

電験どうでしょう管理人
KWG presents

電験オンライン塾

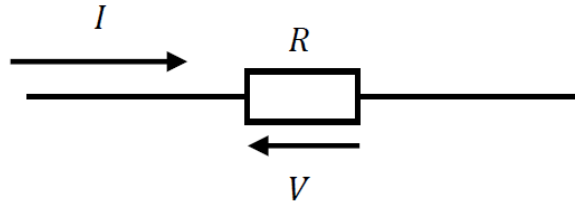
第1回 直流回路
電気回路のルール

2023.04.08 Sat

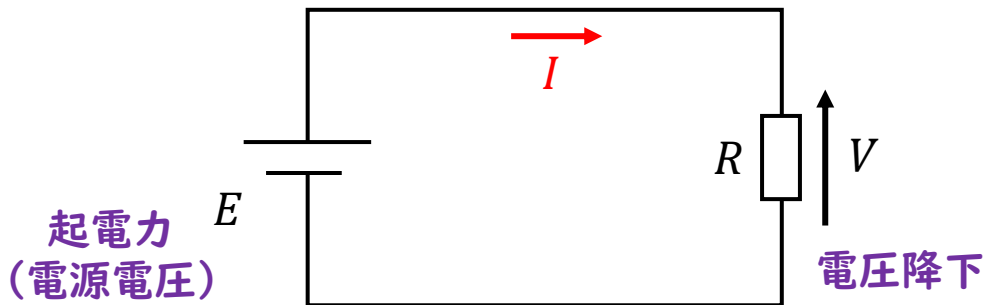
オームの法則

抵抗 R に流れる電流 I とそこに発生する電圧 V の関係は以下の式を満たす。

$$V = RI$$



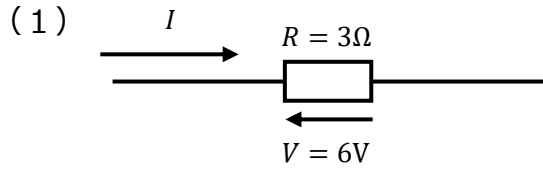
V : 電圧 (単位は[V]ボルト)
 I : 電流 (単位は[A]アンペア)
 R : 抵抗 (単位は[Ω]オーム)



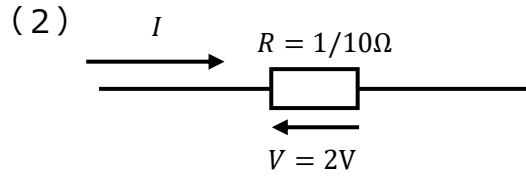
<電気回路のルール>

- ・起電力=電圧降下の関係を必ず満たす
- ・電流は1本道ではどこでも同じ大きさとなる

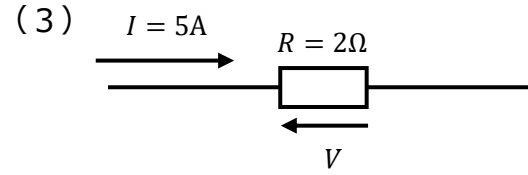
練習問題 I



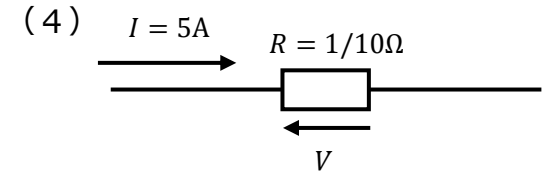
Ans. $I =$ _____



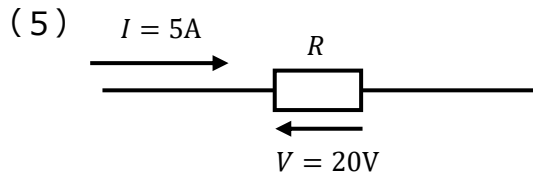
Ans. $I =$ _____



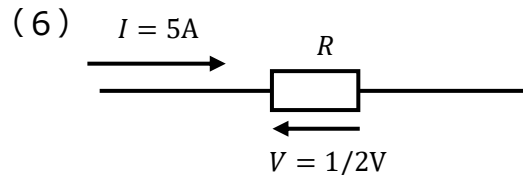
Ans. $v =$ _____



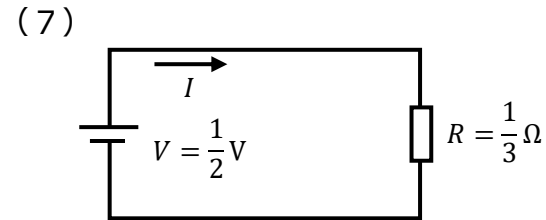
Ans. $v =$ _____



Ans. $R =$ _____

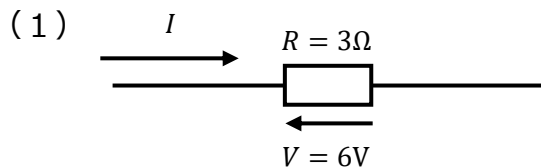


Ans. $R =$ _____



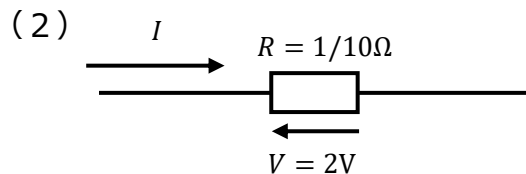
Ans. $I =$ _____

練習問題 I (解答)



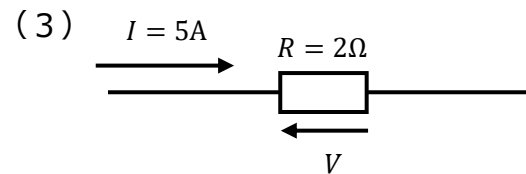
$$I = \frac{V}{R} = \frac{6}{3} = 2\text{A}$$

Ans. $I = 2\text{A}$



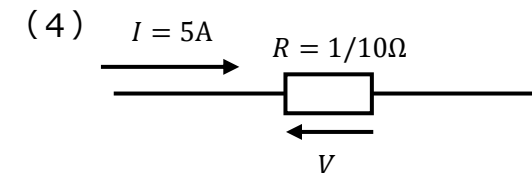
$$I = \frac{V}{R} = \frac{2}{1/10} = 2 \times \frac{10}{1} = 20\text{A}$$

Ans. $I = 20\text{A}$



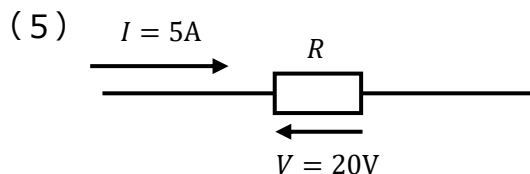
$$V = RI = 2 \times 5 = 10\text{V}$$

Ans. $V = 10\text{V}$



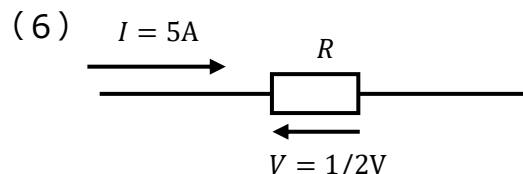
$$V = RI = \frac{1}{10} \times 5 = \frac{1}{2}\text{V}$$

Ans. $V = \frac{1}{2}\text{V}$



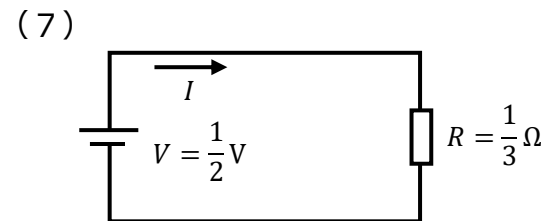
$$R = \frac{V}{I} = \frac{20}{5} = 4\Omega$$

Ans. $R = 4\Omega$



$$R = \frac{V}{I} = \frac{1/2}{5} = \frac{1}{2} \times \frac{1}{5} = \frac{1}{10}\Omega$$

Ans. $R = \frac{1}{10}\Omega$

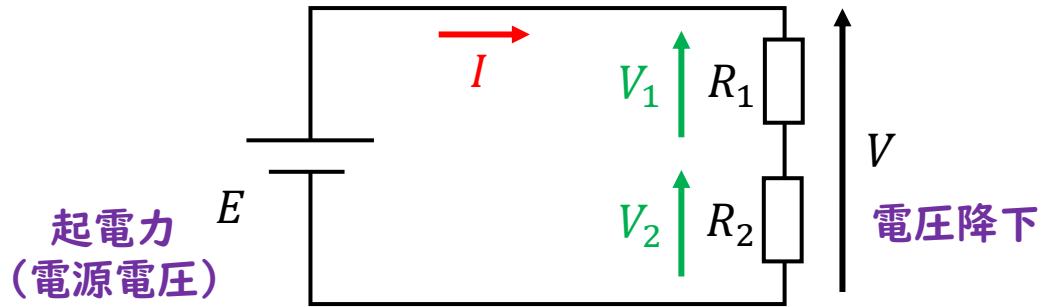


$$I = \frac{V}{R} = \frac{1/2}{1/3} = \frac{1}{2} \times \frac{3}{1} = \frac{3}{2}\text{A}$$

Ans. $I = \frac{3}{2}\text{A}$

直列回路

電源に対して抵抗が直列に接続された回路



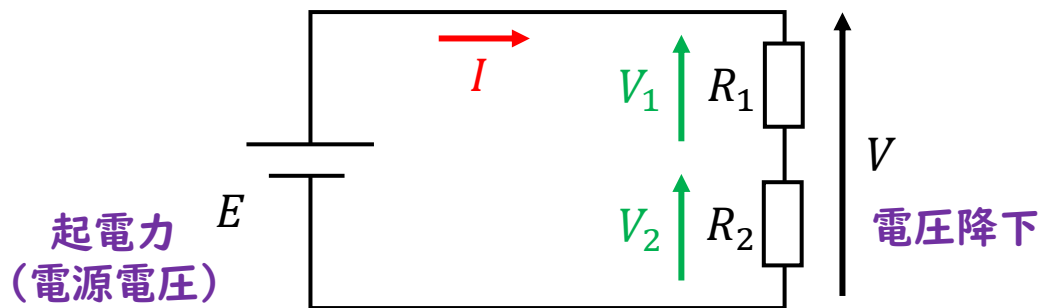
<電気回路のルール>

- 起電力 = 電圧降下の関係を必ず満たす
- 電流は1本道ではどこでも同じ大きさとなる

- 2つの抵抗で生じる電圧降下の和 $V =$ 起電力 E
- 2つの抵抗には同じ電流 I が流れる

直列回路

電源に対して抵抗が直列に接続された回路



<電気回路のルール>

- ・起電力=電圧降下の関係を必ず満たす
- ・電流は1本道ではどこでも同じ大きさとなる

- ・2つの抵抗で生じる電圧降下の和 $V = \text{起電力 } E$
- ・2つの抵抗には同じ電流 I が流れる

$$V_1 = R_1 I$$

$$V_2 = R_2 I$$

$$E = V = V_1 + V_2 = R_1 I + R_2 I = (R_1 + R_2) I$$

回路全体の抵抗(合成抵抗) R

$$R = R_1 + R_2$$

$$V_1 : V_2 = R_1 I : R_2 I = R_1 : R_2$$

$$\rightarrow V_1 : V_2 = R_1 : R_2$$

それぞれの抵抗で生じる電圧降下は抵抗の大きさの比で決まる

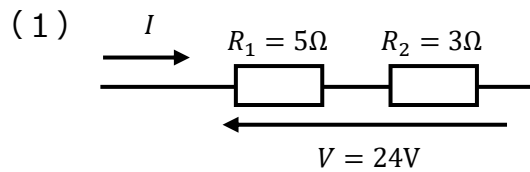
電流と各抵抗の電圧降下を起電力 E で表すと

$$I = \frac{E}{R_1 + R_2}$$

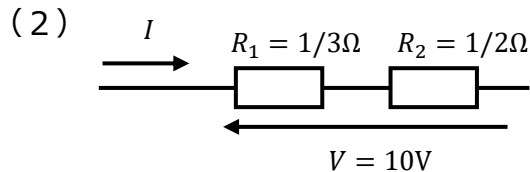
$$V_1 = R_1 I = \frac{R_1}{R_1 + R_2} E$$

$$V_2 = R_2 I = \frac{R_2}{R_1 + R_2} E$$

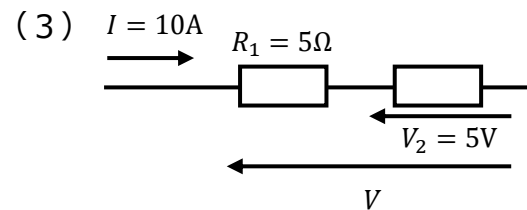
練習問題2



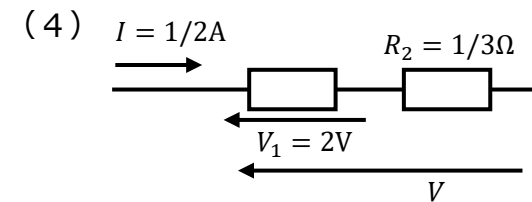
Ans. $I =$ _____



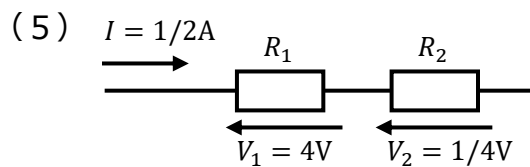
Ans. $I =$ _____



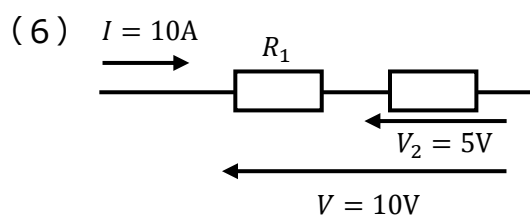
Ans. $V =$ _____



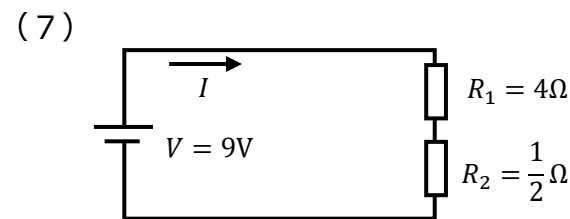
Ans. $V =$ _____



Ans. $R_1 =$ $R_2 =$ _____

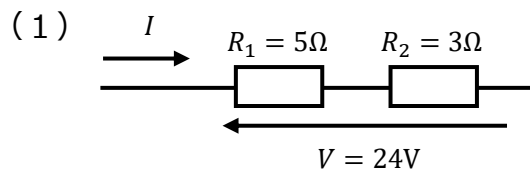


Ans. $R_1 =$ _____



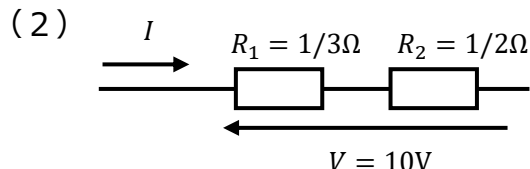
Ans. $I =$ _____

練習問題2 (解答)



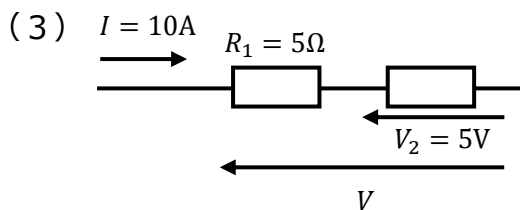
$$I = \frac{V}{R_1 + R_2} = \frac{24}{5 + 3} = 3\text{A}$$

Ans. $I = 3\text{A}$



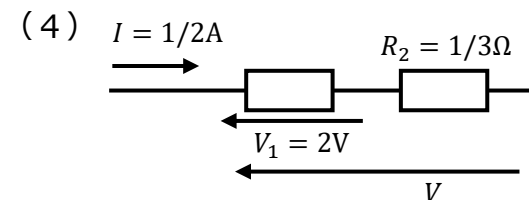
$$I = \frac{V}{R_1 + R_2} = \frac{10}{1/3 + 1/2} = \frac{10}{5/6} = 10 \cdot \frac{6}{5} = 12\text{A}$$

Ans. $I = 12\text{A}$



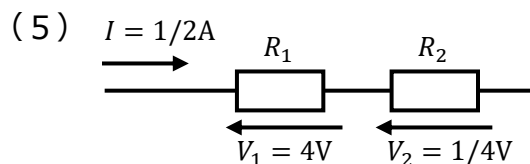
$$V = R_1 I + V_2 = 10 \times 5 + 5 = 55\text{V}$$

Ans. $V = 55\text{V}$



$$V = V_1 + R_2 I = 2 + \frac{1}{3} \times \frac{1}{2} = 2 + \frac{1}{6} = \frac{13}{6}\text{V}$$

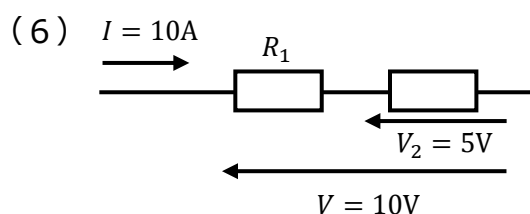
Ans. $V = \frac{13}{6}\text{V}$



$$R_1 = \frac{V_1}{I} = \frac{4}{1/2} = 4 \times 2 = 8\Omega$$

$$R_2 = \frac{V_2}{I} = \frac{1/4}{1/2} = \frac{1}{4} \times 2 = \frac{1}{2}\Omega$$

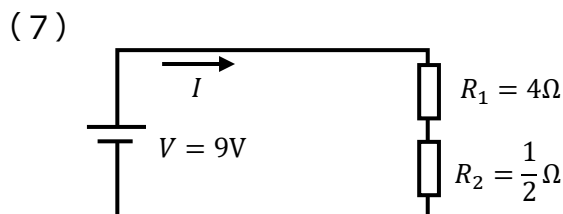
Ans. $R_1 = 8\Omega$ $R_2 = \frac{1}{2}\Omega$



$$V_1 = V - V_2 = 10 - 5 = 5\text{V}$$

$$R_1 = \frac{V_1}{I} = \frac{5}{10} = \frac{1}{2}\Omega$$

Ans. $R_1 = \frac{1}{2}\Omega$

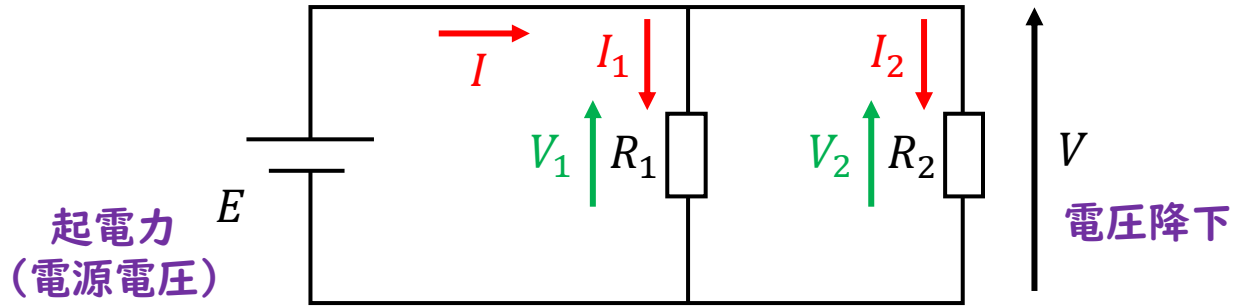


$$I = \frac{V}{R_1 + R_2} = \frac{9}{4 + \frac{1}{2}} = \frac{9}{\frac{9}{2}} = 9 \times \frac{2}{9} = 2\text{A}$$

Ans. $I = 2\text{A}$

並列回路

電源に対して抵抗が並列に接続された回路



起電力
(電源電圧)

V
電圧降下

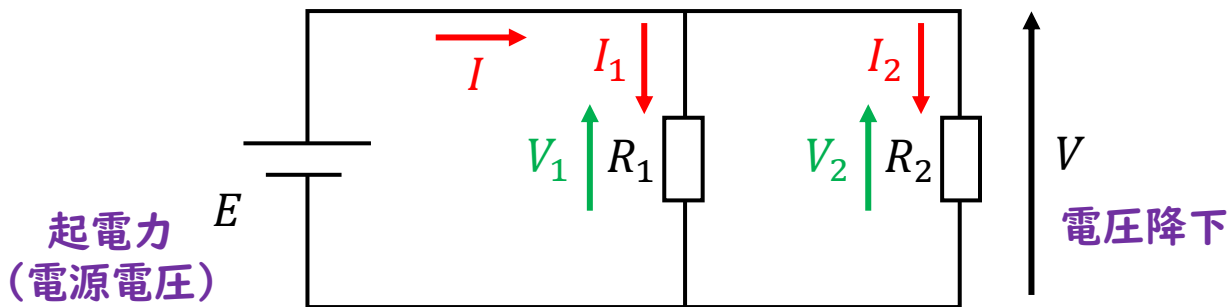
<電気回路のルール>

- 起電力=電圧降下の関係を必ず満たす
- 電流は1本道ではどこでも同じ大きさとなる

- 2つの抵抗には同じ大きさの電圧降下 V が生じる
- 電流 I は2つの抵抗で I_1 と I_2 に分かれる

並列回路

電源に対して抵抗が並列に接続された回路



起電力
(電源電圧) \$E\$

\$V\$
電圧降下

- 2つの抵抗には同じ大きさの電圧降下 \$V\$ が生じる
- 電流 \$I\$ は2つの抵抗で \$I_1\$ と \$I_2\$ に分かれる

$$V_1 = V = E \quad V_2 = V = E$$

$$I_1 = \frac{V_1}{R_1} = \frac{E}{R_1} \quad I_2 = \frac{V_2}{R_2} = \frac{E}{R_2}$$

$$I = I_1 + I_2 = \frac{E}{R_1} + \frac{E}{R_2} = \left(\frac{1}{R_1} + \frac{1}{R_2} \right) E = \frac{R_1 + R_2}{R_1 R_2} E$$

$$E = \frac{R_1 R_2}{R_1 + R_2} I \quad R = \frac{R_1 R_2}{R_1 + R_2}$$

回路全体の抵抗 (合成抵抗) \$R\$

<電気回路のルール>

- 起電力=電圧降下の関係を必ず満たす
- 電流は1本道ではどこでも同じ大きさとなる

$$I_1 : I_2 = \frac{E}{R_1} : \frac{E}{R_2} = \frac{1}{R_1} : \frac{1}{R_2} = R_2 : R_1$$

(Note: A blue arrow points from the \$R_1\$ in the denominator of the second term to the \$R_2\$ in the numerator of the result, with the label \$\times R_1 R_2\$.)

$$\rightarrow I_1 : I_2 = R_2 : R_1$$

それぞれの抵抗に流れる電流は抵抗の大きさの逆比で決まる

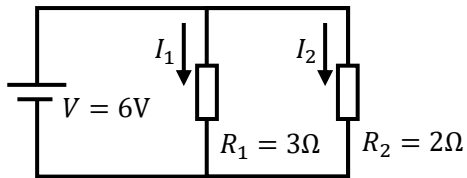
電流と各抵抗の電圧降下を回路全体の電流 \$I\$ で表すと

$$I_1 = \frac{E}{R_1} = \frac{1}{R_1} \times \frac{R_1 R_2}{R_1 + R_2} I = \frac{R_2}{R_1 + R_2} I$$

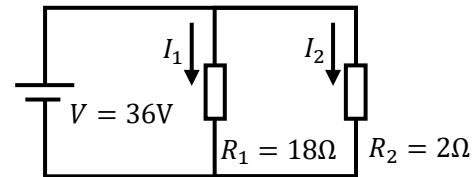
$$I_2 = \frac{E}{R_2} = \frac{1}{R_2} \times \frac{R_1 R_2}{R_1 + R_2} I = \frac{R_1}{R_1 + R_2} I$$

練習問題3

(1)



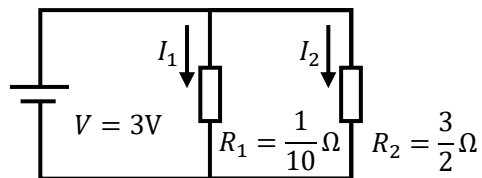
(2)



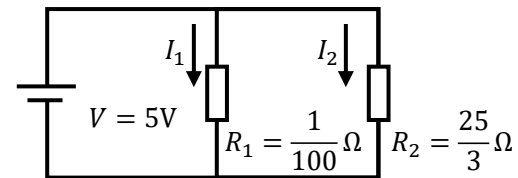
Ans. $I_1 =$ $I_2 =$

Ans. $I_1 =$ $I_2 =$

(3)



(4)

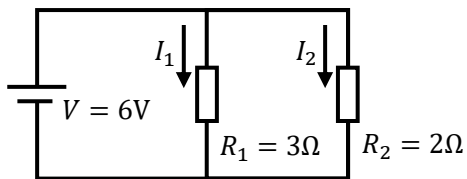


Ans. $I_1 =$ $I_2 =$

Ans. $I_1 =$ $I_2 =$

練習問題3 (解答)

(1)

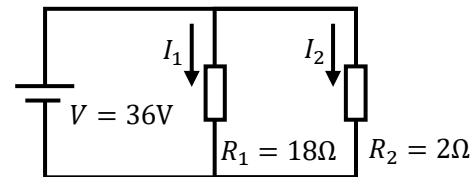


$$I_1 = \frac{V}{R_1} = \frac{6}{3} = 2A$$

$$I_2 = \frac{V}{R_2} = \frac{6}{2} = 3A$$

Ans. $I_1 = 2A$ $I_2 = 3A$

(2)

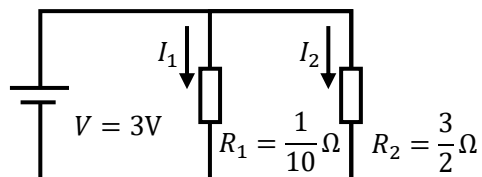


$$I_1 = \frac{V}{R_1} = \frac{36}{18} = 2A$$

$$I_2 = \frac{V}{R_2} = \frac{36}{2} = 18A$$

Ans. $I_1 = 2A$ $I_2 = 18A$

(3)

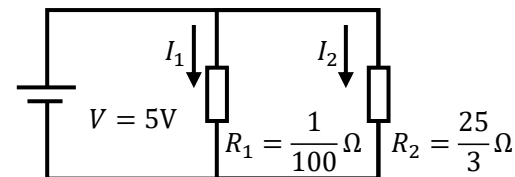


$$I_1 = \frac{V}{R_1} = \frac{3}{1/10} = 3 \times \frac{10}{1} = 30A$$

$$I_2 = \frac{V}{R_2} = \frac{3}{3/2} = 3 \times \frac{2}{3} = 2A$$

Ans. $I_1 = 30A$ $I_2 = 2A$

(4)



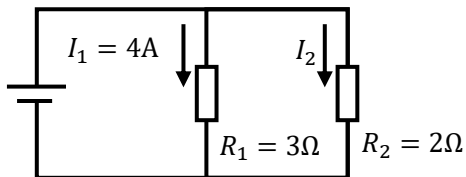
$$I_1 = \frac{V}{R_1} = \frac{5}{1/100} = 5 \times \frac{100}{1} = 500A$$

$$I_2 = \frac{V}{R_2} = \frac{5}{25/3} = 5 \times \frac{3}{25} = \frac{3}{5}A$$

Ans. $I_1 = 500A$ $I_2 = \frac{3}{5}A$

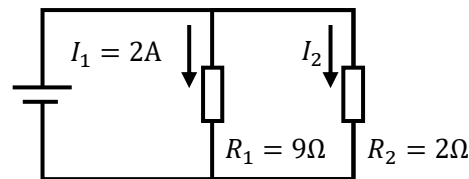
練習問題4

(1)



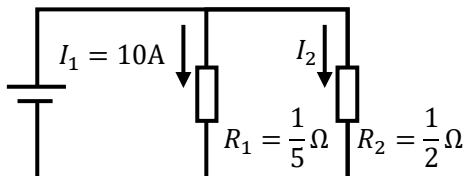
Ans. $I_2 =$ _____

(2)



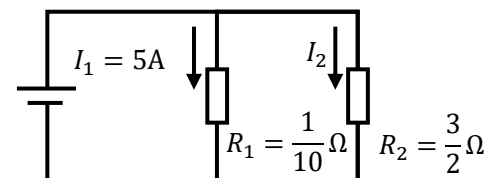
Ans. $I_2 =$ _____

(3)



Ans. $I_2 =$ _____

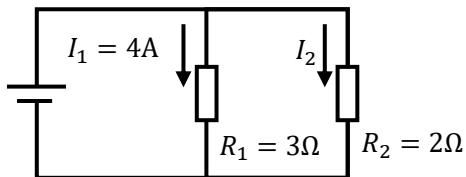
(4)



Ans. $I_2 =$ _____

練習問題4 (解答)

(1)

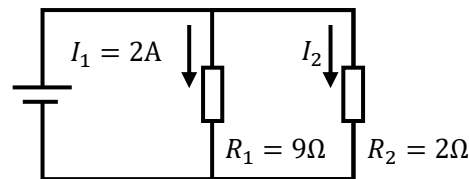


$$V = R_1 I_1 = 3 \times 4 = 12V$$

$$I_2 = \frac{V}{R_2} = \frac{12}{2} = 6A$$

Ans. $I_2 = 6A$

(2)

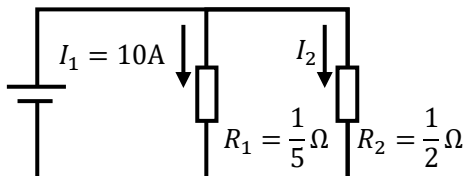


$$V = R_1 I_1 = 9 \times 2 = 18V$$

$$I_2 = \frac{V}{R_2} = \frac{18}{2} = 9A$$

Ans. $I_2 = 9A$

(3)

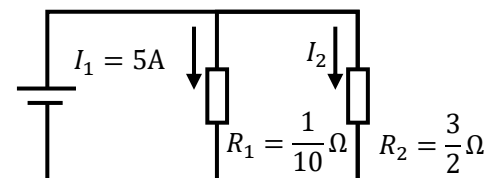


$$V = R_1 I_1 = \frac{1}{5} \times 10 = 2V$$

$$I_2 = \frac{V}{R_2} = \frac{2}{1/2} = 2 \times \frac{2}{1} = 4A$$

Ans. $I_2 = 4A$

(4)



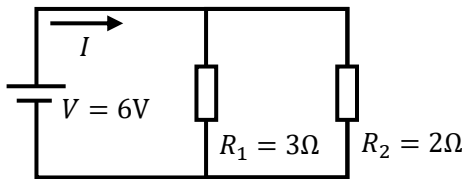
$$V = R_1 I_1 = 5 \times \frac{1}{10} = \frac{1}{2}V$$

$$I_2 = \frac{V}{R_2} = \frac{1/2}{3/2} = \frac{1}{2} \times \frac{2}{3} = \frac{1}{3}A$$

Ans. $I_2 = \frac{1}{3}A$

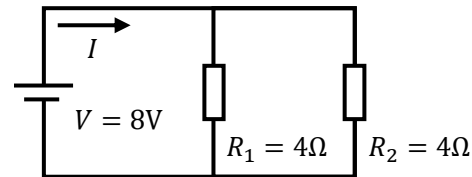
練習問題5

(1)



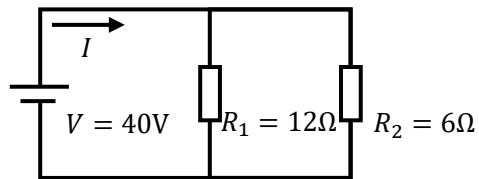
Ans. $I =$ _____

(2)



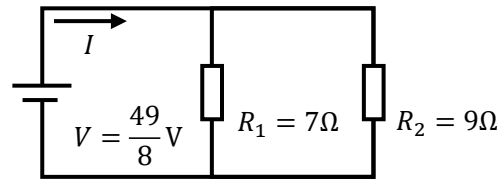
Ans. $I =$ _____

(3)



Ans. $I =$ _____

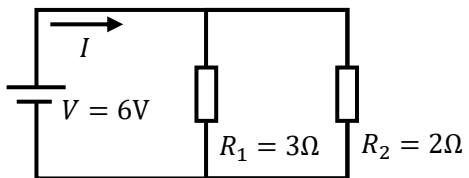
(4)



Ans. $I =$ _____

練習問題5 (解答)

(1)

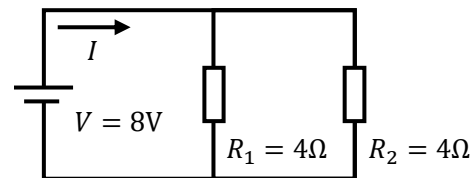


$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{3 \times 2}{3 + 2} = \frac{6}{5} \Omega$$

$$I = \frac{V}{R} = \frac{6}{6/5} = 6 \times \frac{5}{6} = 5A$$

Ans. $I = 5A$

(2)

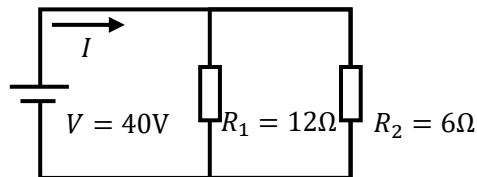


$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{4 \times 4}{4 + 4} = \frac{16}{8} = 2 \Omega$$

$$I = \frac{V}{R} = \frac{8}{2} = 4A$$

Ans. $I = 4A$

(3)

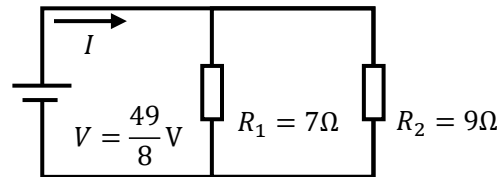


$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{12 \times 6}{12 + 6} = \frac{72}{18} = 4 \Omega$$

$$I = \frac{V}{R} = \frac{40}{4} = 10A$$

Ans. $I = 10A$

(4)



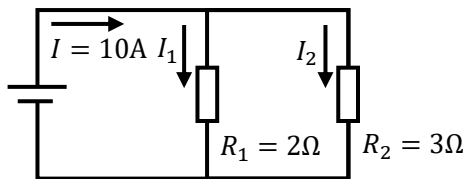
$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{7 \times 9}{7 + 9} = \frac{63}{16} \Omega$$

$$I = \frac{V}{R} = \frac{49/8}{63/16} = \frac{49}{8} \times \frac{16}{63} = \frac{7}{1} \times \frac{2}{9} = \frac{14}{9} A$$

Ans. $I = \frac{14}{9} A$

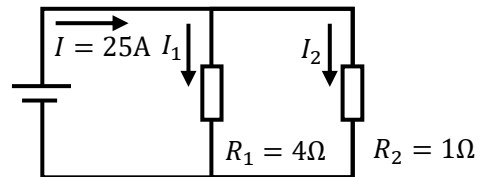
練習問題6

(1)



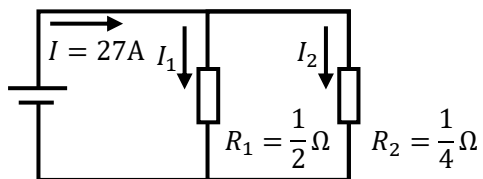
Ans. $I_1 =$ $I_2 =$

(2)



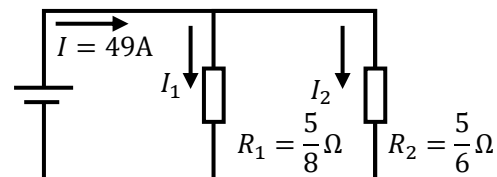
Ans. $I_1 =$ $I_2 =$

(3)



Ans. $I_1 =$ $I_2 =$

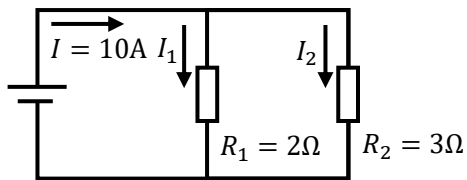
(4)



Ans. $I_1 =$ $I_2 =$

練習問題6 (解答)

(1)

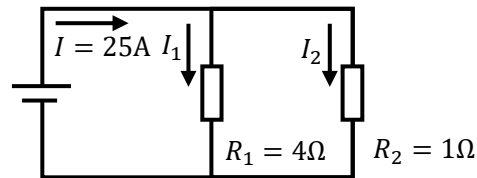


$$I_1 : I_2 = \frac{V}{R_1} : \frac{V}{R_2} = \frac{1}{R_1} : \frac{1}{R_2} = R_2 : R_1$$

$$I_1 : I_2 = R_2 : R_1 = 3 : 2 = 6 : 4$$

Ans. $I_1 = 6 \text{ A}$ $I_2 = 4 \text{ A}$

(2)

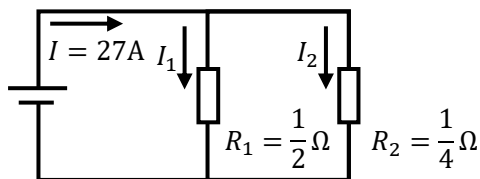


$$I_1 : I_2 = R_2 : R_1 = 1 : 4 = 5 : 20$$

$$\frac{25}{4+1} = 5 \xrightarrow{\times 5}$$

Ans. $I_1 = 5 \text{ A}$ $I_2 = 20 \text{ A}$

(3)

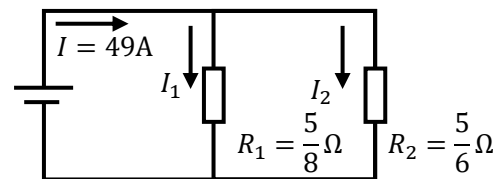


$$I_1 : I_2 = R_2 : R_1 = \frac{1}{4} : \frac{1}{2} = 1 : 2 = 9 : 18$$

$$\frac{27}{1+2} = 9 \xrightarrow{\times 9}$$

Ans. $I_1 = 9 \text{ A}$ $I_2 = 18 \text{ A}$

(4)



$$I_1 : I_2 = R_2 : R_1 = \frac{5}{6} : \frac{5}{8} = 20 : 15 = 28 : 21$$

$$\frac{49}{20+15} = \frac{49}{35} = \frac{7}{5} \xrightarrow{\times \frac{7}{5}}$$

Ans. $I_1 = 28 \text{ A}$ $I_2 = 21 \text{ A}$

ご聴講ありがとうございました
ございました!!