

华东交通大学 2015—2016 学年第二学期考试卷

(A) 卷

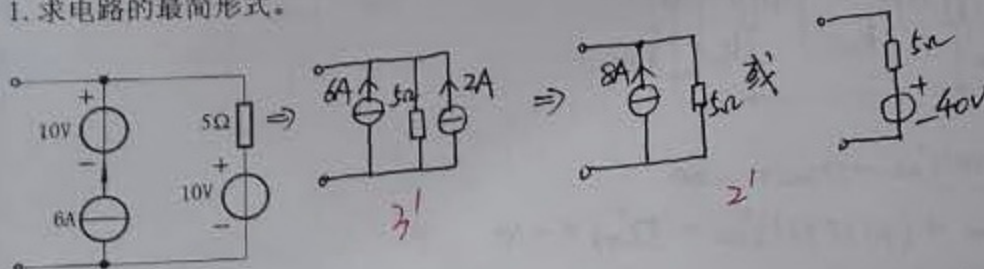
课程名称: 电路原理 I 考试时间: 120 分钟 考试方式: 闭卷

学生姓名: _____ 学号: _____ 教学班级: _____ 教学小班序号: _____

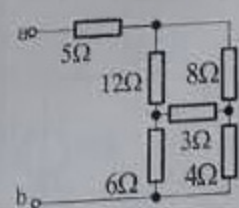
题号	一	二	三	四	五	六	七	八	九	十	总分
得分											
阅卷人											

一、计算题(每题 5 分, 共 25 分)

1. 求电路的最简形式。



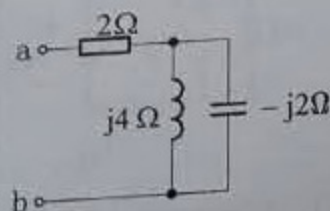
2. 求等效电阻 R_{ab}



$\because 12 \times 4 = 6 \times 8 = 48 \quad \therefore \text{电桥平衡} \quad 1'$
 3Ω 电阻既可开路也可短路

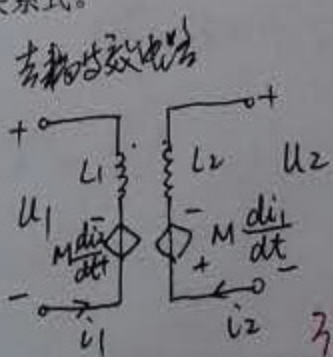
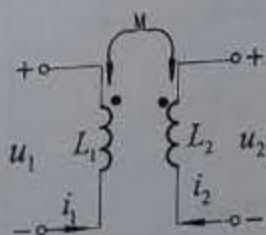
$\therefore R_{ab} = 5 + \frac{12 \times 8}{12 + 8} + \frac{6 \times 4}{6 + 4} = 5 + 4.8 + 2.4 = 12.2\Omega \quad 4'$

3. 求输入阻抗 Z_{ab}



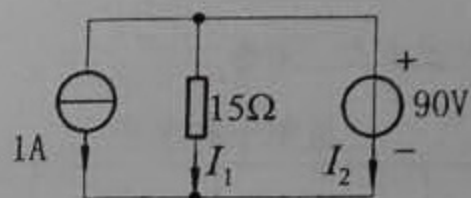
$Z_{ab} = 2 + \frac{j4(-j2)}{j4 - j2} = 2 - j4 \quad 2'$

4. 写出 u_1 和 u_2 的时域关系式。



$$\begin{cases} u_1 = -L_1 \frac{di_1}{dt} - M \frac{di_2}{dt} \quad 1' \\ u_2 = -L_2 \frac{di_2}{dt} - M \frac{di_1}{dt} \quad 1' \end{cases}$$

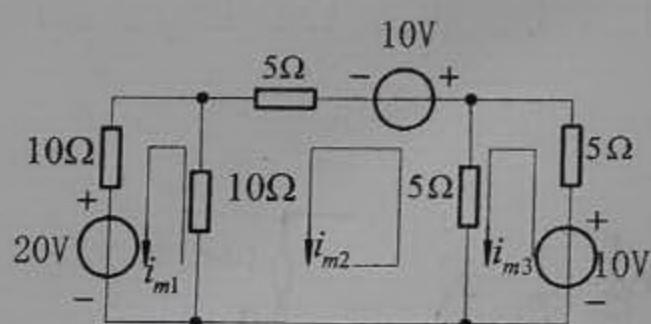
5. 求图示电路中的电流 I_1 和 I_2 。



$$I_1 = \frac{90}{15} = 6A \quad 2.5'$$

$$I_2 = -1 - I_1 = -7A \quad 2.5'$$

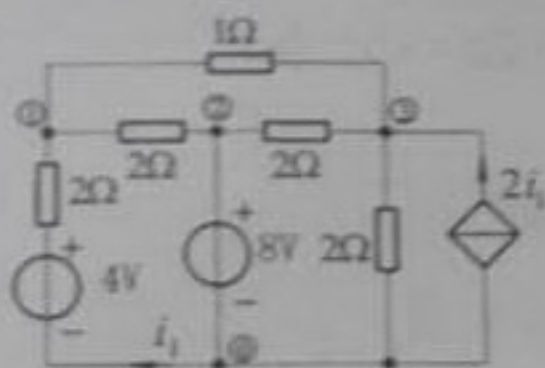
二、求各个网孔电流。(10 分)



$$\begin{cases} (10+10)\dot{i}_{m1} - 10\dot{i}_{m2} = -20 & 3' \\ -10\dot{i}_{m1} + (10+5+5)\dot{i}_{m2} - 5\dot{i}_{m3} = -10 & 3' \\ -5\dot{i}_{m2} + (5+5)\dot{i}_{m3} = 10 & 2' \end{cases}$$

$$\begin{cases} \dot{i}_{m1} = -1.6A \\ \dot{i}_{m2} = -1.2A \\ \dot{i}_{m3} = 0.4A \end{cases} \quad 2'$$

三、求各个结点电压及电流 i_1 。(12分)

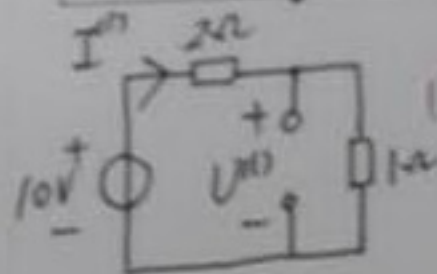
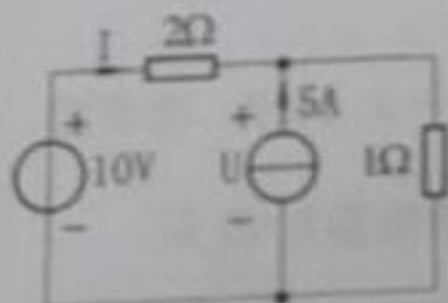


$$\begin{cases} (1 + \frac{1}{2} + \frac{1}{2})U_{n1} - \frac{1}{2}U_{n2} - U_3 = \frac{4}{2} & 3' \\ U_{n2} = 8 & 2' \\ -U_{n1} - \frac{1}{2}U_{n2} + (1 + \frac{1}{2} + \frac{1}{2})U_{n3} = 2i_1 & 3' \\ i_1 = \frac{4 - U_{n1}}{2} \quad (U_{n1} = 4 - 2i_1) & 2' \end{cases}$$

解得:

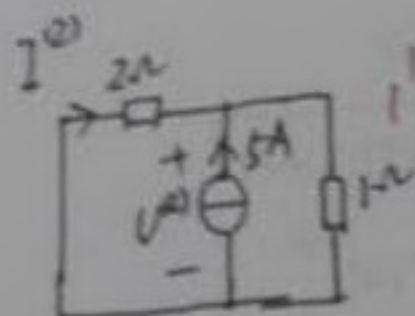
$$\begin{cases} U_{n1} = 5V \\ U_{n2} = 8V \\ U_{n3} = 4V \\ i_1 = -0.5A \end{cases} \quad 2'$$

四、用叠加定理求电流 I 和电压 U 。(10分)



$$I^n = \frac{10}{2+1} = \frac{10}{3}A$$

$$U^n = \frac{1}{2+1} \times 10 = \frac{10}{3}V$$



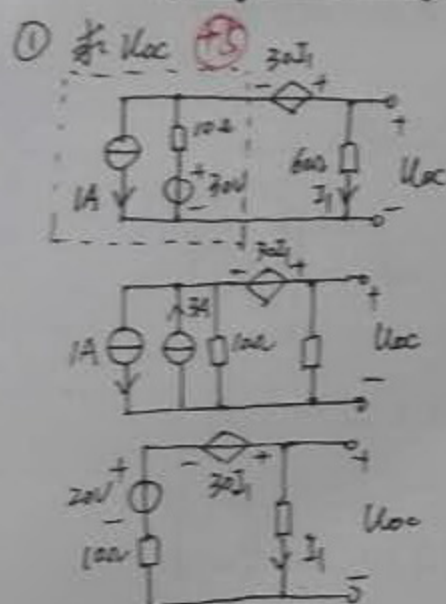
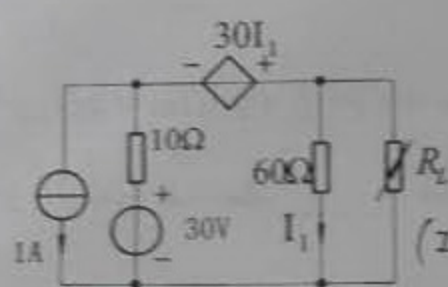
$$I^w = -\frac{1}{1+2} \times 5 = -\frac{5}{3}A$$

$$U^w = 5 \times \frac{1+2}{1 \times 2} = \frac{15}{2}V$$

$$\therefore I = I^n + I^w = \frac{5}{3}A \quad 1'$$

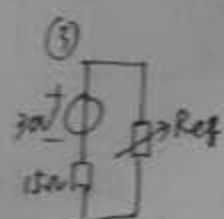
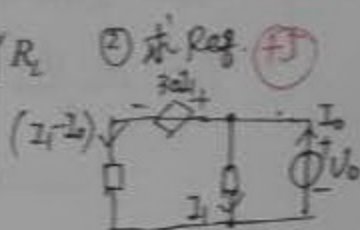
$$U = U^n + U^w = \frac{20}{3}V \quad 1'$$

五、电路如图所示，负载电阻 R_L 任意可变，问 R_L 为何值时可获得最大功率，并求该最大功率。(13分)



$$I_1 = 0.6A$$

$$\therefore U_{oc} = 60I_1 = 30V$$



$$I_1 = \frac{U_o}{60}$$

$$U_o = 30I_1 + 10(I_o - I_1)$$

$$= 20I_1 + 10I_o$$

$$= 20 \times \frac{U_o}{60} + 10I_o$$

$$\frac{2}{3}U_o = 10I_o$$

$$R_{eq} = \frac{U_o}{I_o} = 15\Omega$$

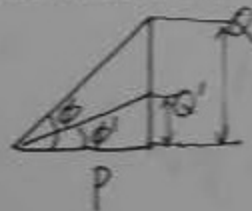
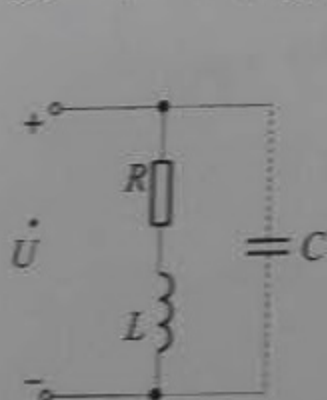
$$R_L = R_{eq} = 15\Omega$$

$$P_{max} = \frac{U_{oc}^2}{4R_{eq}}$$

$$= \frac{30^2}{4 \times 15}$$

$$= 15W$$

六、有一感性负载串联电路如图所示， $f=50Hz$ ， $U=220V$ ， $P=2.64kW$ ，功率因数 $\cos\phi=0.6$ ，要将功率因数提高到 0.9，应并联多大的电容？(6分)



$$Q_c = \omega C U^2$$

$$\therefore C = \frac{Q_c}{\omega U^2}$$

$$= \frac{2244}{2 \times 3.14 \times 50 \times 220^2}$$

$$= 1.47 \times 10^{-5}$$

$$= 147.24 \mu F$$

$$\cos\phi=0.6, \phi=53.13^\circ, \tan\phi=1.33$$

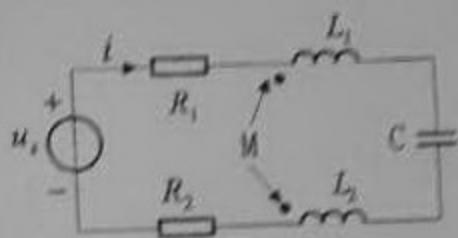
$$\cos\phi'=0.9, \phi'=25.84^\circ, \tan\phi'=0.48$$

$$\therefore Q_c = Q - Q' = P(\tan\phi - \tan\phi')$$

$$= 2.64 \times 10^3 \times (1.33 - 0.48)$$

$$= 2244 \text{ var}$$

七、已知 $R_1 = 20\Omega$, $R_2 = 80\Omega$, $L_1 = 3H$, $L_2 = 10H$, $M = 5H$, $u_s = 100\sqrt{2}\cos(100t)V$ 。求 (1) 电流 i ; (2) 电容 C 为多大时电流 i 与 u_s 同相? (3) 计算此时电压源发出的有功功率。(12分)



$$(1) Z_{eq} = R_1 + R_2 + j\omega(L_1 - M) + j\omega(L_2 - M) + \frac{1}{j\omega C}$$

$$i \text{ 与 } u_s \text{ 同相} \Rightarrow \omega(L_1 - M + L_2 - M) - \frac{1}{\omega C} = 0$$

$$100(3 - 5 + 10 - 5) - \frac{1}{100C} = 0$$

$$C = \frac{1}{3 \times 10^4} = \frac{1}{3} \times 10^{-4} F = \frac{100}{3} \mu F \quad 5'$$

$$(2) \dot{I} = \frac{\dot{U}_s}{R_1 + R_2} = \frac{100 \angle 0^\circ}{20 + 80} = 1 \angle 0^\circ A$$

$$i(t) = \sqrt{2} \cos(100t) (A) \quad 3'$$

$$(3) P = UI \cos \varphi = 100 \times 1 \times \cos 0^\circ = 100 W \quad 4'$$