

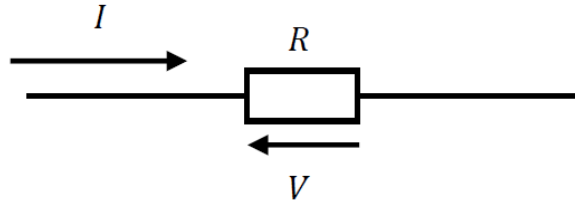
電験三種 オンライン講座

直流回路（Ⅰ） 直流回路の基礎

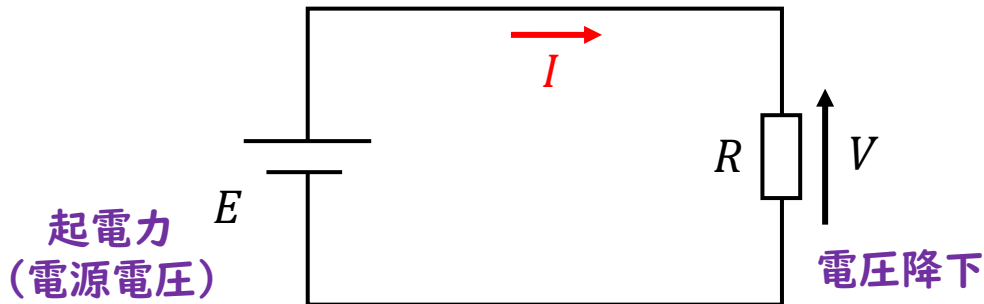
オームの法則

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。

$$V = RI$$



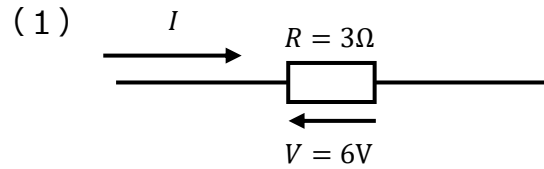
V : 電圧 (単位は[V]ボルト)
 I : 電流 (単位は[A]アンペア)
 R : 抵抗 (単位は[Ω]オーム)



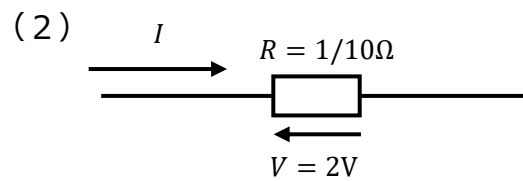
<電気回路のルール>

- ・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

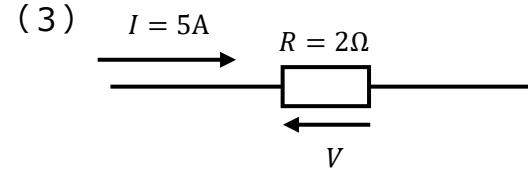
練習問題 I



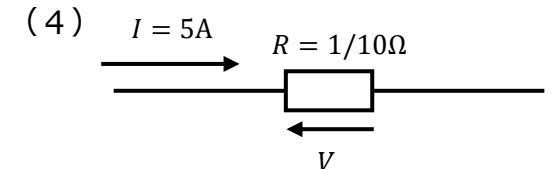
Ans. $I =$ _____



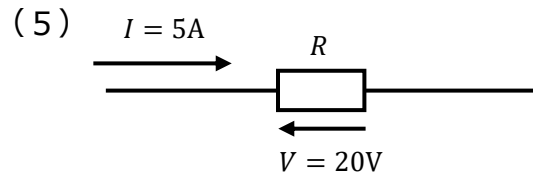
Ans. $I =$ _____



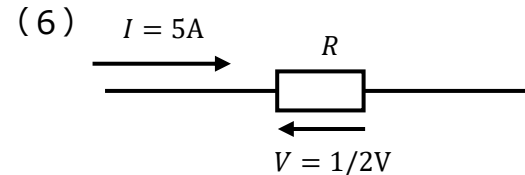
Ans. $v =$ _____



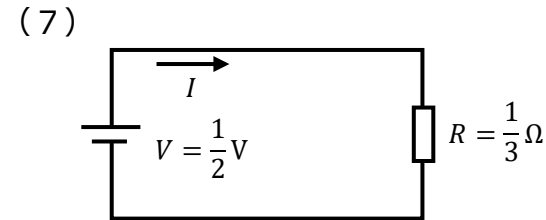
Ans. $v =$ _____



Ans. $R =$ _____

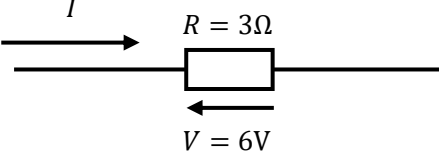


Ans. $R =$ _____



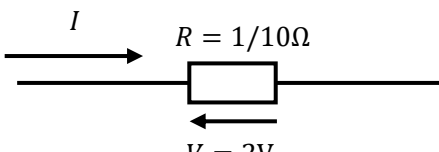
Ans. $I =$ _____

練習問題Ⅰ（解答）

(1) 

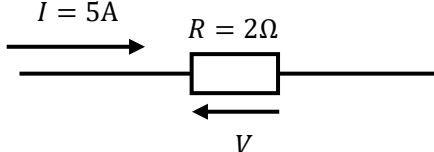
$$I = \frac{V}{R} = \frac{6}{3} = 2\text{A}$$

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

(2) 

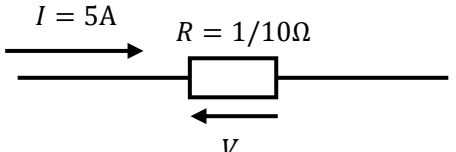
$$I = \frac{V}{R} = \frac{2}{1/10} = 2 \times \frac{10}{1} = 20\text{A}$$

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

(3) 

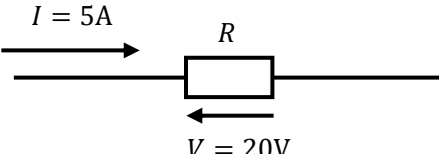
$$V = RI = 2 \times 5 = 10\text{V}$$

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

(4) 

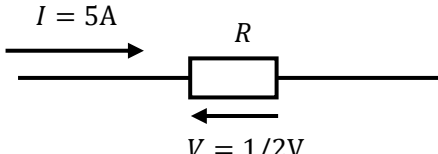
$$V = RI = \frac{1}{10} \times 5 = \frac{1}{2}\text{V}$$

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

(5) 

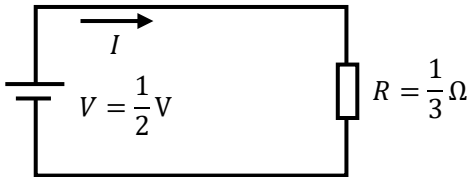
$$R = \frac{V}{I} = \frac{20}{5} = 4\Omega$$

Ans. $R = 4\Omega$

(6) 

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

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

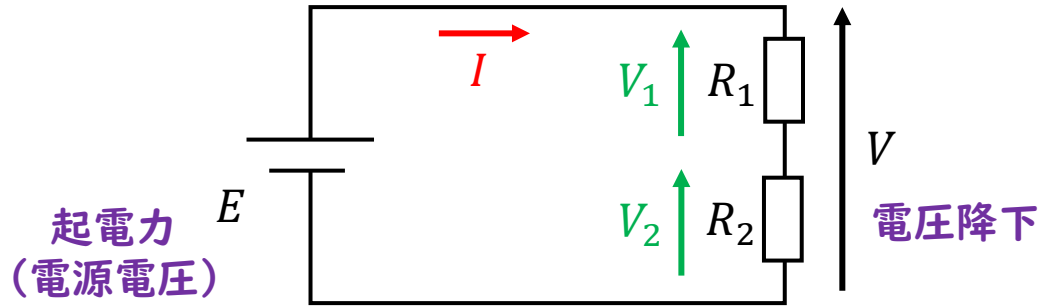
(7) 

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

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



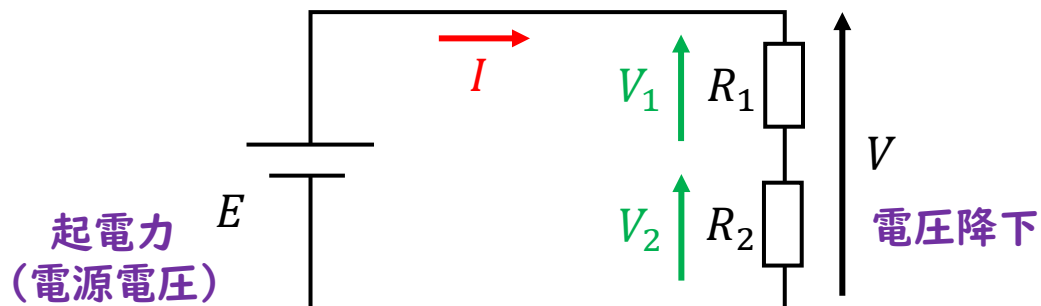
<電気回路のルール>

- ・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 $V = \text{起電力 } E$
- ・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

$$R = R_1 + R_2$$

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

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

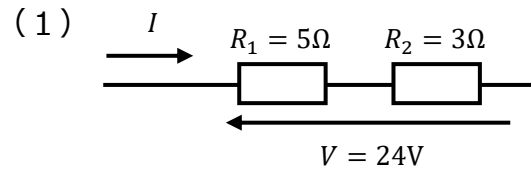
それぞれの抵抗で生じる電圧降下は抵抗の大きさの比で決まる

電流と各抵抗の電圧降下を起電力 E で表すと

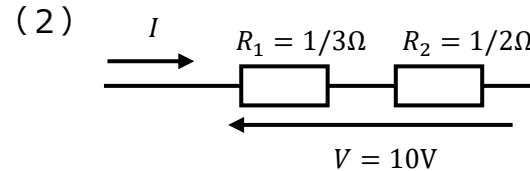
$$I = \frac{E}{R_1 + R_2}$$

$$V_1 = R_1 I = \frac{R_1}{R_1 + R_2} E \quad V_2 = R_2 I = \frac{R_2}{R_1 + R_2} E$$

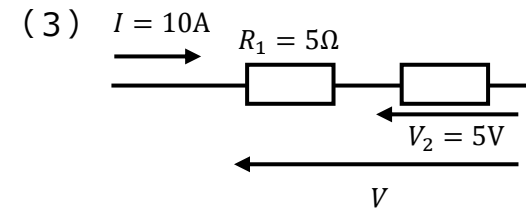
練習問題2



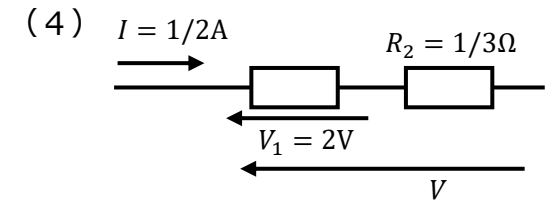
Ans. $I =$ _____



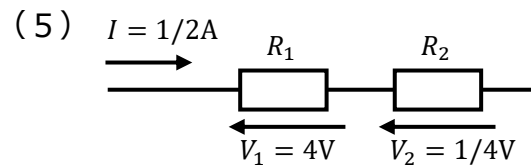
Ans. $I =$ _____



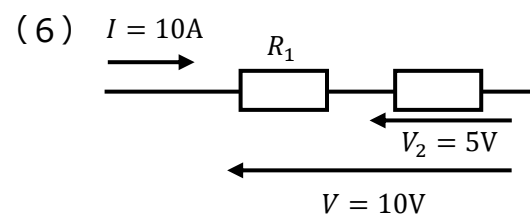
Ans. $V =$ _____



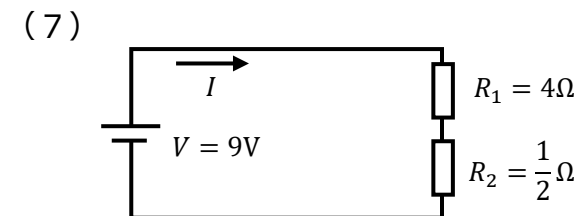
Ans. $V =$ _____



Ans. $R_1 =$ _____ $R_2 =$ _____

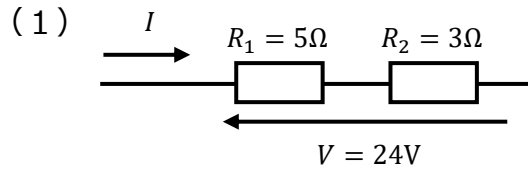


Ans. $R_1 =$ _____



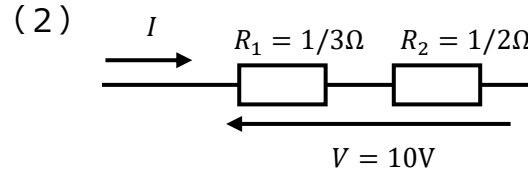
Ans. $I =$ _____

練習問題2 (解答)



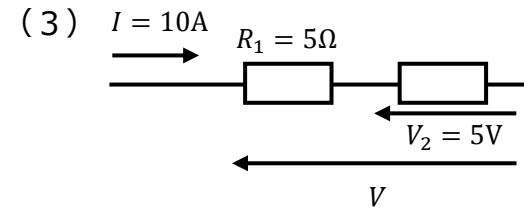
$$I = \frac{V}{R_1 + R_2} = \frac{24}{5 + 3} = 3\text{A}$$

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



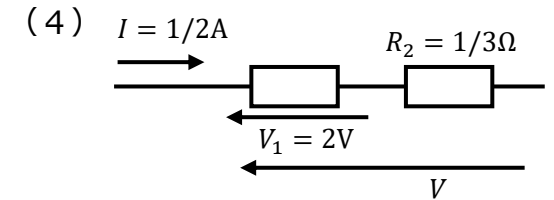
$$I = \frac{V}{R_1 + R_2} = \frac{10}{1/3 + 1/2} = \frac{10}{5/6} = 10 \cdot \frac{6}{5} = 12\text{A}$$

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



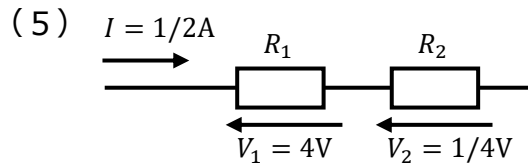
$$V = R_1 I + V_2 = 10 \times 5 + 5 = 55\text{V}$$

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



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

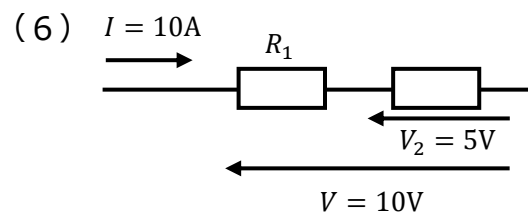
Ans. $V = \frac{13}{6}\text{V}$



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

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

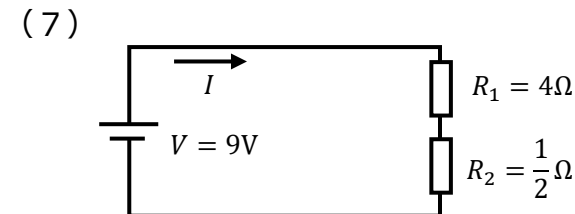
Ans. $R_1 = 8\Omega$ $R_2 = \frac{1}{2}\Omega$



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

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

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

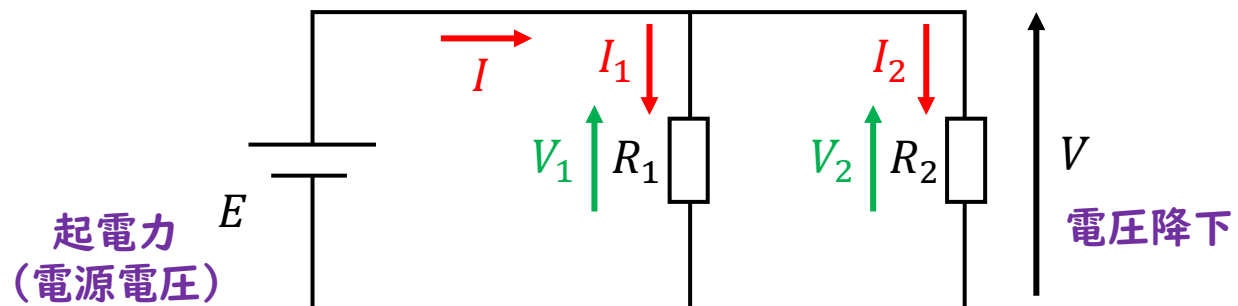


$$I = \frac{V}{R_1 + R_2} = \frac{9}{4 + \frac{1}{2}} = \frac{9}{9/2} = 9 \times \frac{2}{9} = 2\text{A}$$

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



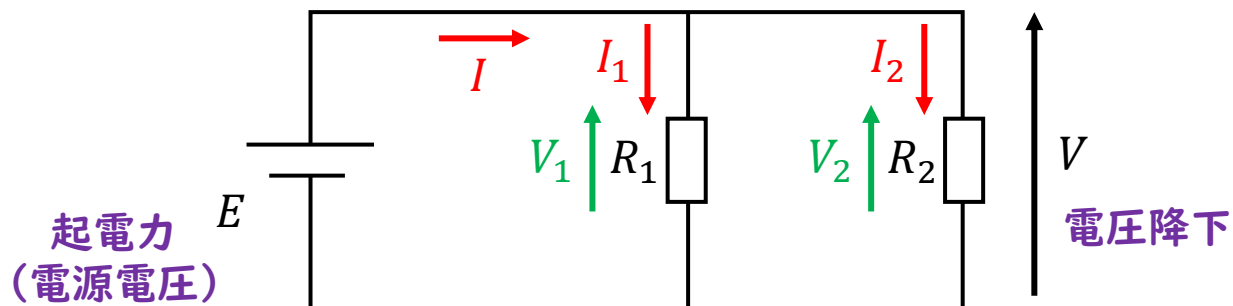
<電気回路のルール>

- ・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



- 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

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

× $R_1 R_2$

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

それぞれの抵抗で生じる電圧降下は抵抗の大きさの逆比で決まる

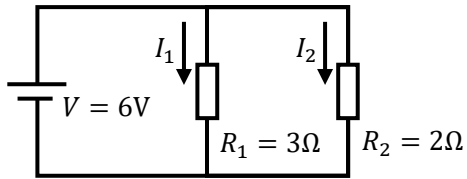
電流と各抵抗の電圧降下を回路全体の電流 I で表すと

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

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

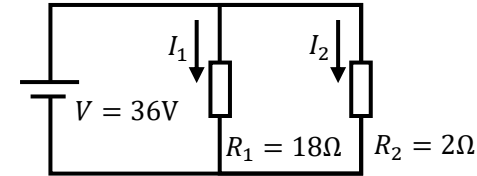
練習問題3

(1)



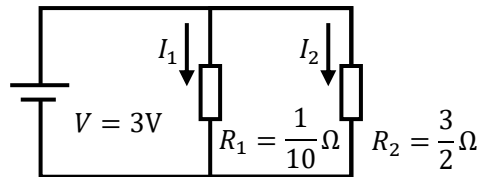
Ans. $I_1 =$ $I_2 =$

(2)



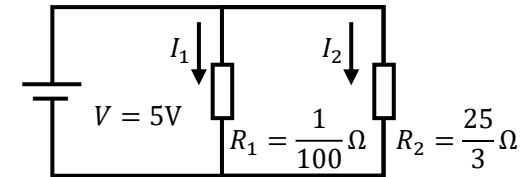
Ans. $I_1 =$ $I_2 =$

(3)



Ans. $I_1 =$ $I_2 =$

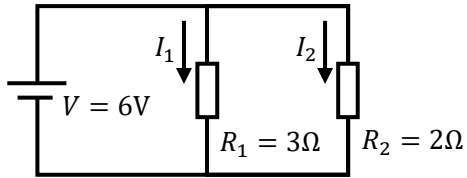
(4)



Ans. $I_1 =$ $I_2 =$

練習問題3 (解答)

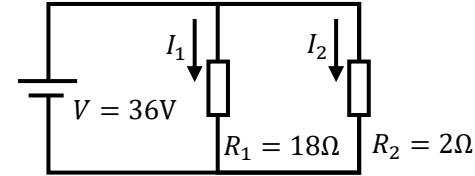
(1)



$$I_1 = \frac{V}{R_1} = \frac{6}{3} = 2A$$
$$I_2 = \frac{V}{R_2} = \frac{6}{2} = 3A$$

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

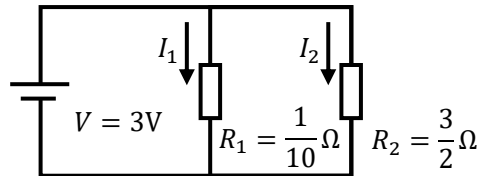
(2)



$$I_1 = \frac{V}{R_1} = \frac{36}{18} = 2A$$
$$I_2 = \frac{V}{R_2} = \frac{36}{2} = 18A$$

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

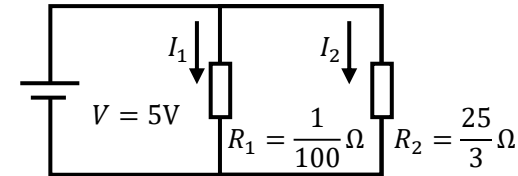
(3)



$$I_1 = \frac{V}{R_1} = \frac{3}{1/10} = 3 \times \frac{10}{1} = 30A$$
$$I_2 = \frac{V}{R_2} = \frac{3}{3/2} = 3 \times \frac{2}{3} = 2A$$

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

(4)

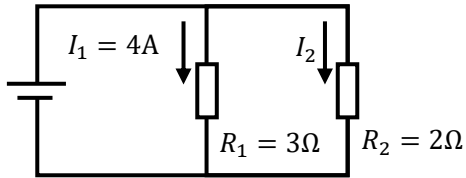


$$I_1 = \frac{V}{R_1} = \frac{5}{1/100} = 5 \times \frac{100}{1} = 500A$$
$$I_2 = \frac{V}{R_2} = \frac{5}{25/3} = 5 \times \frac{3}{25} = \frac{3}{5}A$$

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

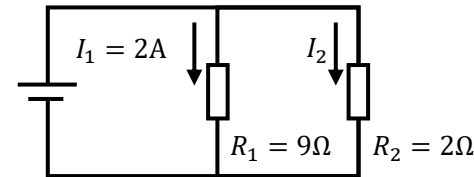
練習問題4

(1)



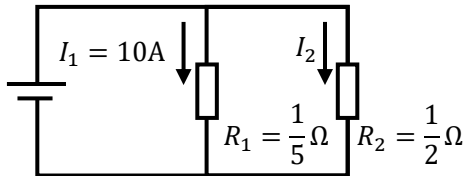
Ans. $I_2 =$ _____

(2)



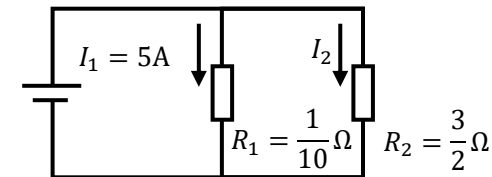
Ans. $I_2 =$ _____

(3)



Ans. $I_2 =$ _____

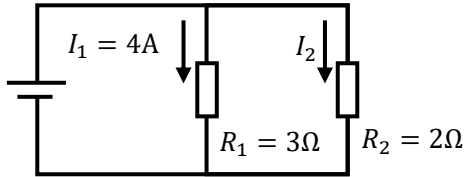
(4)



Ans. $I_2 =$ _____

練習問題4 (解答)

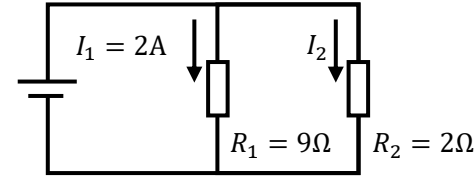
(1)



$$V = R_1 I_1 = 3 \times 4 = 12V$$
$$I_2 = \frac{V}{R_2} = \frac{12}{2} = 6A$$

Ans. $I_2 = 6A$

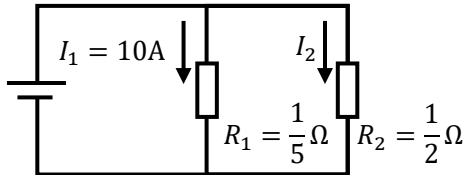
(2)



$$V = R_1 I_1 = 9 \times 2 = 18V$$
$$I_2 = \frac{V}{R_2} = \frac{18}{2} = 9A$$

Ans. $I_2 = 9A$

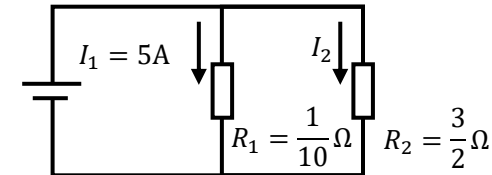
(3)



$$V = R_1 I_1 = \frac{1}{5} \times 10 = 2V$$
$$I_2 = \frac{V}{R_2} = \frac{2}{1/2} = 2 \times \frac{2}{1} = 4A$$

Ans. $I_2 = 4A$

(4)

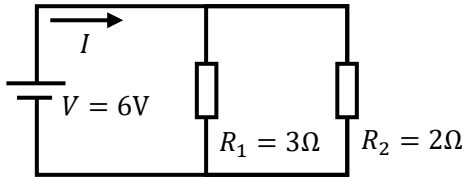


$$V = R_1 I_1 = 5 \times \frac{1}{10} = \frac{1}{2}V$$
$$I_2 = \frac{V}{R_2} = \frac{1/2}{3/2} = \frac{1}{2} \times \frac{2}{3} = \frac{1}{3}A$$

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

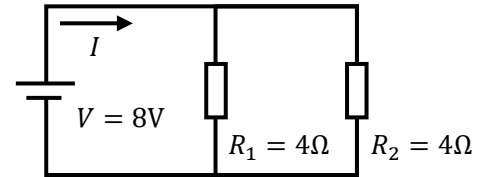
練習問題5

(1)



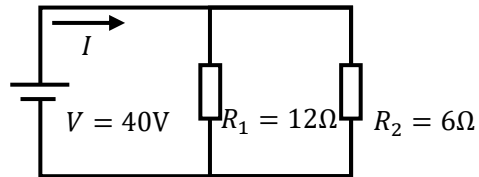
Ans. $I =$ _____

(2)



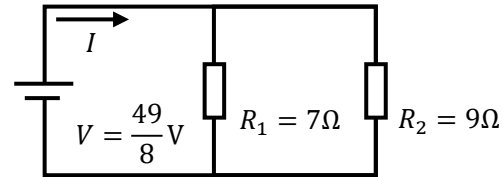
Ans. $I =$ _____

(3)



Ans. $I =$ _____

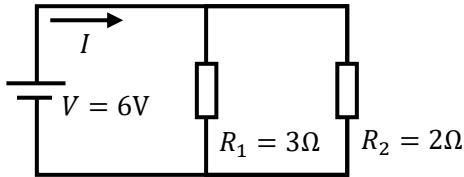
(4)



Ans. $I =$ _____

練習問題5 (解答)

(1)

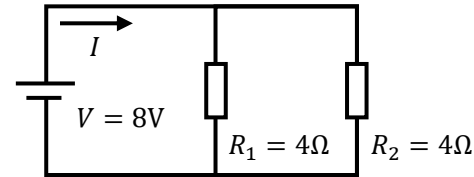


$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{3 \times 2}{3 + 2} = \frac{6}{5} \Omega$$

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

Ans. $I = 5 \text{ A}$

(2)

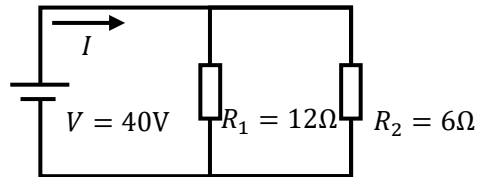


$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{4 \times 4}{4 + 4} = \frac{16}{8} = 2 \Omega$$

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

Ans. $I = 4 \text{ A}$

(3)

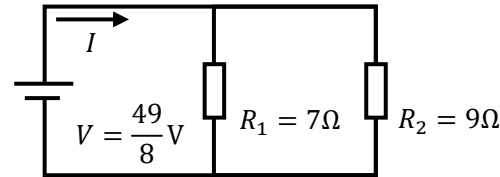


$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{12 \times 6}{12 + 6} = \frac{72}{18} = 4 \Omega$$

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

Ans. $I = 10 \text{ A}$

(4)



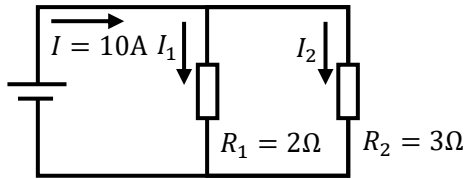
$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{7 \times 9}{7 + 9} = \frac{63}{16} \Omega$$

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

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

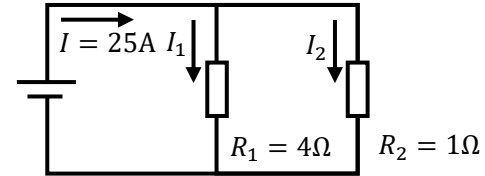
練習問題6

(1)



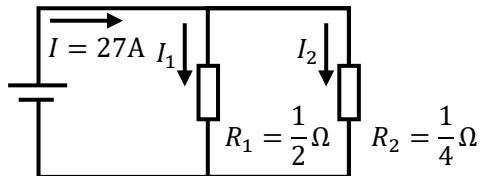
Ans. $I_1 =$ $I_2 =$

(2)



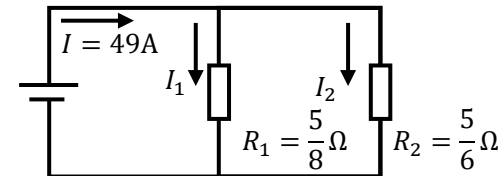
Ans. $I_1 =$ $I_2 =$

(4)



Ans. $I_1 =$ $I_2 =$

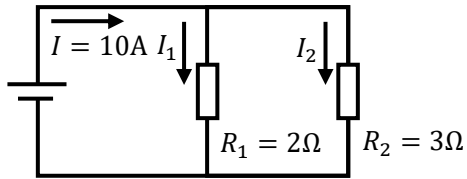
(6)



Ans. $I_1 =$ $I_2 =$

練習問題6 (解答)

(1)

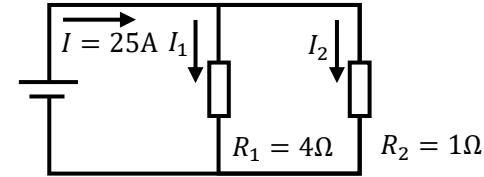


$$I_1:I_2 = \frac{V}{R_1}:\frac{V}{R_2} = \frac{1}{R_1}:\frac{1}{R_2} = R_2:R_1$$

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

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

(2)

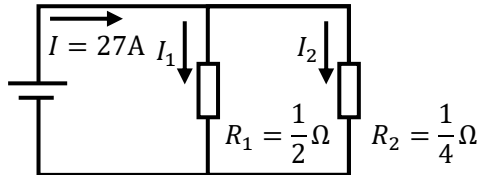


$$I_1:I_2 = R_2:R_1 = 1:4 = 5:20$$

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

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

(4)

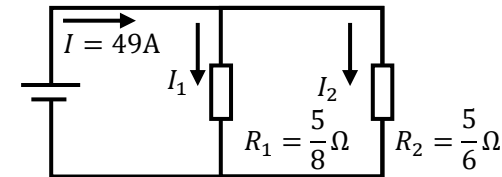


$$I_1:I_2 = R_2:R_1 = \frac{1}{4}:\frac{1}{2} = 1:2 = 9:18$$

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

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

(6)



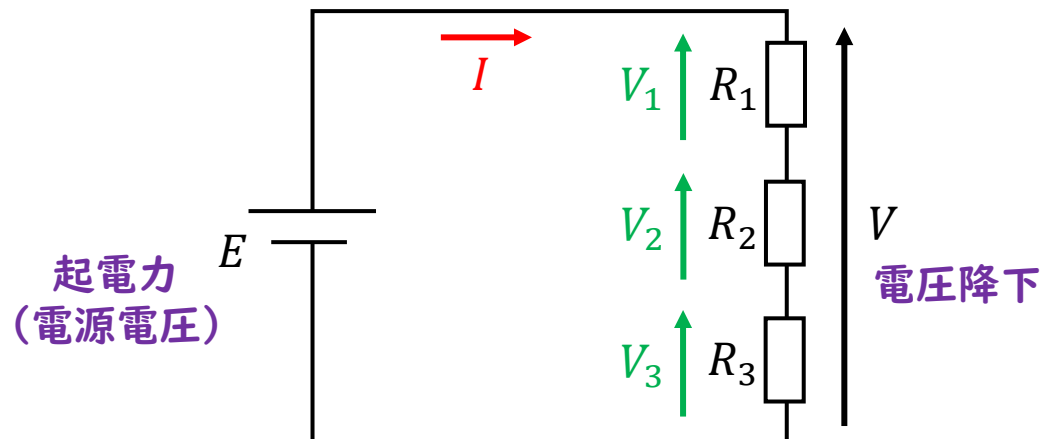
$$I_1:I_2 = R_2:R_1 = \frac{5}{6}:\frac{5}{8} = 20:15 = 28:21$$

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

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

3個以上の抵抗が接続される場合

直列回路

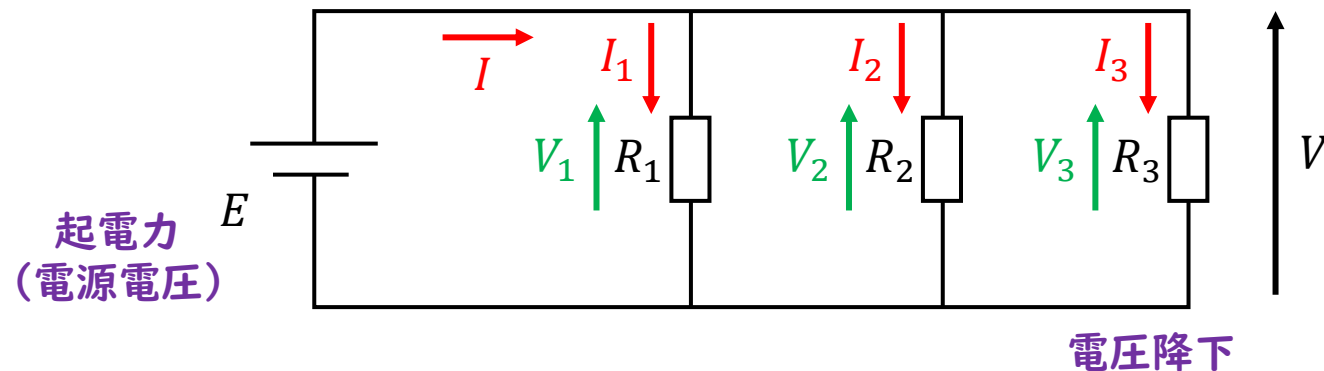


$$\begin{aligned} V_1 &= R_1 I \\ V_2 &= R_2 I \\ V_3 &= R_3 I \\ E = V &= V_1 + V_2 + V_3 = R_1 I + R_2 I + R_3 I = (R_1 + R_2 + R_3) I \end{aligned}$$

$$R = R_1 + R_2 + R_3$$

$$V_1 : V_2 : V_3 = R_1 I : R_2 I : R_3 I = R_1 : R_2 : R_3$$

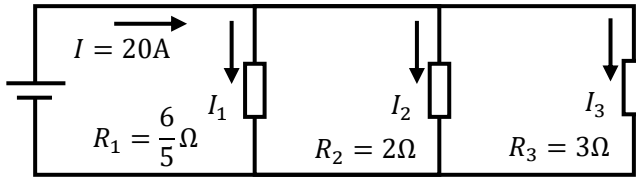
並列回路



$$\begin{aligned} V_1 &= V = E & V_2 &= V = E & V_3 &= V = E \\ I_1 &= \frac{V_1}{R_1} = \frac{E}{R_1} & I_2 &= \frac{V_2}{R_2} = \frac{E}{R_2} & I_3 &= \frac{V_3}{R_3} = \frac{E}{R_3} \\ I &= I_1 + I_2 + I_3 = \frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right) E \\ \frac{1}{R} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \\ I_1 : I_2 : I_3 &= \frac{E}{R_1} : \frac{E}{R_2} : \frac{E}{R_3} = \frac{1}{R_1} : \frac{1}{R_2} : \frac{1}{R_3} \end{aligned}$$

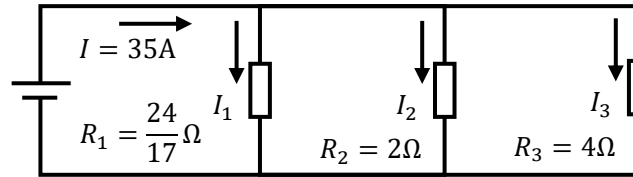
練習問題7

(1)



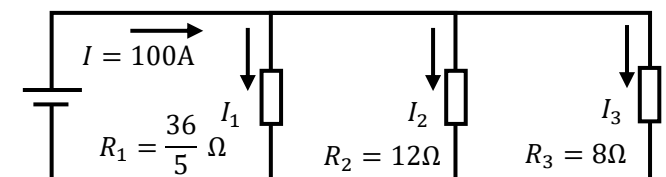
Ans. $I_1 =$ $I_2 =$ $I_3 =$

(2)



Ans. $I_1 =$ $I_2 = 1$ $I_3 =$

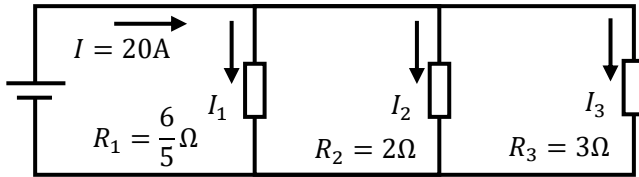
(3)



Ans. $I_1 = 2$ $I_2 =$ $I_3 =$

練習問題7 (解答)

(1)



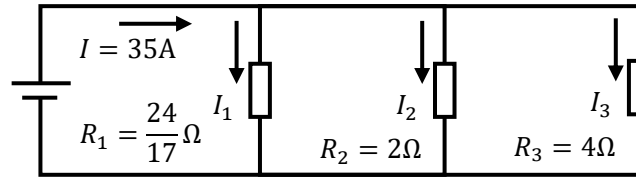
$$I_1 : I_2 : I_3 = \frac{1}{R_1} : \frac{1}{R_2} : \frac{1}{R_3} = \frac{5}{6} : \frac{1}{2} : \frac{1}{3}$$

$$= 10 : 6 : 4 \quad \leftarrow \times 12$$

$$\frac{\text{電流 } I}{\text{比の総和}} = \frac{20}{10 + 6 + 4} = 1$$

Ans. $I_1 = 10A$ $I_2 = 6A$ $I_3 = 4A$

(2)



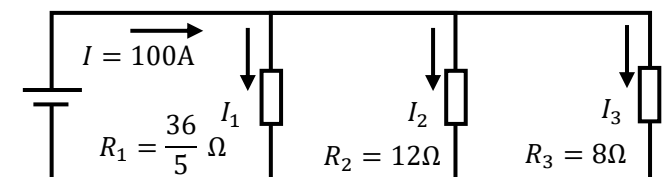
$$I_1 : I_2 : I_3 = \frac{1}{R_1} : \frac{1}{R_2} : \frac{1}{R_3} = \frac{17}{24} : \frac{1}{2} : \frac{1}{4}$$

$$= 17 : 12 : 6 \quad \leftarrow \times 24$$

$$\frac{\text{電流 } I}{\text{比の総和}} = \frac{35}{17 + 12 + 6} = 1$$

Ans. $I_1 = 17A$ $I_2 = 12A$ $I_3 = 6A$

(3)



$$I_1 : I_2 : I_3 = \frac{1}{R_1} : \frac{1}{R_2} : \frac{1}{R_3} = \frac{5}{36} : \frac{1}{12} : \frac{1}{8}$$

$$= 20 : 12 : 18 \quad \leftarrow \times 144$$

$$= 40 : 24 : 36 \quad \leftarrow \times 2$$

$$\frac{\text{電流 } I}{\text{比の総和}} = \frac{100}{20 + 12 + 18} = 2$$

Ans. $I_1 = 20A$ $I_2 = 12A$ $I_3 = 18A$

ご聴講ありがとうございました!!