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Y

2   1

2 2

- (equivalence)
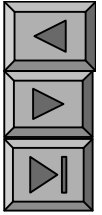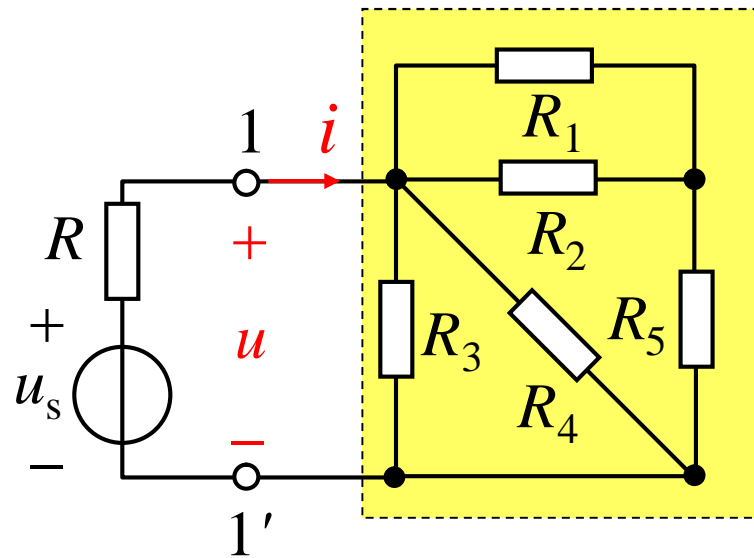

1 1′

R_{eq}

1 1′

R_1

R_2

1 i

R

+

u_s

−

1′

R_3 i_4 R_5 u_5

R_4

+ u

−

+ −

1 i

R

+

u_s

−

1′

+ u −

R_{eq}

i_4 u_5

i u

1.

KVL
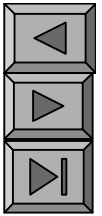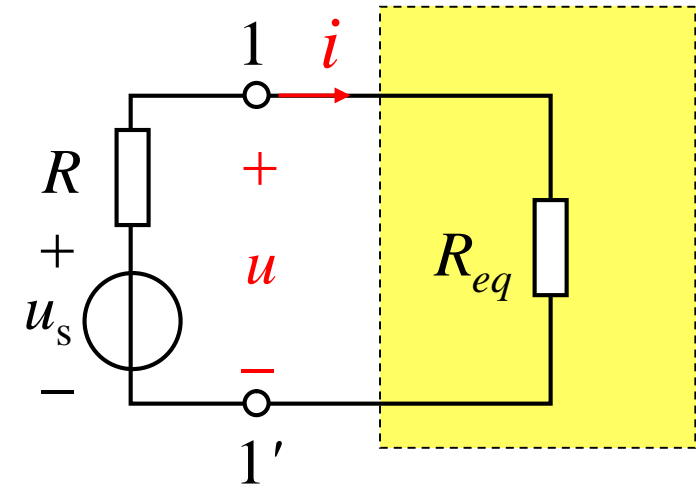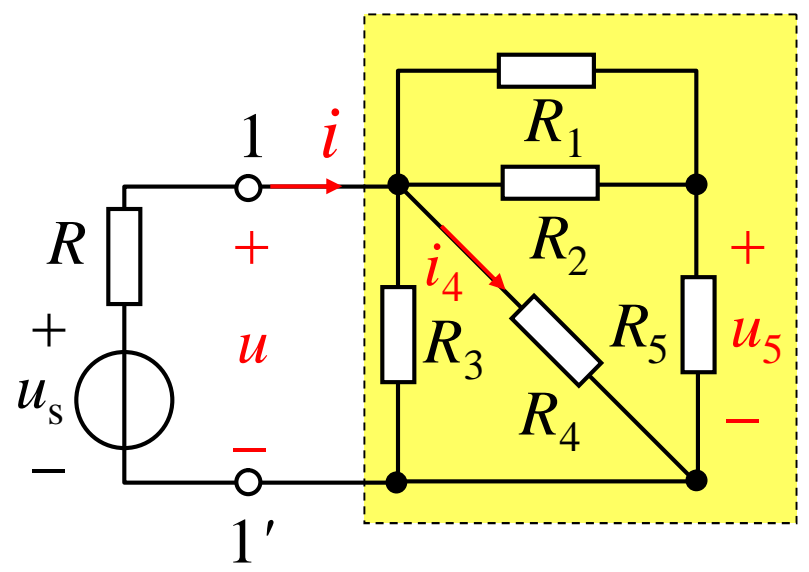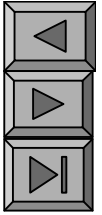
$$u = R_1 i + R_2 i + \cdots + R_n i$$

$$= (R_1 + R_2 + \cdots + R_n)\, i$$
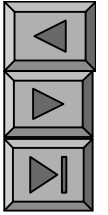
$$u = R_{eq}\, i$$

(1)

$$R_{eq} \stackrel{\mathrm{def}}{=\!=\!=} \sum_{k=1}^{n} R_k$$

R_{eq}
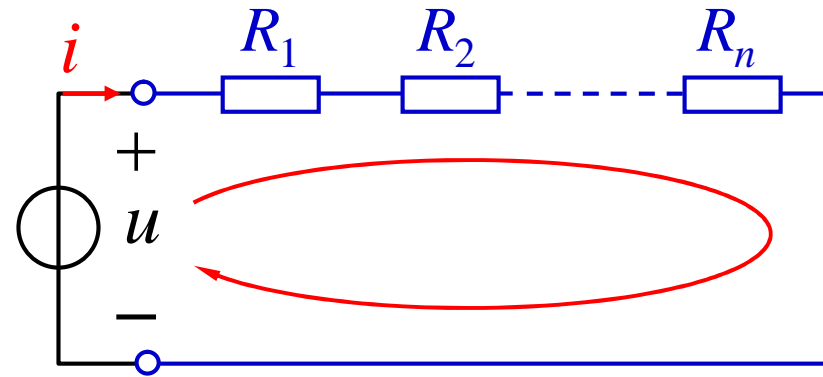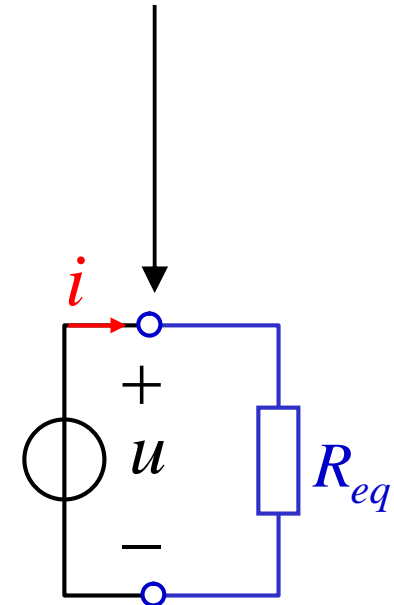
$$u_k =$$

$$+ u_1 - \quad + u_2 - \qquad + u_n -$$

1.

2. ———

3.

4.

(1) ,

(2)

(3)

VCR

2.

KCL
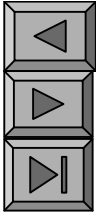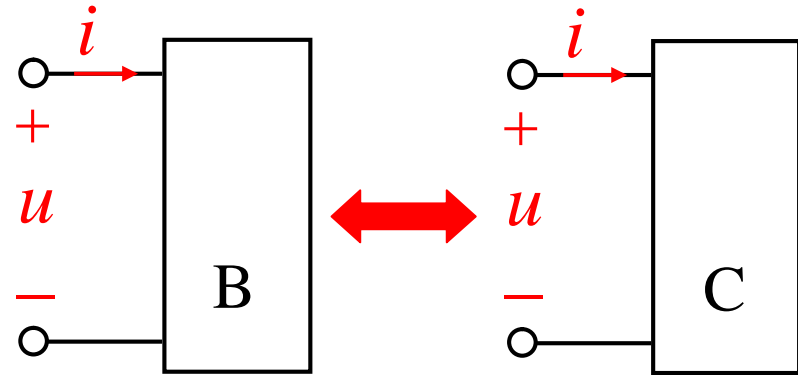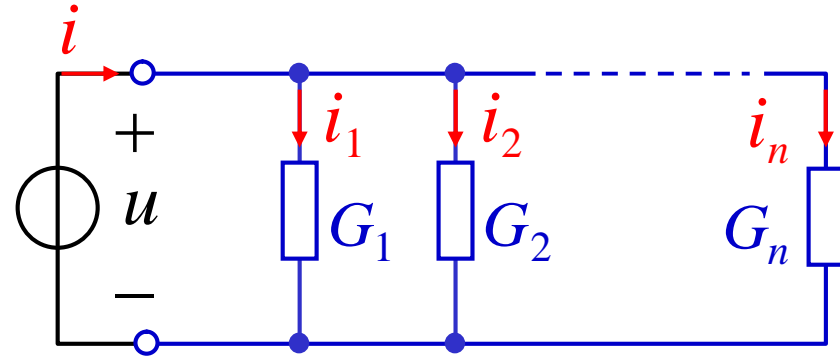
$i = i_1 + i_2 + \cdots + i_n$

$\quad = G_1 u + G_2 u + \cdots + G_n u$

$\quad = (G_1 + G_2 + \cdots + G_n)\, u$

$i = G_{eq}\, u$

$$G_{eq} \overset{\text{def}}{=\!=\!=} \sum_{k=1}^{n} G_k \qquad R_{eq} = \frac{1}{G_{eq}} = \frac{1}{\sum\limits_{k=1}^{n} G_k}$$
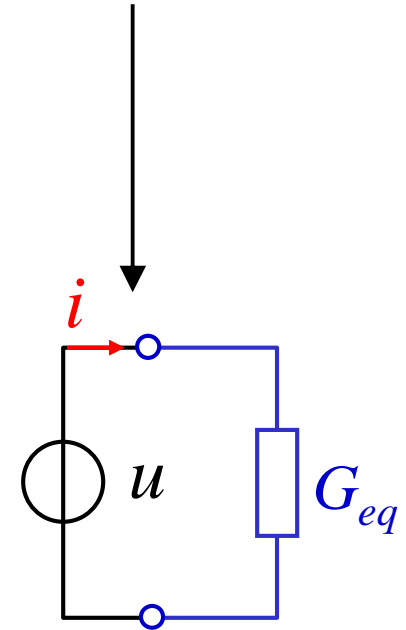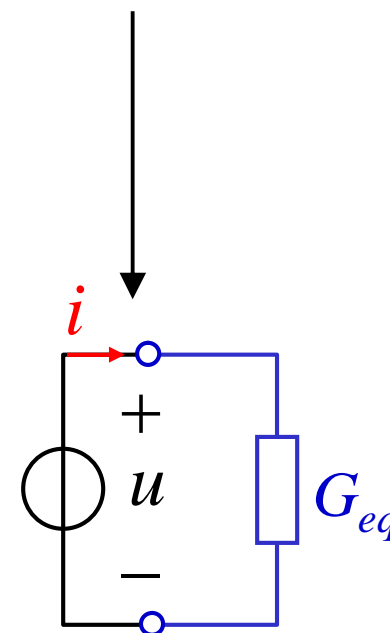
$$\frac{1}{R_{eq}} = \sum_{k=1}^{n} \frac{1}{R_k}$$
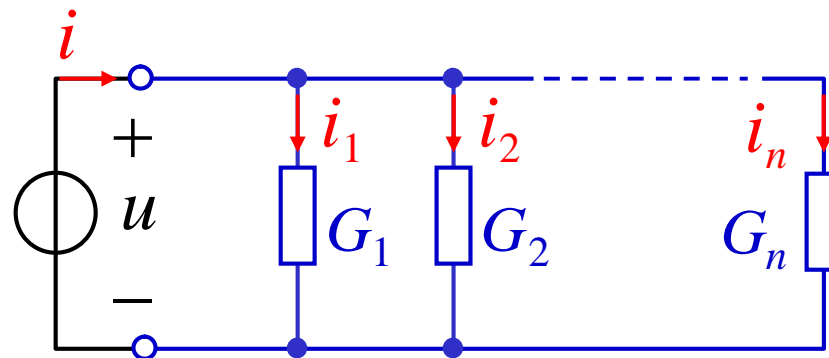
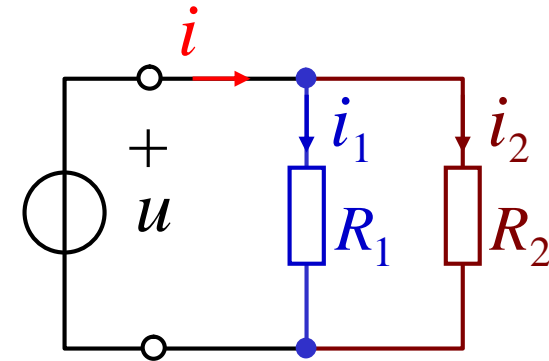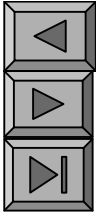
$$i_k = G_k u = G_k \frac{i}{G_{eq}}$$

$$i_k = \frac{G_k}{G_{eq}} i \longrightarrow$$

$$k = 1 \quad 2 \quad \cdots \quad n$$

$$i_1 = \frac{\dfrac{1}{R_1}}{\dfrac{1}{R_1} + \dfrac{1}{R_2}} \, i = \frac{\dfrac{1}{\cancel{R_1}}}{\dfrac{R_1 + R_2}{\cancel{R_1} R_2}} \, i$$
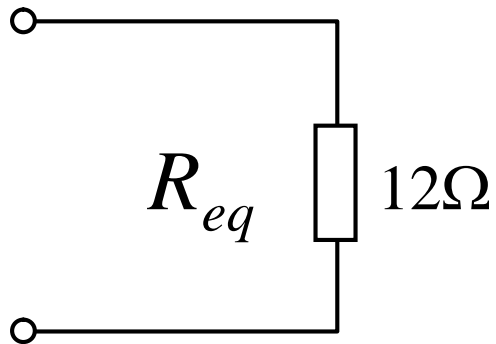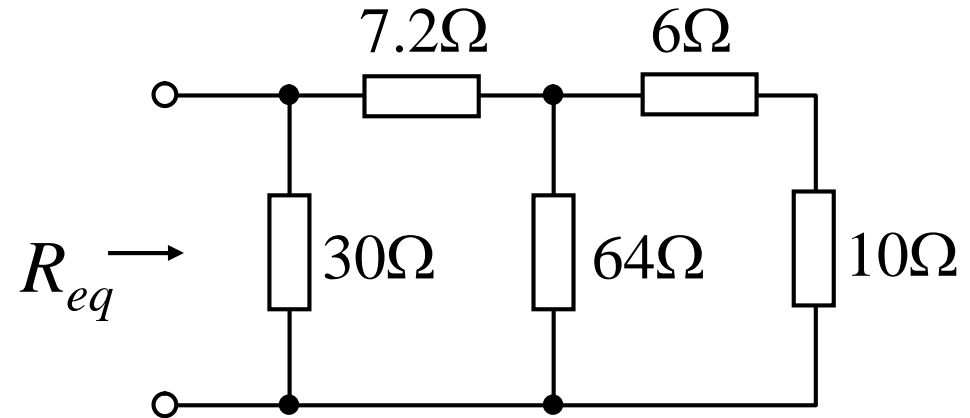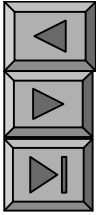
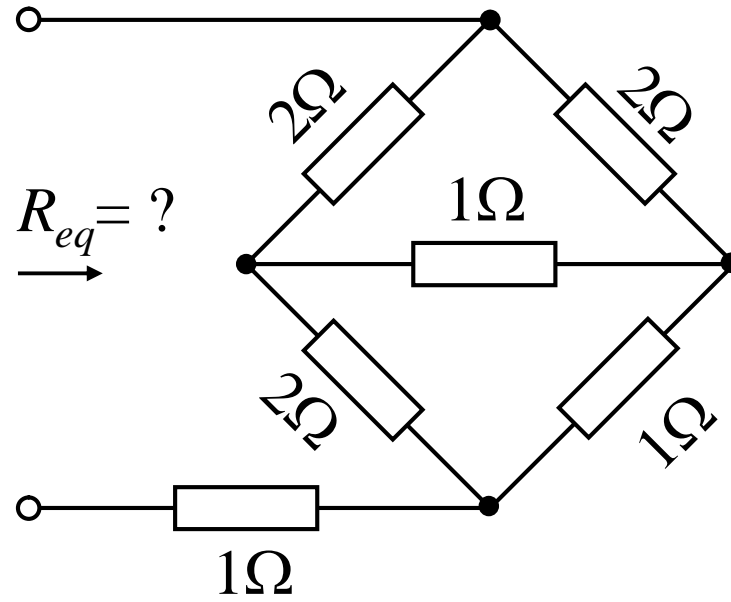$$i_k = \frac{G_k}{G_{eq}} \, i$$

$$i_1 = \frac{R_2}{R_1 + R_2} \, i$$
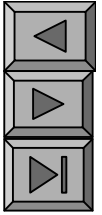
$$i_2 = \frac{R_1}{R_1 + R_2} \, i$$
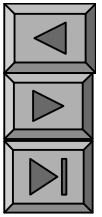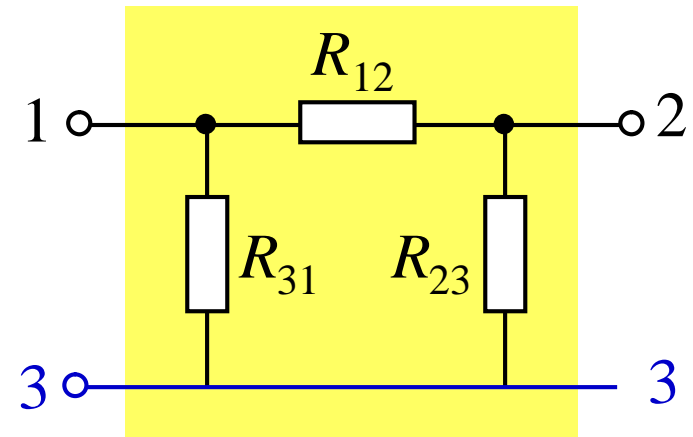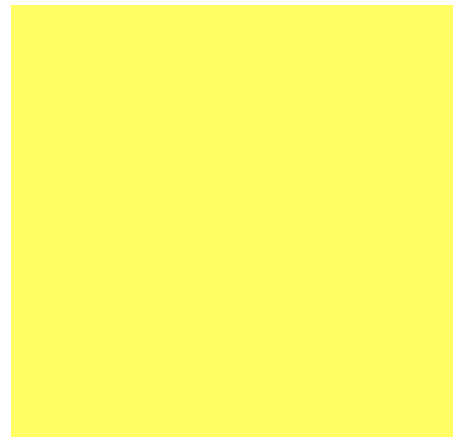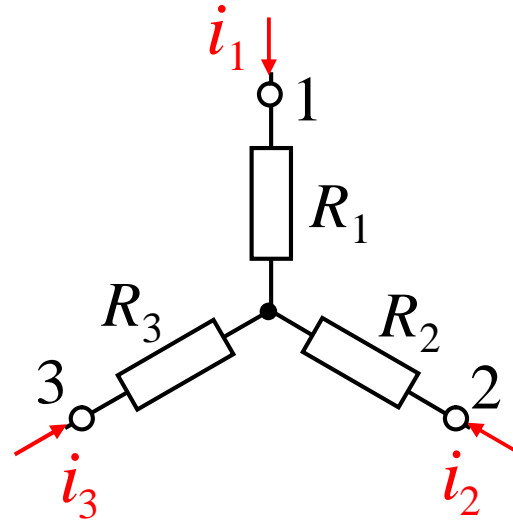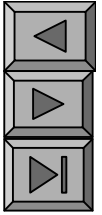
2010 3 3

7.2Ω   6Ω

$R_{eq} \longrightarrow$ 30Ω   64Ω   10Ω

R_{eq} 12Ω

$$\frac{64 \quad 16}{64+16} = 12.8\Omega$$

$$R_{eq} = \frac{30 \quad 20}{30+20} = 12\Omega$$

2 4   Y

1.   ( )

T

2.   ( )

Y 　　　　　KCL

$$i_1' = \frac{u_{12}}{R_{12}} \quad \frac{u_{31}}{R_{31}}$$

$$i_2' = \frac{u_{23}}{R_{23}} \quad \frac{u_{12}}{R_{12}}$$
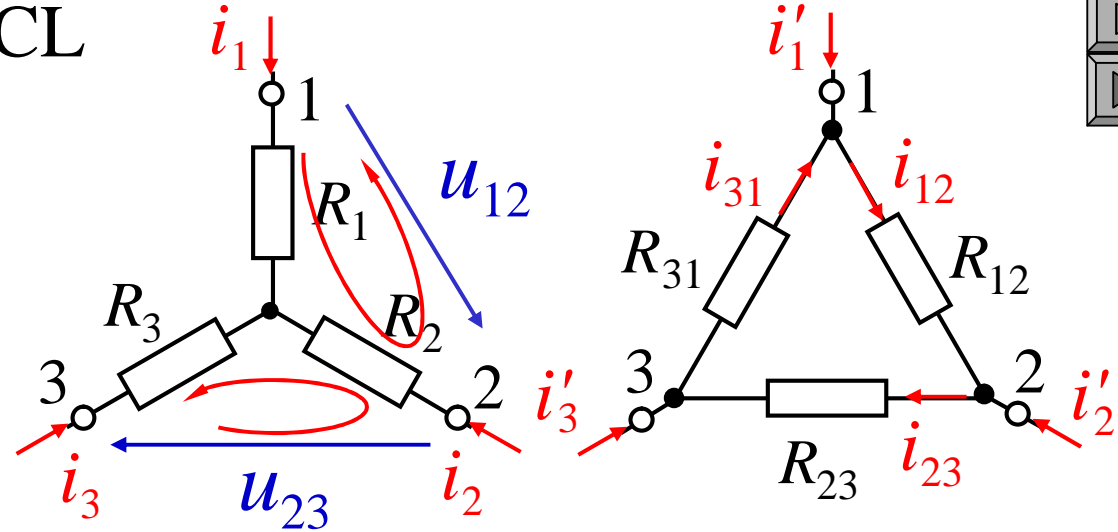
$$i_3' = \frac{u_{31}}{R_{31}} \quad \frac{u_{23}}{R_{23}}$$

Y 　 KCL 　 KVL

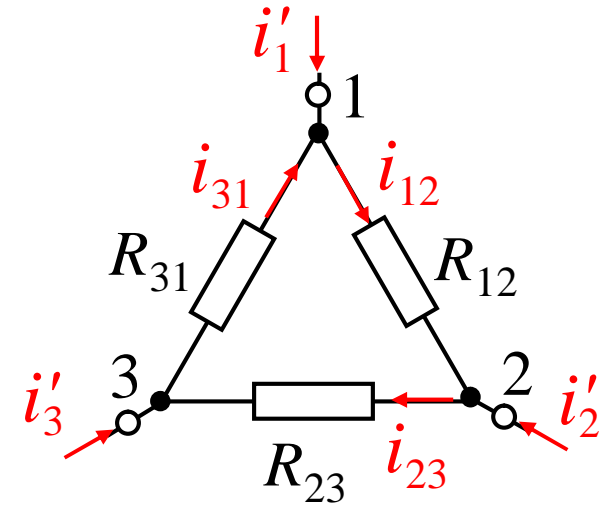$$\begin{cases} i_1 + i_2 + i_3 = 0 \\ R_1 i_1 \quad R_2 i_2 = u_{12} \\ R_2 i_2 \quad R_3 i_3 = u_{23} \end{cases}$$

$$i_1 = \frac{R_3\, u_{12} \quad R_2\, u_{31}}{R_1 R_2 + R_2 R_3 + R_3 R_1}$$

$$i_2 = \frac{R_1\, u_{23} \quad R_3\, u_{12}}{R_1 R_2 + R_2 R_3 + R_3 R_1}$$

$$i_3 = \frac{R_2\, u_{31} \quad R_1\, u_{23}}{R_1 R_2 + R_2 R_3 + R_3 R_1}$$
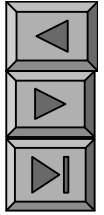
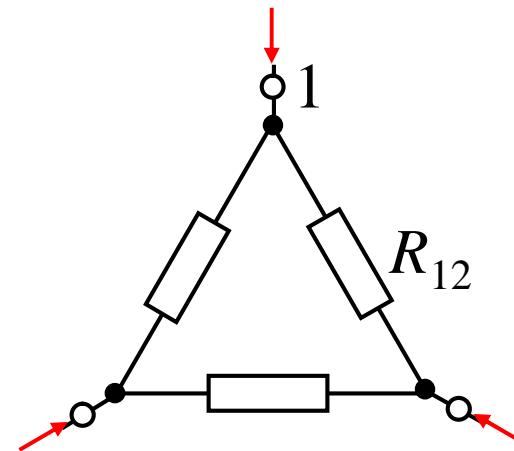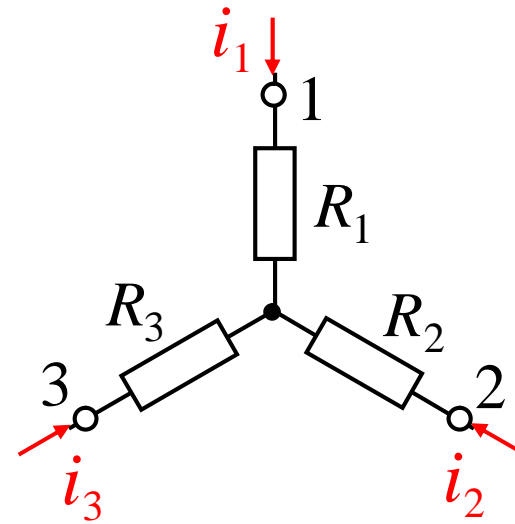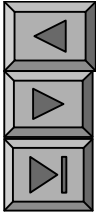$$i_1' = \frac{u_{12}}{R_{12}} \qquad \frac{u_{31}}{R_{31}}$$

$$i_2' = \frac{u_{23}}{R_{23}} \qquad \frac{u_{12}}{R_{12}}$$

$$i_3' = \frac{u_{31}}{R_{31}} \qquad \frac{u_{23}}{R_{23}}$$

$$i_1 = \frac{R_3\, u_{12} \qquad R_2\, u_{31}}{R_1\, R_2 + R_2\, R_3 + R_3\, R_1}$$

$$i_2 = \frac{}{R_1\, R_2 + R_2\, R}$$

i_1

1

R_1

R_3 R_2

3   2

i_3 i_2

1

R_{12}

$$\begin{cases} R_{12} = \dfrac{\boxed{R_1 R_2 + R_2 R_3 + R_3 R_1}}{R_3} = \dfrac{R_{12}R_3}{} = R_{23}R_1 = \dfrac{R_{31}R_2}{} \\[2mm] + \\ R_{23} = \dfrac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1} \\[2mm] + \\ R_{31} = \dfrac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_2} \end{cases}$$

$$R_{12} + R_{23} + R_{31} = \dfrac{R_{31} \qquad R_{12}}{R_1}$$

$$R_1 \qquad R_3$$

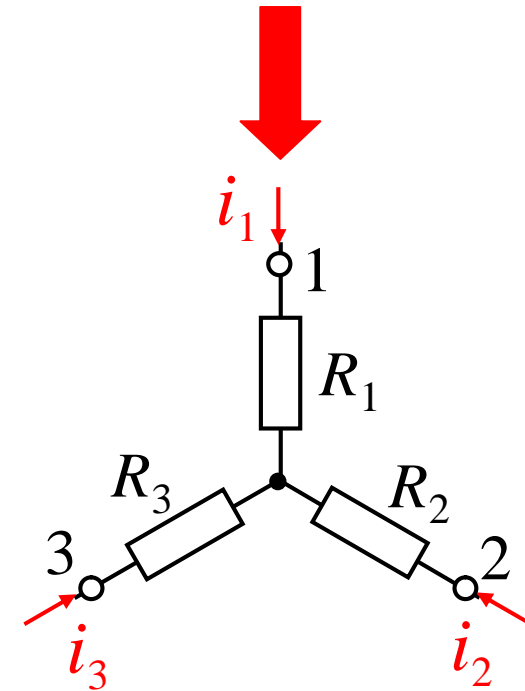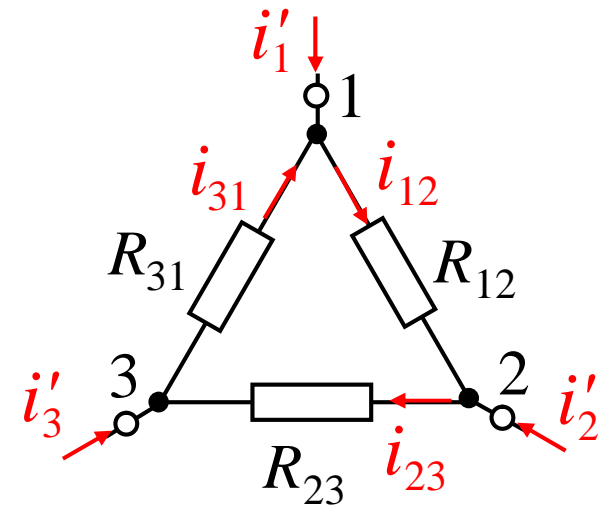$$R_1 = \dfrac{R_{12}R_{31}}{R_{12} + R_{23} + R_{31}}$$

R_2　R_3
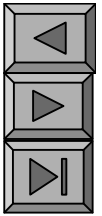
$$R_1 = \frac{R_{12}R_{31}}{R_{12} + R_{23} + R_{31}}$$

$$R_2 = \frac{R_{23}R_{12}}{R_{12} + R_{23} + R_{31}}$$

$$R_3 = \frac{R_{31}R_{23}}{R_{12} + R_{23} + R_{31}}$$

$$R_Y = \frac{R}{R}$$
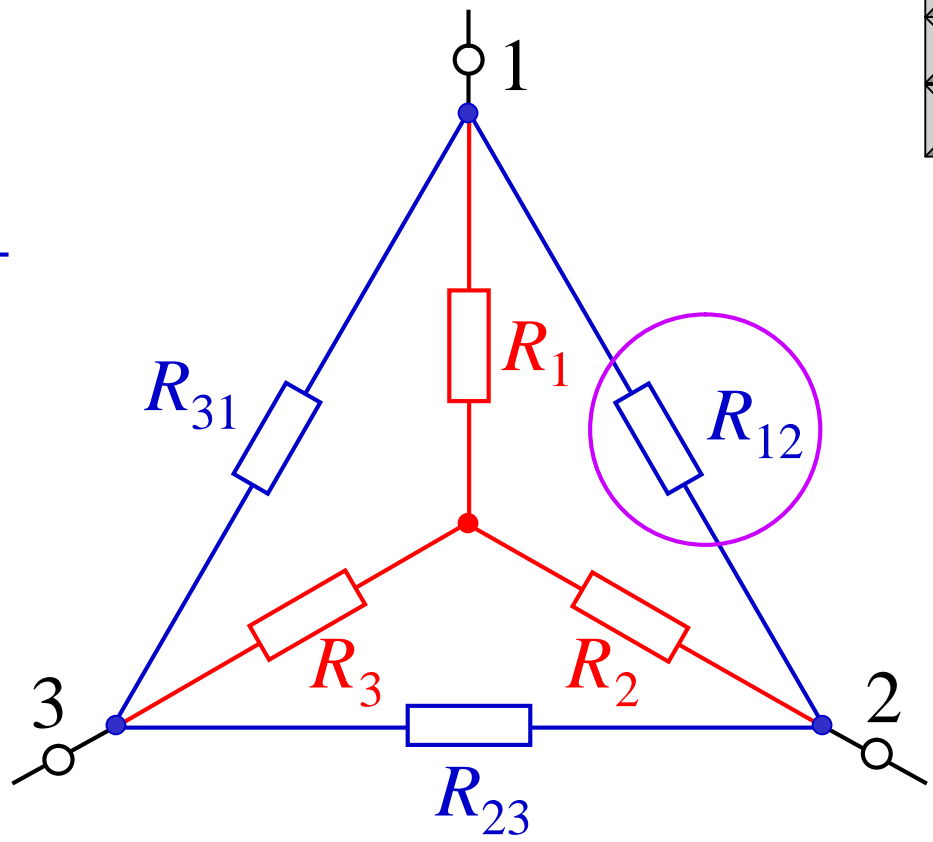
Y —

（　）

2010　3　3

$$R\ = \frac{\mathrm{Y}\quad R}{\mathrm{Y}\qquad R}$$

$$R_1 R_2 + R_2 R_3 + R_3 R_1$$

$$R_{12} \text{——} R_3$$
$$R_{23} \text{——} R_1$$
$$R_{31} \text{——} R_2$$

$$R_{\mathrm{Y}} = \frac{R}{\underbrace{R}_{R_{12} + R_{23} + R_{31}}}$$
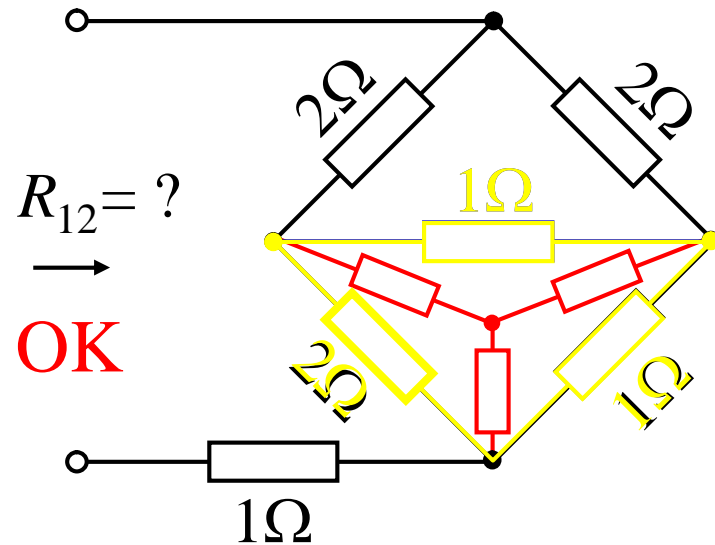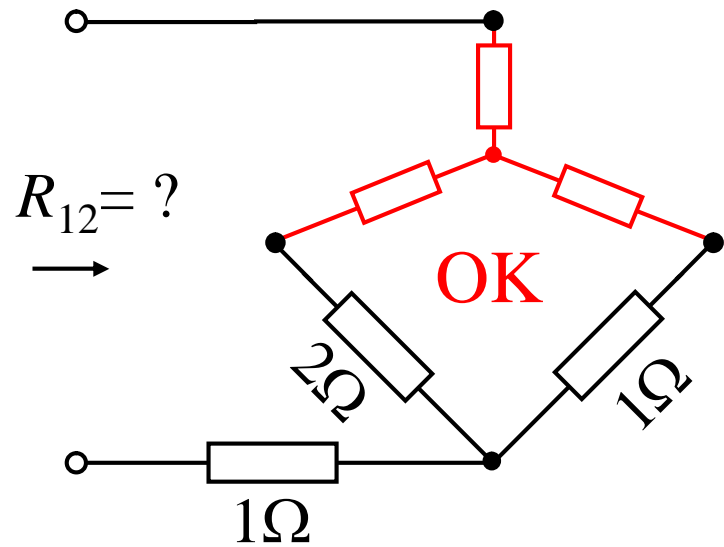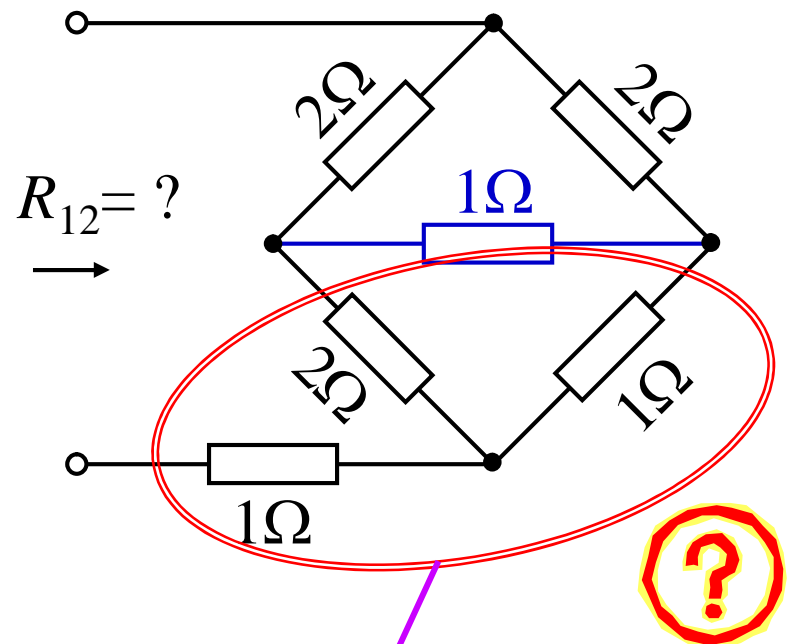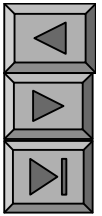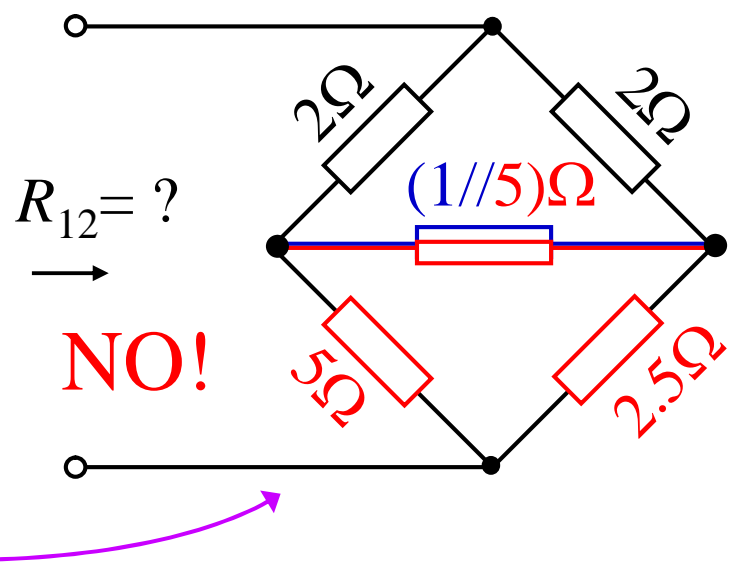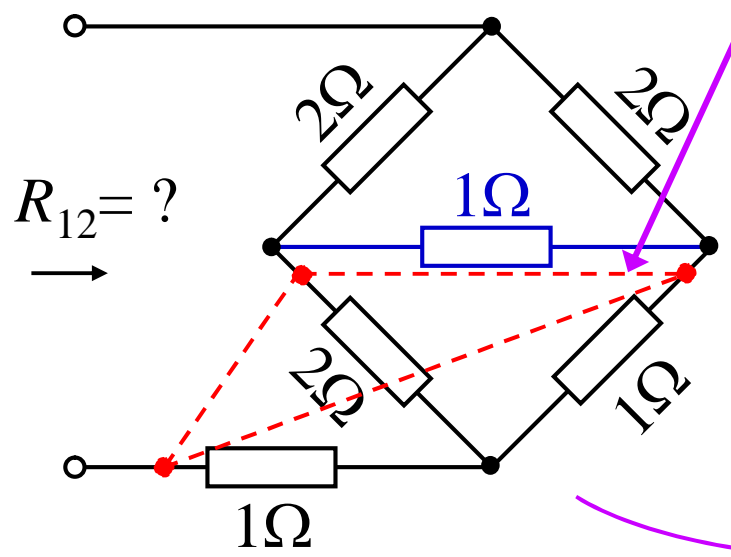
$$R_1 \text{——} R_{12} R_{31}$$
$$R_2 \text{——} R_{23} R_{12}$$
$$R_3 \text{——} R_{31} R_{23}$$

P39   2–2

$R_{12}= ?$

OK

2Ω

1Ω

1Ω

$R_{12}= ?$

OK

2Ω

2Ω

1Ω

2Ω

1Ω

1Ω

$R_{12}= ?$

2Ω

2Ω

1Ω

2Ω

1Ω

1Ω

$R_{12}= ?$

OK

2Ω

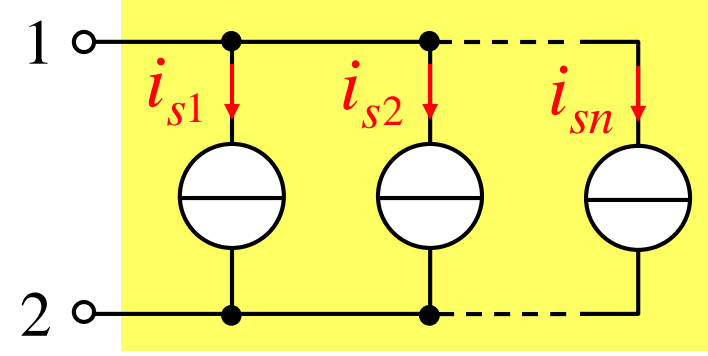2Ω

2Ω

1Ω

1Ω

2010   3   3

2010
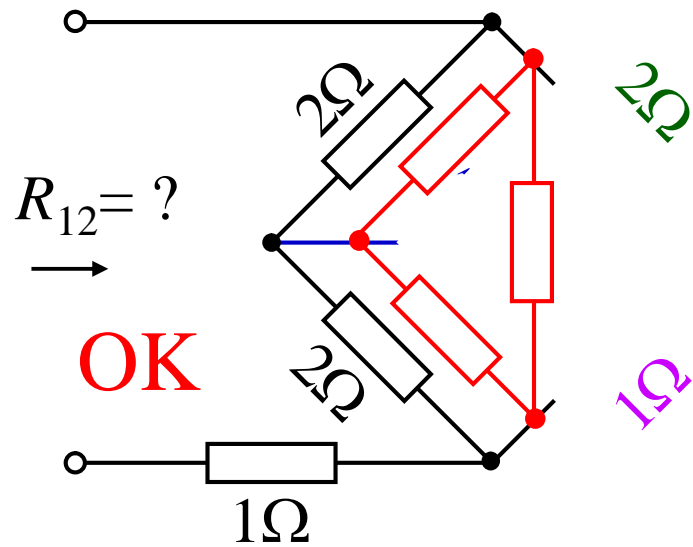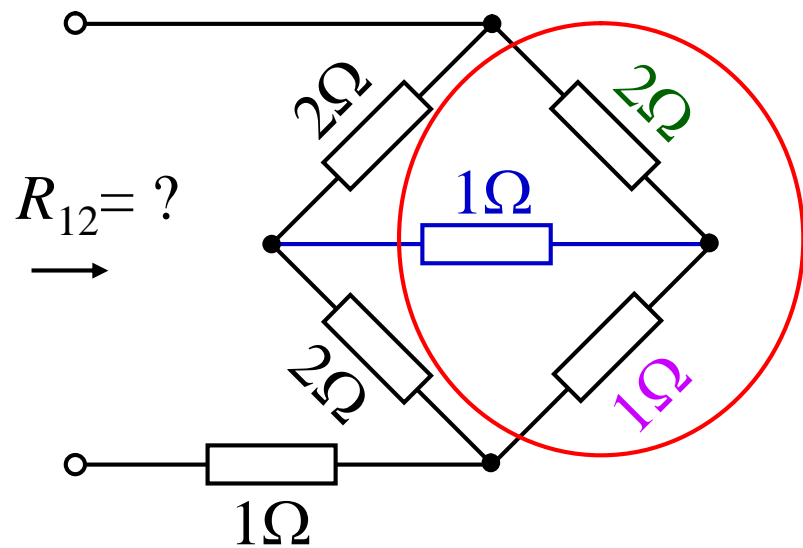
2. n
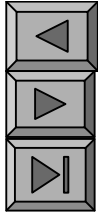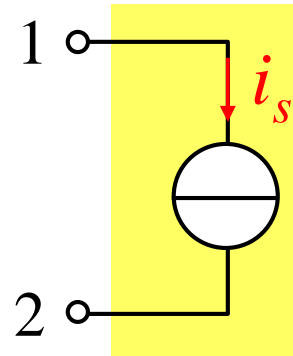
$$i_s = \sum_{k=1}^{n} i_{sk}$$

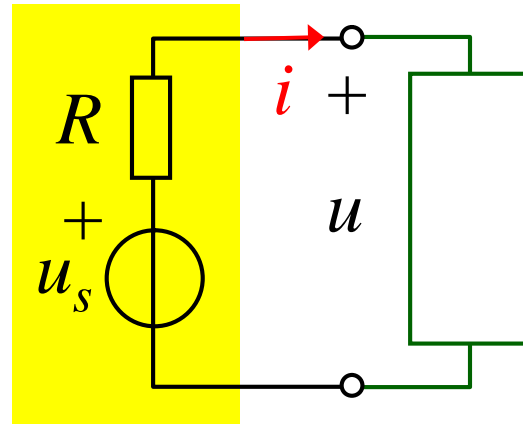i_{sk} i_s

i_{sk} "+"   " "

- _____

- _____
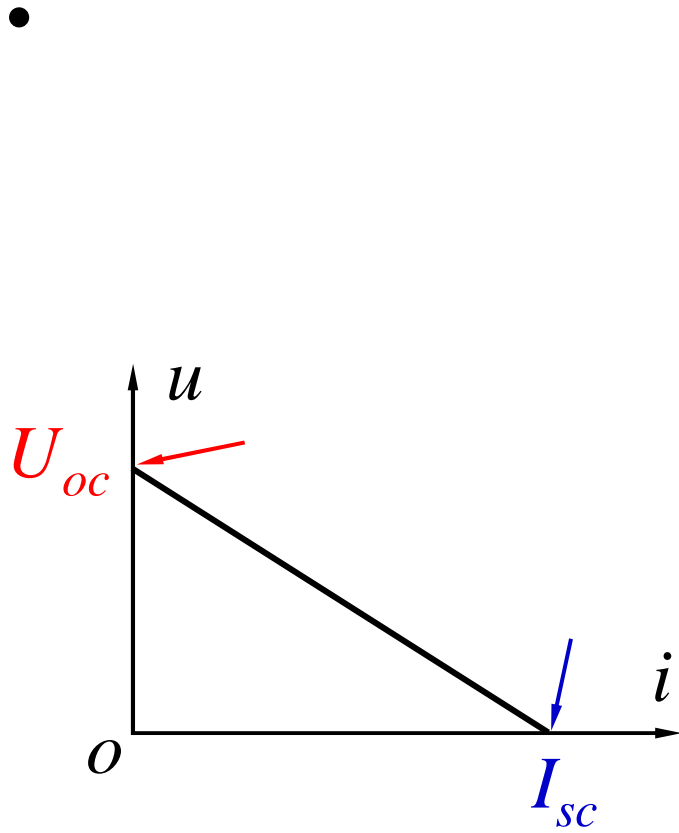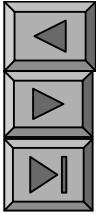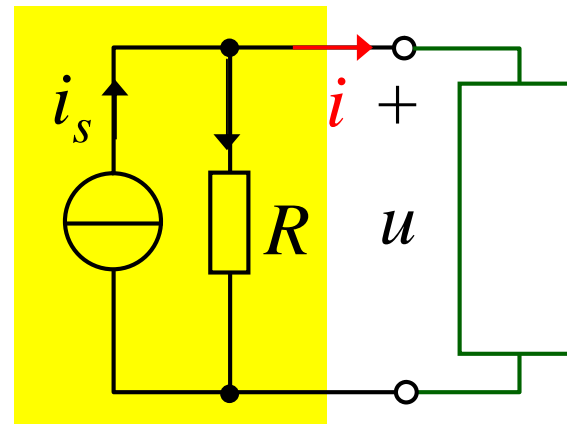
- KVL   KCL

$u = u_s - Ri$

$u_{oc} = u_s$

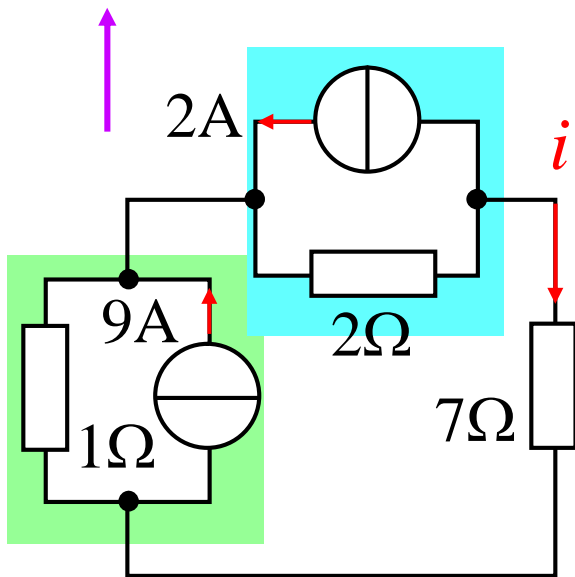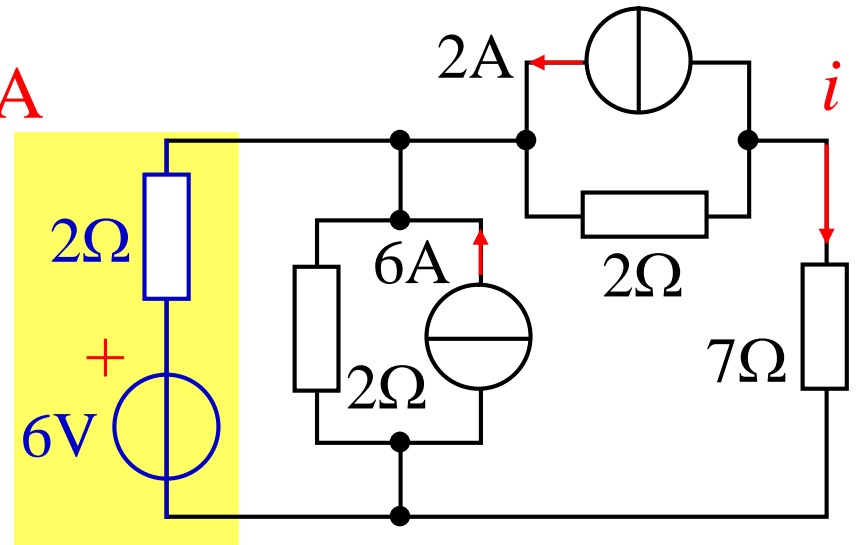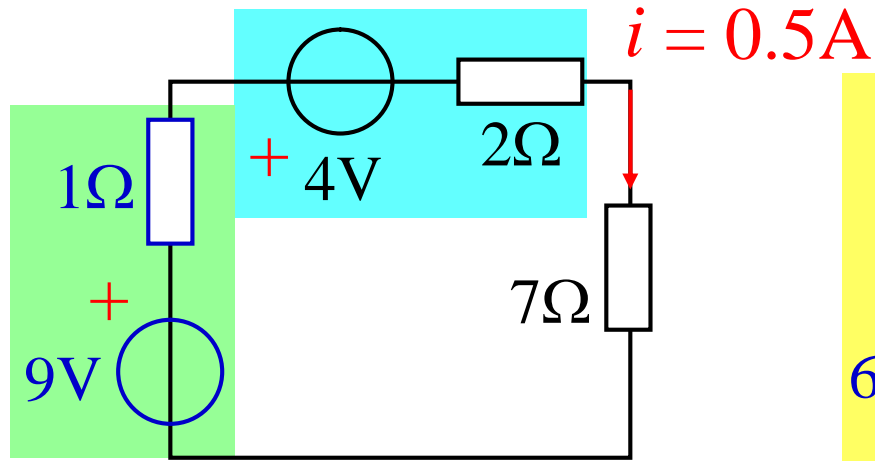$i_{sc} = \dfrac{u_s}{R}$

$i_s = \dfrac{u_s}{R}$ $u_s = i_s R$

$i = i_s - \dfrac{1}{R}u$

$u_{oc} = i_s R$

$i_{sc} = i_s$

P43–44   2–3

$i = 0.5\text{A}$

1Ω +4V 2Ω

9V 7Ω

2Ω 2A i

6A 2A

6V 2Ω 2Ω 7Ω

2A i

9A

1Ω 2Ω 7Ω

2A i

3A 6A

2Ω 2Ω 2Ω 7Ω

2010 3 3
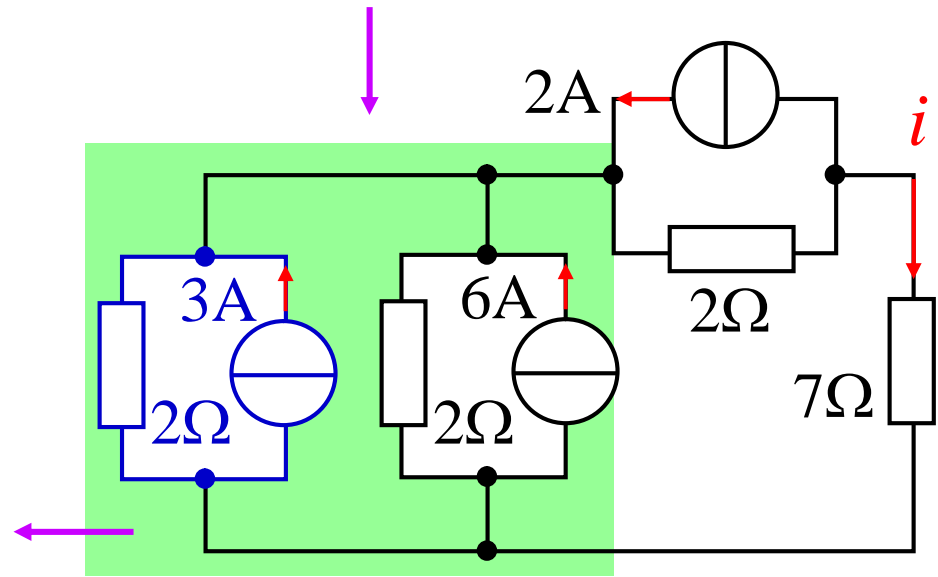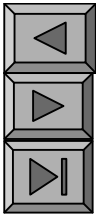
P45　2–4　u_s=12V　R =2Ω　g =2 S

$u_{R.}$
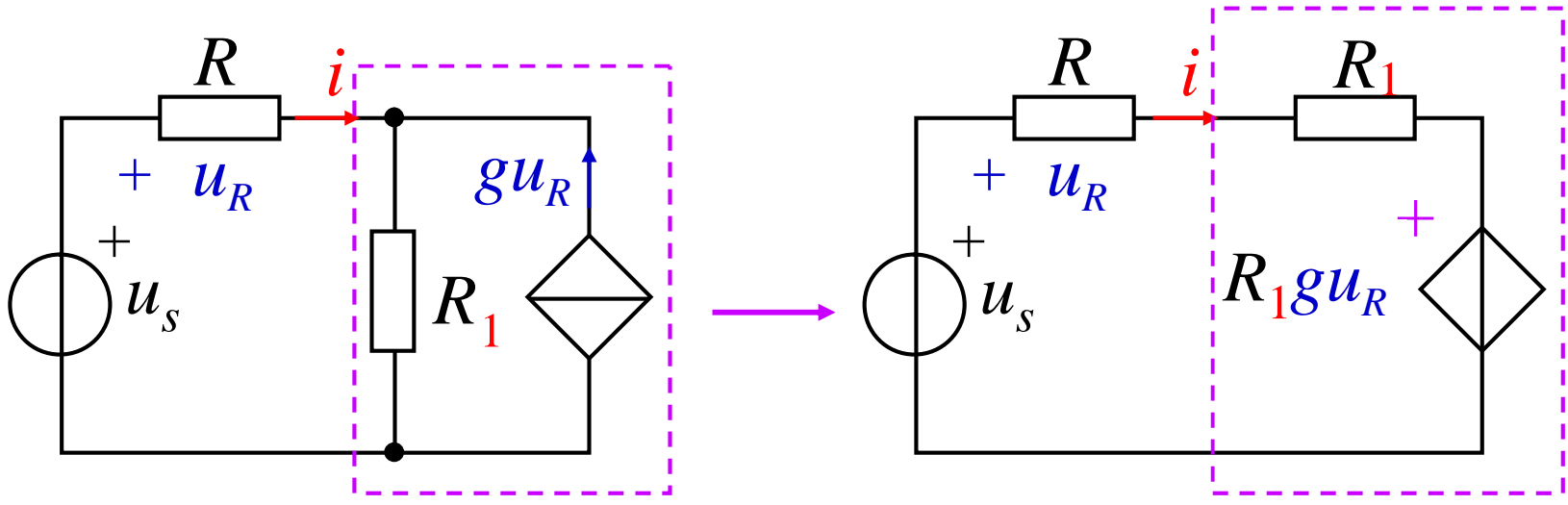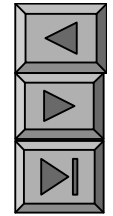
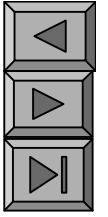$$u_s = u_R + u_R + Rgu_R$$

$$u_R = \frac{u_s}{2 + Rg}$$

$$= \frac{12}{2 + 2 \quad 2}$$

$$= 2V$$

$$i = \frac{u_R}{R}$$
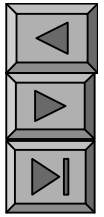
$$u_s = u_R + \frac{u_R}{R} R_1 + R_1 gu_R$$

1.   *4*
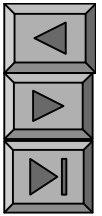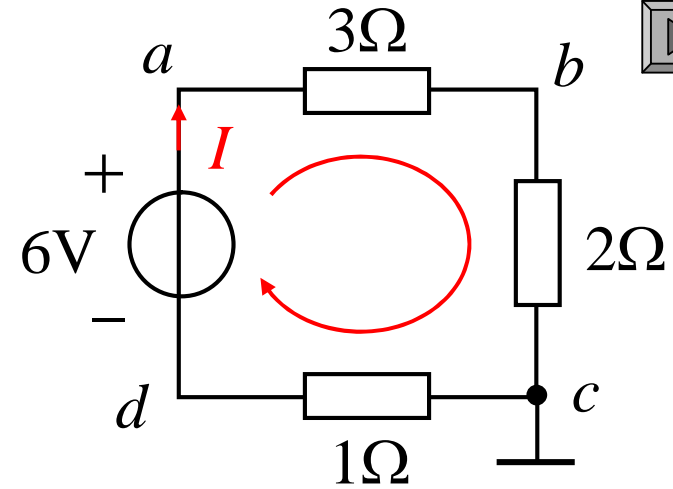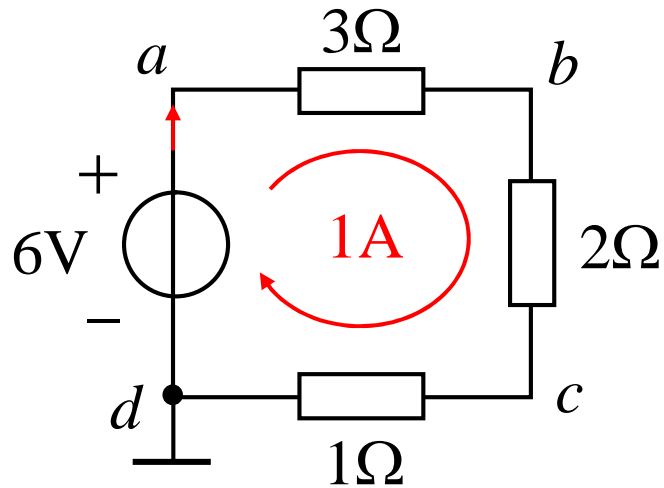
(1)

(2)

(3)

(4)

q

①

②

③

c

$U_C = 0$ $\qquad\qquad I = 1\text{A}$

$U_a = 5\text{V}, \quad U_b = 2\text{V}, \quad U_d = -1\text{V}$

d

a $\quad 3\Omega \quad$ b

I

6V $\quad 2\Omega$

d $\qquad c$

1Ω

$U_d = 0 \qquad U_a = 6\text{V},$

$U_C = 1\text{V}, \quad U_b = 3\text{V},$

a $\quad 3\Omega \quad$ b

6V $\quad 1\text{A} \quad 2\Omega$

d $\qquad c$

1Ω

2. *—Y*

$($ $)$

3.

n

n

4.

VCR
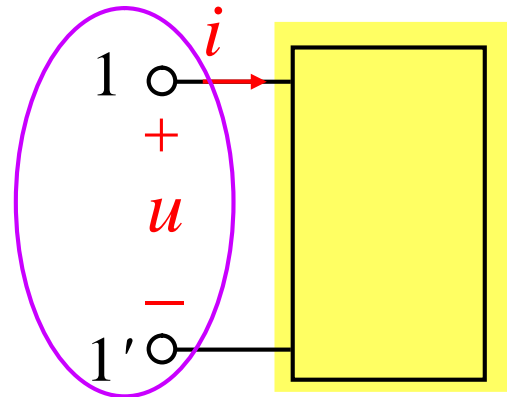
2 7
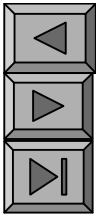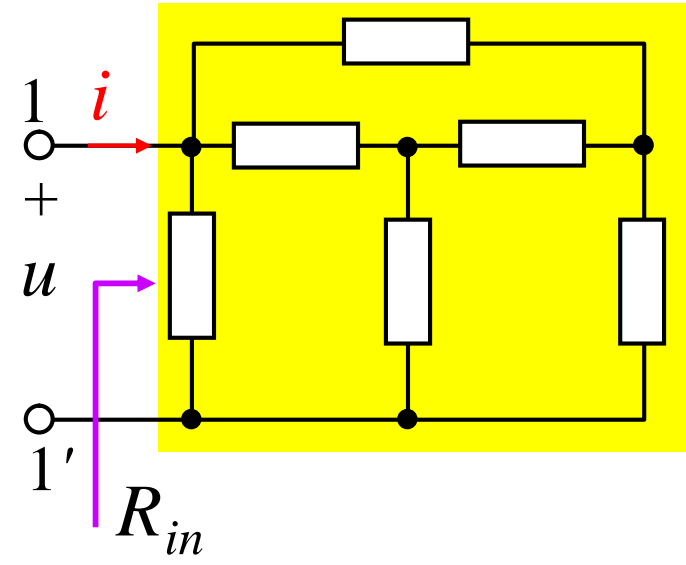
Y

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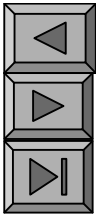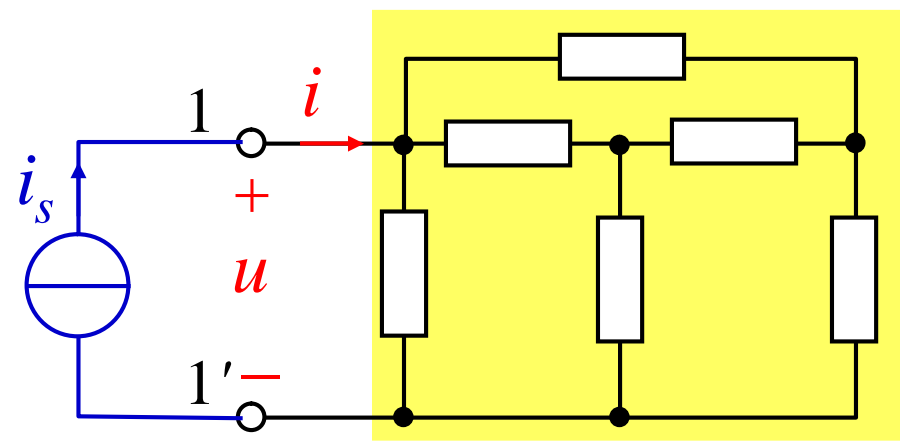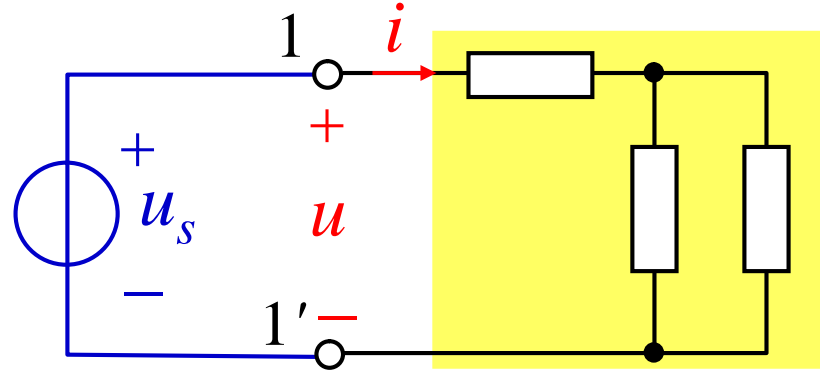
$$R_{in} \stackrel{\text{def}}{=\!=\!=} \frac{u}{i}$$
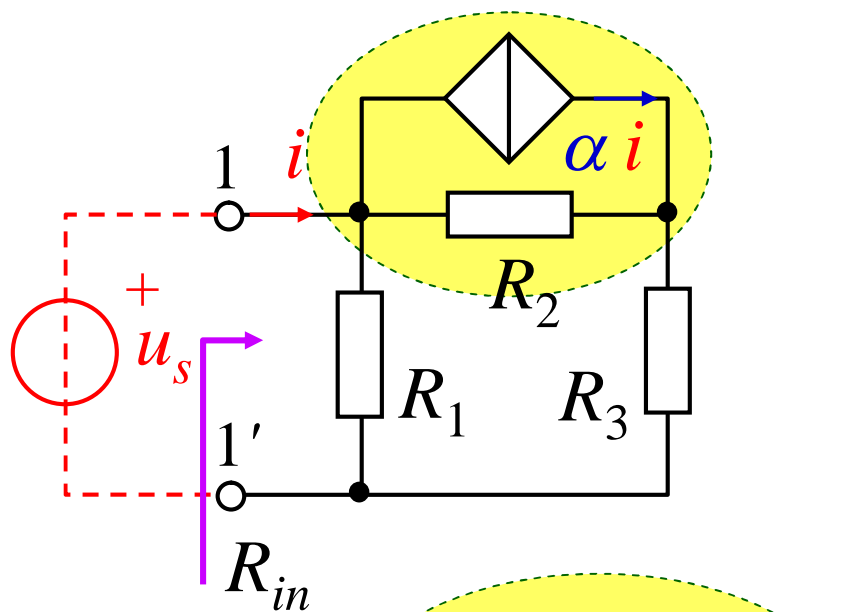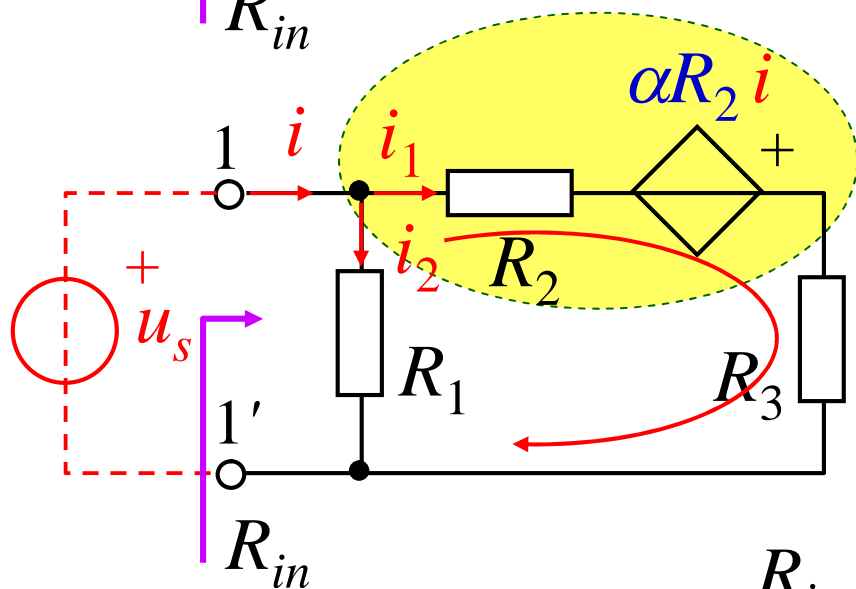
• R_{in} R_{eq}

$$u_s = -\alpha R_2 i + (R_2 + R_3) i_1$$

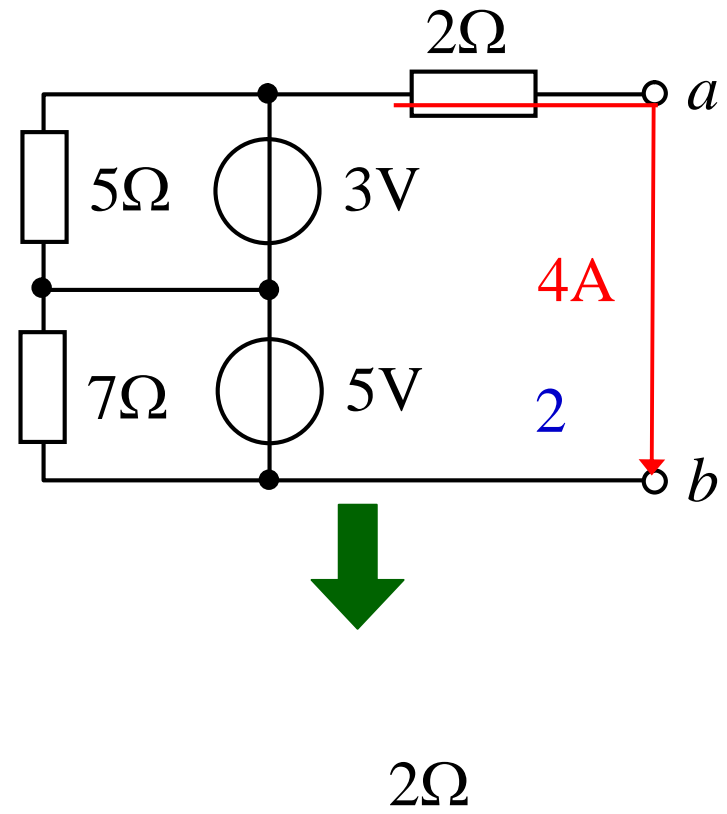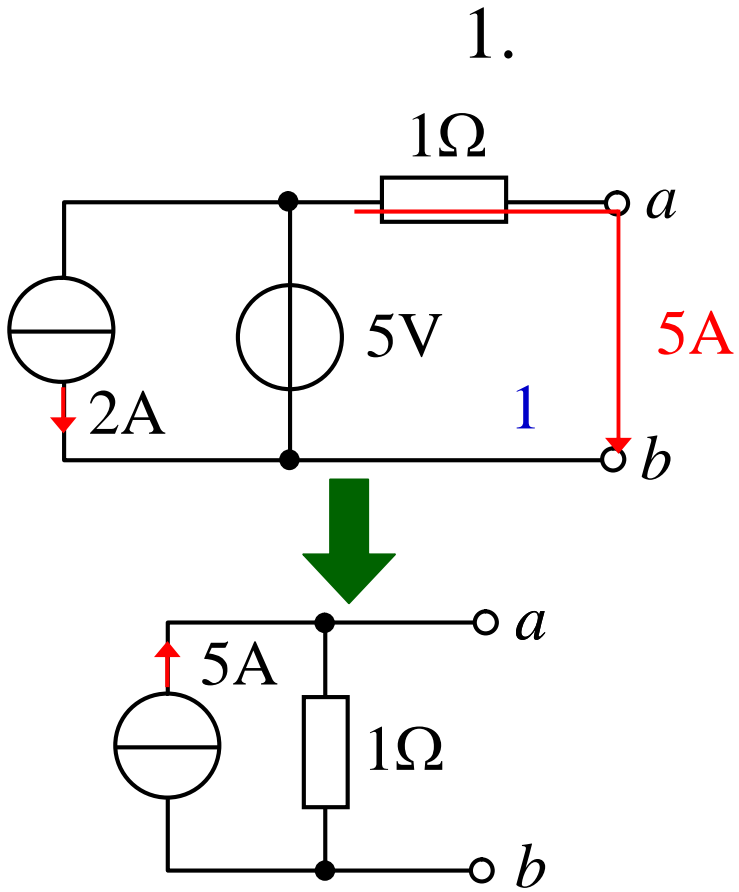$$i_2 = \frac{u_s}{R_1}$$

$$i_1 = i - i_2 = i - \frac{u_s}{R_1}$$

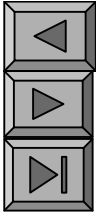
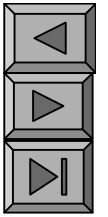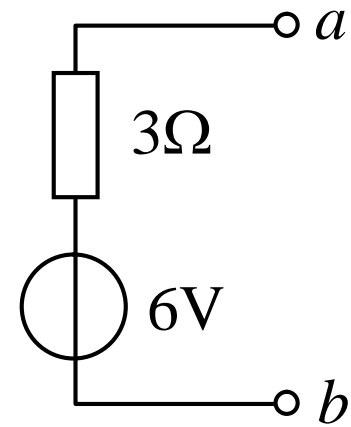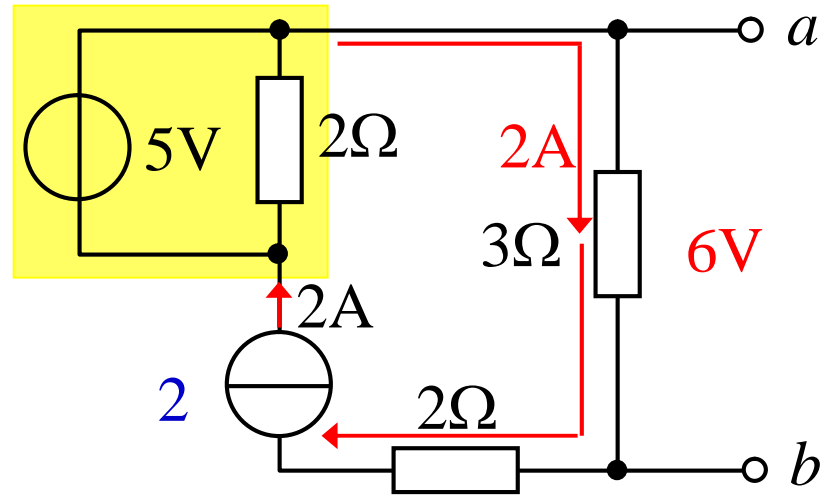
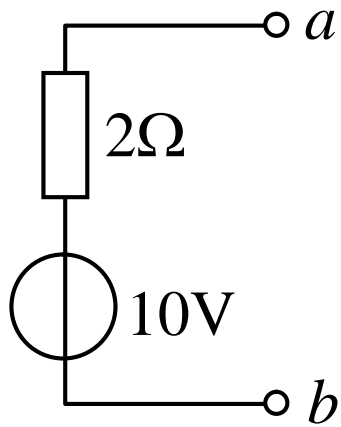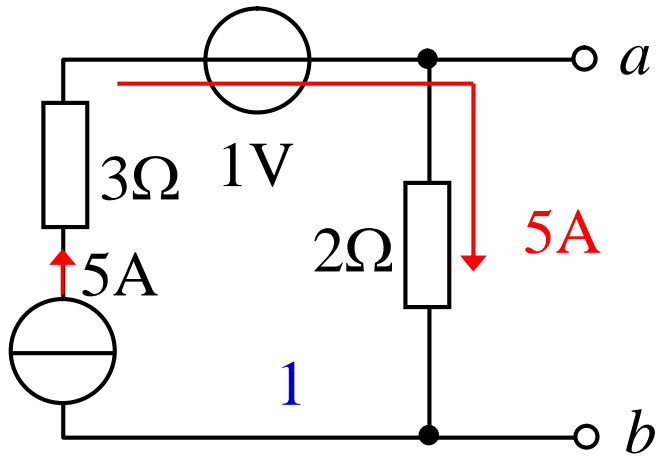$$u_s = -\alpha R_2 i + (R_2 + R_3)(i - \frac{u_s}{R_1})$$

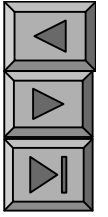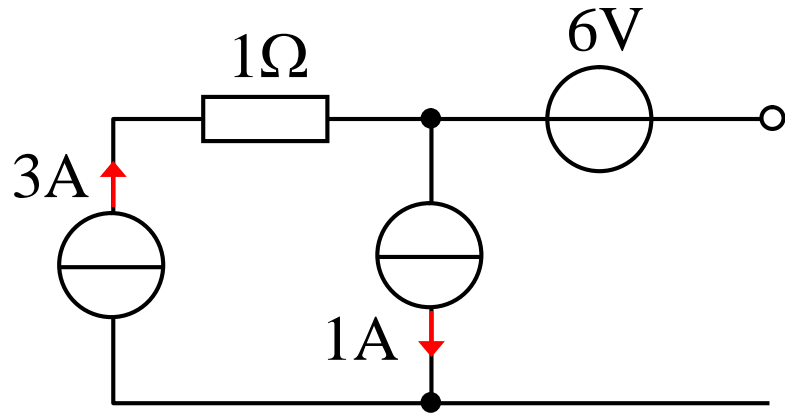$$u_s + \frac{(R_2 + R_3)}{R_1} u_s$$

$$= -\alpha R_2 i + (R_2 + R_3) i$$

$$R_{in} = \frac{u_s}{i} = \frac{(R_1 R_3) + (1 - \alpha) R_1 R_2}{R_1 + R_2 + R_3}$$

2010 3 3
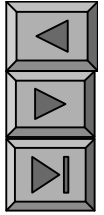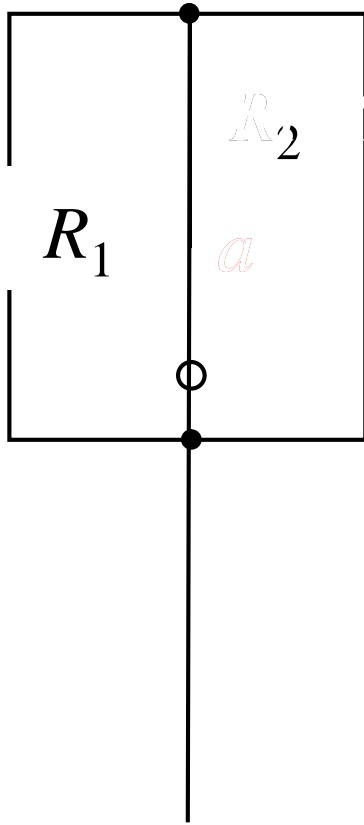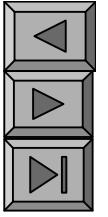
1.

1Ω

5V

2A

5A

1

a

b

5A

1Ω

a

b

2Ω

5Ω **3V**

7Ω **5V**

4A

2

a

b

2Ω

2.

3.

$\underline{\hspace{2cm}}$　　2–4　　(e)

$\underline{\hspace{2cm}}$　　2–4　　(g)

$\underline{\hspace{2cm}}$　　2　10

R_1

R_2

a

M $\quad R \quad 12$
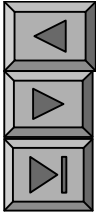
b

MN

a

N

ab
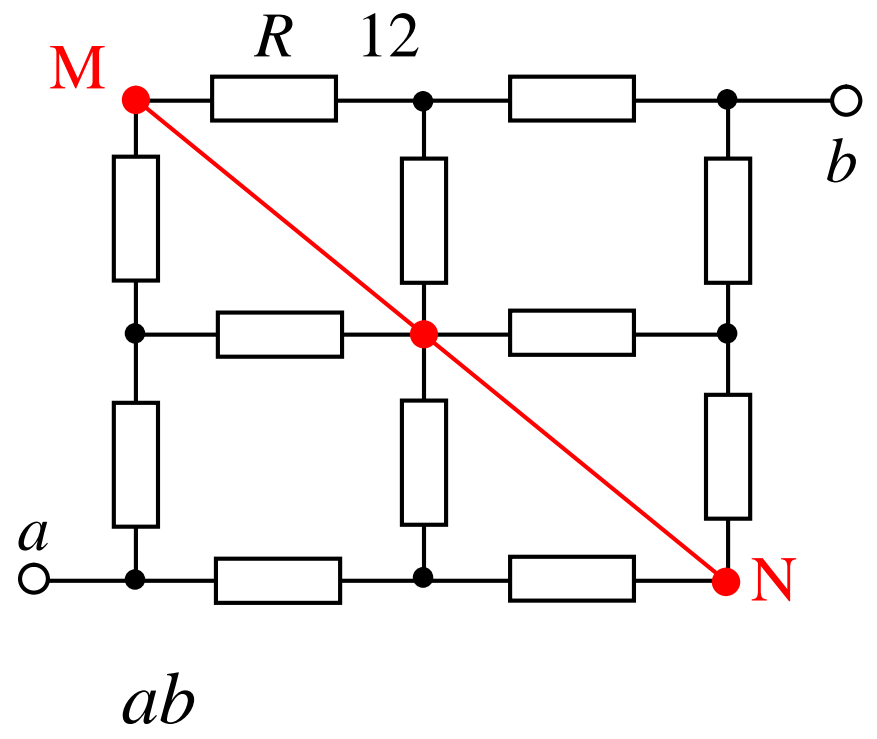
$$\frac{R_{ab}}{2} = \left(\frac{R}{2} + R\right) // \left(\frac{R}{2} + R\right)$$

$$R_{ab} = \left(\frac{R}{2} + R\right) = \frac{3}{2}R$$

$$R = 2\Omega \qquad R_{ab} = 3\Omega$$
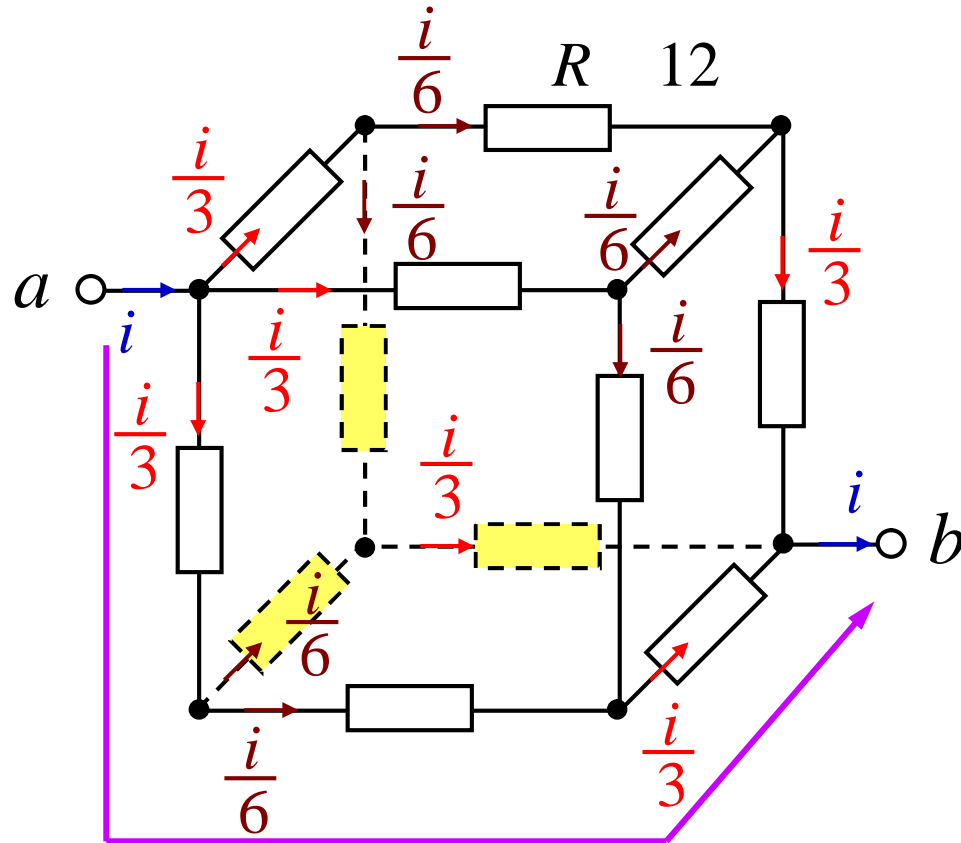
KVL

$$U_{ab} = \frac{i}{3}R + \frac{i}{6}R + \frac{i}{3}R$$

$$R_{ab} = \frac{u_{ab}}{i}$$
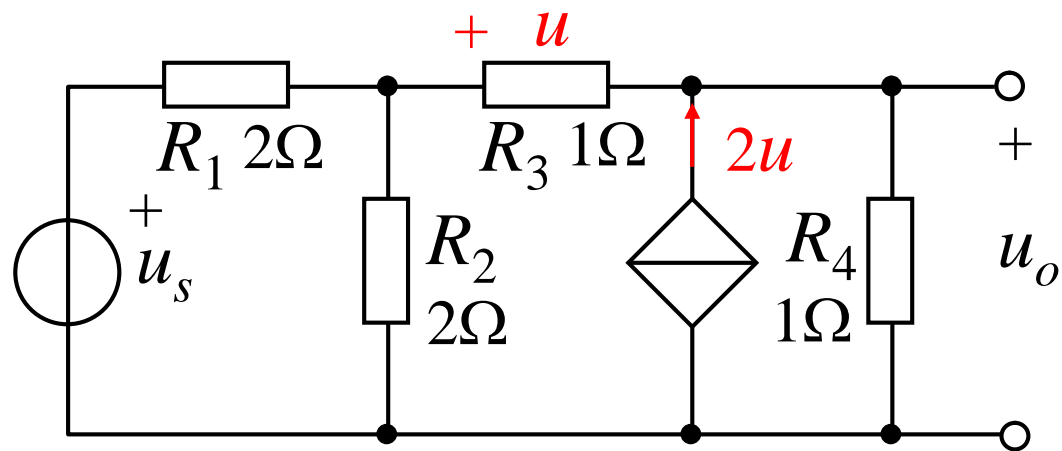
$$= \frac{1}{3}R + \frac{1}{6}R + \frac{1}{3}R$$

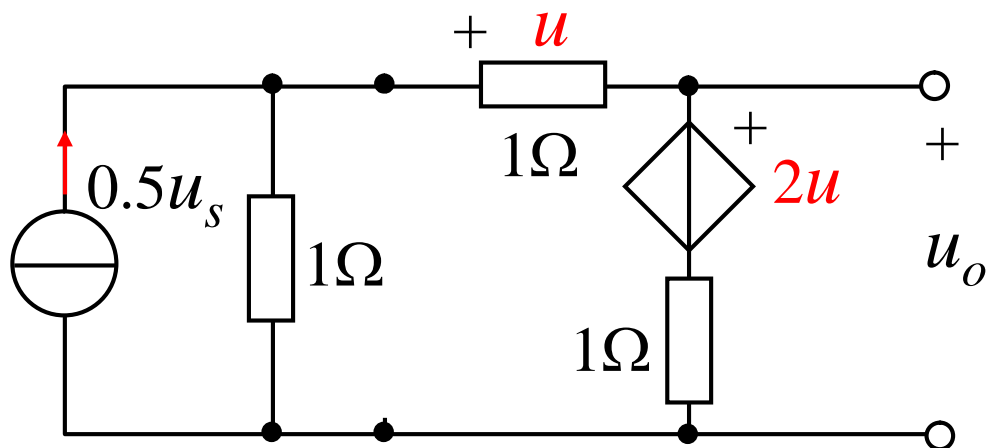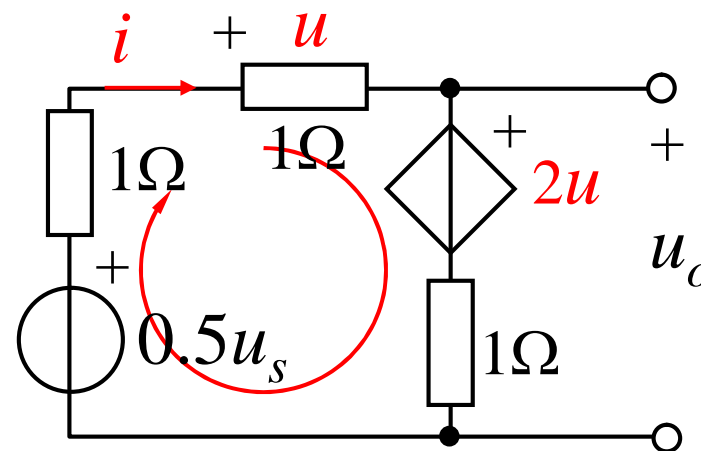$$= \frac{5}{6}R$$

$R=2\Omega$

R_{ab} 1.667Ω

( )

$u=1$ $i=i$

$3u+2u=0.5u_s$

$u=0.1u_s$

$R_1\ 2\Omega$ $+\ u$ $R_3\ 1\Omega$ $2u$ $R_4\ 1\Omega$

$R_2\ 2\Omega$

u_s u_o

$u_o=2u+u=3\quad 0.1u_s$

$u_o/u_s=0.3$