電験どうでしょう管理人

KWG presents

電験オンライン塾

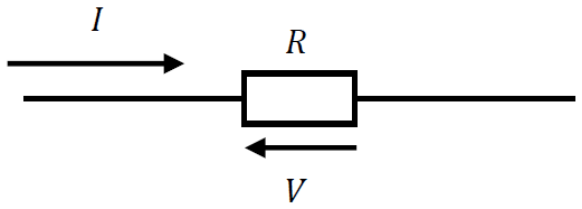
第3回　直流回路
起電力と電圧降下

2023.04.22 Sat

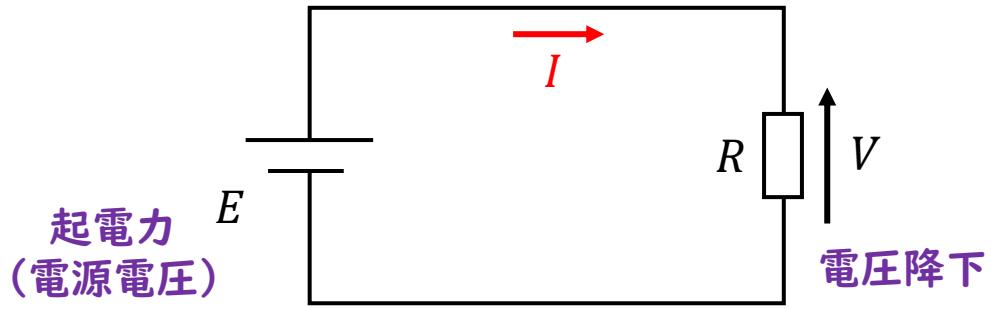
オームの法則

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。

$$V = RI$$



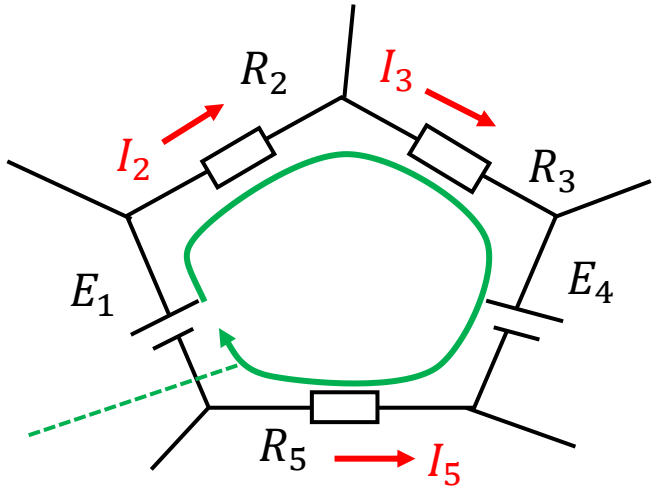
V：電圧（単位は[V]ボルト）
I：電流（単位は[A]アンペア）
R：抵抗（単位は[Ω]オーム）



＜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

キルヒホッフの電圧則

回路網中の任意の閉路を一巡するとき、起電力の総和と電圧降下の総和は等しい



$$E_1 - E_4 = R_2 I_2 + R_3 I_3 - R_5 I_5$$

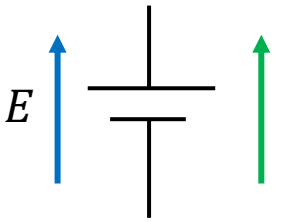
（起電力の総和）＝（電圧降下の総和）

＜ポイント1＞
電流ループとその向き
自分を決める

＜ポイント2＞
起電力（電源）と電圧降下で
正負の符号の考え方が違う

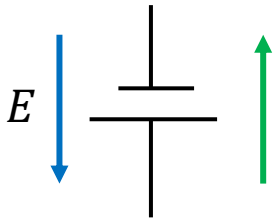
電位差
電流の向き
任意経路の向き

起電力



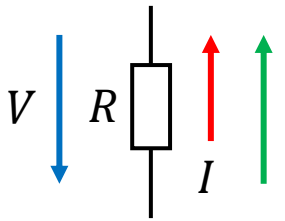
$+E$

起電力



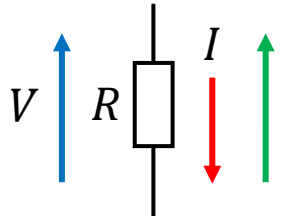
$-E$

電圧降下



$+RI$

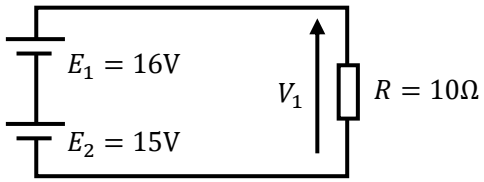
電圧降下



$-RI$

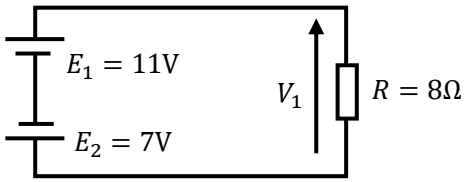
練習問題1

（1）



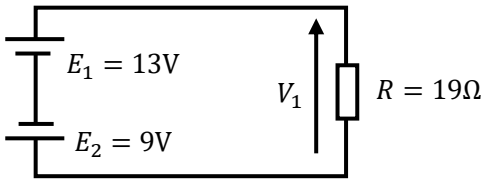
Ans. $V_1 =$

（2）



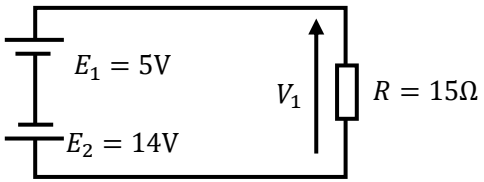
Ans. $V_1 =$

（3）



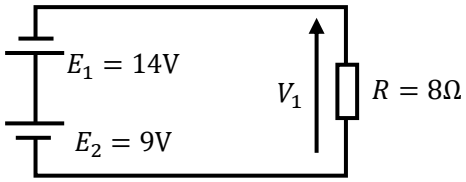
Ans. $V_1 =$

（4）



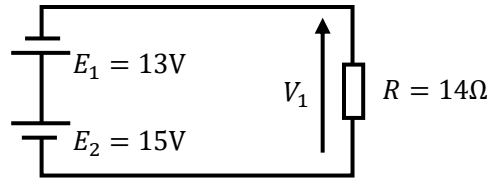
Ans. $V_1 =$

（5）



Ans. $V_1 =$

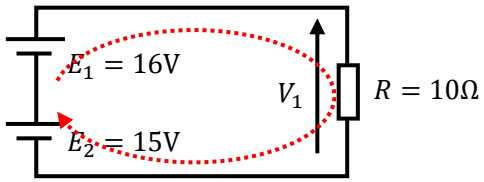
（6）



Ans. $V_1 =$

練習問題１（解説）

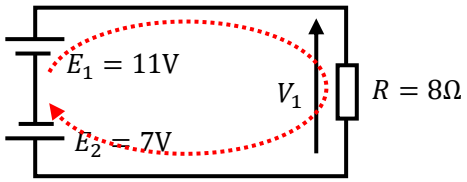
（１）



$V_1 = E_1 + E_2 = 16 + 15 = 31\mathrm{V}$

Ans. $V_1 = 31\mathrm{V}$

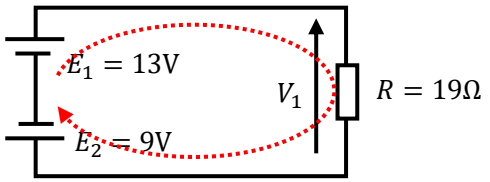
（２）



$V_1 = E_1 - E_2 = 11 - 7 = 4\mathrm{V}$

Ans. $V_1 = 4\mathrm{V}$

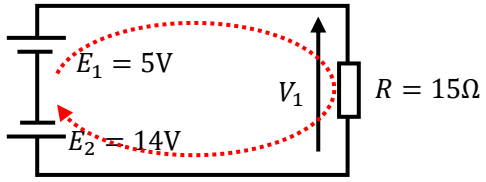
（３）



$V_1 = E_1 - E_2 = 13 - 9 = 4\mathrm{V}$

Ans. $V_1 = 4\mathrm{V}$

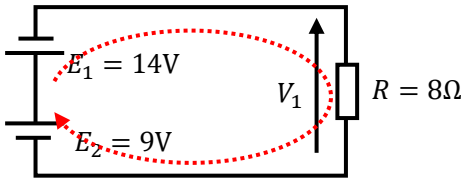
（４）



$V_1 = E_1 - E_2 = 5 - 14 = -9\mathrm{V}$

Ans. $V_1 = -9\mathrm{V}$

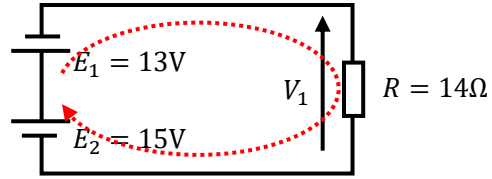
（５）



$V_1 = -E_1 + E_2 = -14 + 9 = -5\mathrm{V}$

Ans. $V_1 = -5\mathrm{V}$

（６）

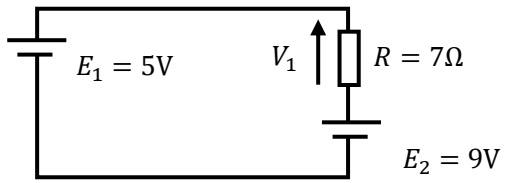


$V_1 = -E_1 + E_2 = -13 + 15 = 2\mathrm{V}$

Ans. $V_1 = 2\mathrm{V}$

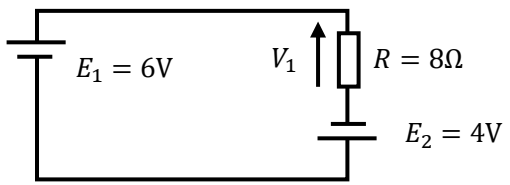
練習問題2

（1）



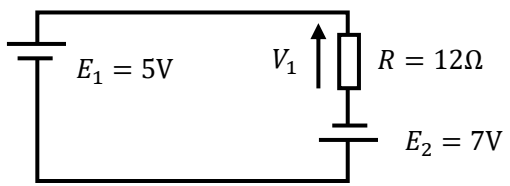
Ans. $V_1 =$

（2）



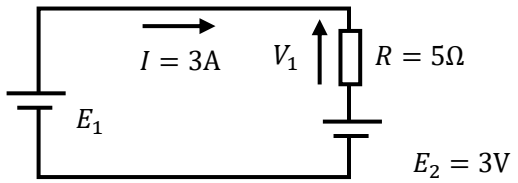
Ans. $V_1 =$

（3）



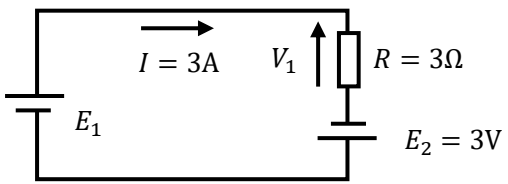
Ans. $V_1 =$

（4）



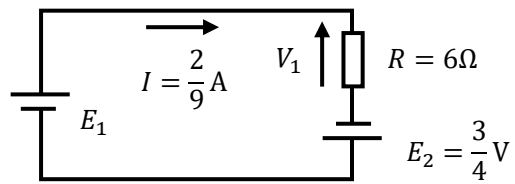
Ans. $E_1 =$

（5）



Ans. $E_1 =$

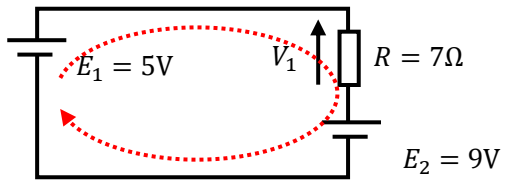
（6）



Ans. $E_1 =$

練習問題2（解説）

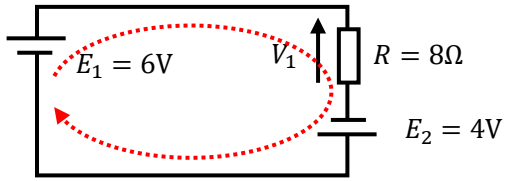
（1）



$V_1 = E_1 - E_2 = 5 - 9 = -4\text{V}$

Ans. $V_1 = -4\text{V}$

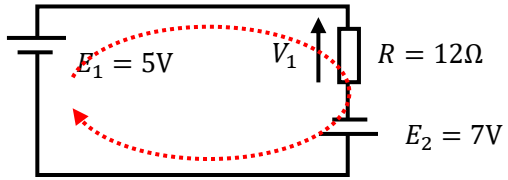
（2）



$V_1 = E_1 + E_2 = 6 + 4 = 10\text{V}$

Ans. $V_1 = 10\text{V}$

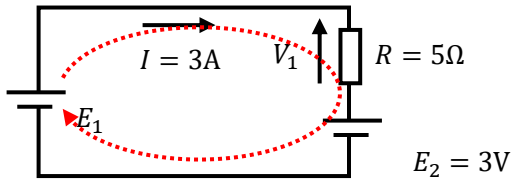
（3）



$V_1 = E_1 + E_2 = 5 + 7 = 12\text{V}$

Ans. $V_1 = 12\text{V}$

（4）

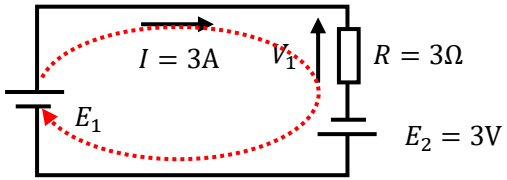


$V_1 = RI = 5 \times 3 = 15\text{V}$

$V_1 = E_1 - E_2 \rightarrow E_1 = V_1 + E_2$
$E_1 = V_1 + E_2 = 15 + 3 = 18\text{V}$

Ans. $E_1 = 18\text{V}$

（5）

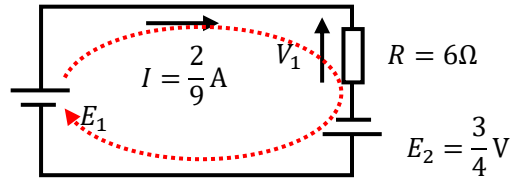


$V_1 = RI = 3 \times 3 = 9\text{V}$

$V_1 = E_1 + E_2 \rightarrow E_1 = V_1 - E_2$
$E_1 = V_1 - E_2 = 9 - 3 = 6\text{V}$

Ans. $E_1 = 6\text{V}$

（6）



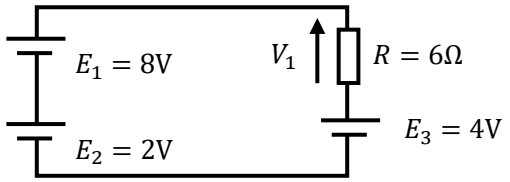
$V_1 = RI = 6 \times \frac{2}{9} = \frac{4}{3}\text{V}$

$V_1 = E_1 + E_2 \rightarrow E_1 = V_1 - E_2$
$E_1 = V_1 - E_2 = \frac{4}{3} - \frac{3}{4} = \frac{16}{12} - \frac{9}{12} = \frac{7}{12}\text{V}$

Ans. $E_1 = \frac{7}{12}\text{V}$

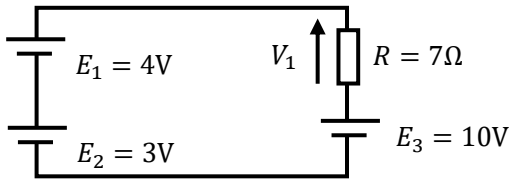
練習問題3

（1）



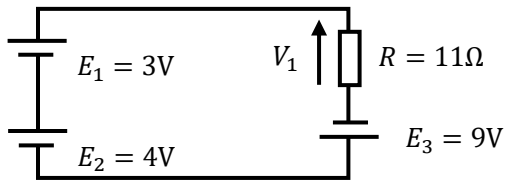
Ans. $V_1 =$

（2）



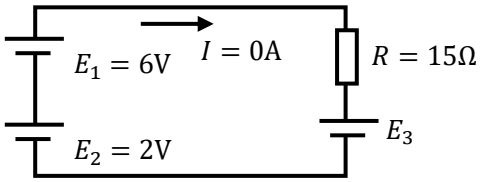
Ans. $V_1 =$

（3）



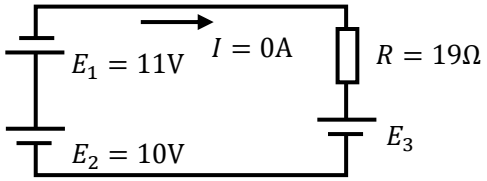
Ans. $V_1 =$

（4）



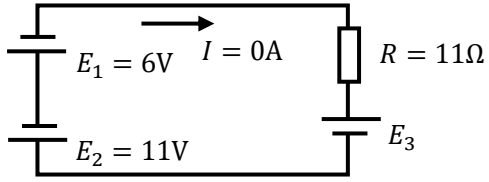
Ans. $E_3 =$

（5）



Ans. $E_3 =$

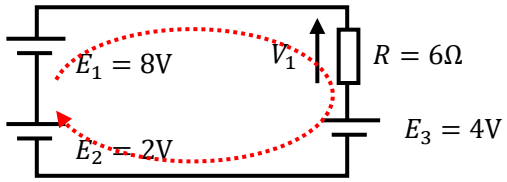
（6）



Ans. $E_3 =$

練習問題3（解説）

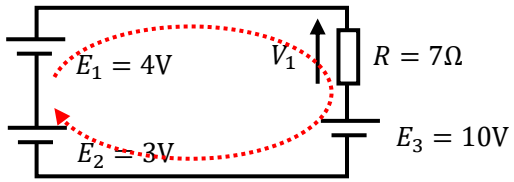
（1）



$V_1 = E_1 + E_2 - E_3$
$V_1 = 8 + 2 - 4 = 6\mathrm{V}$

Ans. $V_1 = 6\mathrm{V}$

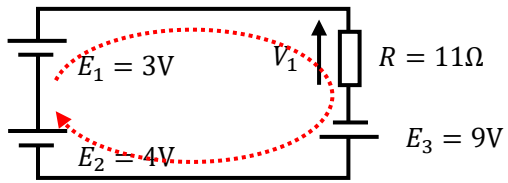
（2）



$V_1 = E_1 + E_2 - E_3$
$V_1 = 4 + 3 - 10 = -3\mathrm{V}$

Ans. $V_1 = -3\mathrm{V}$

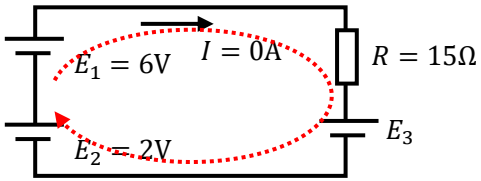
（3）



$V_1 = E_1 + E_2 + E_3$
$V_1 = 3 + 4 + 9 = 16\mathrm{V}$

Ans. $V_1 = 16\mathrm{V}$

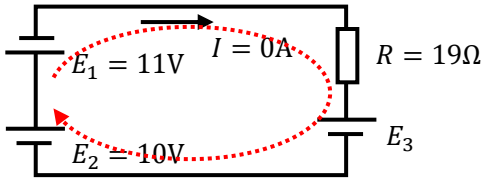
（4）



$E_1 + E_2 - E_3 = 0\mathrm{V}$
$E_3 = E_1 + E_2 = 6 + 2 = 8\mathrm{V}$

Ans. $E_3 = 8\mathrm{V}$

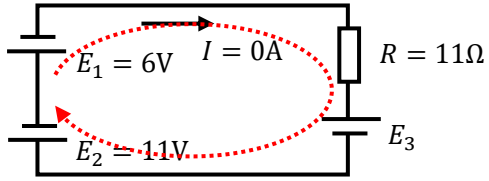
（5）



$-E_1 + E_2 - E_3 = 0\mathrm{V}$
$E_3 = -E_1 + E_2 = -11 + 10 = -1\mathrm{V}$

Ans. $E_3 = -1\mathrm{V}$

（6）

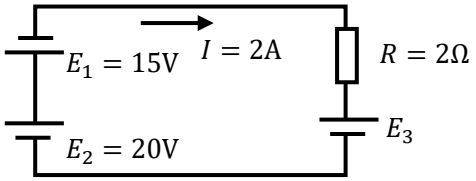


$-E_1 - E_2 - E_3 = 0\mathrm{V}$
$E_3 = -E_1 - E_2 = -6 - 11 = -17\mathrm{V}$

Ans. $E_3 = -17\mathrm{V}$

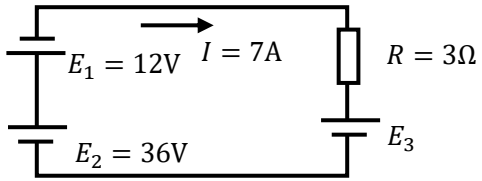
練習問題4

（1）



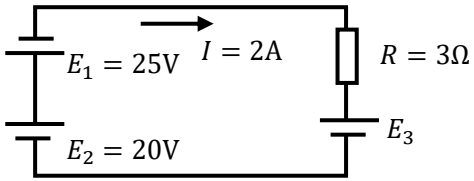
Ans. $E_3 =$

（2）



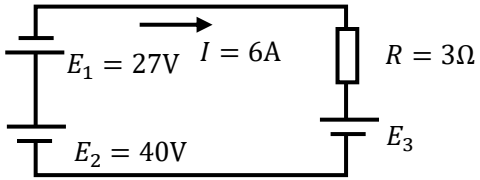
Ans. $E_3 =$

（3）



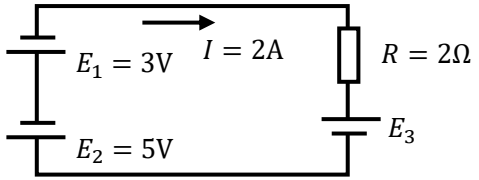
Ans. $E_3 =$

（4）



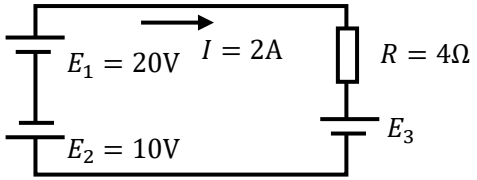
Ans. $E_3 =$

（5）



Ans. $E_3 =$

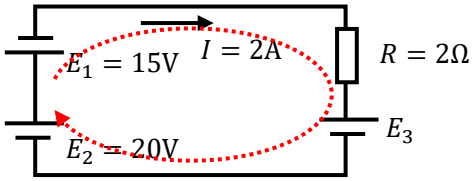
（6）



Ans. $E_3 =$

練習問題4（解説）

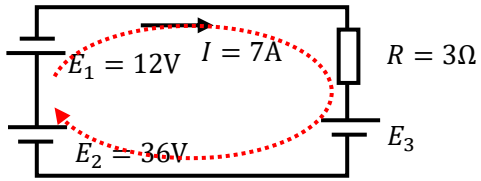
（1）



$-E_1 + E_2 - E_3 = RI$
$E_3 = -E_1 + E_2 - RI = -15 + 20 - 2 \times 2$
$= 1\mathrm{V}$

Ans. $E_3 = 1\mathrm{V}$

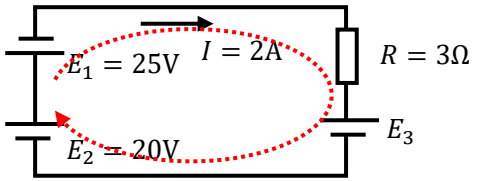
（2）



$-E_1 + E_2 - E_3 = RI$
$E_3 = -E_1 + E_2 - RI = -12 + 36 - 3 \times 7$
$= 36 - 33 = 3\mathrm{V}$

Ans. $E_3 = 3\mathrm{V}$

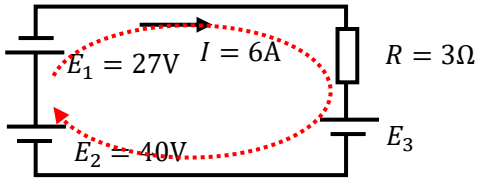
（3）



$-E_1 + E_2 - E_3 = RI$
$E_3 = -E_1 + E_2 - RI = -25 + 20 - 3 \times 2$
$= 20 - 31 = -11\mathrm{V}$

Ans. $E_3 = -11\mathrm{V}$

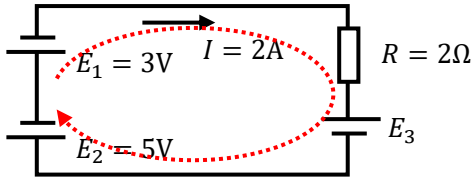
（4）



$-E_1 + E_2 - E_3 = RI$
$E_3 = -E_1 + E_2 - RI = -27 + 40 - 3 \times 6$
$= 40 - 45 = -5\mathrm{V}$

Ans. $E_3 = -5\mathrm{V}$

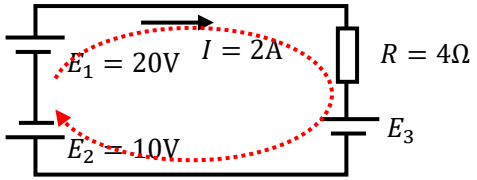
（5）



$-E_1 - E_2 - E_3 = RI$
$E_3 = -E_1 - E_2 - RI = -3 - 5 - 2 \times 2$
$= -12\mathrm{V}$

Ans. $E_3 = -12\mathrm{V}$

（6）

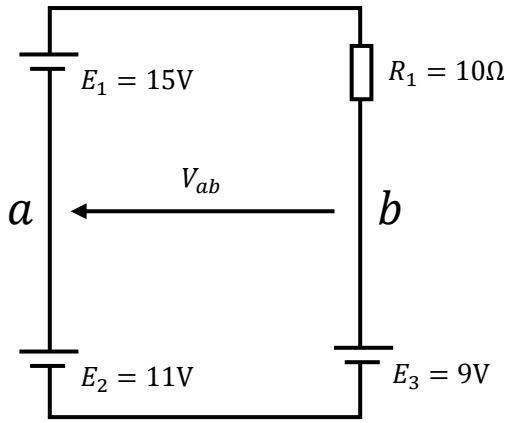


$E_1 - E_2 - E_3 = RI$
$E_3 = E_1 - E_2 - RI = 20 - 10 - 4 \times 2$
$= 2\mathrm{V}$

Ans. $E_3 = 2\mathrm{V}$

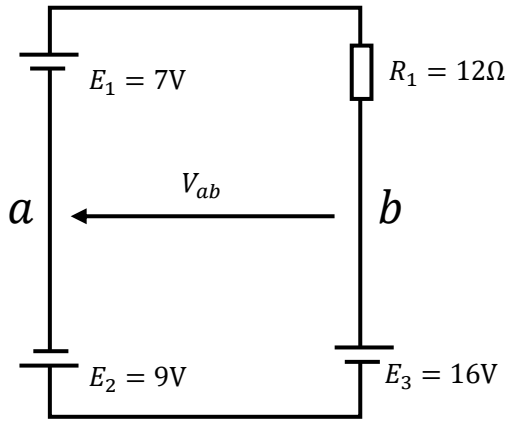
練習問題5

（1）



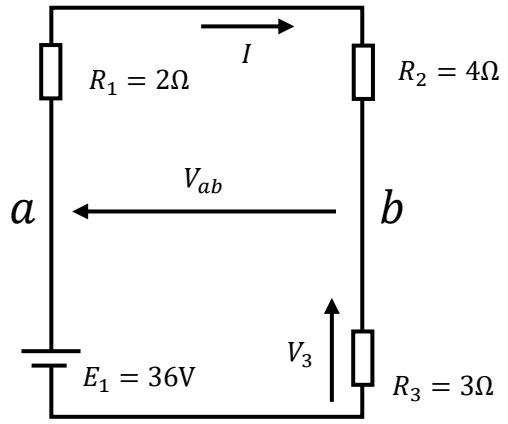
Ans. V_{ab} =

（2）



Ans. V_{ab} =

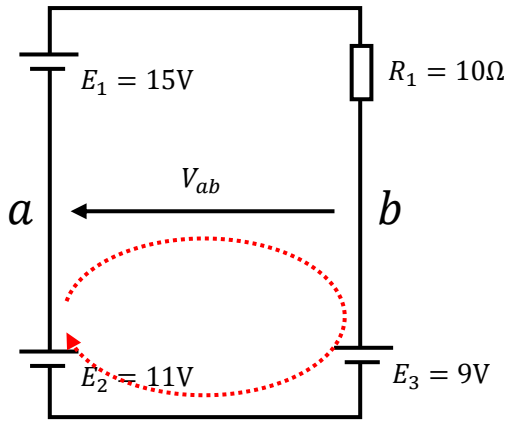
（3）



Ans. V_{ab} =

練習問題５（解説）

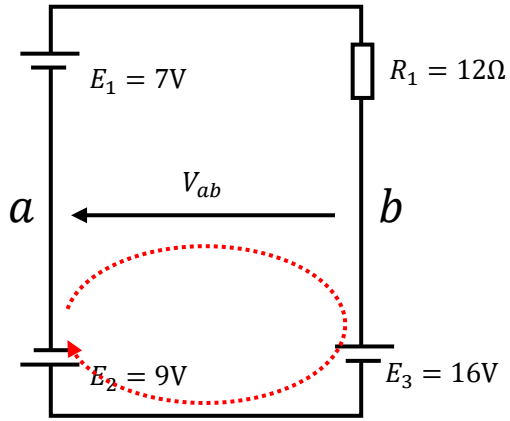
（１）



$V_{ab} = E_2 - E_3 = 11 - 9 = 2\mathrm{V}$

Ans. $V_{ab} = 2\mathrm{V}$

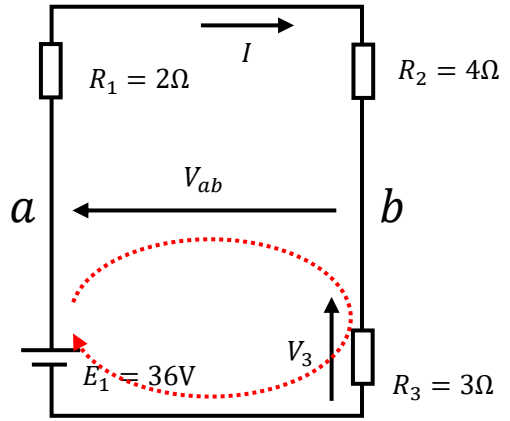
（２）



$V_{ab} = -E_2 - E_3 = -9 - 16 = -25\mathrm{V}$

Ans. $V_{ab} = -25\mathrm{V}$

（３）



$$I = \frac{E_1}{R_1 + R_2 + R_3} = \frac{36}{2 + 4 + 3} = \frac{36}{9} = 4\mathrm{A}$$

$V_{ab} + V_3 = E_1$
$V_{ab} = E_1 - V_3 = E_1 - R_3 I$
$= 36 - 3 \times 4 = 24\mathrm{V}$

Ans. $V_{ab} = 24\mathrm{V}$

ご聴講ありがとうございました!!