15

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

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

$$x^2 + \underline{6}x + 9 = -4 + 9 \qquad 6 \times \frac{1}{2} = (3)^2 = 9$$

$$\sqrt{(x+3)^2} = \sqrt{5} \qquad \text{square root both sides}$$

$$x + 3 = \pm\sqrt{5}$$

$$\boxed{x = -3 \pm \sqrt{5}}$$

$$x = -3 + \sqrt{5} \quad \text{or} \quad x = -3 - \sqrt{5}$$

$$x = -3 + 2.236 \qquad x = -3 - 2.236$$

$$x = -0.764 \qquad x = -5.236$$

ANSWERS $\Rightarrow$ METHOD 2 – COMPLETING THE SQUARE

15. $x^2+6x+4=0$
$x^2+6x=-4$
$x^2+6x+9=-4+9$
$x^2+6x+9=5$
$(x+3)^2=5$
$x+3=\pm\sqrt{5}$
$x=-3\pm\sqrt{5}$

One solution is $x=-3+\sqrt{5}$, the other is $x=-3-\sqrt{5}$.

By calculator, these roots are approx. -0.76 and -5.24

16. $t^2+8t-7=0$
$t^2+8t=7$
$t^2+8t+16=7+16$
$t^2+8t+16=23$
$(t+4)^2=23$
$t+4=\pm\sqrt{23}$
$t=-4\pm\sqrt{23}$

One solution is $-4+\sqrt{23}$, the other is $-4-\sqrt{23}$.

17. $d^2 = 7d - 9$

$d^2 - 7d + 9 = 0$

$d^2 - 7d = -9$

$d^2 - 7d + \frac{49}{4} = -9 + \frac{49}{4}$.

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

$d^2 - 7d + \frac{49}{4} = \frac{13}{4}$

$(d - \frac{7}{2})^2 = \frac{13}{4}$

$d - \frac{7}{2} = \pm\sqrt{\frac{13}{4}}$

$d = \frac{7}{2} \pm \sqrt{\frac{13}{4}}$

or $d = \frac{7}{2} \pm \frac{\sqrt{13}}{2}$

One solution is $\frac{7}{2} + \frac{\sqrt{13}}{2}$, the other is $\frac{7}{2} - \frac{\sqrt{13}}{2}$.

18. $x - 3 = -x^2$

$x^2 + x - 3 = 0$

$x^2 + 1x = 3$

$x^2 + 1x + \frac{1}{4} = 3 + \frac{1}{4}$

$x^2 + 1x + \frac{1}{4} = \frac{12}{4} + \frac{1}{4}$

$\left(x + \frac{1}{2}\right)^2 = \frac{13}{4}$

$x + \frac{1}{2} = \pm\sqrt{\frac{13}{4}}$

$x = -\frac{1}{2} \pm \sqrt{\frac{13}{4}}$

or $x = -\frac{1}{2} \pm \frac{\sqrt{13}}{2}$

One solution is $x = -\frac{1}{2} + \frac{\sqrt{13}}{2}$, the other is $x = -\frac{1}{2} - \frac{\sqrt{13}}{2}$

(19) $2x^2+8x+5=0$

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

$\frac{\cancel{2}(x^2+4x)}{\cancel{2}}=-\frac{5}{2}$

$x^2+4x+4=-\frac{5}{2}+\frac{4}{1}$ $4\times\frac{1}{2}=(2)^2=4$

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

$\sqrt{(x+2)^2}=\sqrt{\frac{3}{2}}$ square root both sides

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

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

19. $2x^2+8x+5=0$

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

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

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

$$x^2+4x+4=-\frac{5}{2}+\frac{8}{2}$$

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

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

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

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

One solution is $x=-2+\sqrt{\frac{3}{2}}$, the other is $x=-2-\sqrt{\frac{3}{2}}$.

20. $4t^2+10t+5=0$

$$4t^2+10t=-5$$

$$t^2+\frac{10}{4}t=-\frac{5}{4}$$

$$t^2+\frac{5}{2}t=-\frac{5}{4}$$ (lowest terms)

$$t^2+\frac{5}{2}t+\frac{25}{16}=-\frac{5}{4}+\frac{25}{16}$$

$$\left(t+\frac{5}{4}\right)^2=-\frac{20}{16}+\frac{25}{16}$$

$$\left(t+\frac{5}{4}\right)^2=\frac{5}{16}$$

$$t+\frac{5}{4}=\pm\sqrt{\frac{5}{16}}$$

$$t+\frac{5}{4}=\pm\frac{\sqrt{5}}{4}$$

$$t=-\frac{5}{4}\pm\frac{\sqrt{5}}{4}$$

One solution is $t=-\frac{5}{4}+\frac{\sqrt{5}}{4}$, the other is $t=-\frac{5}{4}-\frac{\sqrt{5}}{4}$.

21. $6x^2+3x-2=0$

$$6x^2+3x=2$$

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

$$x^2+\frac{1}{2}x=\frac{1}{3} \quad \text{(lowest terms)}$$

$$x^2+\frac{1}{2}x+\frac{1}{16}=\frac{1}{3}+\frac{1}{16}$$

$$\left(x+\frac{1}{4}\right)^2=\frac{16}{48}+\frac{3}{48}$$

$$\left(x+\frac{1}{4}\right)^2=\frac{19}{48}$$

$$x+\frac{1}{4}=\pm\sqrt{\frac{19}{48}}$$

$$x+\frac{1}{4}=\pm\frac{\sqrt{19}}{\sqrt{16\times3}} \quad \text{(Simplifying } \sqrt{48}\text{)}$$

$$x+\frac{1}{4}=\pm\frac{\sqrt{19}}{4\sqrt{3}}$$

$$x=\frac{-1}{4}\pm\frac{\sqrt{19}}{4\sqrt{3}}$$

One solution is $x=\frac{-1}{4}+\frac{\sqrt{19}}{4\sqrt{3}}$,

the other is $x=\frac{-1}{4}-\frac{\sqrt{19}}{4\sqrt{3}}$.

22. $2x - 6 = -5x^2$ (Rearrange into General Form)

$$5x^2 + 2x - 6 = 0$$
$$5x^2 + 2x = 6$$
$$x^2 + \frac{2}{5}x = \frac{6}{5}$$
$$x^2 + \frac{2}{5}x + \frac{4}{100} = \frac{6}{5} + \frac{4}{100}$$
$$\left(x + \frac{2}{10}\right)^2 = \frac{120}{100} + \frac{4}{100}$$
$$\left(x + \frac{2}{10}\right)^2 = \frac{124}{100}$$
$$x + \frac{2}{10} = \pm\sqrt{\frac{124}{100}}$$
$$x + \frac{2}{10} = \pm\frac{\sqrt{124}}{10}$$
$$x + \frac{2}{10} = \pm\frac{\sqrt{4 \times 31}}{10} \quad \text{(Simplifying } \sqrt{124}\text{)}$$
$$x + \frac{2}{10} = \pm\frac{2\sqrt{31}}{10}$$
$$x = -\frac{2}{10} \pm \frac{2\sqrt{31}}{10}$$
$$x = -\frac{1}{5} \pm \frac{1\sqrt{31}}{5} \quad \text{(lowest terms)}$$

One solution is $x = -\frac{1}{5} + \frac{\sqrt{31}}{5}$,

the other solution is $x = -\frac{1}{5} - \frac{\sqrt{31}}{5}$.

23. $\frac{1}{2}x^2 + x - 13 = 0$

$\frac{1}{2}x^2 + x = 13$ ← Divide by $\frac{1}{2}$

$x^2 + 2x = 26$ ← $2 \times \frac{1}{2} = (1)^2 = 1$

$x^2 + 2x + 1 = 26 + 1$

$(x+1)^2 = 27$ ← square root both sides

$x + 1 = \pm\sqrt{27}$

$x = -1 \pm \sqrt{27}$

$x = -1 \pm \sqrt{9 \times 3}$ (Simplifying $\sqrt{27}$)

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

One solution is $-1 + 3\sqrt{3}$,

the other solution is $-1 - 3\sqrt{3}$.