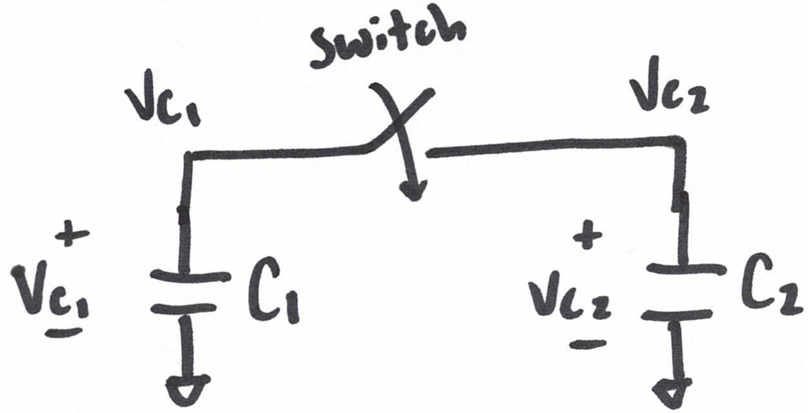
$$I = \frac{1.5V}{1.5K} = 1mA$$

Baker F16 MT, P5



$$I = \frac{3V}{3K} = 1mA$$

~~Yellow~~ Charge sharing



$$C_{new} = C_1 + C_2$$

$$\boxed{V_{new} = \frac{Q_{TOT}}{C_1 + C_2}}$$

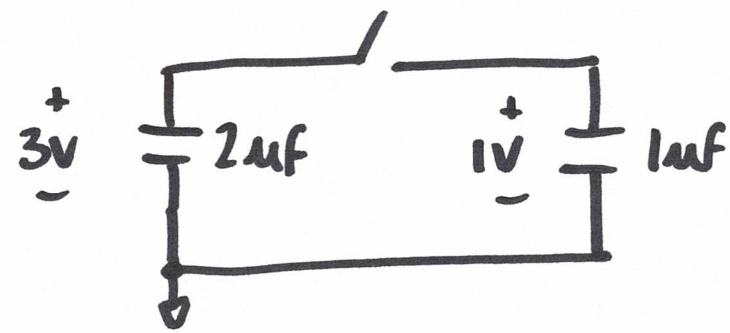
$Q_1 = C_1 \cdot V_{C_1}$

$Q_2 = C_2 \cdot V_{C_2}$

$C \cdot V = Q$

$V = \frac{Q}{C}$

$Q_{TOT} = Q_1 + Q_2$



$\boxed{Q_{TOT} = 7\mu C}$

$\boxed{C_F = 3\mu F}$

$Q_1 = 3V \cdot 2\mu f = 6\mu C$

$Q_2 = 1V \cdot 1\mu f = 1\mu C$

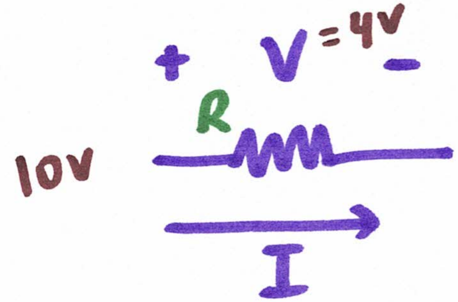
$C_F \cdot V_F = Q_{TOT} \rightarrow V_F = \frac{Q_{TOT}}{C_F} = \frac{7\mu C}{3\mu F}$

$$\boxed{V_F = 2.33\,V}$$

UNLV | HOWARD R. HUGHES COLLEGE OF ENGINEERING

power dissipation

$V \cdot \frac{V}{R} = \frac{V^2}{R} = P$



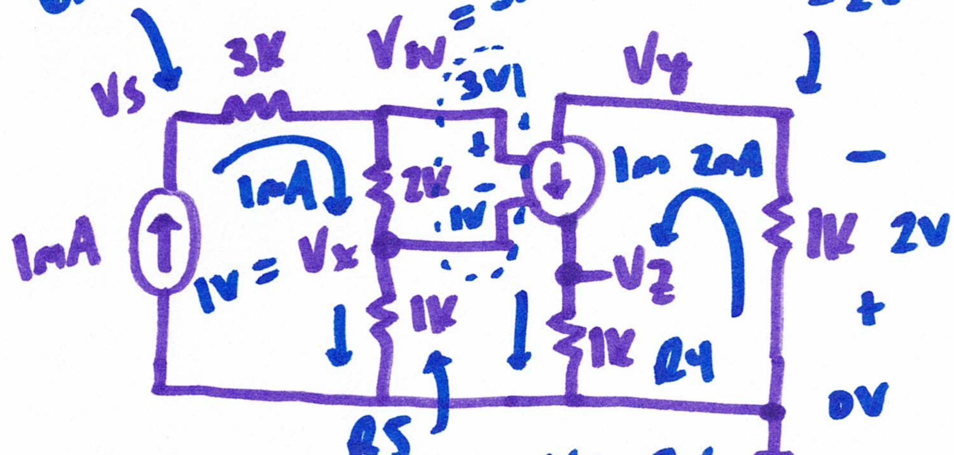
$P_{diss} = V \cdot I$ (Watts)

$V = I \cdot R$

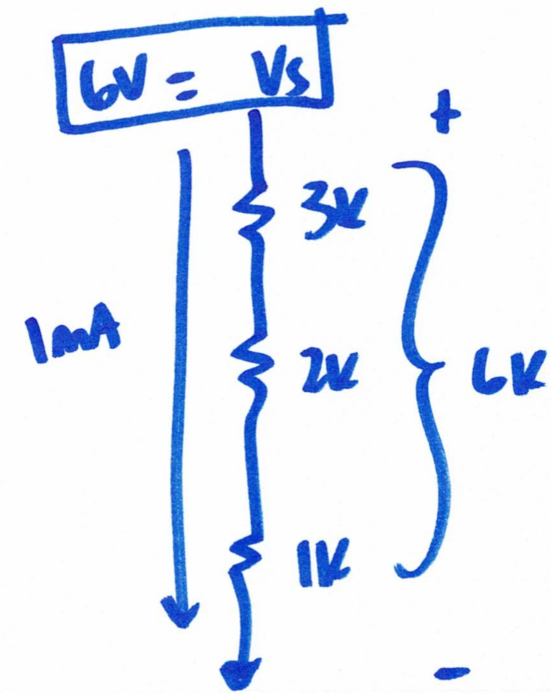
MT P.6

$6K \cdot 1mA = 6V$

$V_W = 3K \cdot 1mA = 3V$



$V_Z = 2V$



$P(R5) = 1V \cdot 1mA = 1mW$

$V(R_4) = V_Z = 2V$

$I(R_4) = 2mA$

$2V \cdot 2mA = 4mW$

X

Caps & inductors in DC

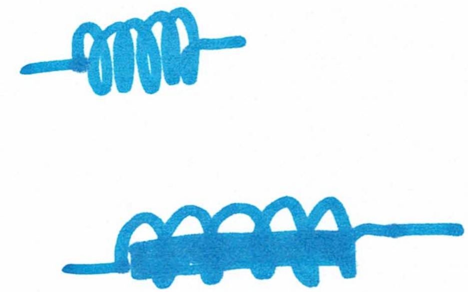
LC oscillations

$$\omega = \frac{1}{\sqrt{LC}}$$

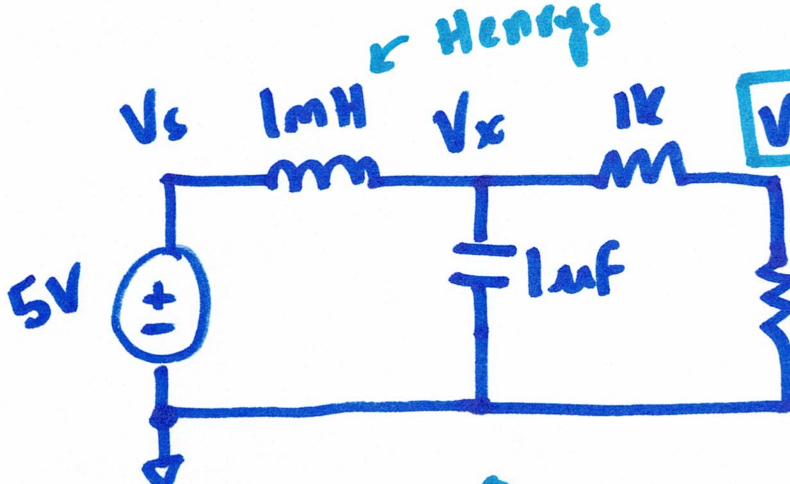
$$\boxed{\frac{1}{2\pi\sqrt{LC}} = f}$$


in DC = open

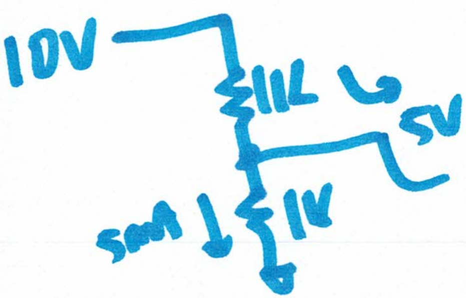

in DC = short

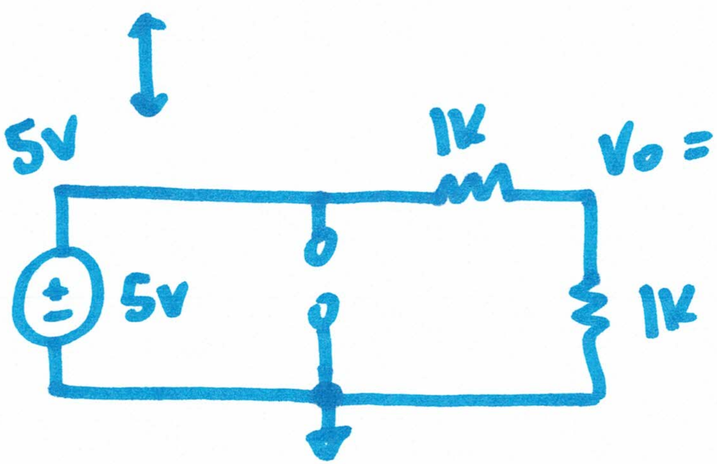


$$V_L = L \cdot \frac{dI}{dt}$$



$\boxed{V_o = 2.5V}$



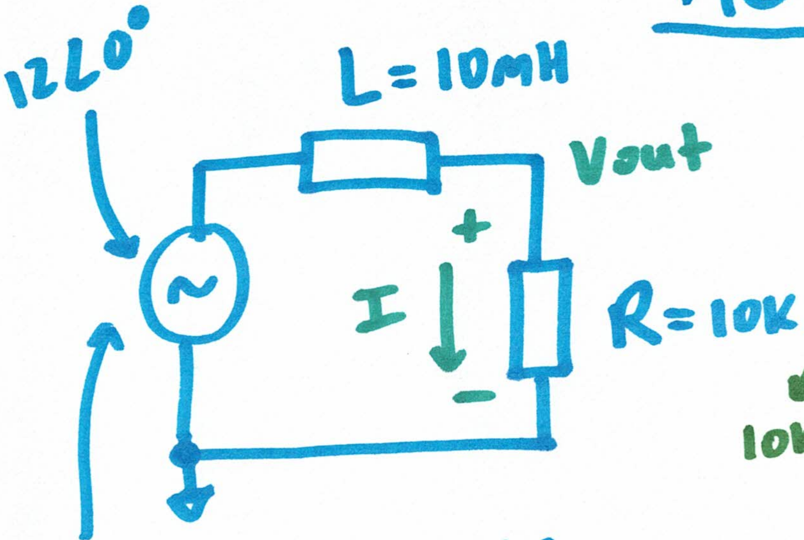


$$I_C = C \cdot \frac{dv}{dt}$$

t

AC Steady State

$Z = x + jy$ (imag.)



$10K + j\omega L$

$12\cos(2\pi f t) = V_{in}(t)$

$f = 200\,KHz$

$|Z_R| = \sqrt{x^2 + 0} = x$

$\phi = \tan^{-1}\left(\frac{0}{x}\right) = 0°$

$Z_R = R\angle 0°$

$Z_L = \omega L \angle 90°$

$Z_C = \frac{1}{\omega C}\angle -90°$

$|Z_L| = \sqrt{0 + y^2} = y$

$\phi = \tan^{-1}\left(\frac{y}{0}\right) = 90°$

$I = \frac{12\angle 0°}{16.06K\angle 51.5°}$

$= 0.75m\angle -51.5°\ A = I$

$2\pi f = 2\pi \cdot 200KHz$ → $j\omega L$ ← 10mH

$Z_T = Z_R + Z_L$

$Z_L = \underbrace{10mH}_{L} \cdot \underbrace{2\pi \cdot 200KHz}_{\omega} \cdot j$

$Z_L = j12.57K$

$Z_R = 10K\angle 0°$

$Z_T = 10K + j12.57K$

$|Z_T| = 16.06K$

$\phi_{Z_T} = \tan^{-1}\left(\frac{12.57K}{10K}\right) = 51.5°$

$Z_T = 16.06\angle 51.5°\ K\Omega$

UNLV | HOWARD R. HUGHES COLLEGE OF ENGINEERING

Op-amp