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Section 1.5

The general form of a quadratic equation is

$$ax^2+bx+c=0,$$

where a, b and c are real numbers, with $a \neq 0$.

Factoring

Solve:

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

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

$$\frac{2x}{2}=\frac{0}{2}$$

$$\boxed{x=0}$$

$$2x-1=0$$

$$+1=+1$$

$$\frac{2x}{2}=\frac{1}{2}$$

$$\boxed{x=1/2}$$

The solution set: $\{0, \frac{1}{2}\}$

Solve: $2x^2+7x=4$

$-4 \quad -4$

~~$x(2x+7)=4$~~

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

$2\cdot(-4)=-8$

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Find A, C so that

$A\cdot C=-8$ and $A+C=7$ $\Rightarrow$ $A=8$, $C=-1$

Rewrite $7x$ as $8x-1x$

$2x^2+8x-1x-4=0$

$2x(x+4)-(x+4)=0$

$(x+4)(2x-1)=0$

$x+4=0$

$-4 \quad -4$

$\boxed{x=-4}$

$2x-1=0$

$+1 \quad +1$

$\frac{2x}{2}=\frac{1}{2}$

$\boxed{x=1/2}$

Solve: $2x^2+x=1$

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

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

$A \cdot C = -2$ and $A+C=1$ $\Rightarrow$ $A=-1$, $C=2$

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

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

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

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

$\boxed{x=1/2}$ $\quad$ $\boxed{x=-1}$

Square root property:

$3x^2-15=0$

$+15 \quad +15$

$\frac{3x^2}{3}=\frac{15}{3}$

$x^2=5 \rightarrow \boxed{x=\sqrt{5}}, \boxed{x=-\sqrt{5}}$

$9x^2+25=0$

$-25 \quad -25$

$\frac{9x^2}{9}=\frac{-25}{9}$

9 9

$x^2 = -\frac{25}{9} \longrightarrow x = \sqrt{-\frac{25}{9}}$ or $x = -\sqrt{-\frac{25}{9}}$

$x = i\sqrt{\frac{25}{9}}$ $\quad$ $x = -i\sqrt{\frac{25}{9}}$

$x = i\frac{\sqrt{25}}{\sqrt{9}}$ $\quad$ $x = -i\frac{\sqrt{25}}{\sqrt{9}}$

$x = \boxed{i\frac{5}{3}}$ $\quad$ $x = \boxed{-i\frac{5}{3}}$

Solve $(x-2)^2 = 6$

$y^2 = 6 \longrightarrow y = \sqrt{6}$ $\quad$ $y = -\sqrt{6}$

$x - 2 = \sqrt{6}$ $\quad$ $x - 2 = -\sqrt{6}$

$+2 \quad +2$ $\quad$ $+2 \quad +2$

$x = \boxed{2 + \sqrt{6}}$ $\quad$ $x = \boxed{2 - \sqrt{6}}$

Complete the square:

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

$x^2 + 8x = \left(x + \frac{8}{2}\right)^2 - \frac{8^2}{4} = (x+4)^2 - \frac{64}{4}$

$= (x+4)^2 - 16$

$b = 8$

//

$x^2 + 2x \cdot 4 + 4^2 - 16$

$x^2+2x\cdot 4+4^2-16$

$x^2+8x+16-16$

Compl. the square

- $x^2-7x=\left(x+\frac{-7}{2}\right)^2-\frac{(-7)^2}{4}=\boxed{\left(x-\frac{7}{2}\right)^2-\frac{49}{4}}$

$b=-7$

- $x^2+\frac{3}{5}x=\left(x+\frac{3}{10}\right)^2-\frac{9}{100}$

$b=\frac{3}{5}$

$\frac{b}{2}=\frac{\frac{3}{5}}{2}=\frac{\frac{3}{5}}{\frac{2}{1}}=\frac{3}{5}\cdot\frac{1}{2}=\frac{3}{10}$

$\frac{b^2}{4}=\frac{\left(\frac{3}{5}\right)^2}{4}=\frac{\frac{9}{25}}{4}=\frac{9}{100}$

Solve by completing the square

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

$b=-6$

$\left(x-\frac{6}{2}\right)^2-\frac{6^2}{4}+4=0$

$$(x-3)^2 - \frac{36}{4} + 4 = 0$$

$$(x-3)^2 - 9 + 4 = 0$$

$$(x-3)^2 - 5 = 0$$

$$(x-3)^2 = 5 \rightarrow x - 3 = \sqrt{5} \qquad x - 3 = -\sqrt{5}$$

$$+3 \quad +3 \qquad +3 \quad +3$$

$$x = \boxed{3+\sqrt{5}} \qquad x = \boxed{3-\sqrt{5}}$$

Solve: $9x^2 - 6x - 4 = 0$

Factoring:

$A \cdot C = 9 \cdot (-4)$

$A \cdot C = -36$

$A + C = -6$

To complete the square divide eq. by 9.

$$\frac{9x^2}{9} - \frac{6x}{9} - \frac{4}{9} = \frac{0}{9}$$

$$x^2 - \frac{2x}{3} - \frac{4}{9} = 0$$

$$x^2 - \frac{2}{3}x - \frac{4}{9} = 0$$

$b = -\frac{2}{3}$

$\frac{b}{2} = -\frac{2}{6} = -\frac{1}{3}$

$\frac{b^2}{4} = \frac{\left(-\frac{2}{3}\right)^2}{4} = \frac{\frac{4}{9}}{4}$

$= \frac{4}{} = \frac{1}{9}$

$$\left(x - \frac{1}{3}\right)^2 - \frac{1}{9} - \frac{4}{9} = 0$$

$$\left(x - \frac{1}{3}\right)^2 - \frac{1-4}{} = 0$$

$$\left(x-\frac{1}{3}\right)^2-\frac{1-4}{9}=0 \qquad = \frac{4}{4\cdot 9}=\frac{1}{9}$$

$$\left(x-\tfrac{1}{3}\right)^2-\tfrac{5}{9}=0$$

$$+\tfrac{5}{9} \quad +\tfrac{5}{9}$$

$$\left(x-\tfrac{1}{3}\right)^2=\tfrac{5}{9} \longrightarrow \quad x-\tfrac{1}{3}=\sqrt{\tfrac{5}{9}} \qquad x-\tfrac{1}{3}=-\sqrt{\tfrac{5}{9}}$$

$$x-\tfrac{1}{3}=\tfrac{\sqrt{5}}{3} \qquad x-\tfrac{1}{3}=\tfrac{-\sqrt{5}}{3}$$

$$+\tfrac{1}{3} \quad +\tfrac{1}{3} \qquad +\tfrac{1}{3} \quad +\tfrac{1}{3}$$

$$x=\tfrac{\sqrt{5}}{3}+\tfrac{1}{3} \qquad x=\tfrac{-\sqrt{5}}{3}+\tfrac{1}{3}$$

$$x=\boxed{\frac{1+\sqrt{5}}{3}} \qquad x=\boxed{\frac{1-\sqrt{5}}{3}}$$

Use the quadratic formula:

$$9x^2-6x-4=0$$

$a \quad b \quad c$

$a=9$

$b=-6$

$c=-4$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$x=\frac{-(-6)\pm\sqrt{(-6)^2-4\cdot 9\cdot(-4)}}{2\cdot 9}$$

$$=\frac{6\pm\sqrt{36+36\cdot 4}}{}$$

$$\begin{array}{r} 36 \\ \cdot\,4 \\ \hline 144 \end{array}$$

$$= \frac{6 \pm \sqrt{36 + 36 \cdot 4}}{18}$$

$$\begin{array}{r} \cdot 7 \\ \hline 144 \\ +36 \\ \hline 180 \end{array}$$

$$= \frac{6 \pm \sqrt{180}}{18} = \frac{6 \pm \sqrt{5 \cdot 36}}{18}$$

$$= \frac{6 \pm \sqrt{36} \cdot \sqrt{5}}{18} = \frac{6 \pm 6\sqrt{5}}{18} = \frac{\cancel{6}(1 \pm \sqrt{5})}{\cancel{18}\,3} = \boxed{\frac{1 \pm \sqrt{5}}{3}}$$

Solve: $3x^2 - 2x + 4 = 0$

$a = 3$

$b = -2$

$c = 4$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 3 \cdot 4}}{2 \cdot 3}$$

$$x = \frac{2 \pm \sqrt{4 - 12 \cdot 4}}{6} = \frac{2 \pm \sqrt{4 - 48}}{6} = \frac{2 \pm \sqrt{-44}}{6}$$

$$= \frac{2 \pm i\sqrt{44}}{6} = \frac{2 \pm i\sqrt{4} \cdot \sqrt{11}}{6} = \frac{2 \pm i \cdot 2\sqrt{11}}{6}$$

$$= \boxed{\frac{1 \pm i\sqrt{11}}{3}}$$