Circuit Model Test I

Solve the following problems. (100 points)

1、(6 points) Find U_{ab} in the circuit in Figure 1.

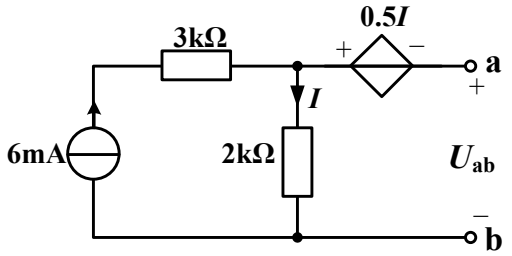

Figure 1

Solution:

$$U_{ab} = 9\text{V}$$

2、(8 points) Find u_o and i_o in the circuit in Figure 2.

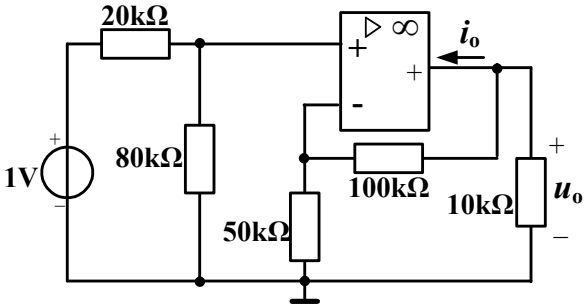

Figure 2

Solution:

$$u_o = 2.4\text{V}, \qquad i_o = -0.256\text{mA}$$

3、(6 points) In the circuit of Figure 3, readings of voltmeter Ⓥ1, Ⓥ2 and Ⓥ3 are 10V, 18V and 6V, respectively. Please determinate the reading of the voltmeter Ⓥ.

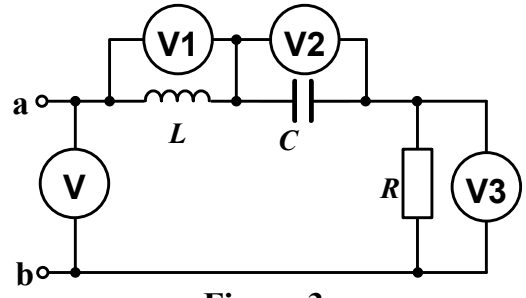

Figure 3

Solution:

The reading of the voltmeter Ⓥ is 10V.

4、(8 points) The resonant or tuner circuit of a radio is portrayed in Figure 4, where u_{s1} represents a broadcast signal, given that R=10Ω， L=200μH, U_{s1rms}=1.5mV， f_1=1008kHz. If the circuit is resonant with signal u_{s1}, please determinate: (1) the value of C; (2) the quality factor Q of the circuit; (3) the current I_{rms}; (4) the voltage U_{crms}.

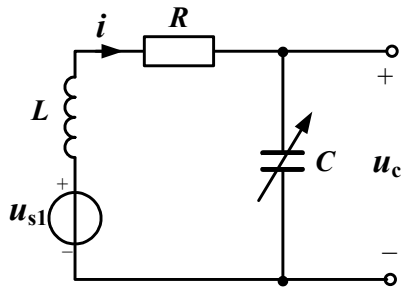

Figure 4

Solution:

(1)$C \approx 12.5\text{pF}$ (2)$Q \approx 126.6$ (3)$I_{rms} = 150\,\mu\text{A}$ (4)$U_{Crms} = 190\,\text{mV}$

5、(8 points) A balanced three-phase circuit is shown in Figure 5. Calculate the phase currents and voltages in the delta-connected load Z, if $\dot{U}_A = 220\angle 0°V$, Z=(24+j15)Ω， Z_L=(1+j1)Ω.

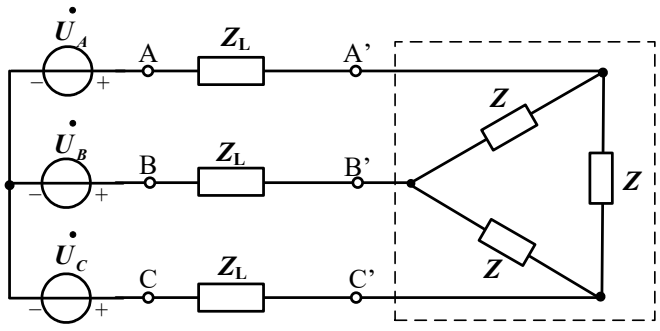

Figure 5

Solution:

$\dot{I}_{A'B'} = 11.74\angle -3.69°\text{A}$, $\dot{U}_{A'B'} = 332\angle 28.31°\text{V}$

6、(8 points) Find the y parameters for the circuit in Figure 6.

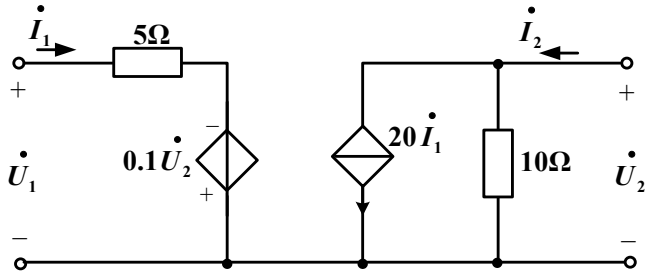

Figure 6

Solution:

$$[y]=\begin{bmatrix}0.2 & 0.02\\ 4 & 0.5\end{bmatrix}S$$

7、(15 points) For the circuit in figure 7, find the rms value of the current *i* and the average power absorbed by the circuit, given that $\omega L = 10\Omega$, $R_1 = 5\Omega$, $R_2 = 20\Omega$, $1/\omega C = 20\Omega$, $u_s(t) = 80 + 100\cos\omega t + 50\cos(2\omega t + 30°)$ V.

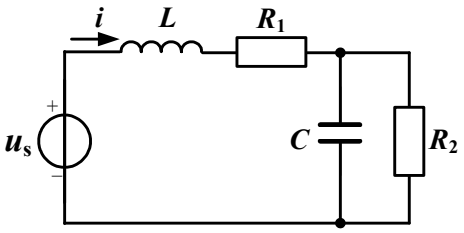

Figure 7

Solution:

$$I_{rms} = \sqrt{I_0^2 + I_1^2 + I_2^2} = \sqrt{3.2^2 + 4.714^2 + 2.357^2} = 6.17\text{A}$$

$$P=P_0+P_1+P_2=256+333.28+50=639.28\text{W}$$

8、(12 points) In the circuit of Figure 8, determinate the value of *Z* that will absorb the maximum power and calculate the value of the maximum power.

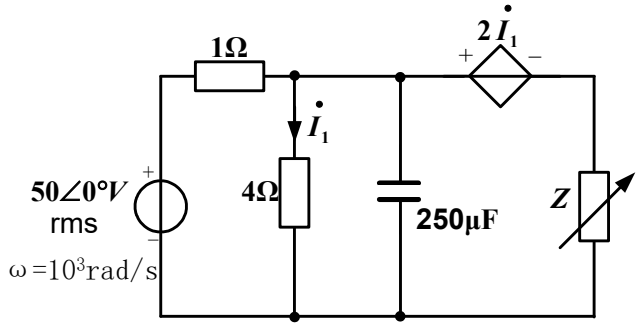

Figure 8

Solution:

If $Z = Z_{eq}^{*} = \dfrac{5+j}{13}\Omega$, Z will absorb the maximum average power.

The maximum average power is, $P_{\max} = \dfrac{1}{4}\cdot\dfrac{U_{OC}^{*}}{R_{eq}} = \dfrac{1}{4}\cdot\dfrac{19.6^2}{5/13} = 249.7\text{W}$

9、(14 points) If the switch in Figure 9 has been closed for a long time and is opened at $t = 0$, find u_c, i_L, u_k for $t \geq 0$.

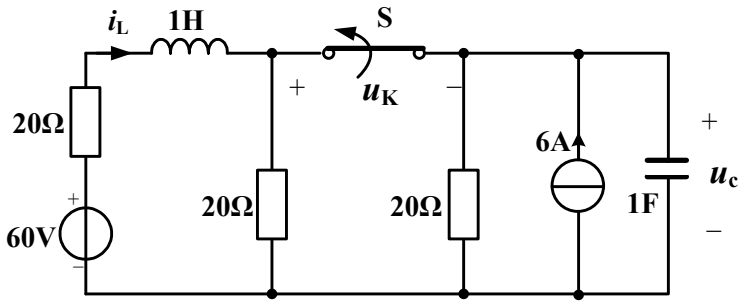

Figure 9

Solution:

$i_L = 1.5 + (0-1.5)e^{-40t} = 1.5 - 1.5e^{-40t}\text{A}, \quad t > 0$,

$u_C = 120 + (60-120)e^{-t/20} = 120 - 60e^{-t/20}\text{V}, \quad t > 0$

$u_K = 20i_L - u_C = -90 - 30e^{-40t} + 60e^{-t/20}\text{V}, \quad t > 0$

10、(15 points) The switch in Figure 10 has been in position a for a long time. At t = 0, it moves to position b. Find i_2(t) for $t \geq 0$ and sketch it. (Attention: Please mark the key data in your graph.)

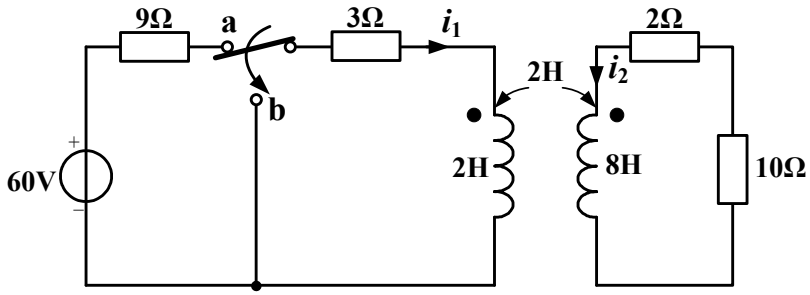

Figure 10

Solution: $i_2 = 1.25e^{-t} - 1.25e^{-3t}\text{A}$