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KWG presents

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第2回 電気数学
方程式

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式の変形 (等式のルール)

1. 加算

$$a = b \rightarrow a + c = b + c$$

$$x - z = y \rightarrow x - z + z = y + z$$

$$x - z = y \rightarrow x = y + z$$

2. 減算

$$a = b \rightarrow a - c = b - c$$

$$x + z = y \rightarrow x + z - z = y - z$$

$$x + z = y \rightarrow x = y - z$$

3. 乗算

$$a = b \rightarrow a \times c = b \times c$$

$$\frac{x}{z} = y \rightarrow \frac{x}{z} \times z = y \times z$$

$$\frac{x}{z} = y \rightarrow x = yz$$

4. 除算

$$a = b \rightarrow a \div c = b \div c$$

$$xZ = y \rightarrow xZ \div Z = y \div Z$$

$$xZ = y \rightarrow x = \frac{y}{Z}$$

式の変形（展開と因数分解）

1. 式の展開

$$a(b + c) = ab + ac$$

$$\frac{b + c}{a} = \frac{1}{a}(b + c) = \frac{b}{a} + \frac{c}{a}$$

$$a\left(a + \frac{1}{a}\right) = a^2 + 1$$

$$\frac{1}{a}\left(a + \frac{1}{a}\right) = 1 + \frac{1}{a^2}$$

2. 因数分解

$$ab + ac = a(b + c)$$

$$\frac{b}{a} + \frac{c}{a} = \frac{1}{a}(b + c) = \frac{b + c}{a}$$

$$a^2 + 1 = a\left(a + \frac{1}{a}\right)$$

$$1 + \frac{1}{a^2} = \frac{1}{a}\left(a + \frac{1}{a}\right)$$

計算の手順

$$3(x + 3) = 2(2x + 1) + 5$$

1. 括弧の部分を展開

$$3(x + 3) = 2(2x + 1) + 5$$

$$3x + 9 = 4x + 2 + 5$$

2. 移項をする

(x は左辺、その他は右辺に集める)

$$3x + 9 = 4x + 2 + 5$$

$$3x - 4x = 2 + 5 - 9$$

$$-x = -2$$

$$x = 2$$

$$\frac{x + 1}{3} = \frac{2x + 6}{8}$$

1. 両辺に分母の最小公倍数をかける (通分っぽいことをする)

$$\frac{x + 1}{3} \times 24 = \frac{2x + 6}{8} \times 24$$

$$(x + 1) \times 8 = (2x + 6) \times 3$$

$$8x + 8 = 6x + 18$$

2. 移項をする

$$8x + 8 = 6x + 18$$

$$8x - 6x = 18 - 8$$

$$2x = 10$$

$$x = 5$$

練習問題 I

各問の方程式の解を求めなさい。

(1) $10 = 3I + 1$

Ans. I =

(2) $10 - 5R = 20$

Ans. R =

(3) $6I + 10 = 2I - 5$

Ans. I =

(4) $\frac{V}{3} + 6 = \frac{V}{6} + 5$

Ans. V =

(5) $-\frac{3}{11}V - 7 = 2$

Ans. V =

(6) $\frac{3}{4}V - \frac{2}{7} = \frac{5}{6}V + \frac{1}{3}$

Ans. V =

練習問題 I

各問の方程式の解を求めなさい。

(1) $10 = 3I + 1$

$$\begin{aligned} 10 - 1 &= 3I \\ 9 &= 3I \\ 3 &= I \end{aligned}$$

Ans. $I = 3$

(2) $10 - 5R = 20$

$$\begin{aligned} -5R &= 20 - 10 \\ -5R &= 10 \\ R &= -2 \end{aligned}$$

Ans. $R = -2$

(3) $6I + 10 = 2I - 5$

$$\begin{aligned} 6I - 2I &= -5 - 10 \\ 4I &= -15 \\ I &= -\frac{15}{4} \end{aligned}$$

Ans. $I = -\frac{15}{4}$

(4) $\frac{V}{3} + 6 = \frac{V}{6} + 5$

$$\begin{array}{l|l} \frac{V}{3} - \frac{V}{6} = 5 - 6 & \frac{V}{6} = -1 \\ \frac{2V}{6} - \frac{V}{6} = -1 & V = -6 \end{array}$$

Ans. $V = -6$

(5) $-\frac{3}{11}V - 7 = 2$

$$\begin{array}{l|l} -\frac{3}{11}V = 2 + 7 & V = 9 \times \left(-\frac{11}{3}\right) \\ -\frac{3}{11}V = 9 & V = -33 \end{array}$$

Ans. $V = -33$

(6) $\frac{3}{4}V - \frac{2}{7} = \frac{5}{6}V + \frac{1}{3}$

$$\begin{array}{l|l} \frac{3}{4}V - \frac{5}{6}V = \frac{1}{3} + \frac{2}{7} & V = -12 \times \frac{13}{21} \\ \frac{9}{12}V - \frac{10}{12}V = \frac{7}{21} + \frac{6}{21} & V = -4 \times \frac{13}{7} \\ -\frac{1}{12}V = \frac{13}{21} & V = -\frac{52}{7} \end{array}$$

Ans. $V = -\frac{52}{7}$

練習問題2

各問の方程式の解を求めなさい。

$$(1) \frac{7-V}{4} = \frac{11-V}{8}$$

$$(2) \frac{4-V}{3} = \frac{6V-4}{2}$$

$$(3) \frac{3V-5}{7} = \frac{2V-5}{3}$$

$$(4) \frac{3V-8}{5} = \frac{-V-8}{9}$$

Ans. $V =$ _____

$$(5) \frac{2-2V}{3} = \frac{V-18}{7}$$

Ans. $V =$ _____

$$(6) \frac{24-V}{11} = \frac{-1+V}{12}$$

Ans. $V =$ _____

Ans. $V =$ _____

Ans. $V =$ _____
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Ans. $V =$ _____

練習問題2

各問の方程式の解を求めなさい。

$$(1) \frac{7-V}{4} = \frac{11-V}{8}$$

$$\begin{aligned} \frac{7-V}{4} \times 8 &= \frac{11-V}{8} \times 8 \\ 2(7-V) &= 11-V \\ 14-2V &= 11-V \\ -2V+V &= 11-14 \\ -V &= -3 \\ V &= 3 \end{aligned}$$

$$\text{Ans. } \underline{V = 3}$$

$$(4) \frac{3V-8}{5} = \frac{-V-8}{9}$$

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

$$(2) \frac{4-V}{3} = \frac{6V-4}{2}$$

$$\begin{aligned} \frac{4-V}{3} &= 3V-2 \\ \frac{4-V}{3} \times 3 &= (3V-2) \times 3 \\ 4-V &= 9V-6 \\ -9V-V &= -6-4 \\ -10V &= -10 \\ V &= 1 \end{aligned}$$

$$\text{Ans. } \underline{V = 1}$$

$$(5) \frac{2-2V}{3} = \frac{V-18}{7}$$

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

$$(3) \frac{3V-5}{7} = \frac{2V-5}{3}$$

$$\begin{aligned} \frac{3V-5}{7} \times 21 &= \frac{2V-5}{3} \times 21 \\ 3(3V-5) &= 7(2V-5) \\ 9V-15 &= 14V-35 \\ 9V-14V &= 15-35 \\ -5V &= -20 \\ V &= 4 \end{aligned}$$

$$\text{Ans. } \underline{V = 4}$$

$$(6) \frac{24-V}{11} = \frac{-1+V}{12}$$

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

練習問題2

各問の方程式の解を求めなさい。

$$(1) \frac{7-V}{4} = \frac{11-V}{8}$$

$$\begin{aligned} \frac{7-V}{4} \times 8 &= \frac{11-V}{8} \times 8 \\ 2(7-V) &= 11-V \\ 14-2V &= 11-V \\ -2V+V &= 11-14 \\ -V &= -3 \\ V &= 3 \end{aligned}$$

$$\text{Ans. } \underline{V = 3}$$

$$(4) \frac{3V-8}{5} = \frac{-V-8}{9}$$

$$\begin{aligned} \frac{3V-8}{5} \times 45 &= \frac{-V-8}{9} \times 45 \\ 9(3V-8) &= 5(-V-8) \\ 27V-72 &= -5V-40 \\ 27V+5V &= 72-40 \\ 32V &= 32 \\ V &= 1 \end{aligned}$$

$$\text{Ans. } \underline{V = 1}$$

$$(2) \frac{4-V}{3} = \frac{6V-4}{2}$$

$$\begin{aligned} \frac{4-V}{3} &= 3V-2 \\ \frac{4-V}{3} \times 3 &= (3V-2) \times 3 \\ 4-V &= 9V-6 \\ -9V-V &= -6-4 \\ -10V &= -10 \\ V &= 1 \end{aligned}$$

$$\text{Ans. } \underline{V = 1}$$

$$(5) \frac{2-2V}{3} = \frac{V-18}{7}$$

$$\begin{aligned} \frac{2-2V}{3} \times 21 &= \frac{V-18}{7} \times 21 \\ 7(2-2V) &= 3(V-18) \\ 14-14V &= 3V-54 \\ -14V-3V &= -14-54 \\ -17V &= -68 \\ V &= 4 \end{aligned}$$

$$\text{Ans. } \underline{V = 4}$$

$$(3) \frac{3V-5}{7} = \frac{2V-5}{3}$$

$$\begin{aligned} \frac{3V-5}{7} \times 21 &= \frac{2V-5}{3} \times 21 \\ 3(3V-5) &= 7(2V-5) \\ 9V-15 &= 14V-35 \\ 9V-14V &= 15-35 \\ -5V &= -20 \\ V &= 4 \end{aligned}$$

$$\text{Ans. } \underline{V = 4}$$

$$(6) \frac{24-V}{11} = \frac{-1+V}{12}$$

$$\begin{aligned} \frac{24-V}{11} \times 121 &= \frac{-1+V}{12} \times 121 \\ 12(24-V) &= 11(-1+V) \\ 288-12V &= -11+11V \\ -12V-11V &= -288-11 \\ -23V &= -299 \\ V &= 13 \end{aligned}$$

$$\text{Ans. } \underline{V = 13}$$

練習問題3

各問の方程式の解を求めなさい。

$$(1) \frac{3(V-2)-1}{8} = \frac{3(V-1)-5}{7}$$

$$(2) \frac{2(3V+2)+3}{13} = \frac{10(3-V)-13}{7}$$

Ans. $V =$ _____

Ans. $V =$ _____

$$(3) \frac{2(2V+3)-5}{9} = \frac{4(2V-1)-7}{5}$$

$$(4) \frac{8(2V-7)+16}{5} = \frac{8(V-1)-8}{3}$$

Ans. $V =$ _____

Ans. $V =$ _____

練習問題3

各問の方程式の解を求めなさい。

$$(1) \frac{3(V-2)-1}{8} = \frac{3(V-1)-5}{7}$$

$$\frac{3V-6-1}{8} = \frac{3V-3-5}{7}$$

$$\frac{3V-7}{8} \times 56 = \frac{3V-8}{7} \times 56$$

$$7(3V-7) = 8(3V-8)$$

$$21V-49 = 24V-64$$

$$21V-24V = -64+49$$

$$-3V = -15$$

$$V = 5$$

Ans. $V = 5$

$$(2) \frac{2(3V+2)+3}{13} = \frac{10(3-V)-13}{7}$$

$$\frac{6V+4+3}{13} = \frac{30-10V-13}{7}$$

$$\frac{6V+7}{13} \times 91 = \frac{17-10V}{7} \times 91$$

$$7(6V+7) = 13(17-10V)$$

$$42V+49 = 221-130V$$

$$42V+130V = 221-49$$

$$172V = 172$$

$$V = 1$$

Ans. $V = 1$

$$(3) \frac{2(2V+3)-5}{9} = \frac{4(2V-1)-7}{5}$$

Ans. $V =$

$$(4) \frac{8(2V-7)+16}{5} = \frac{8(V-1)-8}{3}$$

Ans. $V =$

練習問題3

各問の方程式の解を求めなさい。

$$(1) \frac{3(V-2)-1}{8} = \frac{3(V-1)-5}{7}$$

$$\frac{3V-6-1}{8} = \frac{3V-3-5}{7}$$

$$\frac{3V-7}{8} \times 56 = \frac{3V-8}{7} \times 56$$

$$7(3V-7) = 8(3V-8)$$

$$21V-49 = 24V-64$$

$$21V-24V = -64+49$$

$$-3V = -15$$

$$V = 5$$

Ans. $V = 5$

$$(2) \frac{2(3V+2)+3}{13} = \frac{10(3-V)-13}{7}$$

$$\frac{6V+4+3}{13} = \frac{30-10V-13}{7}$$

$$\frac{6V+7}{13} \times 91 = \frac{17-10V}{7} \times 91$$

$$7(6V+7) = 13(17-10V)$$

$$42V+49 = 221-130V$$

$$42V+130V = 221-49$$

$$172V = 172$$

$$V = 1$$

Ans. $V = 1$

$$(3) \frac{2(2V+3)-5}{9} = \frac{4(2V-1)-7}{5}$$

$$\frac{4V+6-5}{9} = \frac{8V-4-7}{5}$$

$$\frac{4V+1}{9} \times 45 = \frac{8V-11}{5} \times 45$$

$$5(4V+1) = 9(8V-11)$$

$$20V+5 = 72V-99$$

$$20V-72V = -99-5$$

$$-52V = -104$$

$$V = 2$$

Ans. $V = 2$

$$(4) \frac{8(2V-7)+16}{5} = \frac{8(V-1)-8}{3}$$

$$\frac{8\{(2V-7)+2\}}{5} = \frac{8\{(V-1)-1\}}{3}$$

$$\frac{8(2V-5)}{5} \times \frac{15}{8} = \frac{8(V-2)}{3} \times \frac{15}{8}$$

$$3(2V-5) = 5(V-2)$$

$$6V-15 = 5V-10$$

$$6V-5V = -10+15$$

$$V = 5$$

Ans. $V = 5$

練習問題4

各問の方程式の解を求めなさい。

$$(1) \frac{2}{\frac{1}{R} + \frac{1}{R}} = 8$$

$$(2) \frac{6}{\frac{1}{R} + \frac{1}{2R}} = 8$$

Ans. $R =$ _____

Ans. $R =$ _____

$$(3) \frac{14}{\frac{1}{3R} + \frac{1}{4R}} = 48$$

$$(4) \frac{1}{\frac{1}{3R} + \frac{1}{5R}} \cdot \frac{4}{5} = 9$$

Ans. $R =$ _____

Ans. $R =$ _____

練習問題4

各問の方程式の解を求めなさい。

$$(1) \frac{2}{\frac{1}{R} + \frac{1}{R}} = 8$$

$$\frac{2}{2} = 8$$

$$\frac{2}{1} \times \frac{R}{2} = 8$$

$$R = 8$$

Ans. R = 8

$$(2) \frac{6}{\frac{1}{R} + \frac{1}{2R}} = 8$$

$$\frac{6}{\frac{2}{2R} + \frac{1}{2R}} = 8$$

$$\frac{6}{\frac{3}{2R}} = 8$$

$$\frac{6}{1} \times \frac{2R}{3} = 8$$

$$4R = 8$$

$$R = 2$$

Ans. R = 2

$$(3) \frac{14}{\frac{1}{3R} + \frac{1}{4R}} = 48$$

$$\frac{14}{\frac{4}{12R} + \frac{3}{12R}} = 48$$

$$\frac{14}{\frac{7}{12R}} = 48$$

$$\frac{14}{1} \times \frac{12R}{7} = 48$$

$$24R = 48$$

$$R = 2$$

Ans. R = 2

$$(4) \frac{1}{\frac{1}{3R} + \frac{1}{5R}} \cdot \frac{4}{5} = 9$$

$$\frac{1}{\frac{5}{15R} + \frac{3}{15R}} \cdot \frac{4}{5} = 9$$

$$\frac{1}{\frac{8}{15R}} \cdot \frac{4}{5} = 9$$

$$\frac{4}{5} \times \frac{15R}{8} = 9$$

$$\frac{3}{2}R = 9$$

$$R = 9 \times \frac{2}{3} = 6$$

Ans. R = 6

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