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Date _____
Pre Calculus

Solving Quadratic Equations Using Completing the Square (Complex)

$\left(\frac{5}{2}\right)^2=\frac{25}{4}$

$\left(\frac{-9}{2}\right)^2=\frac{81}{4}$

1. $x^2+5x=9$

$\frac{36}{4}+\frac{25}{4}=\frac{61}{4}$

$x^2+5x+\boxed{\frac{25}{4}}=9+\boxed{\frac{25}{4}}$

$\sqrt{\left(x+\frac{5}{2}\right)^2}=\sqrt{\frac{61}{4}}$

$x+\frac{5}{2}=\pm\frac{\sqrt{61}}{2}$

$-\frac{5}{2}\quad -\frac{5}{2}$

$x=\frac{-5}{2}\pm\frac{\sqrt{61}}{2}$

2. $x^2-9x+2=0$

$-2\quad -2$

$-\frac{8}{4}+\frac{81}{4}=\frac{73}{4}$

$x^2-9x=-2$

$x^2-9x+\boxed{\frac{81}{4}}=-2+\boxed{\frac{81}{4}}$

$\sqrt{\left(x-\frac{9}{2}\right)^2}=\sqrt{\frac{73}{4}}$

$x-\frac{9}{2}=\pm\frac{\sqrt{73}}{2}$

$+\frac{9}{2}\quad +\frac{9}{2}$

$x=\frac{9}{2}\pm\frac{\sqrt{73}}{2}$

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

$\left(\frac{11}{2}\right)^2=\frac{121}{4}$

3. $x^2-x=5$

$\frac{20}{4}+\frac{1}{4}=\frac{21}{4}$

$x^2-x+\boxed{\frac{1}{4}}=5+\boxed{\frac{1}{4}}$

$\sqrt{\left(x-\frac{1}{2}\right)^2}=\sqrt{\frac{21}{4}}$

$x-\frac{1}{2}=\pm\frac{\sqrt{21}}{2}$

$+\frac{1}{2}\quad +\frac{1}{2}$

$x=\frac{1}{2}\pm\frac{\sqrt{21}}{2}$

4. $x^2+11x+3=1$

$-3\quad -3$

$-\frac{8}{4}+\frac{121}{4}=\frac{113}{4}$

$x^2+11x+\boxed{\frac{121}{4}}=-2+\boxed{\frac{121}{4}}$

$\sqrt{\left(x+\frac{11}{2}\right)^2}=\sqrt{\frac{113}{4}}$

$x+\frac{11}{2}=\pm\frac{\sqrt{113}}{2}$

$-\frac{11}{2}\quad -\frac{11}{2}$

$x=\frac{-11}{2}\pm\frac{\sqrt{113}}{2}$

$\left(\frac{4}{2}\right)^2=4$

$\left(\frac{-10}{2}\right)^2=25$

5. $2x^2+8x-3=2$

$+3\quad +3$

$\frac{5}{2}+\frac{8}{2}=\frac{13}{2}$

$\frac{2x^2+8x}{2}=\frac{5}{2}$

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

$\sqrt{(x+2)^2}=\sqrt{\frac{13}{2}}$

$x+2=\frac{\pm\sqrt{13}\sqrt{2}}{\sqrt{2}\sqrt{2}}$

$x+2=\frac{\sqrt{26}}{2}$

$-2\quad -2$

$x=-2\pm\frac{\sqrt{26}}{2}$

6. $3x^2=30x-10$

$-30x\quad -30x$

$-\frac{10}{3}+\frac{75}{3}=\frac{65}{3}$

$\frac{3x^2-30x}{3}=\frac{-10}{3}$

$x^2-10x=-\frac{10}{3}$

$x^2-10x+\boxed{25}=-\frac{10}{3}+\boxed{25}$

$\sqrt{(x-5)^2}=\sqrt{\frac{65}{3}}$

$x-5=\pm\frac{\sqrt{65}\sqrt{3}}{\sqrt{3}\sqrt{3}}$

$x-5=\pm\frac{\sqrt{195}}{3}$

$+5\quad +5$

$x=5\pm\frac{\sqrt{195}}{3}$

$\left(\frac{6}{2}\right)^2 = 9$

7. $-2x^2 + 12x = 9$

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

$-\frac{9}{2} + \frac{18}{2} = \frac{9}{2}$

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

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

$\sqrt{(x-3)^2} = \sqrt{\frac{9}{2}}$

$x - 3 = \pm\frac{3}{\sqrt{2}}\frac{\sqrt{2}}{\sqrt{2}}$

$x - 3 = \pm\frac{3\sqrt{2}}{2}$

$+3 \quad +3$

$x = 3 \pm \frac{3\sqrt{2}}{2}$

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

8. $3x^2 - 12x + 4 = 0$

$-4 \quad -4$

$-\frac{4}{3} + \frac{12}{3} = \frac{8}{3}$

$3x^2 - 12x = -4$

$\frac{3}{3} \quad \frac{3}{3}$

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

$\sqrt{(x-2)^2} = \sqrt{\frac{8}{3}}$

$x - 2 = \pm\frac{\sqrt{8}}{\sqrt{3}}\frac{\sqrt{3}}{\sqrt{3}}$

$\sqrt{24} = \sqrt{4}\sqrt{6} = 2\sqrt{6}$

$x - 2 = \pm\frac{\sqrt{24}}{3}$

$+2 \quad +2$

$x = 2 \pm \frac{2\sqrt{6}}{3}$

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

9. $2x^2 + 6x = 7$

$\frac{2}{2} \quad \frac{2}{2}$

$\frac{19}{4} + \frac{9}{4} = \frac{23}{4}$

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

$x^2 + 3x + \frac{9}{4} = \frac{7}{2} + \frac{9}{4}$

$\sqrt{\left(x + \frac{3}{2}\right)^2} = \sqrt{\frac{23}{4}}$

$x + \frac{3}{2} = \pm\frac{\sqrt{23}}{2}$

$-\frac{3}{2} \quad -\frac{3}{2}$

$x = -\frac{3}{2} \pm \frac{\sqrt{23}}{2}$

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

10. $3x^2 + 6x - 11 = 0$

$+11 \quad +11$

$\frac{11}{3} + \frac{3}{3} = \frac{14}{3}$

$\frac{3x^2 + 6x}{3} = \frac{11}{3}$

$x^2 + 2x = \frac{11}{3}$

$x^2 + 2x + 1 = \frac{11}{3} + 1$

$\sqrt{(x+1)^2} = \sqrt{\frac{14}{3}}$

$x + 1 = \pm\frac{\sqrt{14}}{\sqrt{3}}\frac{\sqrt{3}}{\sqrt{3}}$

$x + 1 = \pm\frac{\sqrt{42}}{3}$

$-1 \quad -1$

$x = -1 \pm \frac{\sqrt{42}}{3}$

$\left(\frac{-\frac{3}{2}}{\frac{2}{1}}\right)^2 = \left(-\frac{3}{2} \cdot \frac{1}{2}\right)^2 = \left(-\frac{3}{4}\right)^2 = \frac{9}{16}$

11. $2x^2 - 3x + 9 = 0$

$-9 \quad -9$

$-\frac{72}{16} + \frac{9}{16} = -\frac{63}{16}$

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

$x^2 - \frac{3}{2}x + \frac{9}{16} = -\frac{9}{2} + \frac{9}{16}$

$\sqrt{\left(x - \frac{3}{4}\right)^2} = \sqrt{\frac{-63}{16}}$

$x - \frac{3}{4} = \pm\frac{\sqrt{-63}}{4}$

$\sqrt{-63} = \sqrt{9}\sqrt{7}\,i = 3i\sqrt{7}$

$x - \frac{3}{4} = \pm\frac{3i\sqrt{7}}{4}$

$+\frac{3}{4} \quad +\frac{3}{4}$

$x = \frac{3}{4} \pm \frac{3i\sqrt{7}}{4}$

$\left(\frac{-\frac{7}{3}}{\frac{3}{1}}\right)^2 = -\frac{7}{3} \cdot \frac{1}{3} = \left(-\frac{7}{6}\right)^2 = \frac{49}{36}$

12. $3x^2 - 7x + 12 = 0$

$-12 \quad -12$

$-\frac{144}{36} + \frac{49}{36} = \frac{95}{36}$

$\frac{3x^2 - 7x + \frac{49}{12}}{3} = \frac{-12 + \frac{49}{12}}{3}$

$x^2 - \frac{7}{3}x + \frac{49}{36} = -4 + \frac{49}{36}$

$\sqrt{\left(x - \frac{7}{6}\right)^2} = \sqrt{\frac{95}{36}}$

$x - \frac{7}{6} = \pm\frac{\sqrt{95}}{6}$

$+\frac{7}{6} \quad +\frac{7}{6}$

$x = \frac{7}{6} \pm \frac{\sqrt{95}}{6}$