

标准答案

华东交通大学 2013—2014 学年第二学期考试卷

(A) 卷

课程名称: 电路原理 I

课程类别: 必

考试方式: 闭卷 适用: 2013 电气工程、自动化、电子信息、建筑电气专业

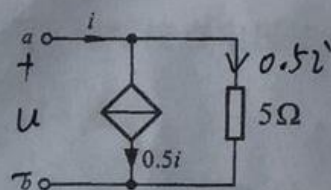
题号	一	二	三	四	五	六	七	八	九	十	总分	累分人签名
题分	16	20	12	14	12	12	14				100	
得分												

考生注意事项: 1、本试卷共 5 页, 总分 100 分, 考试时间 120 分钟。

2、考试结束后, 考生不得将试卷、答题纸和草稿纸带出考场。

一、计算题(每题 4 分, 共 16 分)

1. 电路如图, 求 a 、 b 两端等效电阻。

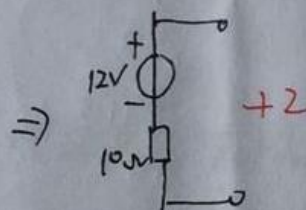
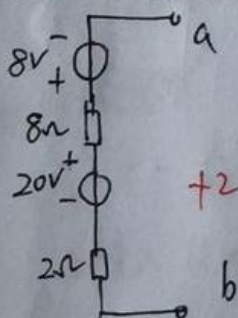
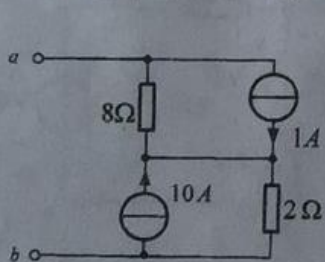


$$u = 0.5i \times 5 = 2.5i + 2$$

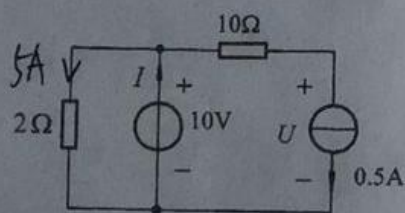
$$R_{ab} = \frac{u}{i} = 2.5\Omega + 2$$

得分	评阅人

2. 电路如图所示, 将电路化简为一个电压源与一个电阻相串联的组合。



3. 电路如图, 求电流 I 和电压 U 。

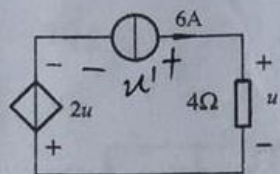


$$I = 5 + 0.5 = 5.5A + 2$$

$$10 = 10 \times 0.5 + U$$

$$\therefore U = 5V + 2$$

4. 电路如图，求各元件功率，并验证功率守恒。



$$u = 4 \times 6 = 24V$$

$$2u = 48V$$

$$\therefore u' = 72V$$

$$P_{6A} = 6 \times 72 = 432W$$

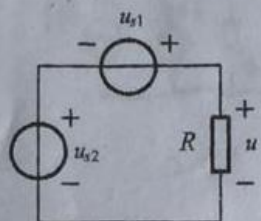
$$P_{2u \text{ (right)}} = 48 \times 6 = 288W$$

$$P_{4\Omega} = 6^2 \times 4 = 144W$$

得分	评阅人

二、计算题(每题 5 分, 共 20 分) $\therefore P_{\text{total}} = 288 + 144 = 432W = P_{6A}$

1. 已知 $u_{s1} = \sqrt{2} \times 10 \times \cos(314t) V$, $u_{s2} = \sqrt{2} \times 10 \sin(314t) V$, 求 u 。



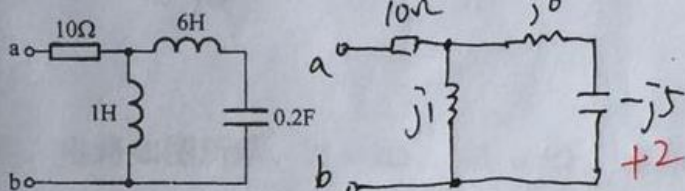
$$u_{s2} = \sqrt{2} \times 10 \cos(314 - 90^\circ)$$

$$\therefore \dot{U}_{s1} = 10 \angle 0^\circ, \quad \dot{U}_{s2} = 10 \angle -90^\circ$$

$$\therefore \dot{U} = \dot{U}_{s1} + \dot{U}_{s2} = 10 \angle 0^\circ + 10 \angle -90^\circ = 10\sqrt{2} \angle -45^\circ$$

$$\therefore u = 20 \cos(314t - 45^\circ) V$$

2. 求图示电路的输入阻抗。($\omega = 1 \text{ rad/s}$)

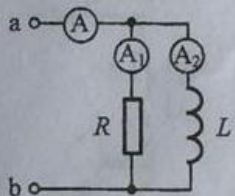


$$Z_{ab} = 10 + (j1) \parallel (j6 - j5)$$

$$= 10 + (j1) \parallel (j1)$$

$$= 10 + j0.5 (\Omega)$$

3. 已知 A_1 、 A_2 表的读数分别为 4A、3A, 求电流表 A 的读数, 并画出相量图。



$$\text{设 } \dot{U} = U \angle 0^\circ V$$

$$\therefore \dot{I}_1 = 4 \angle 0^\circ A$$

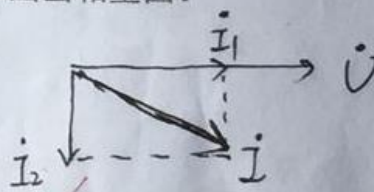
$$\dot{I}_2 = 3 \angle -90^\circ A$$

$$I = \sqrt{I_1^2 + I_2^2}$$

$$= \sqrt{4^2 + 3^2}$$

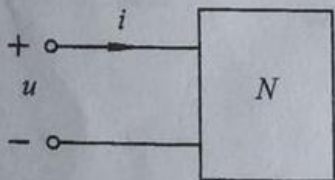
$$= 5A$$

$$\therefore A \text{ 的读数是 } 5A$$



4. 图中 N 不包含独立源, $u(t) = 10 \cos(10t + 30^\circ) V$, $i(t) = 2 \cos(10t - 15^\circ) A$, 整个电

路吸收的平均功率 P 、无功功率 Q 、视在功率 S 和功率因数 λ 。



$$\dot{U} = \frac{10}{\sqrt{2}} \angle 30^\circ V, \quad \dot{I} = \frac{2}{\sqrt{2}} \angle -15^\circ A$$

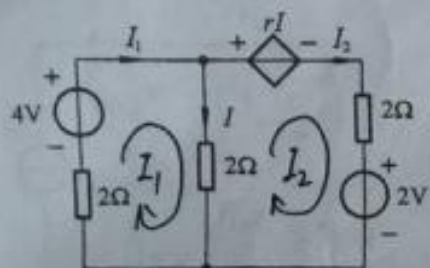
$$\therefore \varphi = 30^\circ - (-15^\circ) = 45^\circ, \quad \lambda = \cos \varphi = \cos 45^\circ = \frac{\sqrt{2}}{2}$$

$$S = UI = \frac{10}{\sqrt{2}} \times \frac{2}{\sqrt{2}} = 10 VA$$

$$P = S \cos \varphi = 5\sqrt{2} = 7.07 W$$

$$Q = S \sin \varphi = 5\sqrt{2} = 7.07 var$$

三、用网孔电流法求电路中的电流 I 、 I_1 、 I_2 。已知 $r=1\Omega$ 。(12分)



解：网孔电流如图

网孔1: $(2+2)I_1 - 2I_2 = 4$ 3'

网孔2: $-2I_1 + (2+2)I_2 + rI = -2$ 3'

补充方程: $I = I_1 - I_2$ 3'

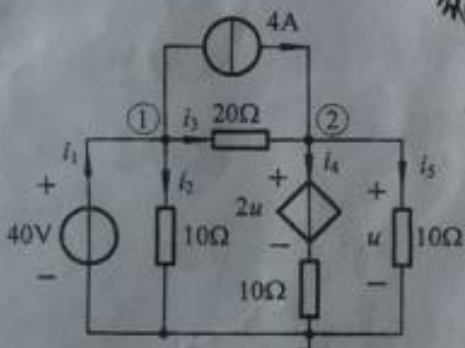
代入数据得: $I_1 = 0.8 A$ 1'

$I_2 = -0.4 A$ 1'

$I = 1.2 A$ 1'

得分	评阅人

四、试用结点电压法求图示电路的结点电压 u_{n1} 、 u_{n2} 及支路电流 i_1 、 i_2 、 i_3 、 i_4 、 i_5 。(14分)



解：结点①: $u_{n1} = 40V$ 2'

或: $(\frac{1}{10} + \frac{1}{20})u_{n1} - \frac{1}{20}u_{n2} = i_1 - 4$

结点②:

$-\frac{1}{20}u_{n1} + (\frac{1}{20} + \frac{1}{10} + \frac{1}{10})u_{n2} = 4 + \frac{2u}{10}$ 2'

补充: $u = u_{n2}$ 2'

—(3)

解①、②、③得 $u_{n1} = 40V$, $u_{n2} = 120V = u$ 1'

$i_2 = \frac{u_{n1}}{10} = 4A$ 1'

$i_4 = \frac{-2u + u_{n2}}{10} = -12A$ 2'

$i_3 = \frac{u_{n1} - u_{n2}}{20} = -4A$ 1'

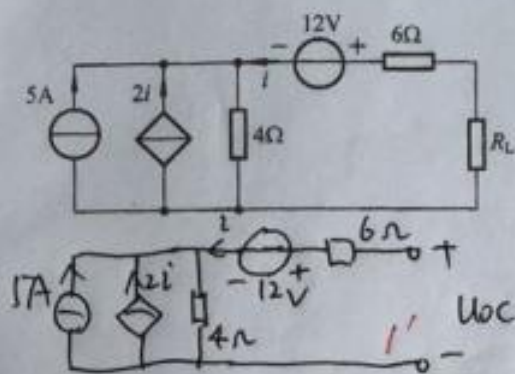
$i_5 = \frac{u_{n2}}{10} = 12A$ 1'

$\therefore i_1 = i_2 + i_3 + 4 = 4A$, 1'

五、电路如图，电阻 R_L 为何值时获得最大功率并计算最大功率。

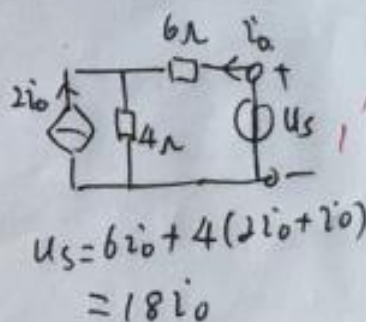
得分	评阅人

(12分)



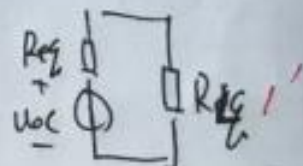
$$i = 0$$

$$U_{OC} = 12 + 5 \times 4 = 32 \text{ V}$$



$$U_S = 6i_0 + 4(2i_0 + i_0) = 18i_0$$

$$R_{eq} = \frac{U_S}{i_0} = 18 \Omega$$

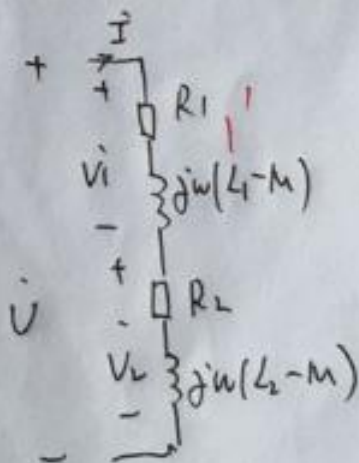
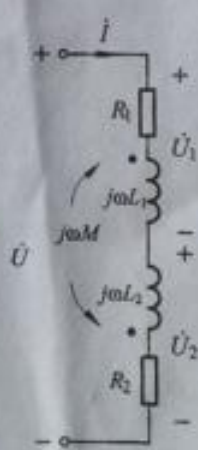


$$R_L = R_{eq} = 18 \Omega$$

$$P_{max} = \frac{U_{OC}^2}{4R_{eq}} = 14.2 \text{ W}$$

六、电路如图所示， $R_1 = 3\Omega$ ， $R_2 = 5\Omega$ ， $\omega L_1 = 7.5\Omega$ ， $\omega L_2 = 12.5\Omega$ ， $\omega M = 6\Omega$ 。电压 $U = 50\text{V}$ ，求电流 I 、电压 $\dot{U}_1$ 、 $\dot{U}_2$ 。(12分)

得分	评阅人



$$\dot{U} = 50 \angle 0^\circ \text{ V}$$

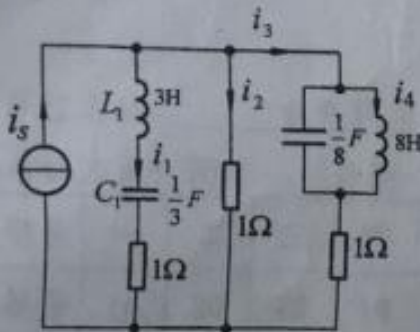
$$\begin{aligned} \dot{I} &= \frac{\dot{U}}{R_1 + R_2 + j(\omega L_1 + \omega L_2 - 2\omega M)} \\ &= \frac{50 \angle 0^\circ}{3 + 5 + j(7.5 + 12.5 - 12)} = \frac{50 \angle 0^\circ}{8 + j8} \\ &= 4.47 \angle -45^\circ \text{ A} \end{aligned}$$

$$\dot{U}_1 = (R_1 + j(\omega L_1 - \omega M)) \dot{I} = 14.8 \angle -18.4^\circ \text{ V}$$

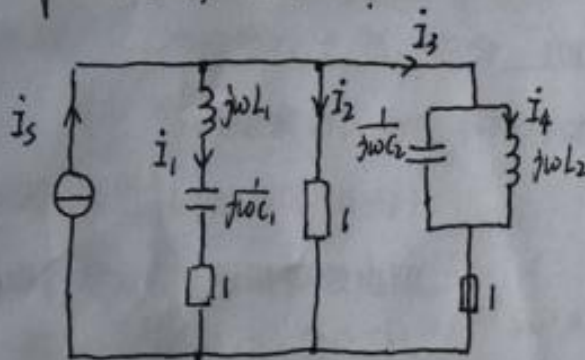
$$\dot{U}_2 = (R_2 + j(\omega L_2 - \omega M)) \dot{I} = 36.2 \angle 7.4^\circ \text{ V}$$

七. 已知 $i_s(t) = \cos t$ A, 求: i_1, i_2, i_3, i_4 . (14 分)

得分	评阅人



解: 作相量形式电路:



支路1: $z_1 = j\omega L_1 + \frac{1}{j\omega C_1} + 1 = j \cdot 3 + \frac{1}{j \cdot \frac{1}{3}} + 1 = 1 \Omega$ (串联谐振) 2'

支路2: $z_2 = 1 \Omega$ 2'

支路3: $z_3 = (j\omega L_2 // \frac{1}{j\omega C_2}) + 1 = (j \cdot 8 // \frac{1}{j \cdot \frac{1}{8}}) + 1 = \infty$ (并联谐振) 2'

令: $\dot{i}_s = 1 \angle 0^\circ$, 有:

$$\dot{i}_1 = \frac{1}{2} \dot{i}_s = \frac{1}{2} \angle 0^\circ, \quad \dot{i}_2 = \frac{1}{2} \dot{i}_s = \frac{1}{2} \angle 0^\circ$$

$$\dot{i}_3 = 0, \quad \dot{i}_4 = (\dot{i}_2 \times 1) / j\omega L_2 = \frac{\frac{1}{2} \angle 0^\circ}{j \cdot 8} = \frac{1}{16} \angle 0^\circ$$

有: $i_1 = \frac{1}{2} \cos t$ A, $i_2 = \frac{1}{2} \cos t$ A, 2'

$$i_3 = 0 \text{ A}, \quad i_4 = \frac{1}{16} \cos t \text{ A}.$$