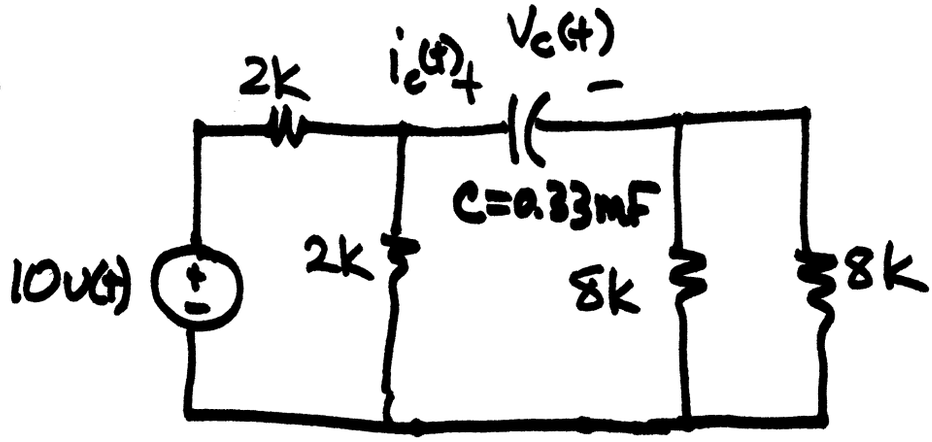
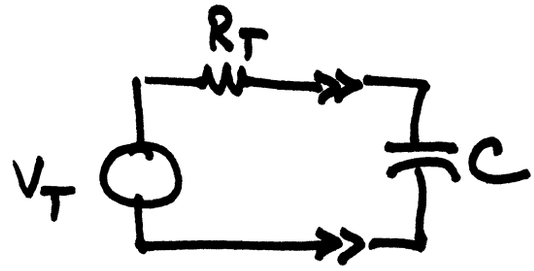
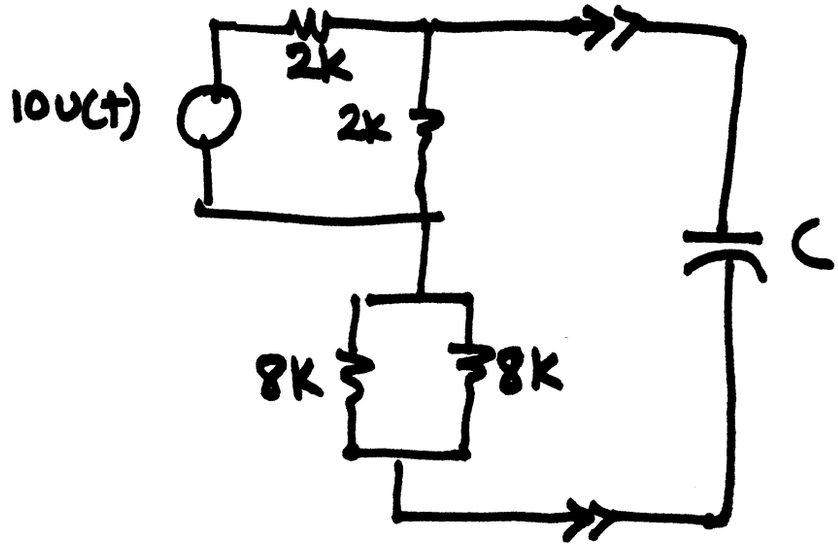
9.





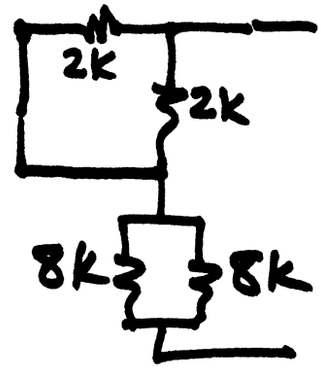
(a) what is state variable? $V_c(t)$

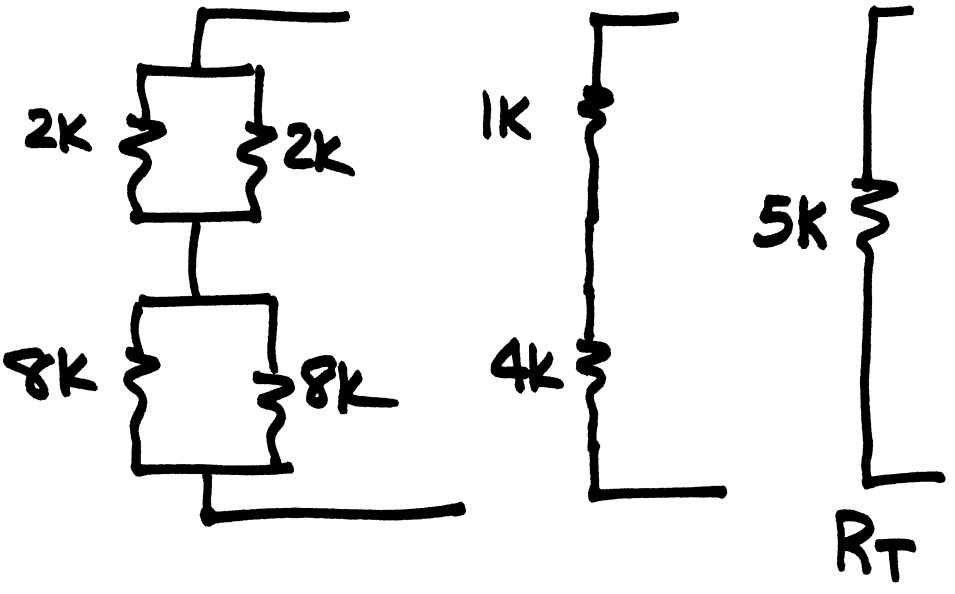
(b) Write the differential equation.

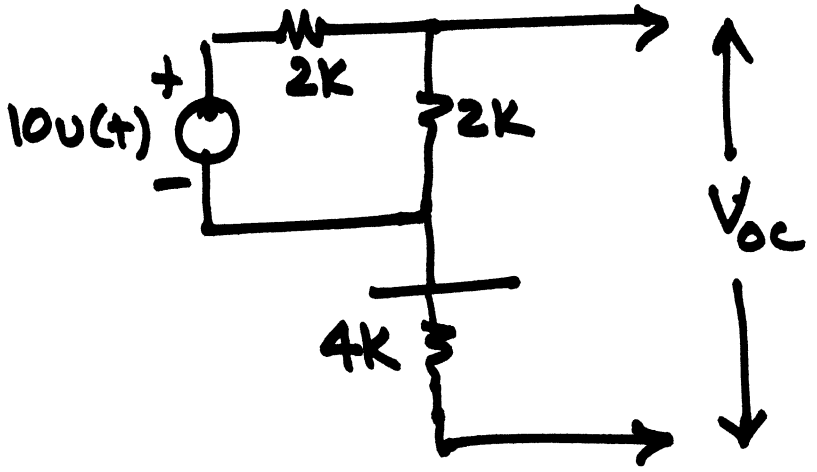


to find R_T turn off sources

$t \geq 0$





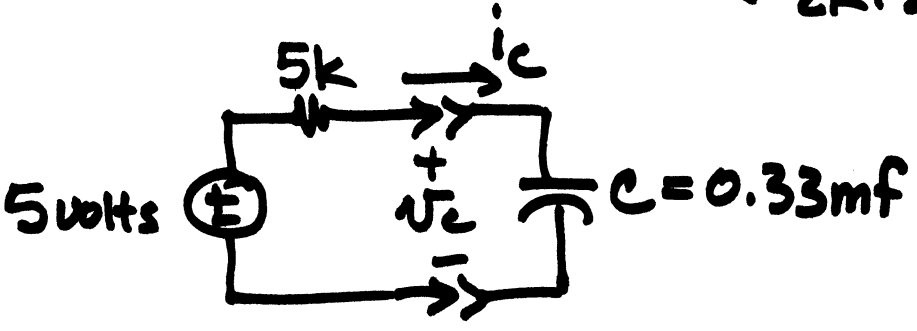


V_{oc} is the voltage across the vertical 2K resistor

voltage divider

$t \geq 0$

$$V_{2K} = \frac{2k}{2k+2k}\,10 = 5 \text{ volts}$$



KVL: $-5+(5k)i_c+v_c=0$

use $i_c = C\frac{dv_c}{dt}$

$$-5+(5k)C\frac{dv_c}{dt}+v_c=0$$

$$(5k)C\frac{dv_c}{dt} + v_c = 5$$

DC forced steady-state $\quad \frac{d}{dt} \to 0 \quad v_F(t) = 5$

natural. $(5k)C\frac{dv_c}{dt} + v_c = 0$

$$v_c(t) = Ke^{st}$$

$$(5k)Cs(Ke^{st}) + (Ke^{st}) = 0$$

$$(5k)Cs + 1 = 0$$

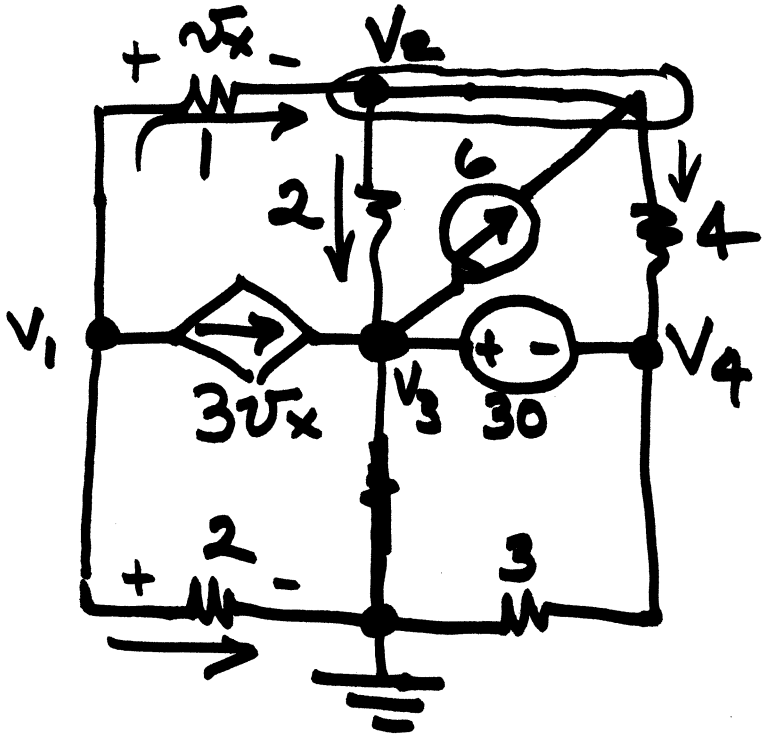
$$s = -\frac{1}{(5k)(C)}$$

$$v_c(t) = v_F(t) + v_{NAT}(t)$$

$$v_c(t) = 5 + Ke^{-\frac{t}{(5k)C}}$$

initial condition $v_c(t) = 0$

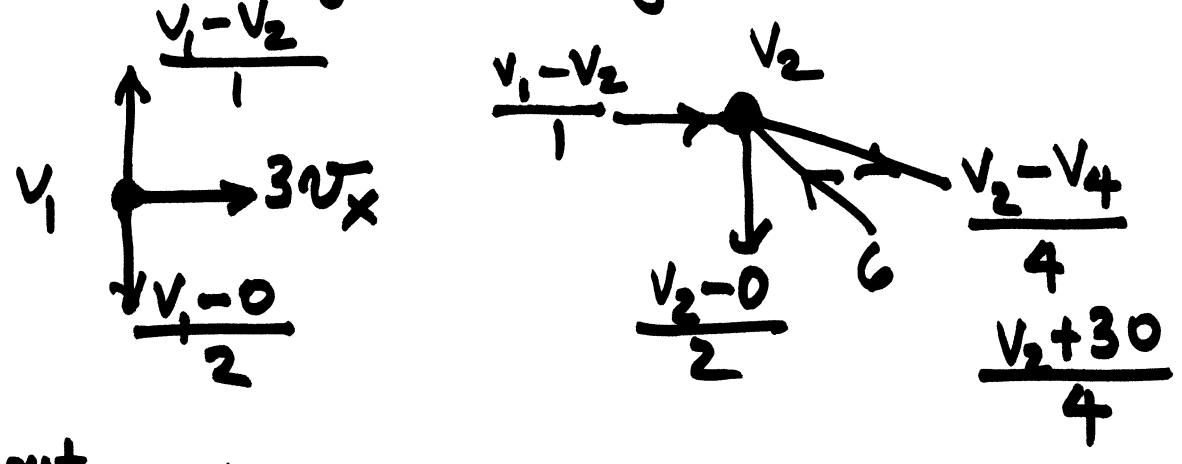
2.



by inspection $V_3 = 0$

$V_4 = V_3 - 30 = -30$

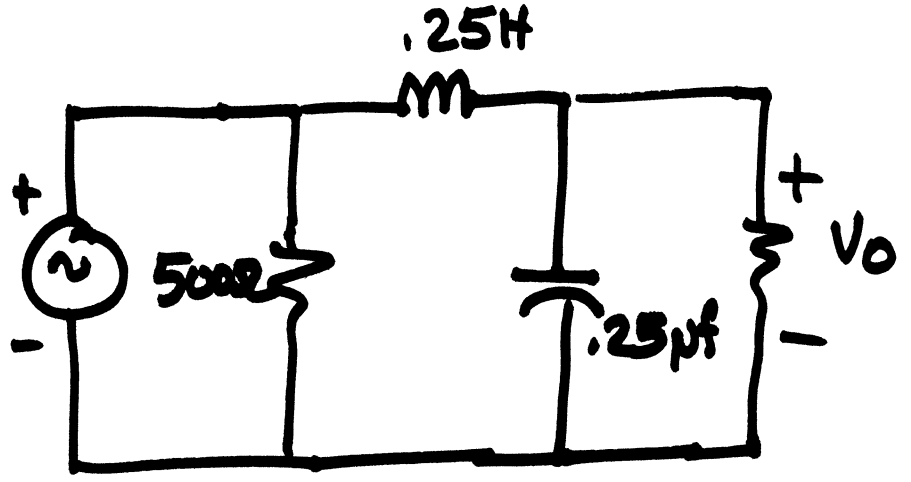
node voltage technique (KCL)



@1 (+ out) $\frac{V_1-V_2}{1} + 3v_x + \frac{V_1}{2} = 0$

@2 (+ out) $-\frac{V_1-V_2}{1} + \frac{V_2}{2} - 6 + \frac{V_2+30}{4} = 0$ substitute $v_x = V_1 - V_2$

6.



$V_s = 1000\cos(400t)$

(a) What is the frequency in Hertz?

$$\omega = 400$$

$$\omega = 2\pi f$$

$$2\pi f = 400$$

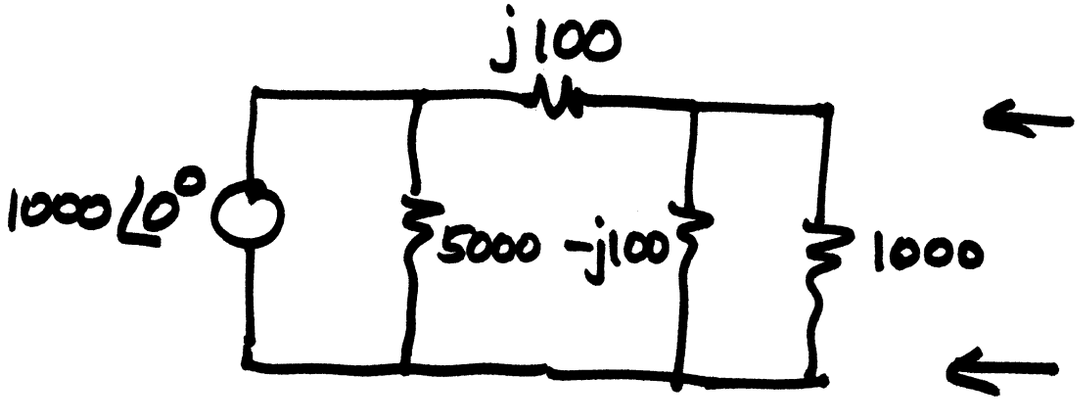
$$f = \frac{400}{2\pi} = 63.6 \text{ Hz}$$

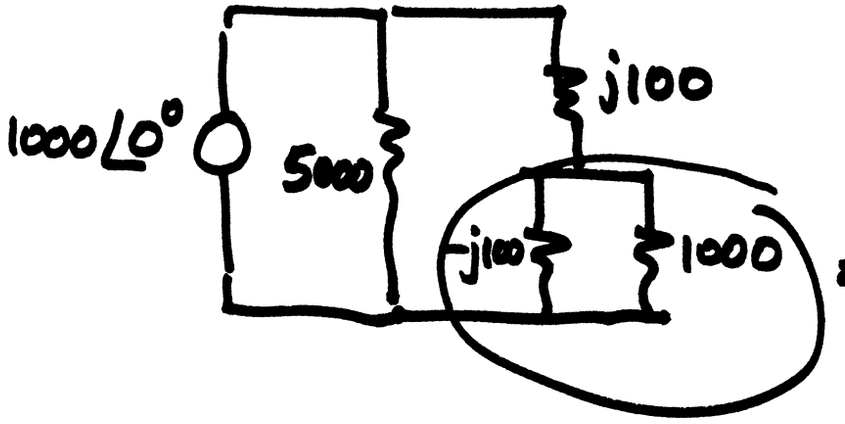
(b) What is the impedance of the C and L?

$$Z_c = \frac{1}{j\omega C} = \frac{1}{j(400)(.25\times10^{-6})} = -j100$$

$$Z_L = j\omega L = j(400)(.25) = +j100$$

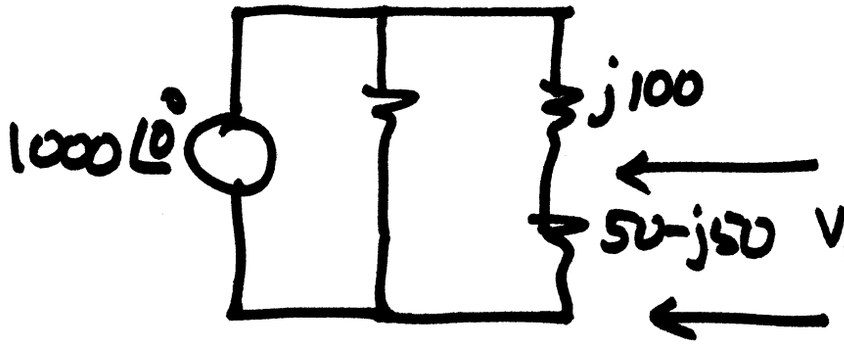
(c) for $R_L = 1000$ determine V_o





$$Z_{EQ} = \frac{(-j100)(1000)}{-j100+1000}$$

$$= 50 - j50$$



$$V_o = \frac{50-j50}{j100+50-j50}\,1000\angle 0$$

$$V_o = -j1000$$

$$= 1000\angle -90^\circ$$

$$V_o = 1000\cos(400t - 90^\circ)$$