Faculty of Engineering

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

EENG223 Circuit Theory I

Spring 2006-07

Instructor:

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Midterm EXAMINATION

April 13, 2007

Duration : 100 minutes

Number of Problems: 4

Good Luck

STUDENT'S	
NUMBER	
NAME	
SURNAME	
GROUP NO	

Problem		**Points**
1		25
2		25
3		25
4		25
TOTAL		100

1. (*a*) Is the interconnection in Fig.P1 valid? Explain. (10 pts.)
   (*b*) Can you find the total energy developed in the circuit? Explain. (15 pts.)

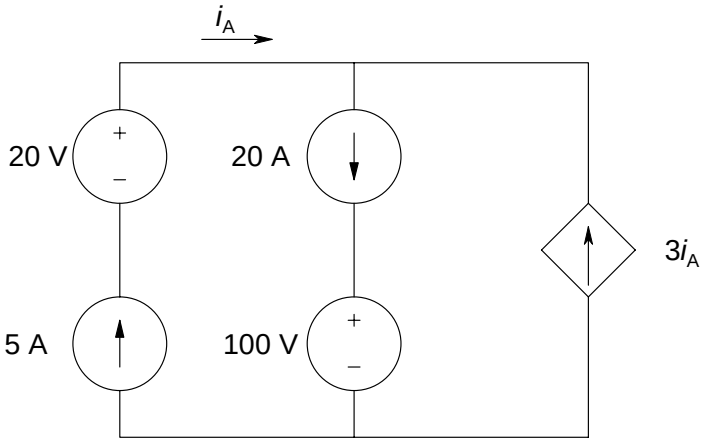


Figure P1

(a) Yes, no violation of Kirchhoff's Laws.

(b) No, because the voltage across the independent and dependent current sources are indeterminate.

2. Use nodal analysis to find v_0 and i_0 in the circuit in Fig. P2. (25 pts.)

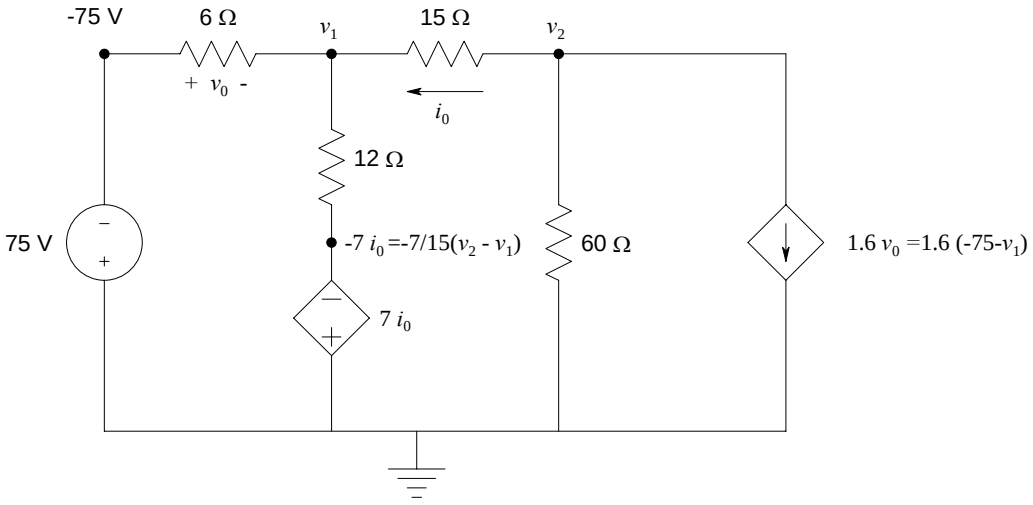


Figure P2

KCL at v_1:

$$\left(\frac{1}{6}+\frac{1}{12}+\frac{1}{15}\right)v_1-\frac{1}{15}v_2-\frac{1}{6}(-75)-\frac{1}{12}\left(-\frac{7}{15}(v_2-v_1)\right)=0$$

Multiply both sides by 180 yields:

$$(30+15+12)v_1-12v_2+(30)(75)+7(v_2-v_1)=0$$

$$50v_1-5v_2=-2250.....(1)$$

KCL at v_2:

$$-\frac{1}{15}v_1+\left(\frac{1}{15}+\frac{1}{60}\right)v_2+1.6(-75-v_1)=0$$

Multiply both sides by 60 yields:

$$-4v_1+5v_2+96(-75-v_1)=0$$

$$-100v_1+5v_2=7200.....(2)$$

One can obtain v_1 and v_2 by solving Eqns. (1) and (2) as:

$$v_1=-99V$$

$$v_2=-540V$$

Therefore

$$v_0=-75-v_1=24V$$

And

$$i_0=\frac{1}{15}(v_2-v_1)=-29.4\,A$$

3. Use superposition theorem to find i_0 and v_0 in the circuit in Fig.P3. (25 pts.)

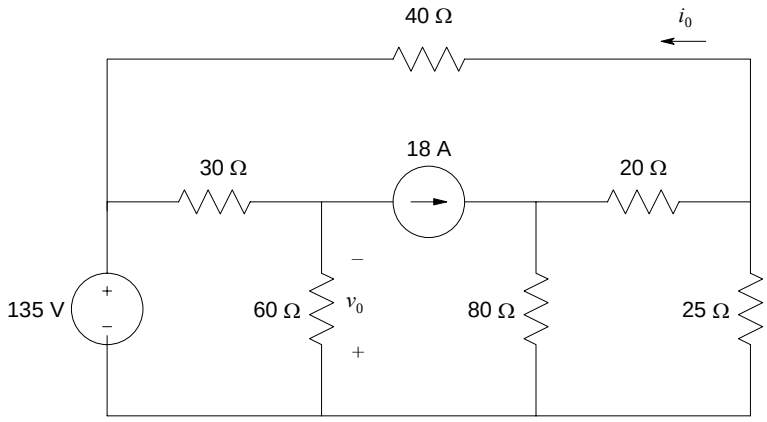
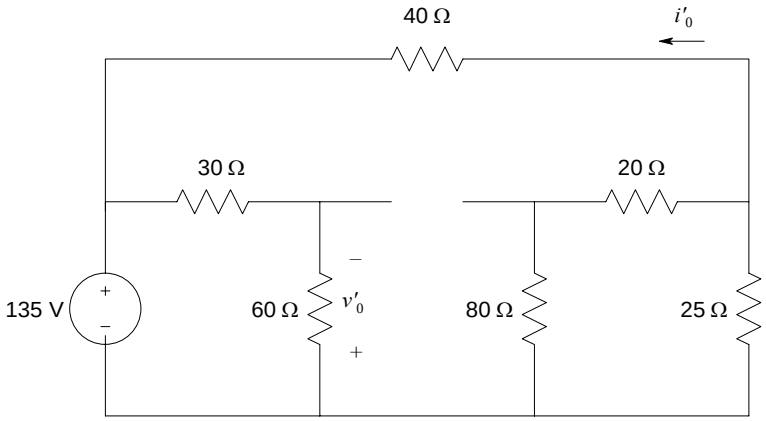
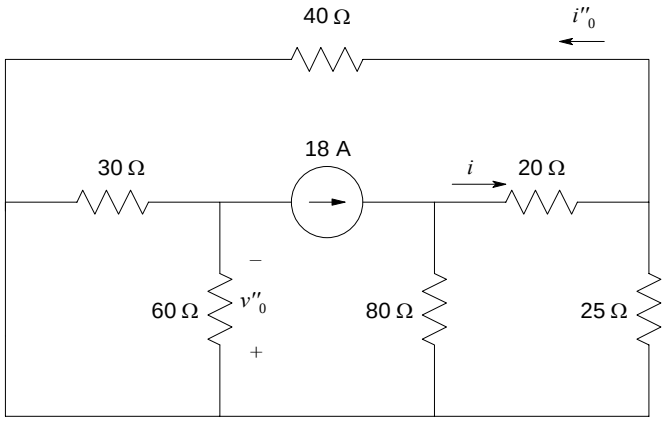


Figure P3





By using voltage division principle:

$$v'_0 = -135\frac{60}{60+30} = -90V$$

$20\,\Omega$ and $80\,\Omega$ resistors are in series.

20+80 = 100 Ω

$100\,\Omega$ and $25\,\Omega$ resistor are in parallel.

$$\frac{100\times 25}{100+25} = 20\Omega$$

$$i'_0 = -\frac{135}{60} = -2.25A$$

$30\,\Omega$ and $60\,\Omega$ resistors are in parallel

30//60=20 Ω. Therefore

$$v''_0 = 20\times 18 = 360V$$

40//25=15.3846 Ω

By using current division principle:

$$i = 18\frac{80}{80+20+15.3846} = 12.48A$$

By using current division principle one more:

$$i''_0 = i\frac{25}{25+45} = 4.8A$$

Therefore

$$v_0 = v'_0 + v''_0 = -90+360 = 270V$$
$$i_0 = i'_0 + i''_0 = -2.25+4.8 = 2.55\,A$$

4. (*a*) Use a series of source transformation to find i_0 in the circuit in Fig. P4. (10 pts.)
(*b*) Verify your solution by using the mesh analysis method to find i_0. (15 pts.)

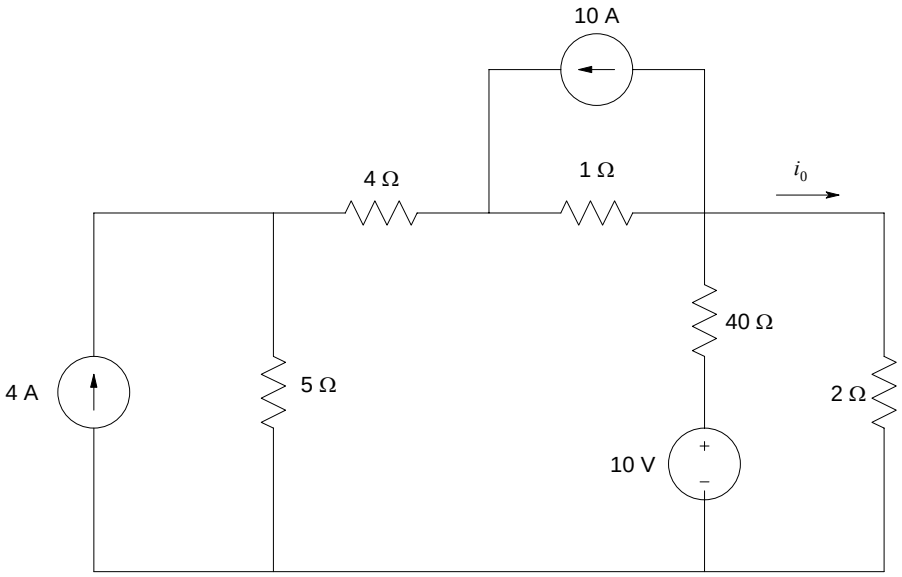
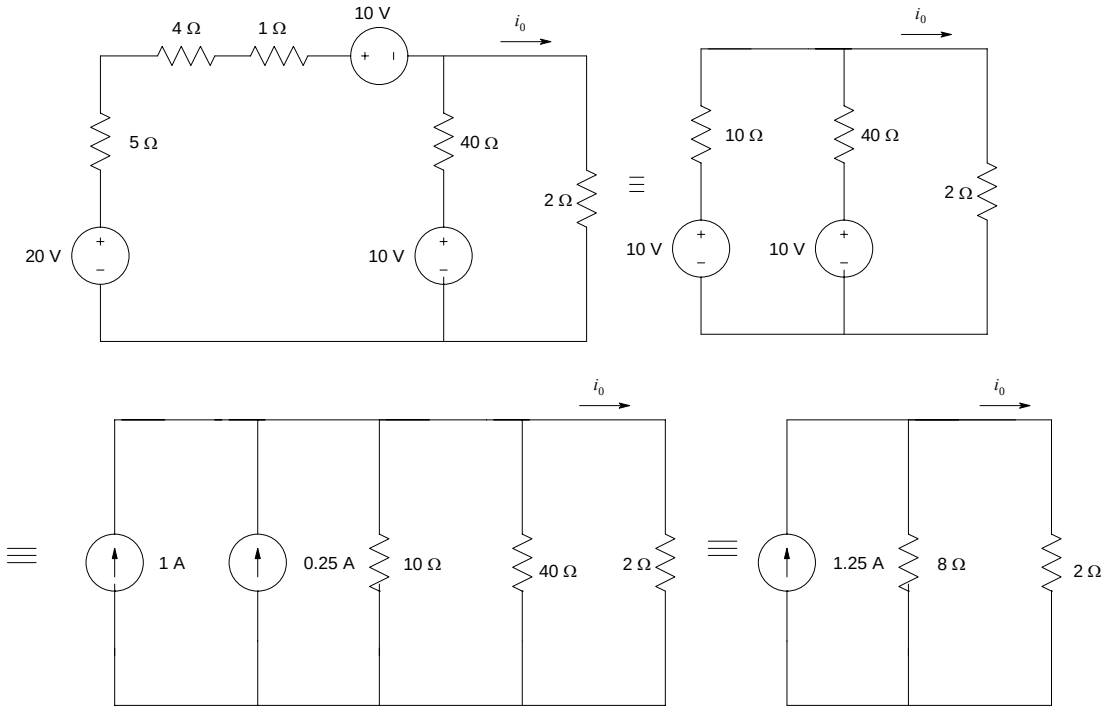


Figure P4

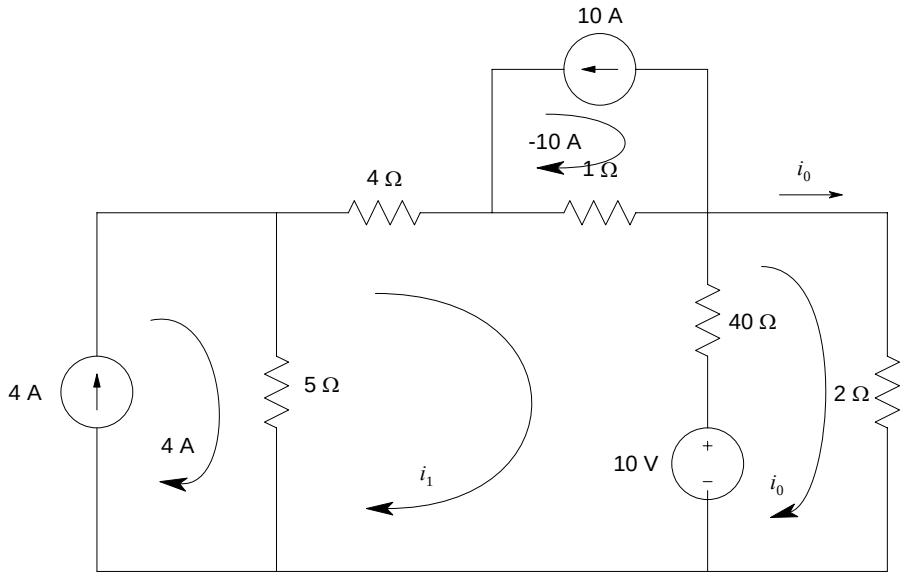
(a)



By using voltage division principle

$$i_0 = 1.25\frac{8}{10} = 1A$$

(b)



KVL around i_1:

$$(5+4+1+40)i_1 - 40i_0 - 5(4) - 1(-10) = -10$$

$$50i_1 - 40i_0 = 0 \text{.....(1)}$$

KVL around i_0:

$$-40i_1 + 42i_0 = 10 \text{.....(2)}$$

Using Eqns.(1) and (2) we can obtain i_0 as:

$$i_0 = 1A$$