山东理工大学
Shandong University of Technology

电 路

任课教师：魏佩瑜教授
电工电子教研室

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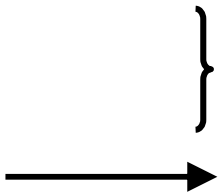

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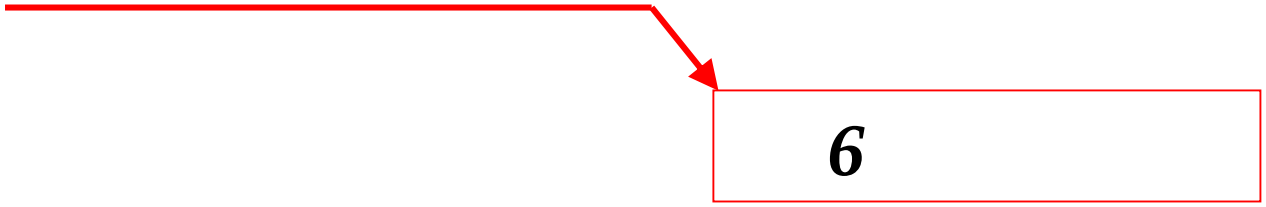
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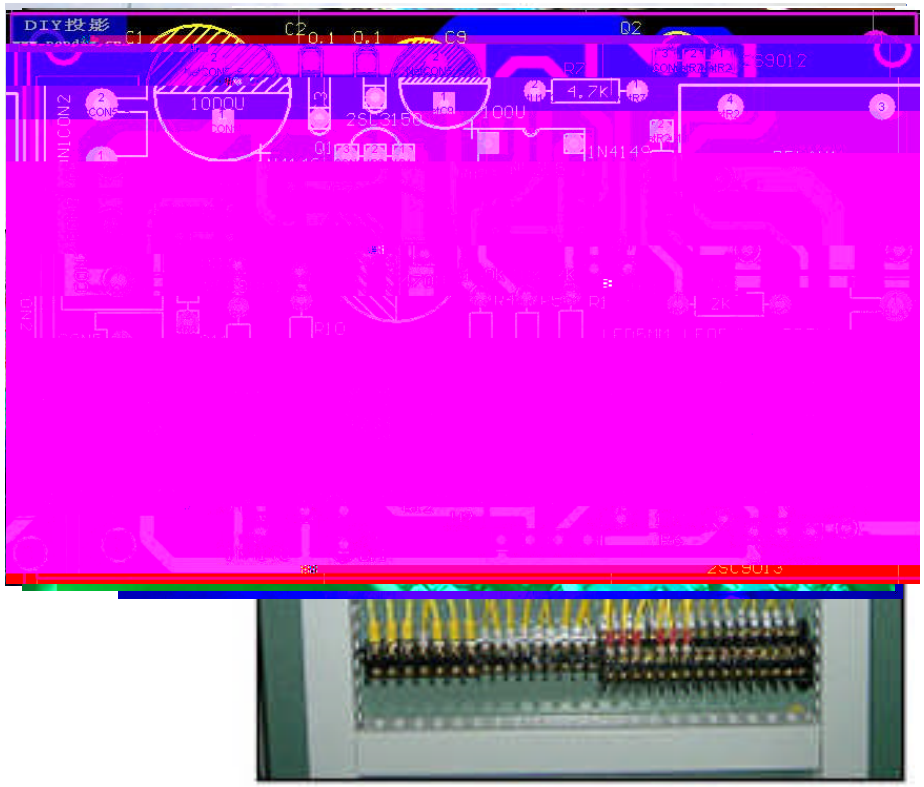

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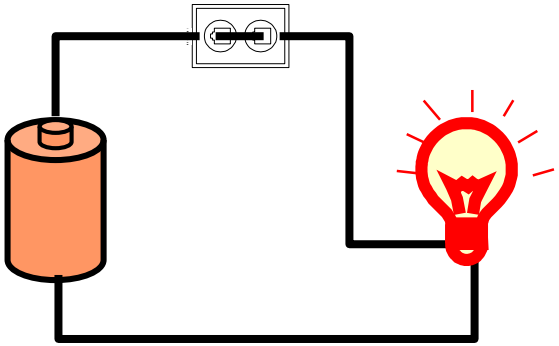

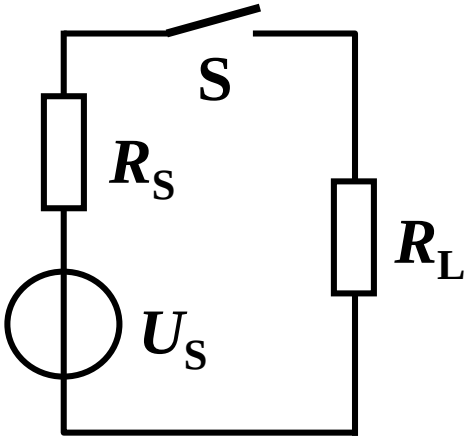

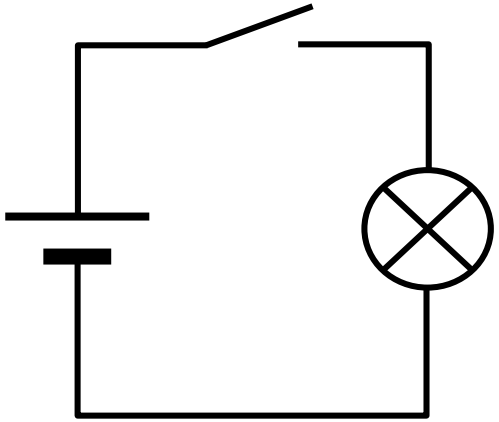

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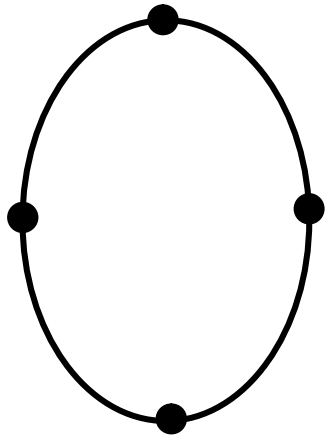

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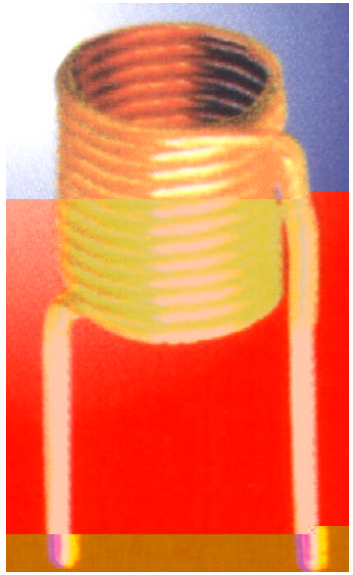

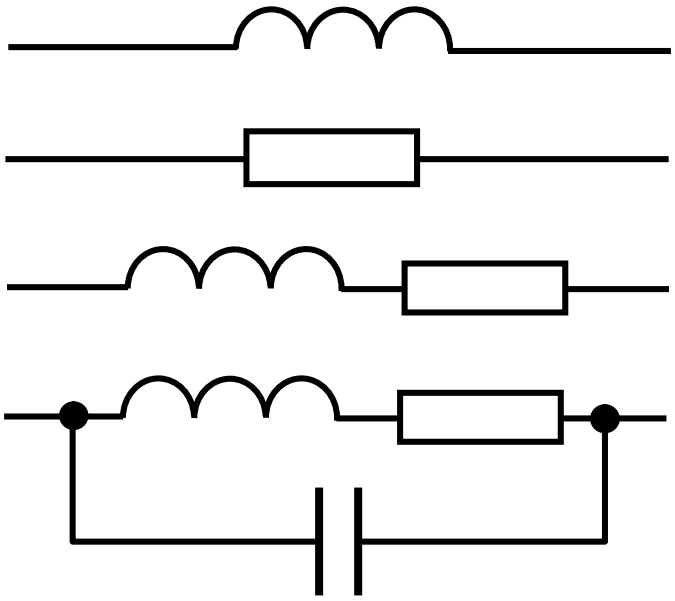

1 2

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$$i(t) \overset{\text{del}}{=\!=} \lim_{t \to 0} \frac{q(t)}{t} \quad \frac{\mathrm{d}q(t)}{\mathrm{d}t}$$

- A ( ) kA mA A

1kA=10^{3}A 1mA=10 A 1 A=10 A

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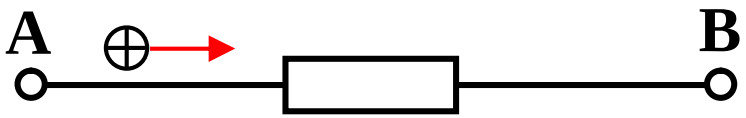
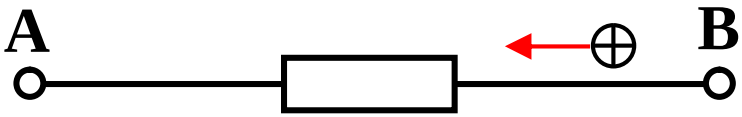
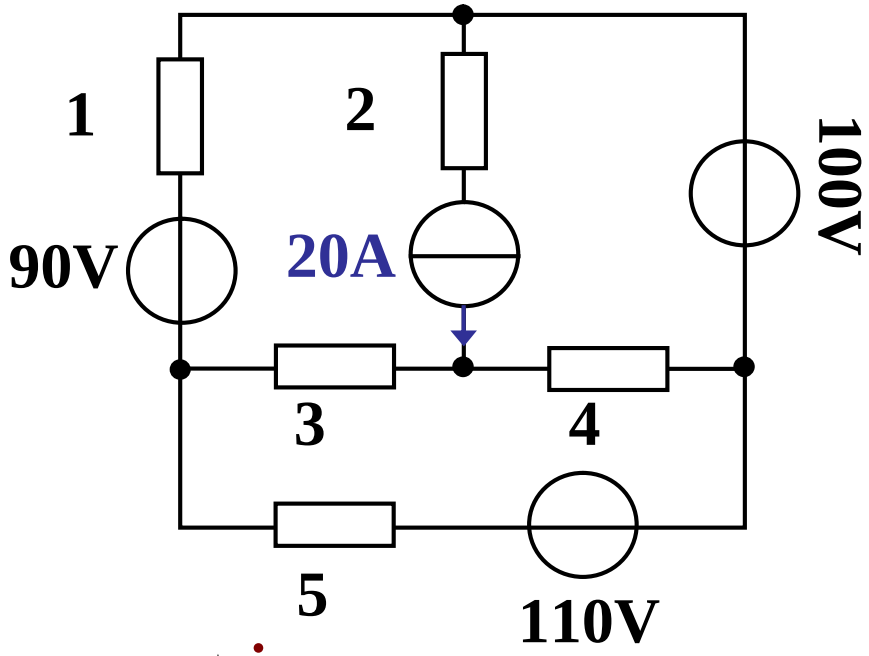
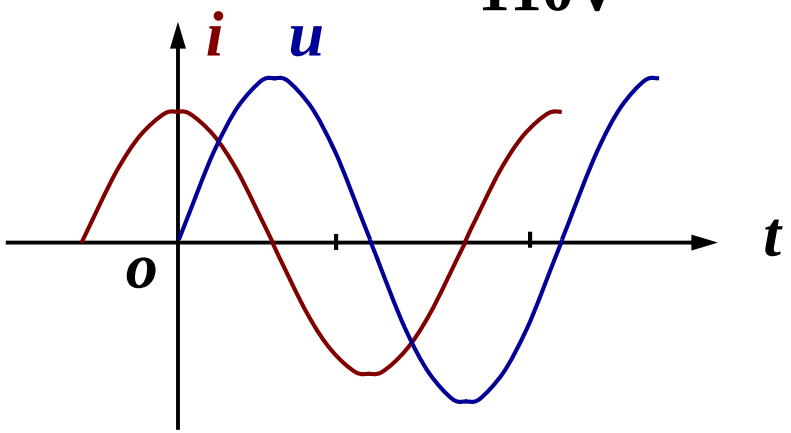

A
B


A
B


1
2
100V
90V
20A
3
4
5
110V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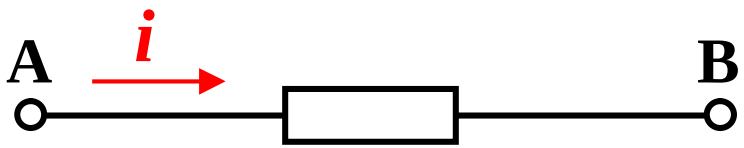
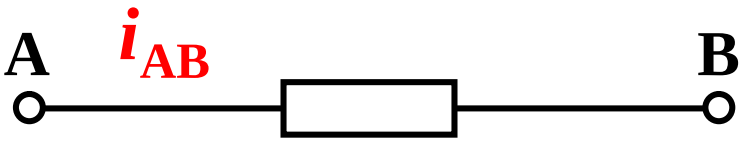
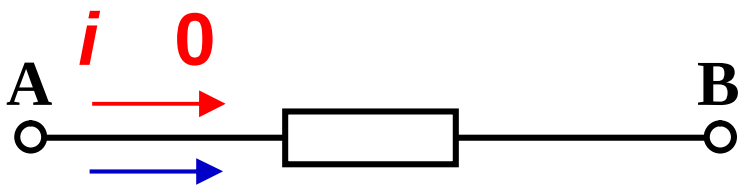
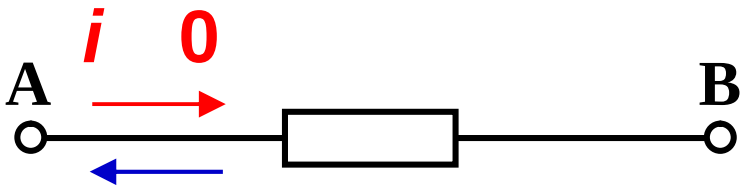








( )

( )

i_{AB}

A B

2.

- ***q***

  (=0)

- ***U*** ***q***

  (W)

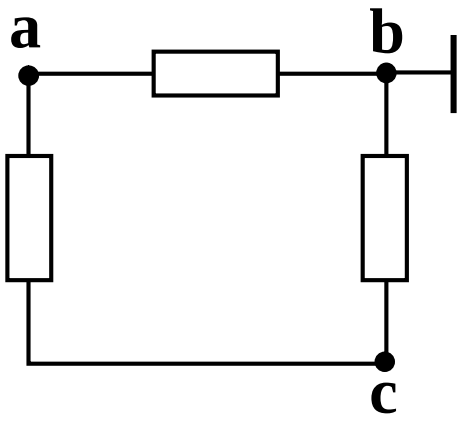
$$U \overset{\text{del}}{=\!=} \frac{\mathrm{d}W}{\mathrm{d}q}$$

- **V ( ) kV mV V**

4C a

b 8J b c

12J



(1) b a b c

U_{ab} U_{bc}

(2) c

(1) b 0

a $\frac{W_{ab}}{q}$ $\frac{8}{4}$ 2V

c $\frac{W_{cb}}{q}$ $\frac{W_{bc}}{q}$ $\frac{12}{4}$ 3V

U_{ab} a b

2 0 2V

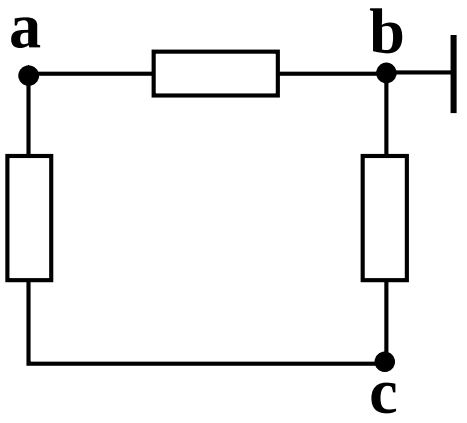
U_{bc} b c

0 3V

4C a

b 8J b c

12J



(1) b a b c

U_{ab} U_{bc}

(2) c

(2) $_c$ 0

$_a$ $\frac{W_{ac}}{q}$ $\frac{(8\ \ 12)}{4}$ 5V

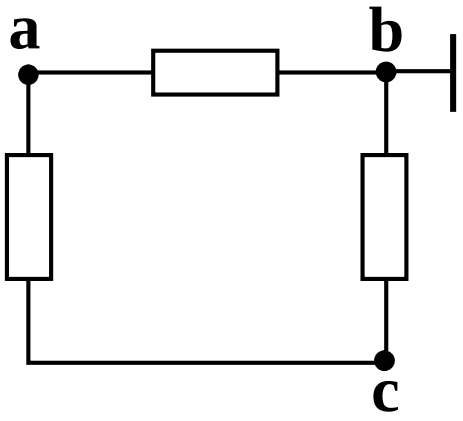
$_b$ $\frac{W_{bc}}{q}$ $\frac{12}{4}$ 3V

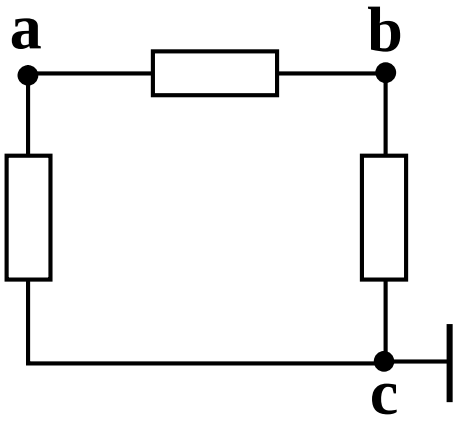
U_{ab} a b

5 3 2V

U_{bc} b c

3 3V





$_{b}$ **0** $_{a}$ **2V** $_{c}$ **3V**

$_{c}$ **0** $_{a}$ **5V** $_{b}$ **3V**

U_{ab} **2V** U_{bc} **3V**

U_{ab} **2V** U_{bc} **3V**

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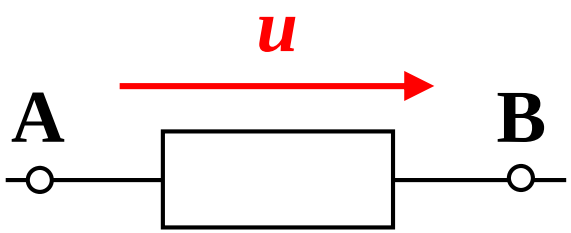
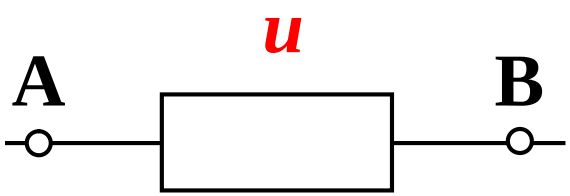
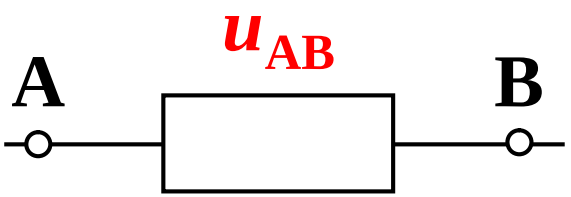
(1)



(2)

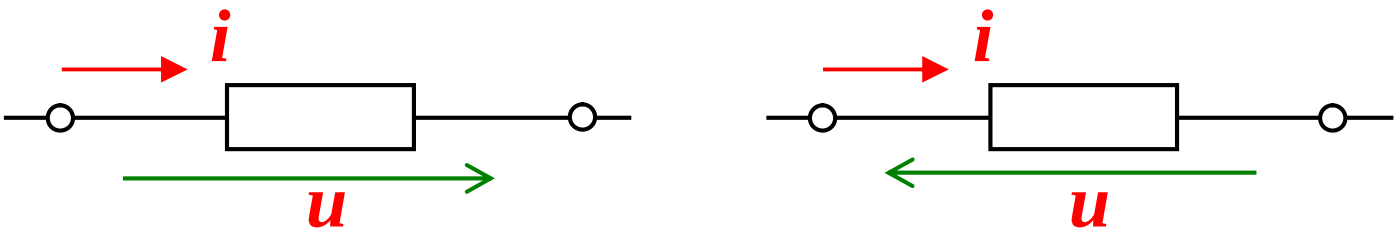


(3)

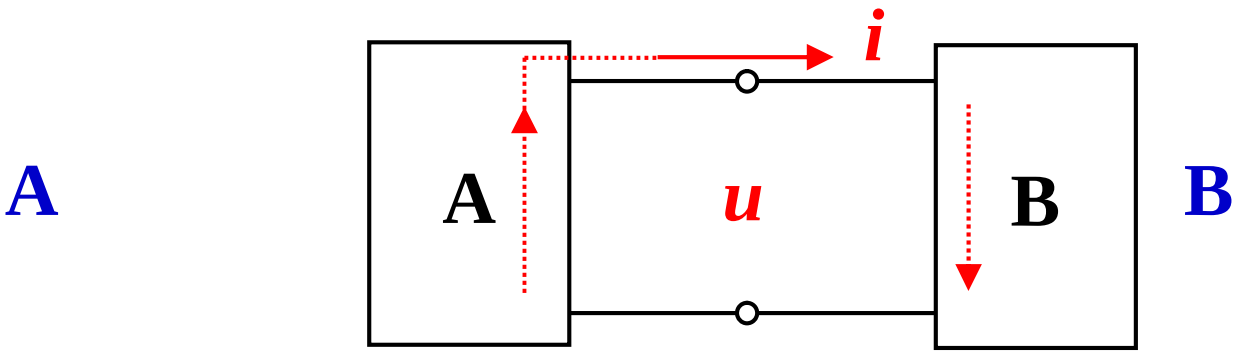


3.

☞ ***u*** ***i***



A **B**



1 3

1.

$p \quad \frac{\mathrm{d}w}{\mathrm{d}t} \qquad u \quad \frac{\mathrm{d}w}{\mathrm{d}q} \qquad i \quad \frac{\mathrm{d}q}{\mathrm{d}t}$

$p \quad \frac{\mathrm{d}w}{\mathrm{d}t} \qquad \frac{\mathrm{d}w}{\mathrm{d}q}\frac{\mathrm{d}q}{\mathrm{d}t} \qquad ui \qquad\qquad\qquad p \quad ui$

W ( ) (Watt) kW mW

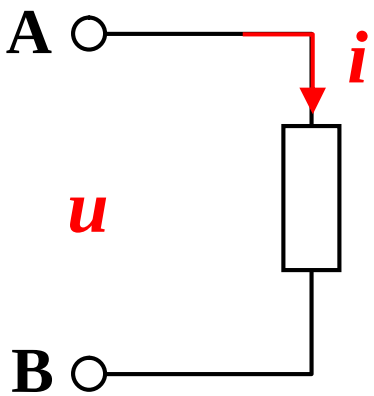
2.

- ***u*** ***i***

  p ***ui***

  p **0** **(** **)**

  p **0** **(** **)**

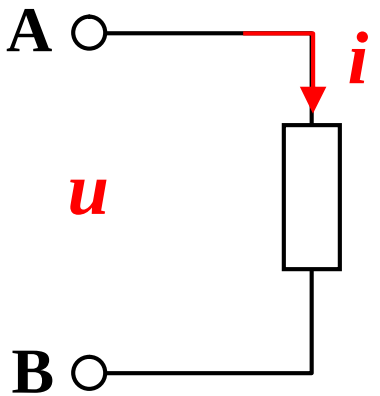


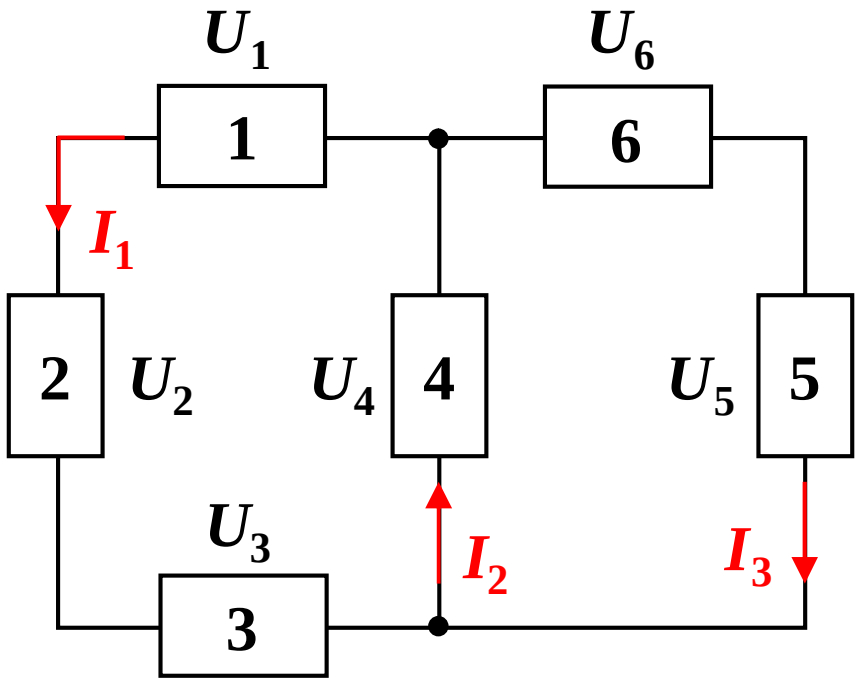
- ***u*** ***i***

  p ***ui***

  p **0** **(** **)**

  p **0** **(** **)**





U_1 1V U_2 3V

U_3 8V U_4 4V

U_5 7V U_6 3V

I_1 2A I_2 1A I_3 1A

P_1 U_1I_1 1 2 2W P_2 U_2I_1 2 6W

P_3 U_3I_1 2 6W P_4 U_4I_2 4W

P_5 U_5I_3 7W P_6 U_6I_3 3W

3.

$$p \quad \frac{\mathrm{d}w}{\mathrm{d}t}$$

$$\mathrm{d}w \quad p\ \mathrm{d}t \quad u\ i\ \mathrm{d}t$$

$t_0 \quad t$

$$w(t) \quad \int_{t_0}^{t} u(\ )i(\ )\ \mathrm{d}$$

J ( ) (Joule)

1　4

1.

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“ ”

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( ) ( )

2.

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$d <<$

🗣 $f = 20kHz$ $v = 3 \quad 10^8 \ m/s$

$\frac{v}{f}$ $15km$

“ ”

“ ”

(

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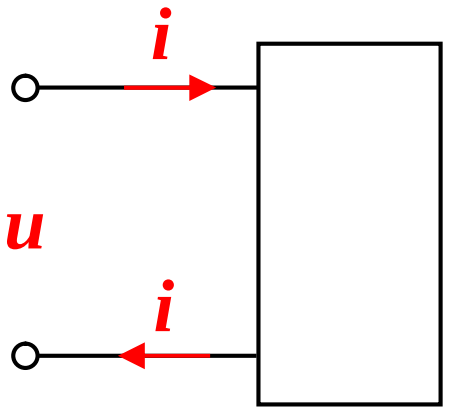
(18)

u ***i***



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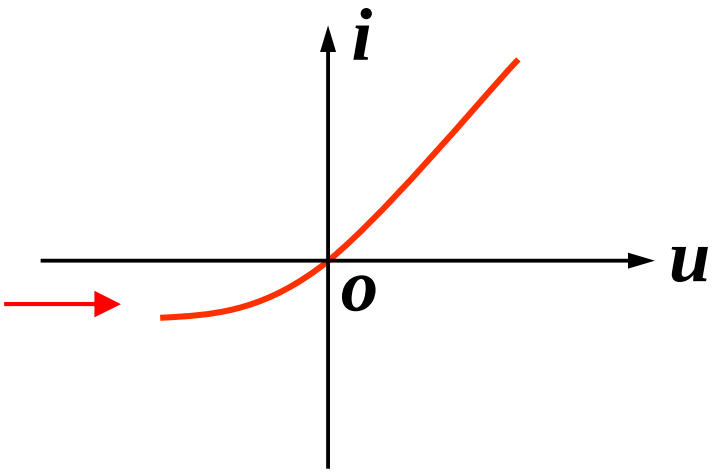
1.

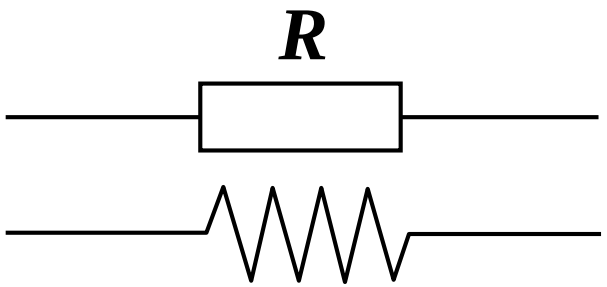
u i

$f(u,i)$ 0 ←



2.

• ( )

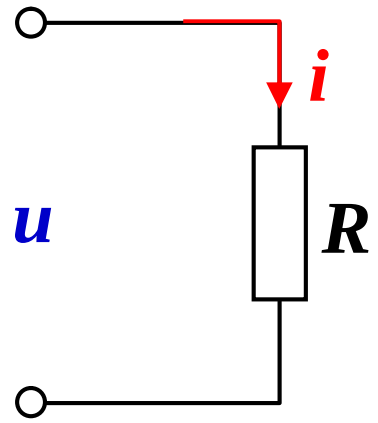


• u i

u i

i $\frac{u}{R}$ u Ri

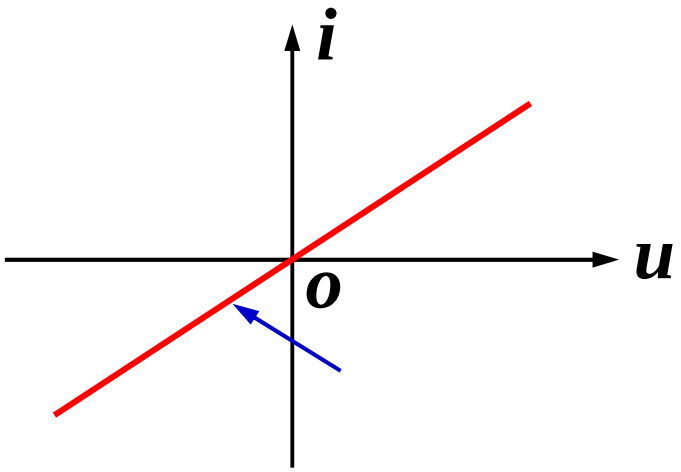
R



• R

u V i A R

G $\frac{1}{R}$



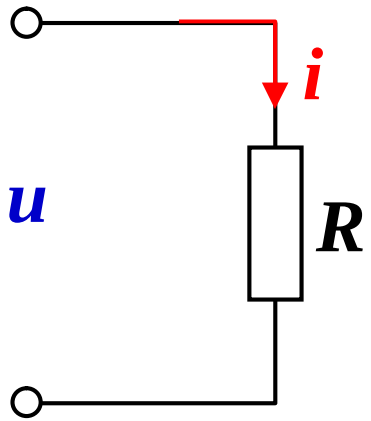
i G u

G S( )

R ***G***

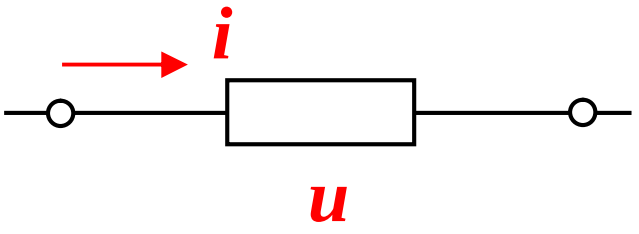
(***R***)

u ***R i*** **or** ***i*** ***G u***



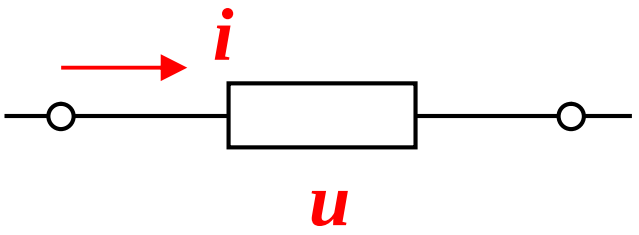
3.

- u i



p ui Ri^2 $\dfrac{u^2}{R}$ Gu^2 $\dfrac{i^2}{G}$

u i



p ui Ri i Ri^2 $\dfrac{u^2}{R}$

- t_0 t

$$w(t) \int_{t_0}^{t} p\,\mathrm{d} \int_{t_0}^{t} u(\ )i(\ )\,\mathrm{d}$$

4. *I* *I*

① $u = f(i)$ $i = f(u)$

🗣

②

$u(t)$ $R(t)$ $i(t)$ $i(t)$ $G(t)$ $u(t)$

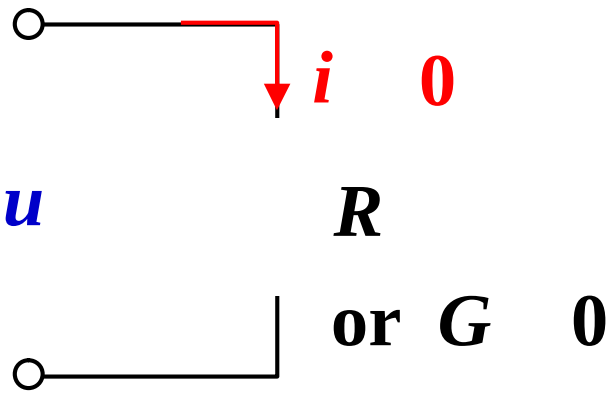
u i $R(t)$

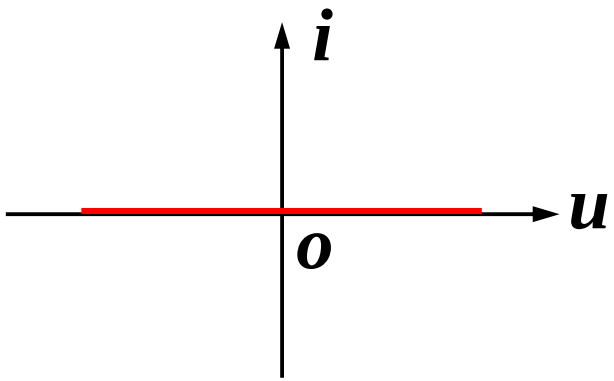
③

5. ( )

(1)

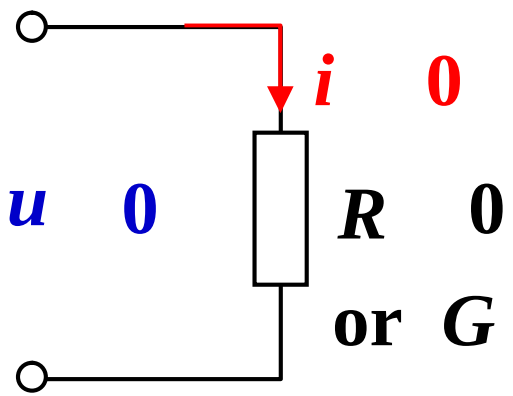
“ ”

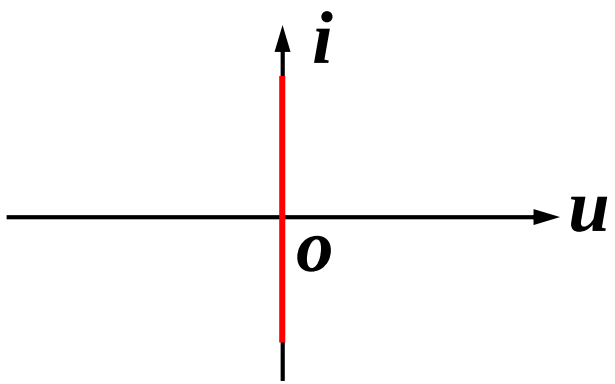




(2)

“ ”



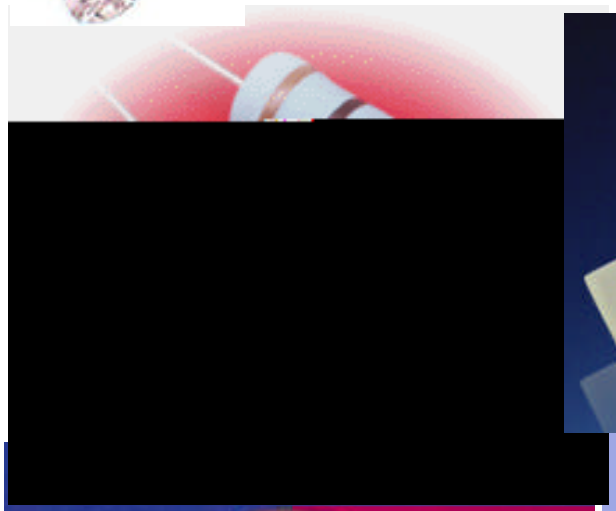


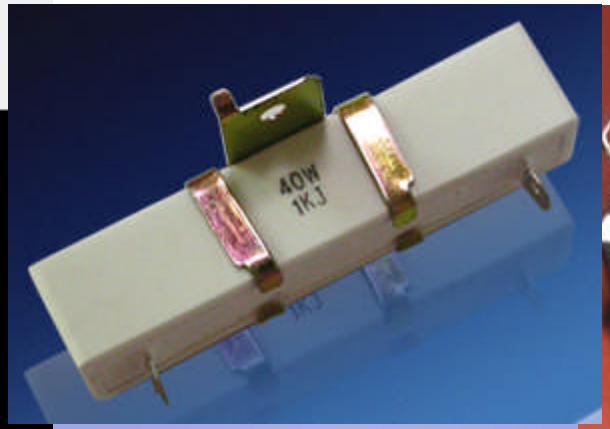
R G

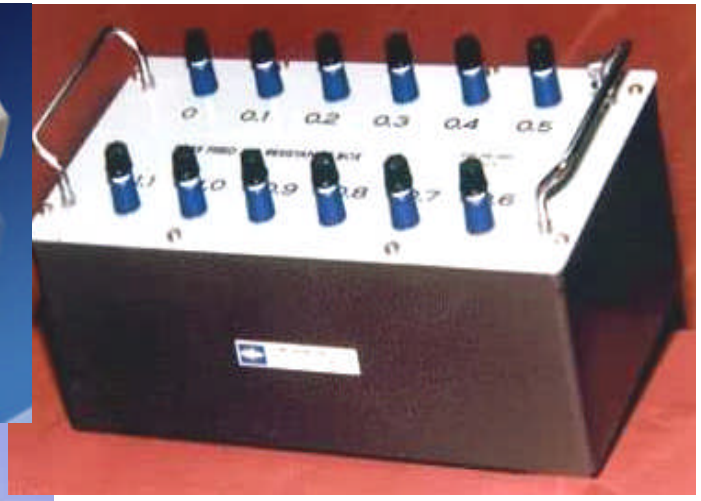
u Ri i Gu

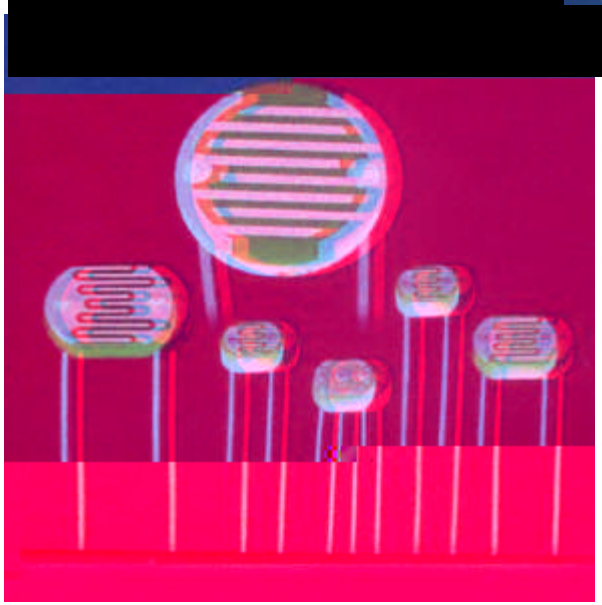
S

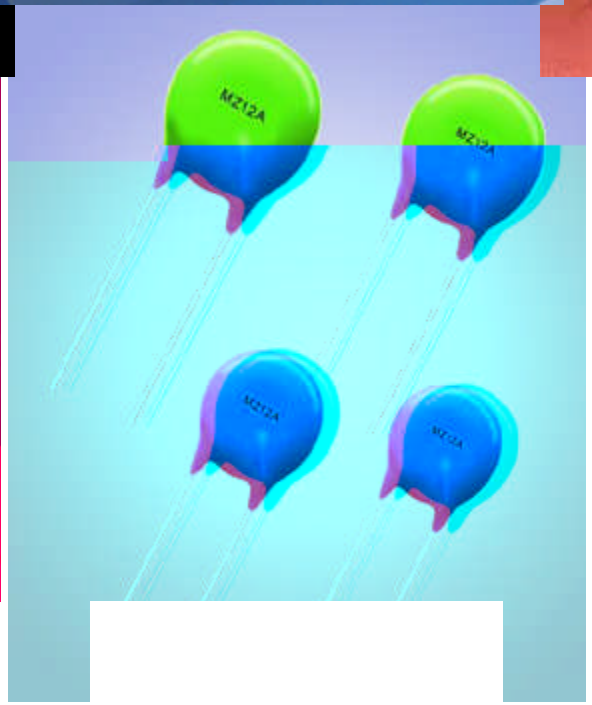
p ui i^2R $\frac{u^2}{R}$




40W
1KJ


0
0.1
0.2
0.3
0.4
0.5




MZ12A
MZ12A
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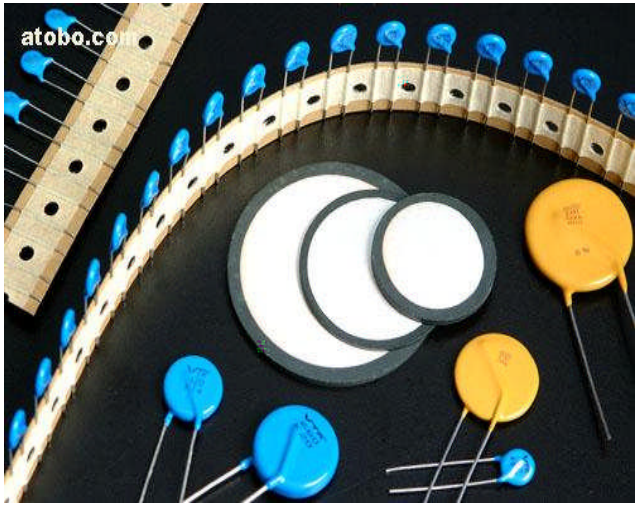
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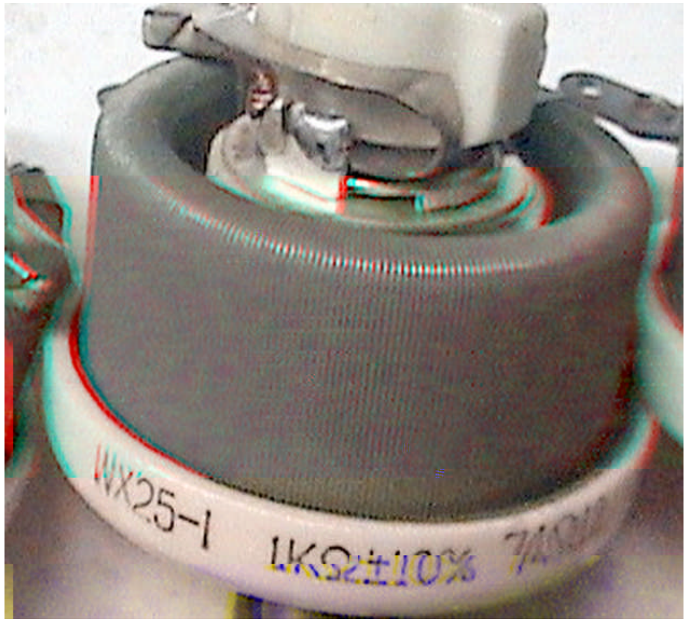
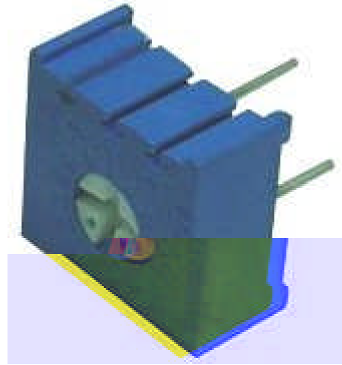
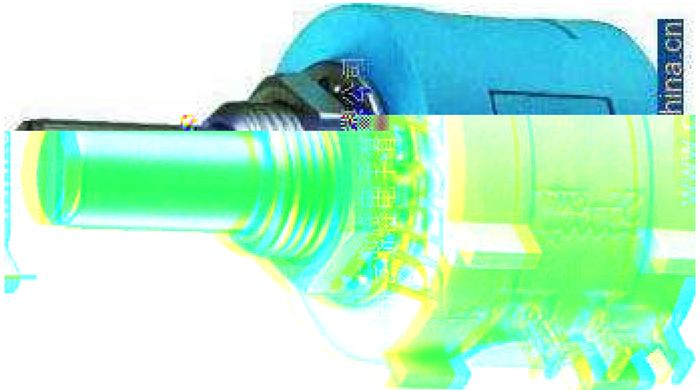

WX25-1
1KΩ±10%


104



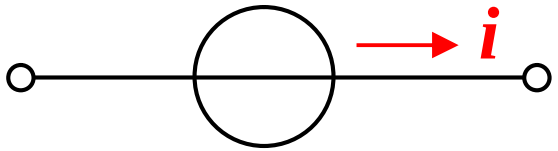



R024
R033
R051
R015
R680
R220
R047
R010
R022
R018
R240
R200
R120
R025
R180
R039
R020
R150
R470
R082
R056
R560
R100
R068

1 6

1.

i



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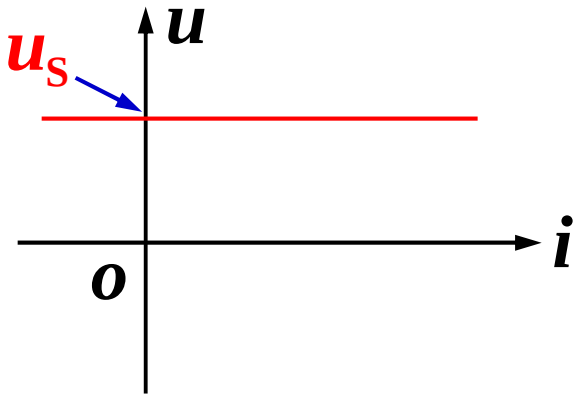
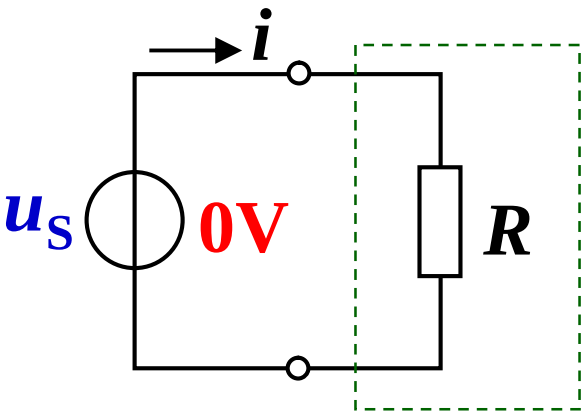
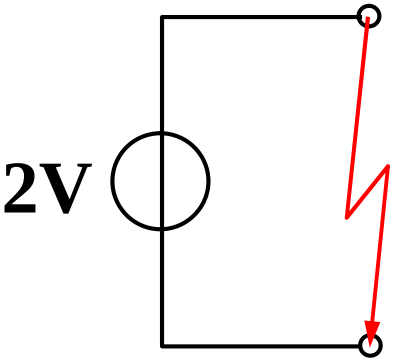




i $\frac{u_S}{R}$

R= ( ) i

R i



0 ?

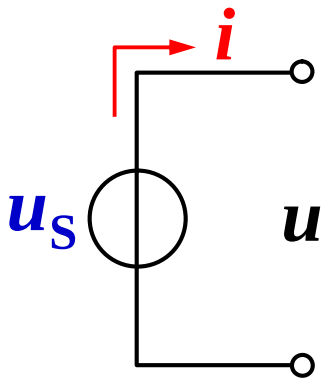
2V ?

u_S 0

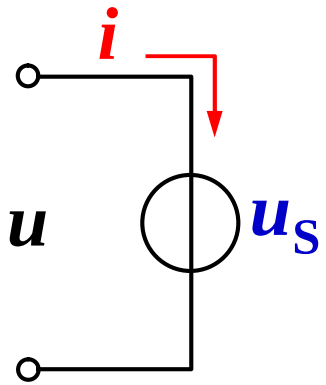
u_S 0

- $P \quad u_s i$

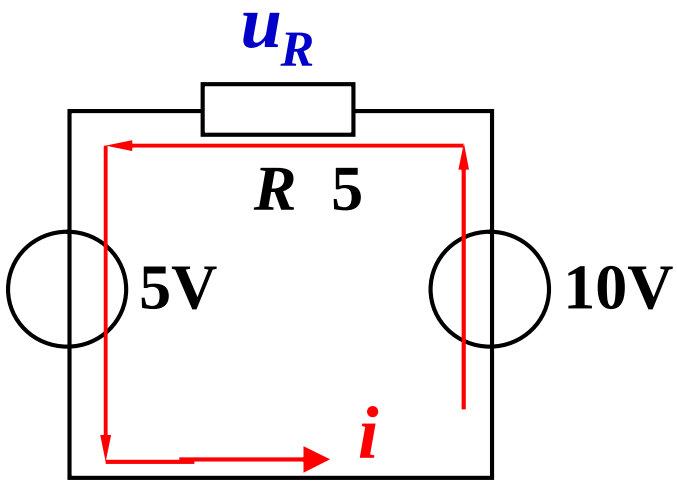
( )



$P \quad u_s i$



$P \quad u_s i$



u_R V

i $\frac{u_R}{R}$ $\frac{5}{5}$ A

P_{10V} $u_s i$ W

P_{5V} $u_s i$ W

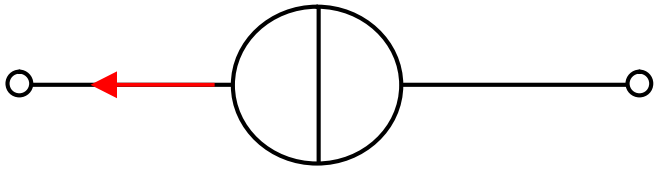
P_R Ri^2 W

P P

2.

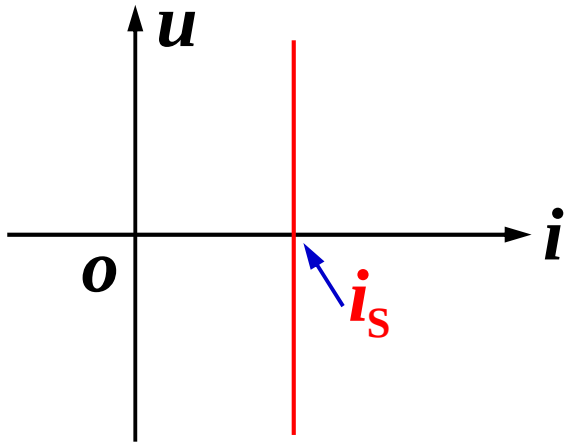
-

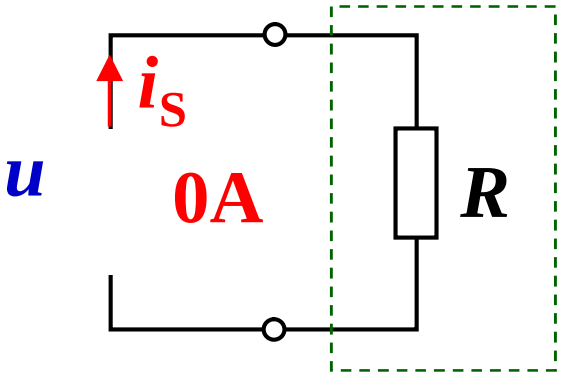
u

- 

u

-

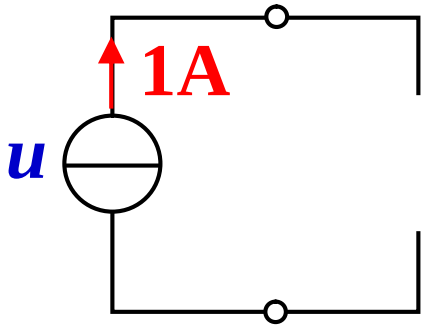




u Ri_S

R u 0

R u

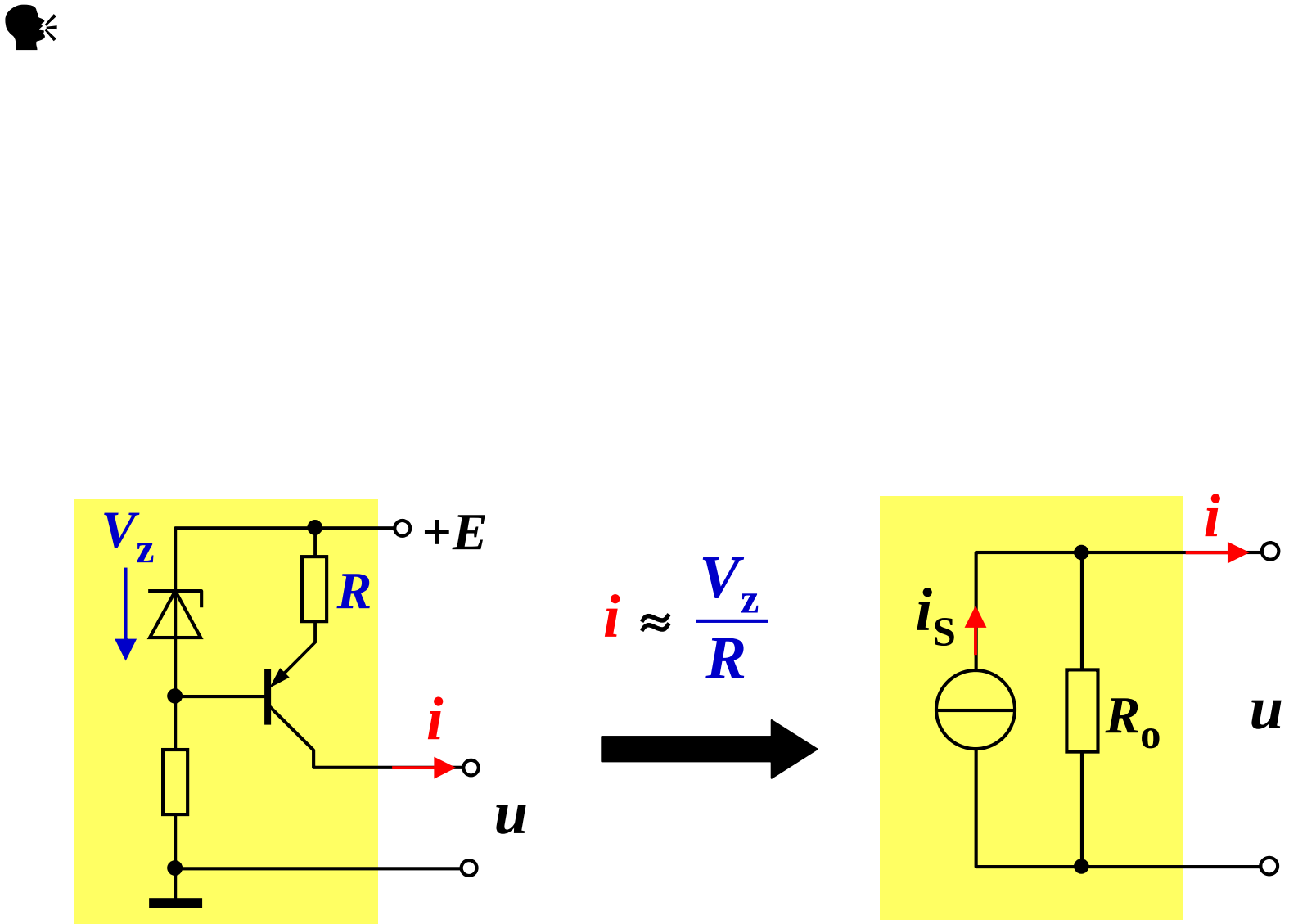


0 ?

1A ?

i_S 0

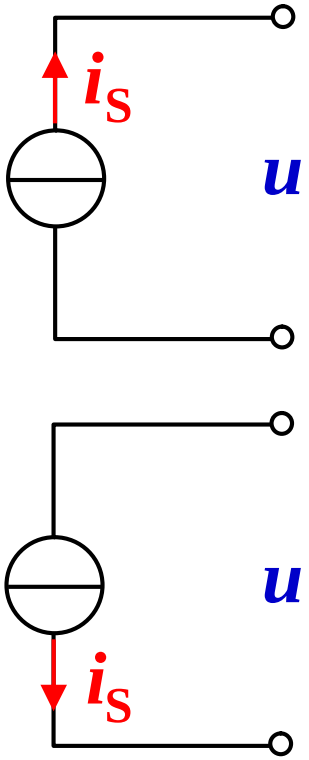
i_S 0


V_z
$+E$
R
i
u
$i \approx \frac{V_z}{R}$
i
i_S
R_o
u

- $P \quad ui_s$

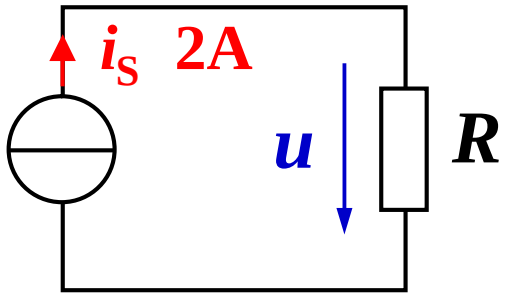
$P \quad ui_s$

$P \quad ui_s$



R 0

U



(1) R u Ri_S

P ui_S $i_S^2 R$

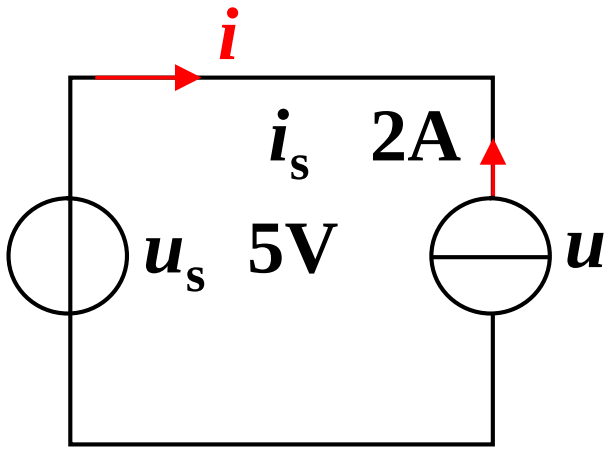
R u

(2) R 0 u 0 P ui_S 0

(3) R u P ui_s

i i_S

u u_S 5V



P_{2A} ui_s W

P_{5V} $u_s i$ W

5V (10 W

10W

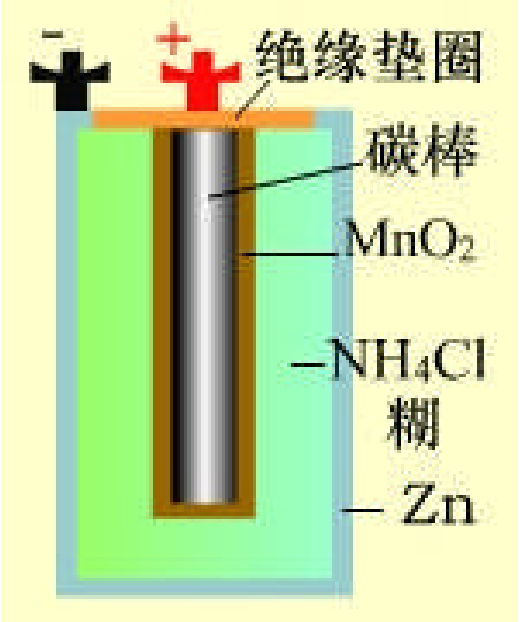
P	P

3.

(1)　　(　　)

🗣　　***1.5V***

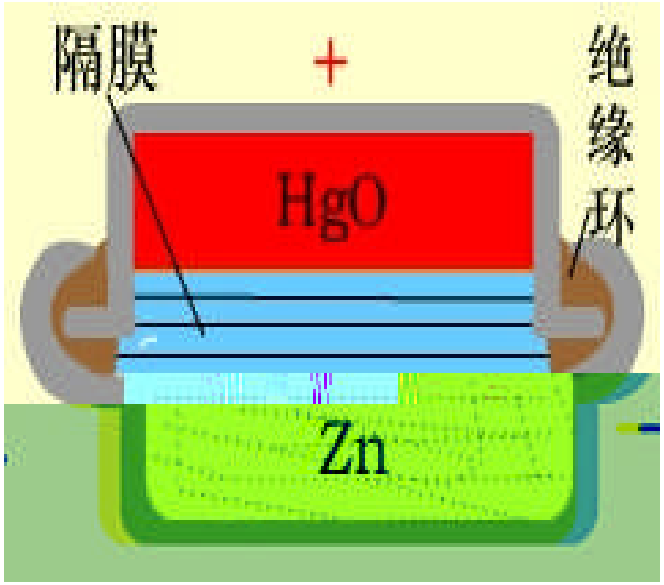
(　　)　　(　　)



(2)　　(　　)

🗣　　***1.35V***

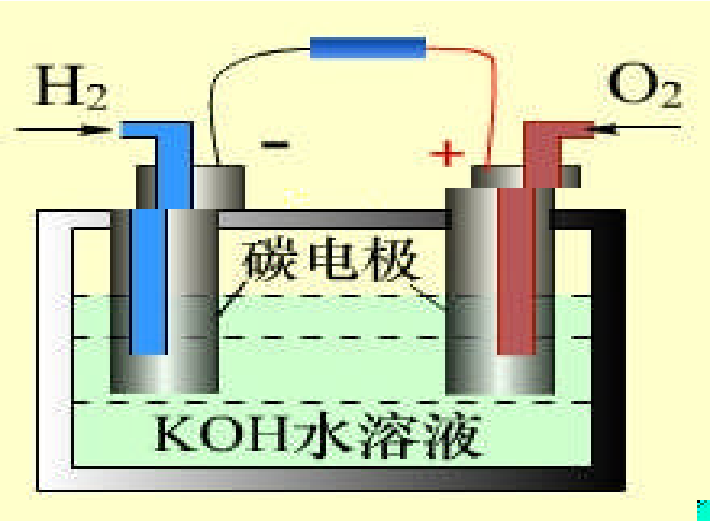
(　　)



(3) ( )

1.23V

40 45%

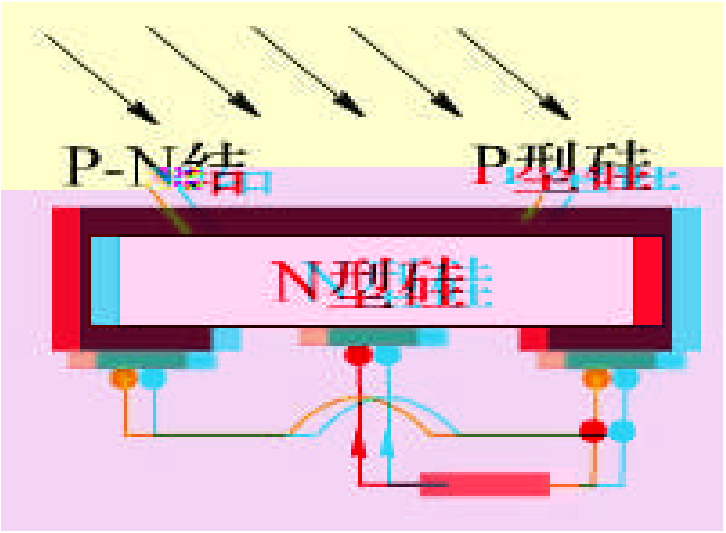


(4) ( )

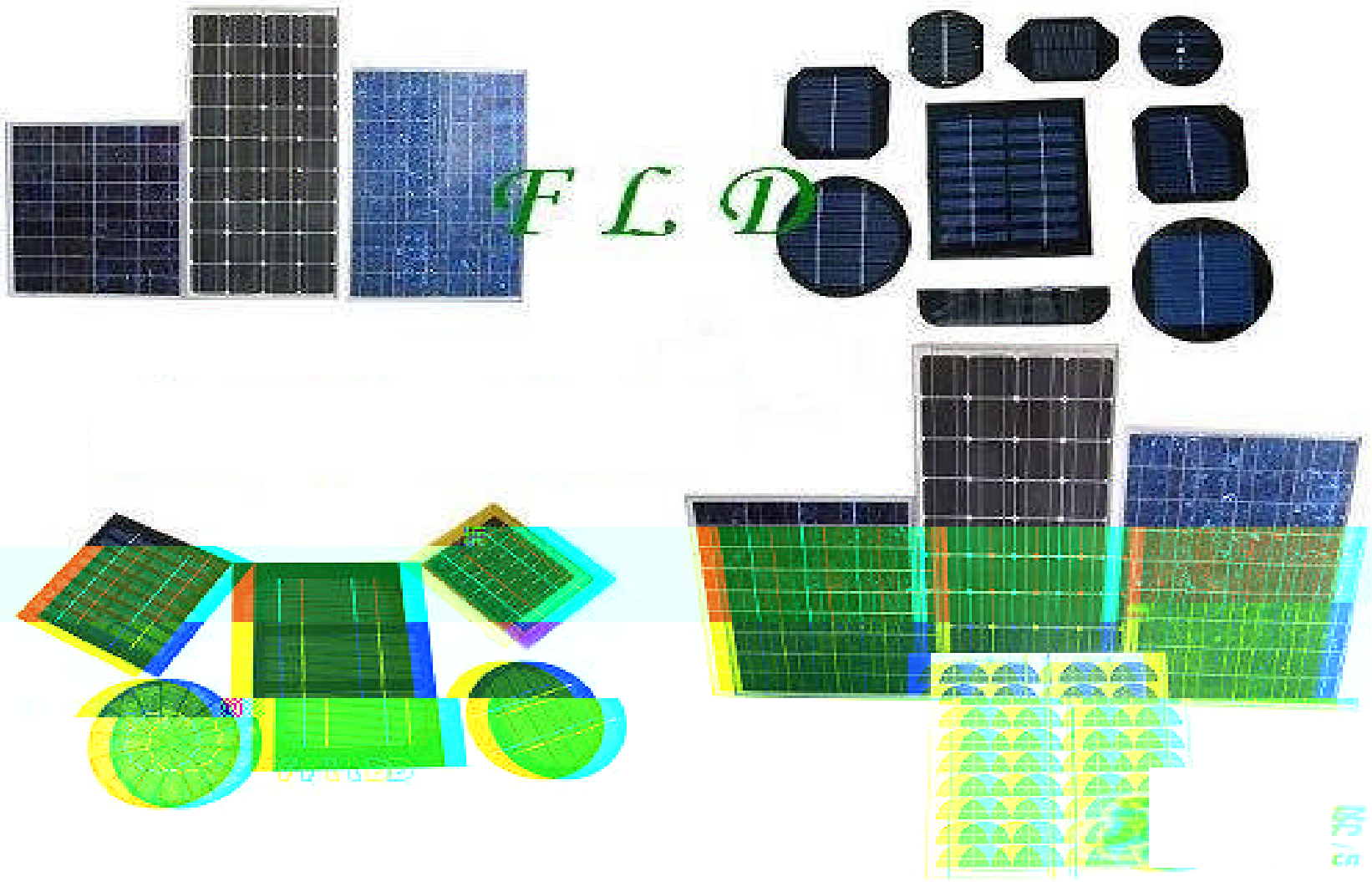
P- N

N P

11%



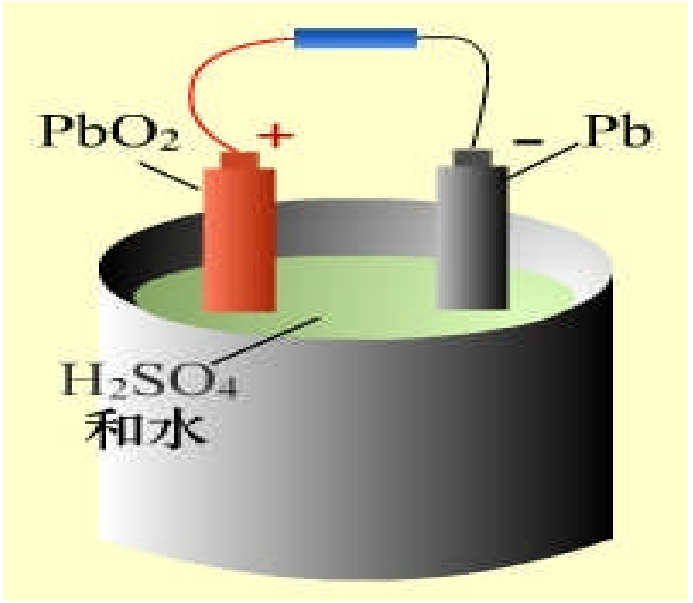
50cm² ***0.6V*** ***0.1A***



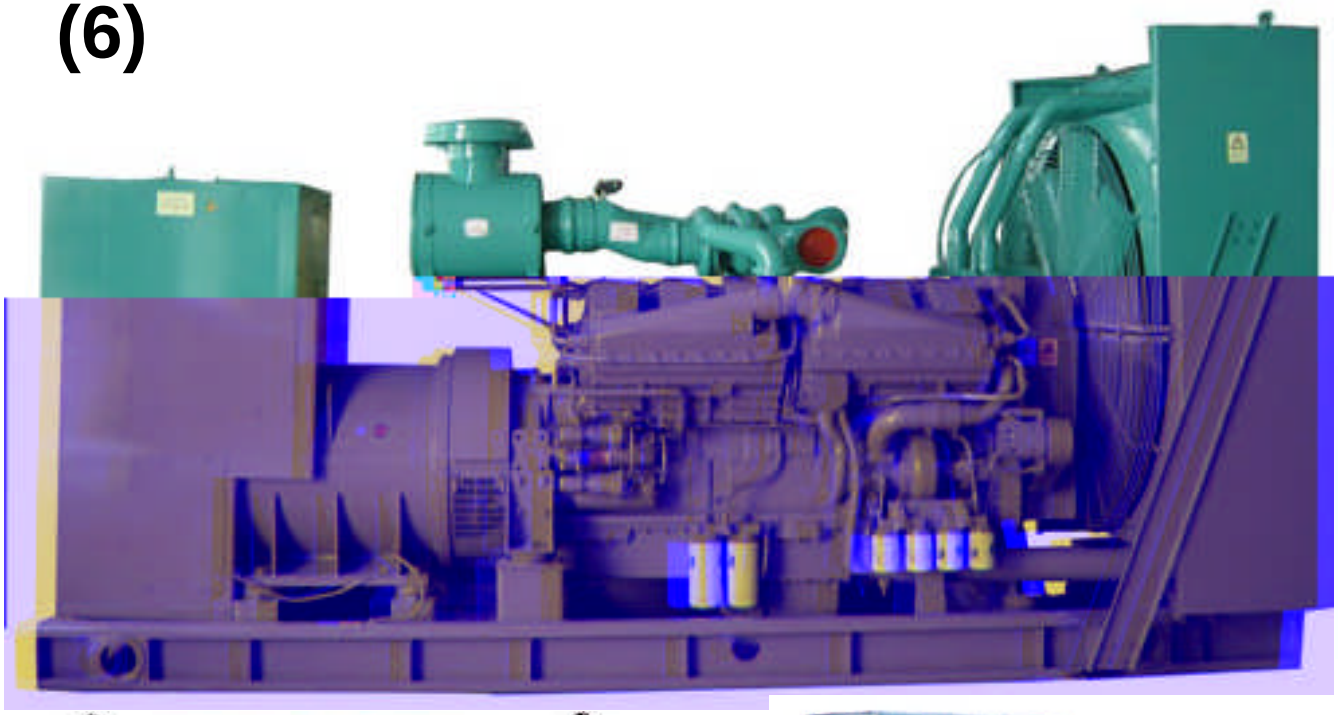
(5) ( )

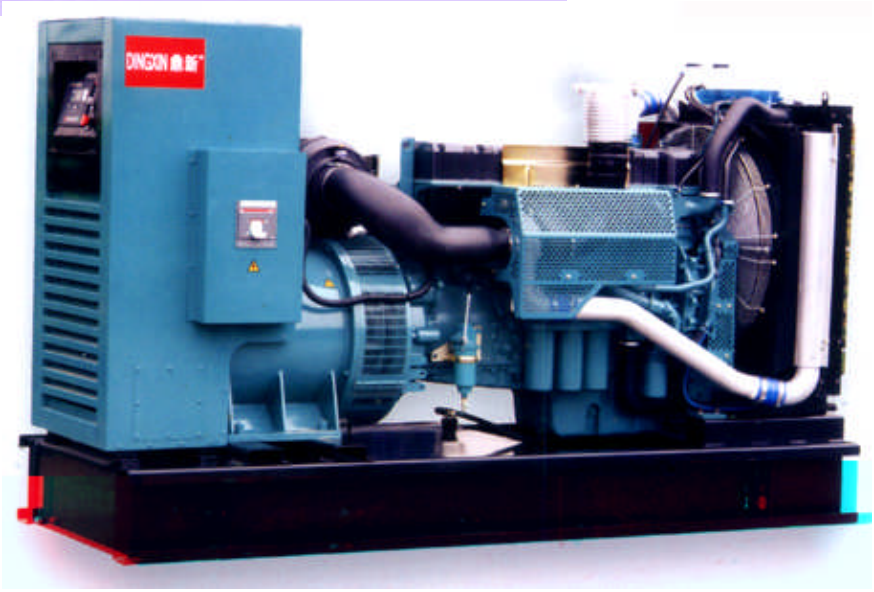
2V

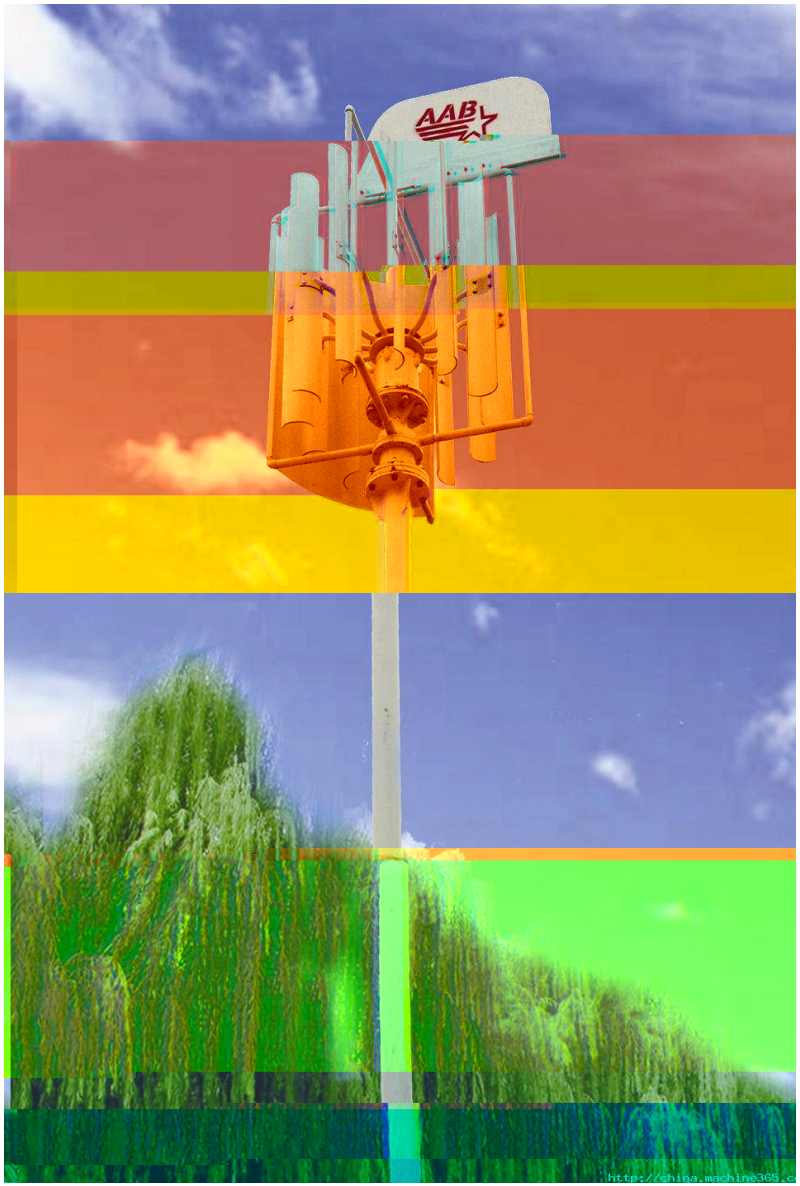
2V



(6)






AAB

(7)


VICTOR
30.00
5.00

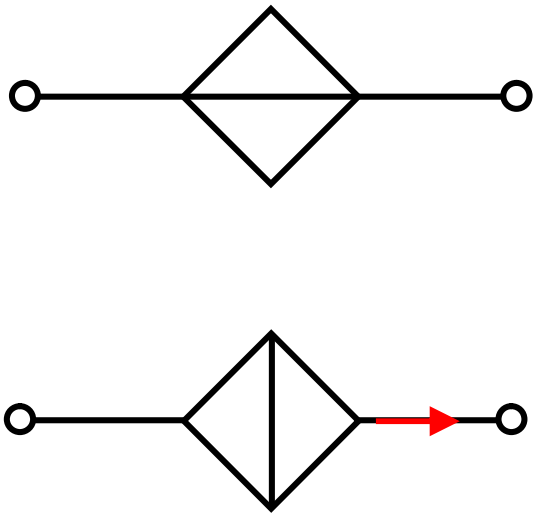

SVC
500VA
全自动交流稳压电源
AC AUTOMATIC VOLTAGE REGULATOR

1 7 ( )

1.

(

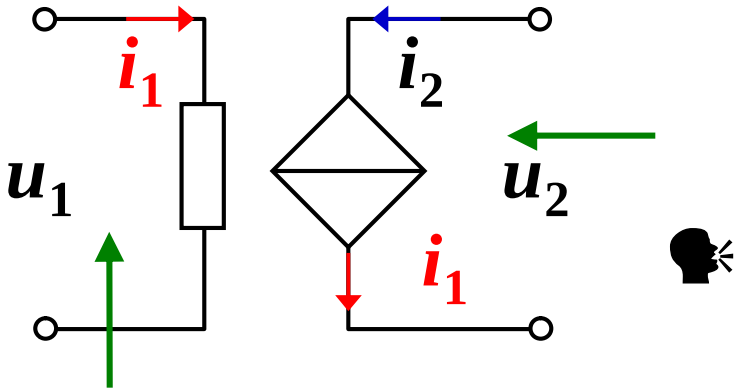
)

- 

2.

u ***i***

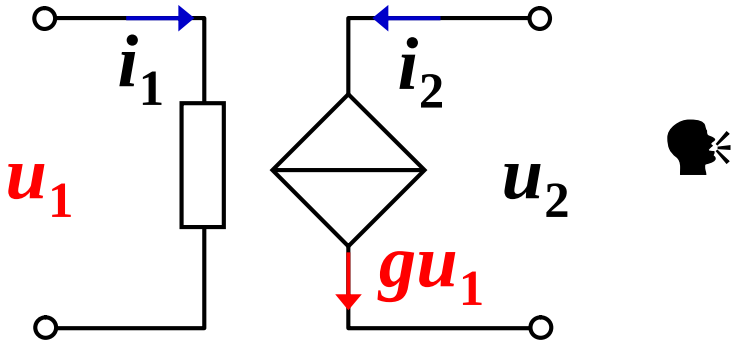
(1) (CCCS)



i_2 i_1

$(i_c \quad i_b)$

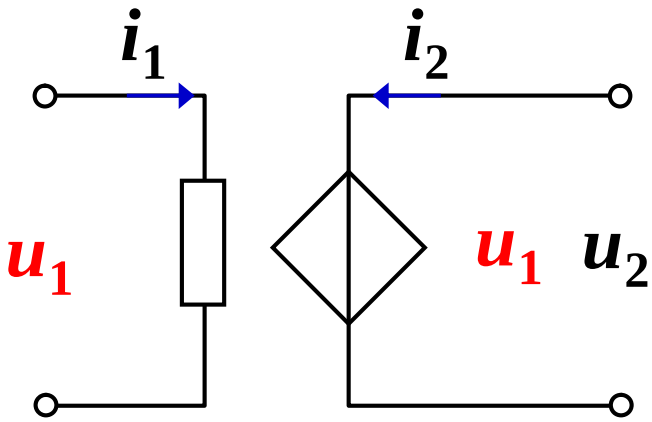
(2) (VCCS)



i_2 gu_1 g

$(i_d \quad gu_{gs})$

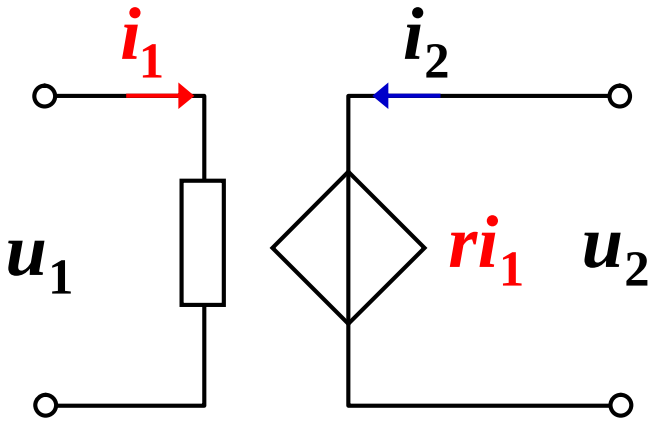
(3) (VCVS)



u_2 u_1

$(u_o \quad Au_d)$

(4) (CCVS)



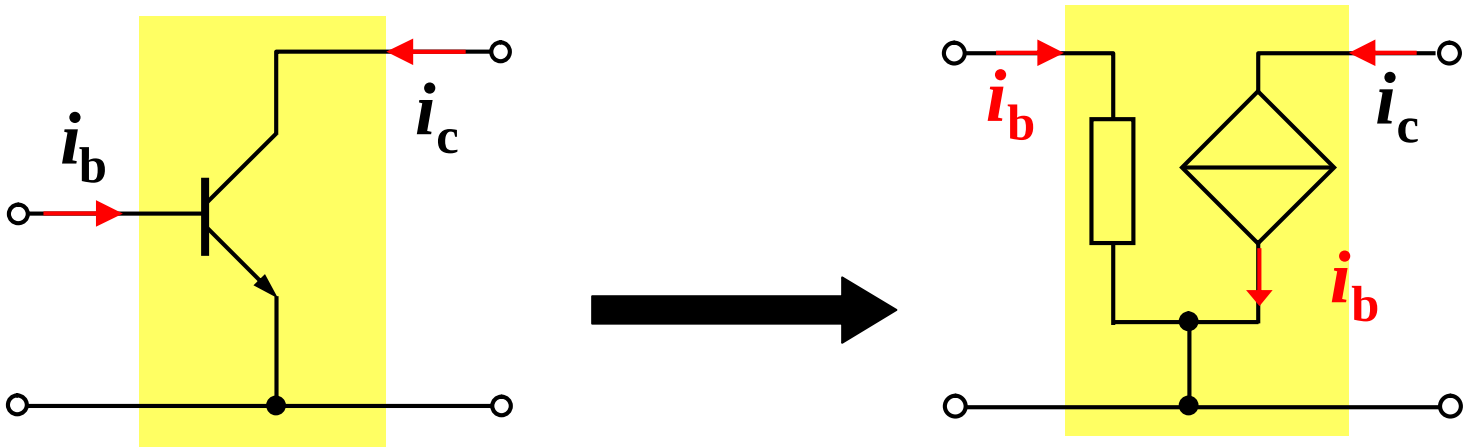
u_2 $r\,i_1$

r

$(u_o \quad ri_f)$

g r

“ ”



3.

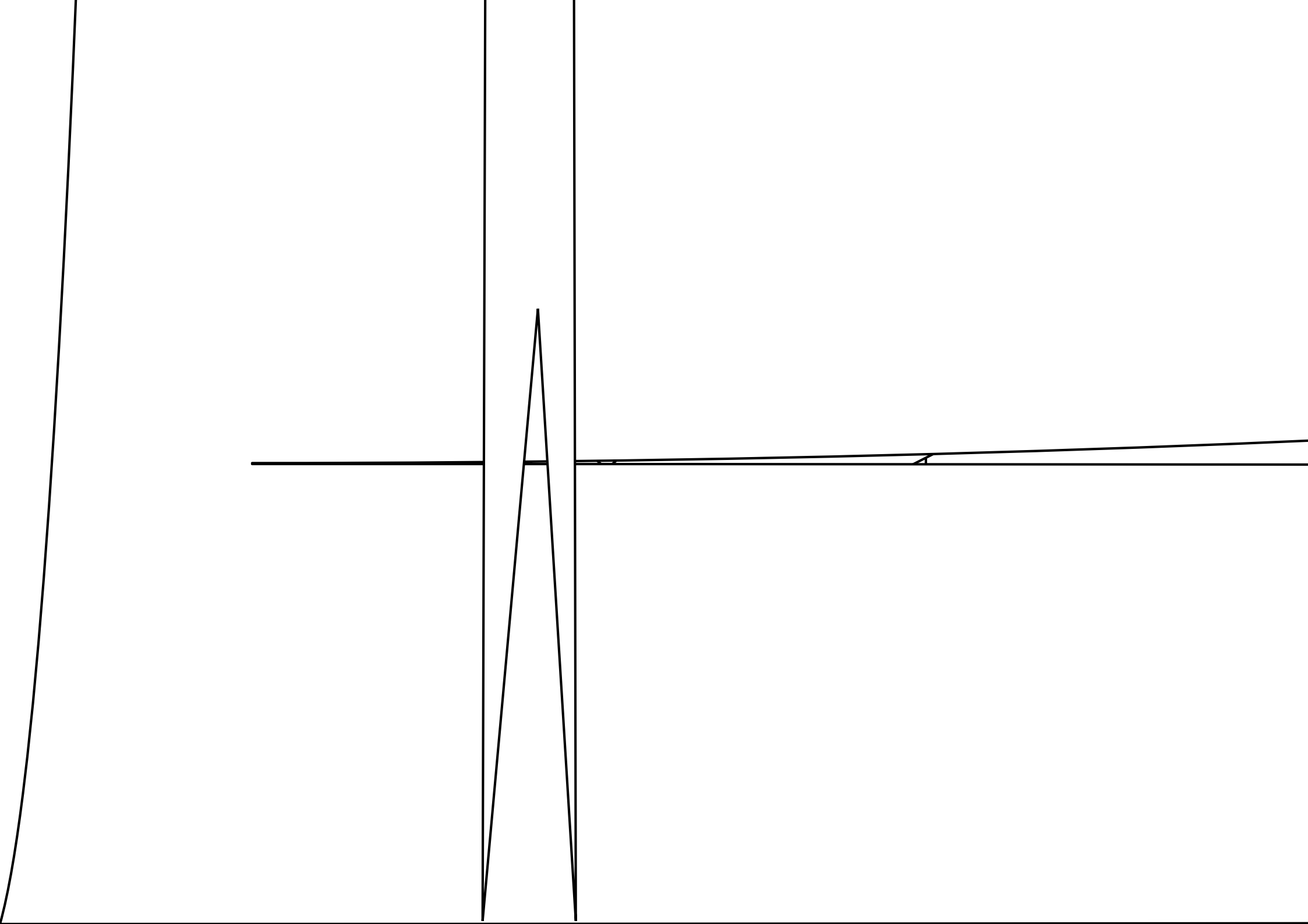
( )

(

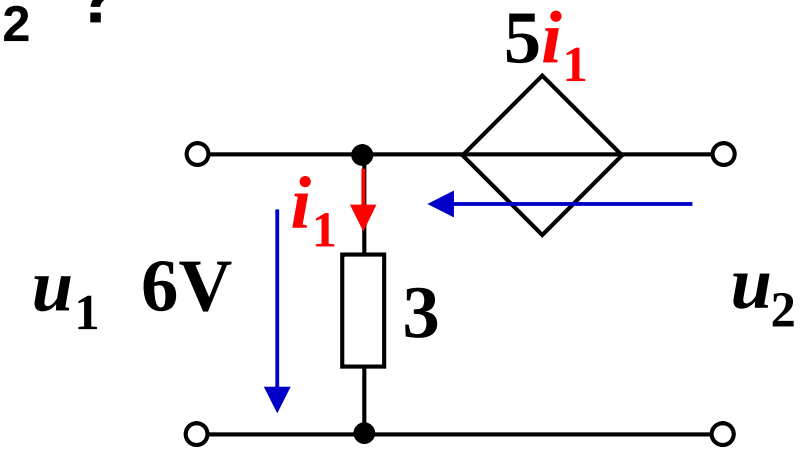
)

“ ”

“ ”



u_2 ?



i_1 $\frac{u_1}{3}$ 2A

u_2 5i_1 u_1

× 2 6

V

1–9 **(KL)**

(KCL)

(KVL)

(VCR)

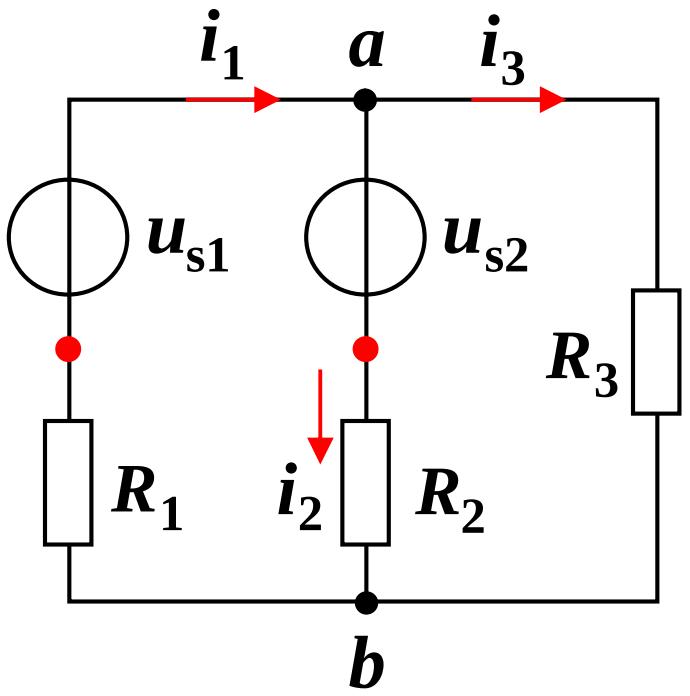
u_R Ri_R

(KCL KVL)

KL VCR

1.

(1)



b 5

b 3

(2)

n 4

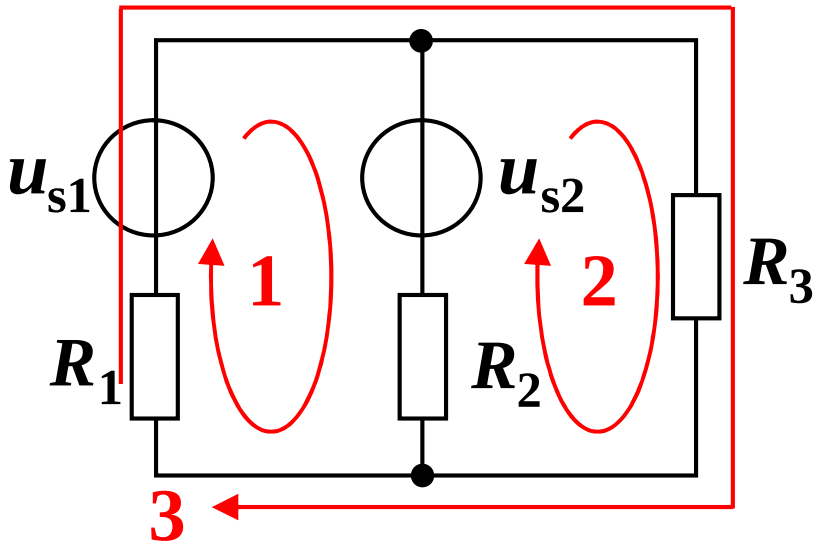
n 2

☞

(3)

(4) *l* 3

(5)



☞

2. KCL ( )

🗣 *KL 1845*

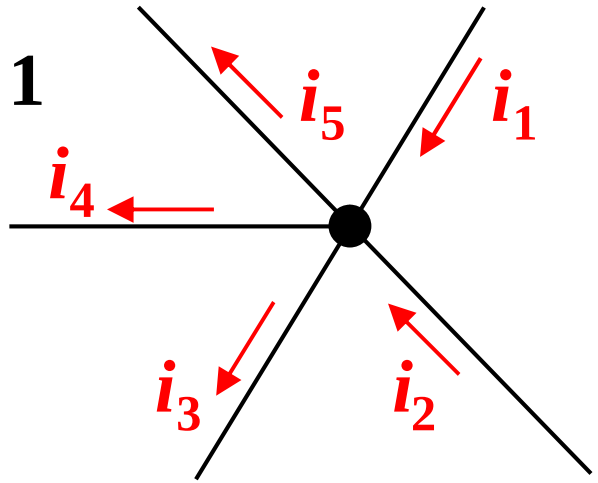
🕯 (

)

b

$i_m(t)$ 0 *i* *i*

m 1



i_1 i_2 i_3 i_4 i_5 0

i_1 i_2 i_3 i_4 i_5

2 $i_1 \quad i_2 \quad i_3 = 0$

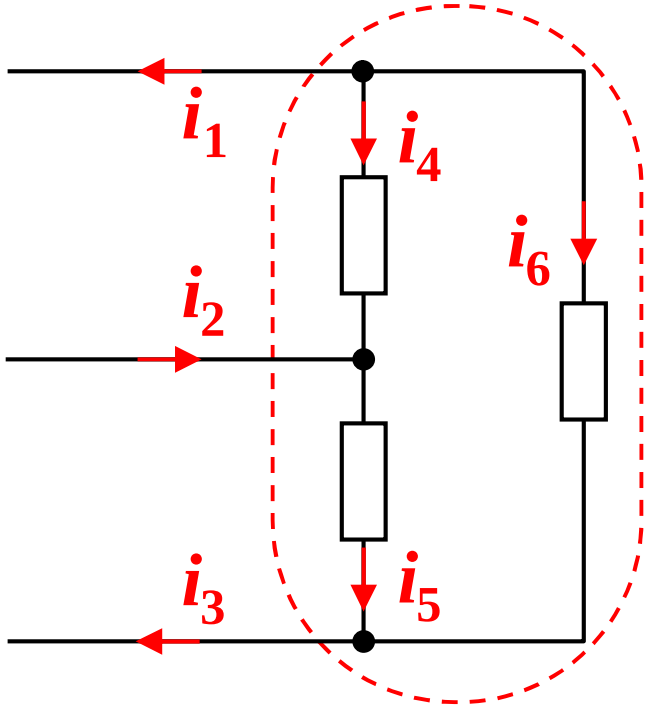
$i_1 \quad i_4 \quad i_6 \quad 0$

$i_2 \quad i_4 \quad i_5 \quad 0$

$i_3 \quad i_5 \quad i_6 \quad 0$

3 $i_1 \quad i_2 \quad i_3 \quad 0$

KCL



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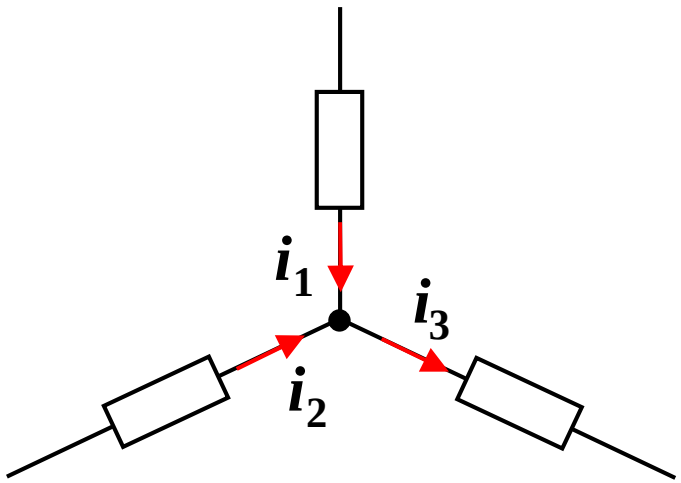
KCL

KCL

KCL

KCL



i_2 2A i_3 3A

i_1

i_1 i_2 i_3 0

i_1 i_2 i_3

2)

3. (KVL)

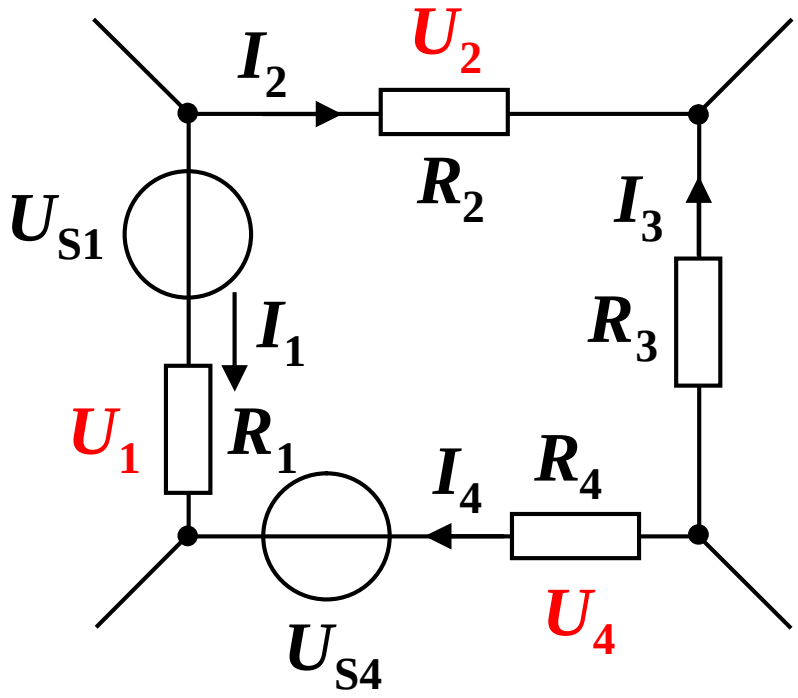
n

$u_m(t)$ 0 u u

m 1

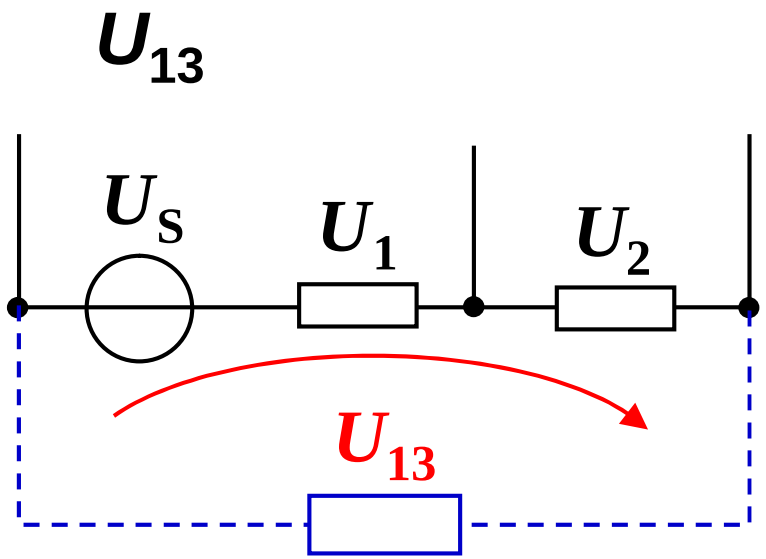
(

)



KVL

U_{13} U_S U_1 U_2



☞

KVL

KVL

KVL

4. KCL KVL

KCL **KVL**

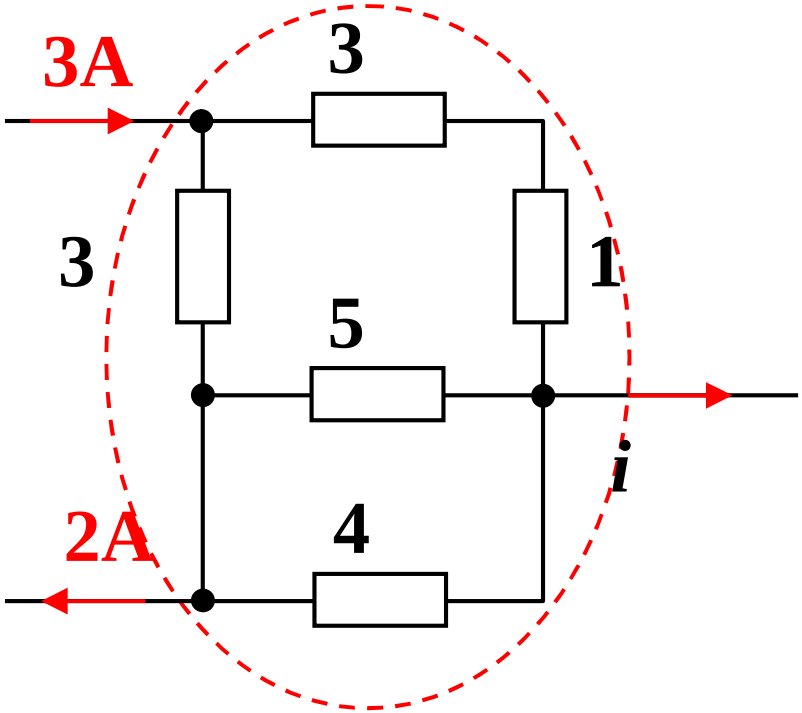
KCL KVL

KCL **KVL**

( )

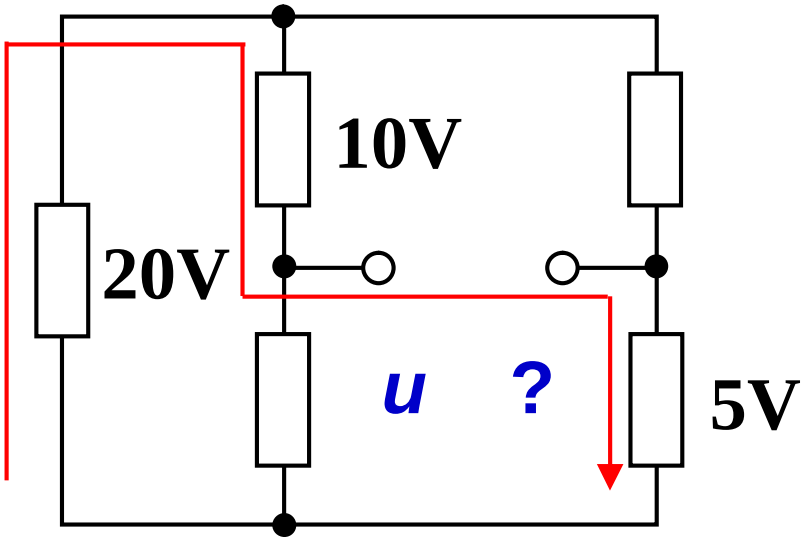
KCL KVL

1 *i*



i 3 (2) 5A

2 *u*



20 10 *u* 5 0

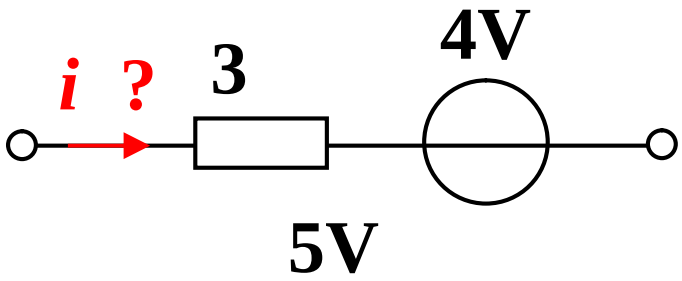
u 10 20 5

15V

3 i

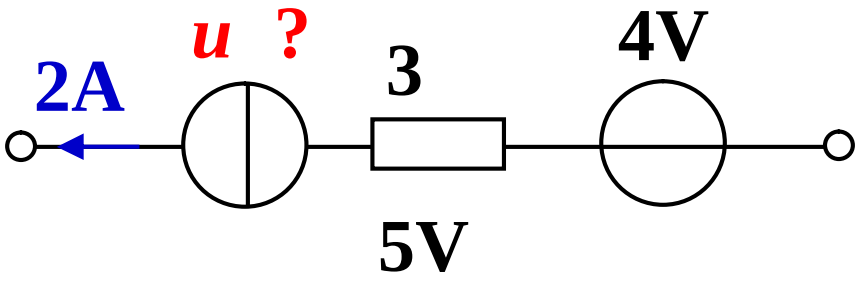
$3i$ 4 5

i 3A



4 u

u 3 2 4



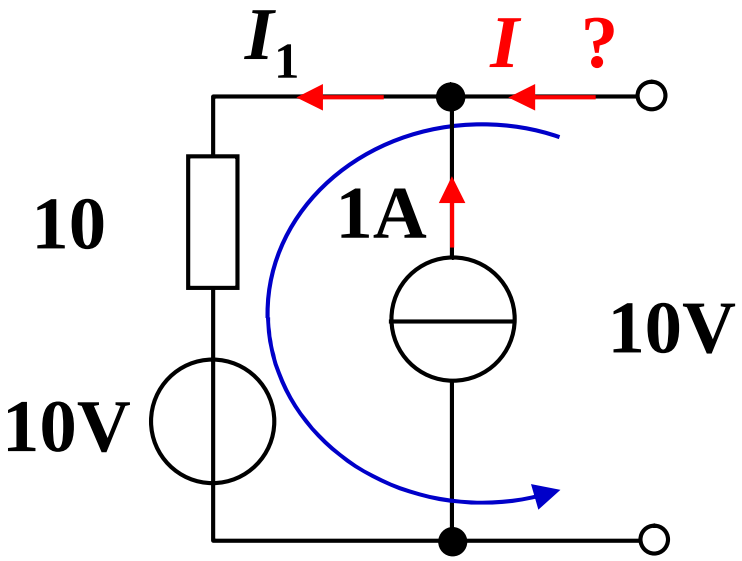
☞

5 I

$10I_1$ 10 10)

I_1 2A

I I_1 1 2 1 3A



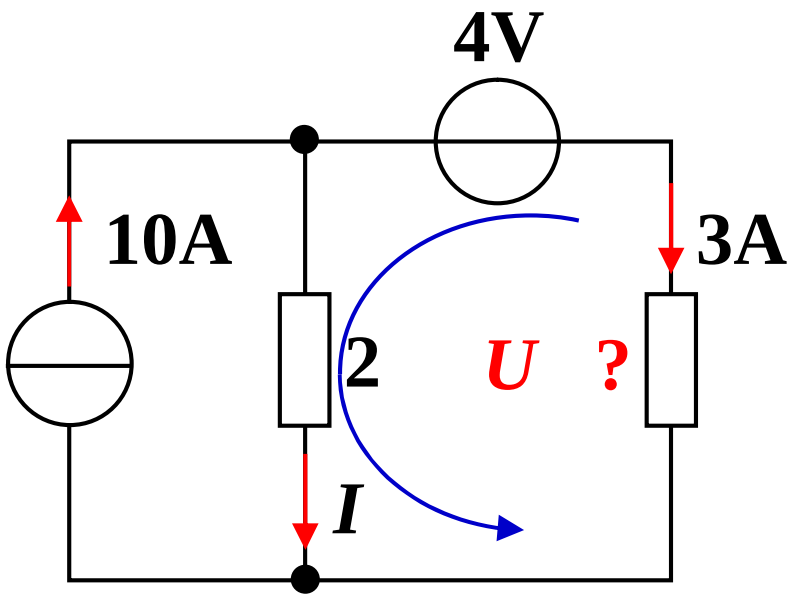
6 U

I 10 3 7A

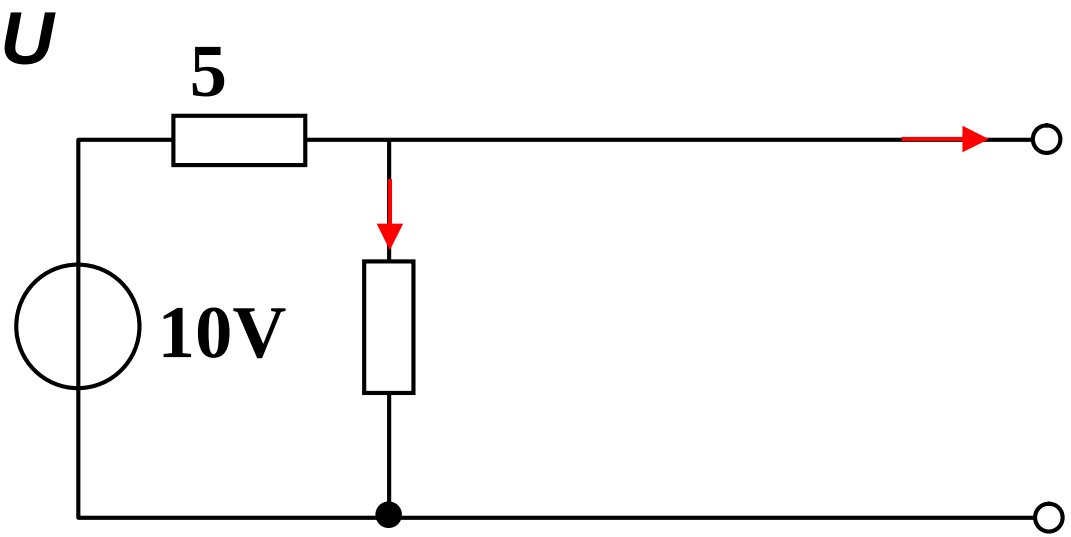
U 4 $2I$ 0

U $2I$ 4

14 4 10V

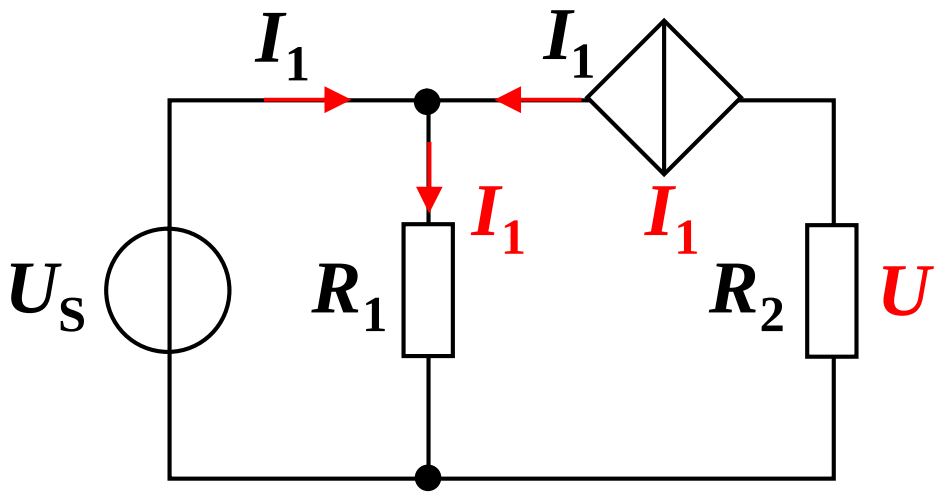


7



5

8 U



U R_2 I_1

U_S $R_1(I_1$ $I_1)$

$$I_1 \quad \frac{U_S}{R_1(1 \quad)}$$

$$U \qquad R_2 \frac{U_S}{R_1(1 \quad)}$$

$$\left| \frac{U}{U_S} \right| \quad \frac{R_2}{R_1} \frac{}{1}$$

1.

2.

3. *p ui*

4.

5. (2) (4)

6. (VCR) (KCL KVL)