Exercise 4.1

Quadratic equation.

$$ax^2+bx+c=0, \qquad a,b,c \in \mathbb{R}, \ a \neq 0$$

$$5x^2+3x-2=0$$

Solve ?

① by factorization

$$\checkmark a x^2 + \checkmark b x + \checkmark c = 0$$

✓ ② by completing square

✓ ③ by quadratic formula.

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① $3x^2+4x+1=0$

$3(1)=3$

$3 = 3 \times 1$

$3x^2+(3+1)x+1=0$

$3x^2+3x+x+1=0$

$3x(x+1)+1(x+1)=0$

$(3x+1)(x+1)=0$

$ab=0$

$\Rightarrow a=0$ or $b=0$

$3x-1=0$, $x+1=0$

$3x=1$, $x=-1$

$x=\frac{1}{3}$

Solution set $= \{-1, \frac{1}{3}\}$

(2)

$1x^2 + 7x + 12 = 0$

$12 = 12 \times 1$
$12 = 6 \times 2$
$12 = \boxed{4 \times 3}$

$x^2 + 4x + 3x + 12 = 0$

$x(x+4) + 3(x+4) = 0$

$(x+3)(x+4) = 0$

$x+3 = 0$, $x+4 = 0$

$x = -3$, $x = -4$

Solution set $= \{-3, -4\}$.

(3)

$9x^2 - 12x - 5 = 0$

$45 = 1 \times 45$
$= 3 \times 15$ ✓

$9x^2 - 15x + 3x - 5 = 0$

$3x(3x-5) + 1(3x-5) = 0$

$(3x+1)(3x-5) = 0$

$3x - 1 = 0$, $3x - 5 = 0$

$3x = 1$, $3x = 5$

$x = \frac{1}{3}$, $x = \frac{5}{3}$

Solution set $= \left\{\frac{1}{3}, \frac{5}{3}\right\}$.

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(4)

$x^2 - x = 2$

$2 = 1 \times 2$

$x^2 - x - 2 = 0$

$x^2 - 2x + x - 2 = 0$

$x(x-2) + 1(x-2) = 0$

$(x+1)(x-2) = 0$

$x + 1 = 0$ $\qquad$ $x - 2 = 0$

$x = -1$ $\qquad$ $x = 2$

Solution set $= \{-1, 2\}$.

(5)

$x(x+7) = (2x-1)(x+4)$

$x^2 + 7x = 2x^2 + 8x - x - 4$

$0 = 2x^2 + 7x - 4 - x^2 - 7x$

$0 = x^2 - 4$

$x^2 - 4 = 0$

$x^2 - 2^2 = 0$

$a^2 - b^2 = (a+b)(a-b)$

$(x+2)(x-2) = 0$

$x + 2 = 0$, $\qquad$ $x - 2 = 0$

$x = -2$, $\qquad$ $x = 2$

Solution set $= \{-2, 2\} = \{\pm 2\}$

(6) $\frac{x}{x+1} + \frac{x+1}{x} = \frac{5}{2}$, $x \neq -1, 0$

$$\frac{x(x) + (x+1)(x+1)}{(x+1)x} = \frac{5}{2}$$

$$\frac{x^2 + x^2 + 2x + 1}{x^2 + x} = \frac{5}{2}$$

$$\frac{2x^2 + 2x + 1}{x^2 + x} = \frac{5}{2}$$

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

$$4x^2 + 4x + 2 = 5x^2 + 5x$$

$$0 = 5x^2 + 5x - 4x^2 - 4x - 2$$

$$x^2 + x - 2 = 0$$

$$x^2 + 2x - x - 2 = 0$$

$$x(x+2) - 1(x+2) = 0$$

$$(x-1)(x+2) = 0$$

$x - 1 = 0$, $x + 2 = 0$

$x = 1$, $x = -2$

Solution set $= \{1, -2\}$

$= \{-2, 1\}$.

(7)

$$\frac{1}{x+1}+\frac{2}{x+2}=\frac{7}{x+5}, \qquad x \neq -1,-2,-5$$

$$\frac{x+2+2x+2}{(x+1)(x+2)}=\frac{7}{x+5}$$

$$\frac{3x+4}{x^2+3x+2}=\frac{7}{x+5}$$

$$(3x+4)(x+5)=7(x^2+3x+2)$$

$$3x^2+15x+4x+20=7x^2+21x+14$$

$$0=7x^2+21x+14-3x^2-15x-4x-20$$

$$4x^2+2x-6=0$$

$$2(2x^2+x-3)=0$$

$$2x^2+x-3=0$$

$6=1\times 6$
$=2\times 3$

$$2x^2+3x-2x-3=0$$

$$x(2x+3)-1(2x+3)=0$$

$$(x-1)(2x+3)=0$$

$x-1=0$, $2x+3=0$

$x=1$, $x=-\frac{3}{2}$

Solution set $=\left\{-\frac{3}{2}, 1\right\}$.