



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

$$2x-1=0 \quad x+4=0$$
$$+1 \quad +1 \quad -4 \quad -4$$

$$\begin{array}{c} \cancel{2}x = 1 \\ \cancel{2} \quad \quad \quad x = -4 \end{array}$$

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

$$\boxed{x = -4}$$

$$\blacktriangleright f(x) = (x-5)(5x+2)$$

$$x-5=0 \quad 5x+2=0$$

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

$$\boxed{x=5}$$

$$\boxed{x = -\frac{2}{5}}$$


$$f(x) = (x-5)(5x+2)$$

$$\begin{array}{l} x-5=0 \\ x=5 \end{array} \quad \begin{array}{l} 5x+2=0 \\ -2 \\ \hline 5x=-2 \end{array}$$

$$\frac{5x}{5} = \frac{-2}{5}$$

$$\boxed{x=5}$$

$$\boxed{x = -\frac{2}{5}}$$


$$(-5x+4)(x-3) = 0$$

$$\begin{array}{l} -5x+4=0 \\ -4 \end{array} \quad \begin{array}{l} x-3=0 \\ +3 \end{array}$$

$$\begin{array}{r} -5x=-4 \\ \hline -5 \end{array} \quad \begin{array}{r} x=3 \\ \downarrow \end{array}$$

$$\boxed{x = \frac{4}{5}}$$

$$\boxed{x = 3}$$

▶ $f(x) = (x-3)(2x-8)$

$$\begin{array}{rcl} x-3=0 & & 2x-8=0 \\ +3 \quad +3 & & +8 \quad +8 \\ \hline x=3 & & \cancel{2x=8} \end{array}$$

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

$$\boxed{x=3} \quad \boxed{x=4}$$

▶ $(x-4)(-5x+1)=0$

$$\begin{array}{rcl} x-4=0 & & -5x+1=0 \\ +4 \quad +4 & & -1 \quad -1 \\ \hline x=4 & & \end{array}$$

$$\frac{-5x}{-5} = \frac{-1}{-5}$$

$$\boxed{x=4} \quad \boxed{x=\frac{1}{5}}$$



$$y = \frac{1}{2}(x-6)(x+2)$$

$$x = 6 \quad x = -2$$

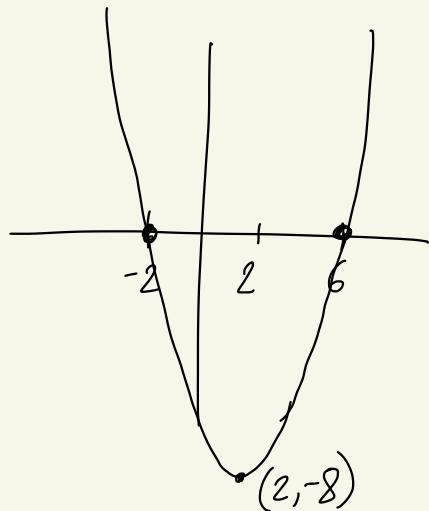
$$\text{mid} - x = 2$$

$$y = \frac{1}{2}(2-6)(2+2)$$

$$y = \frac{1}{2}(-4)(4)$$

$$y = \frac{1}{2}(-16)$$

$$y = -8$$



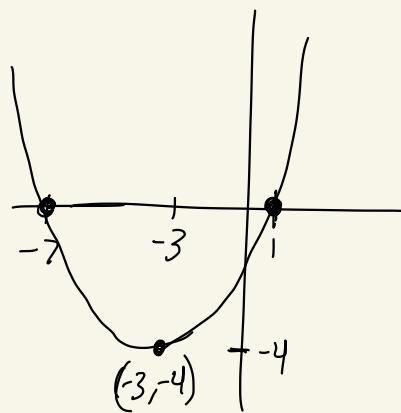
$$h(x) = \frac{1}{4}(x-1)(x+7)$$

$$x = 1 \quad x = -7$$

$$y = \frac{1}{4}((-3)-1)(-3+7)$$

$$y = \frac{1}{4}(-4)(4)$$

$$y = \frac{1}{4}(-16) = -4$$



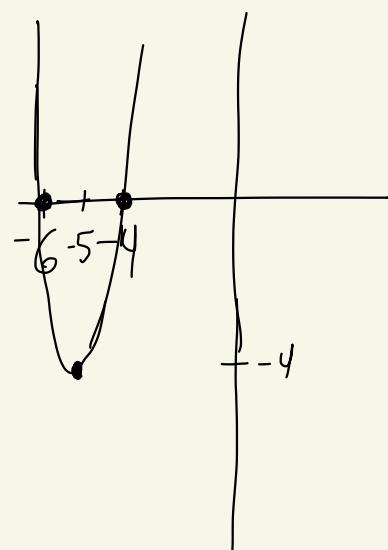
$$y = 4(x+6)(x+4)$$

$$x = -6 \quad x = -4$$

$$y = 4(-5+6)(-5+4)$$

$$y = 4(1)(-1)$$

$$y = -4$$



$$h(x) = -4(x-3)(x-1)$$

$$x = 3 \quad x = 1$$

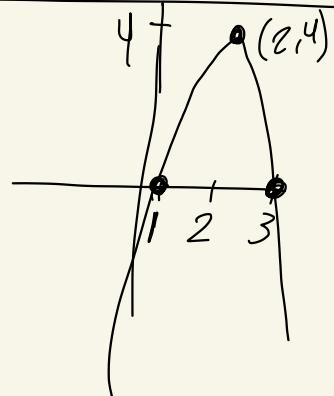
$$y = -4(2-3)(2-1)$$

$$y = -4(-1)(1)$$

$$y = -4(-1)$$

$$y = 4$$

$$(2, 4) = \text{midpoint}$$



► $y = -\frac{3}{4}(x+3)(x+7)$

$$x = -3 \quad x = -7$$

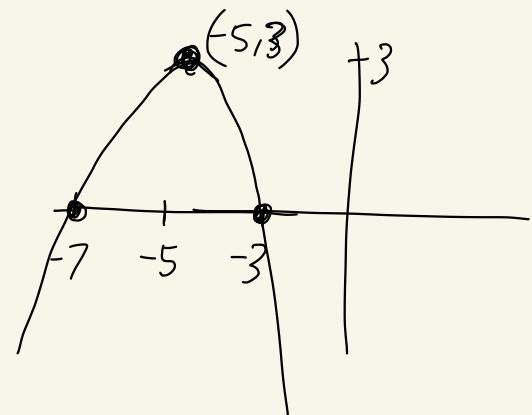
$$y = -\frac{3}{4}(-5+3)(-5+7)$$

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

$$y = -\frac{3}{4}(-4)$$

$$y = 3$$

$\boxed{-5, 3}$



► $h(x) = -4(x+2)(x-18)$

$$-4(0+2)(0-18)$$

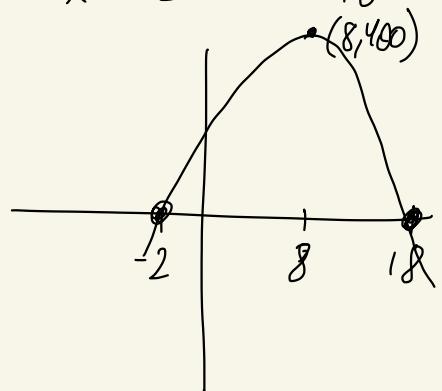
$$-4(2)(-18)$$

$$-4(-36)$$

$y = 144$

$$x+2=0 \quad x-18=0$$

$$x = -2 \quad x = 18$$



$$h(x) = -4(x+2)(x-18)$$

$$-4(8+2)(8-18)$$

$$-4(10)(-10)$$

$$-4(-100)$$

$$\boxed{400}$$

$$\boxed{8,400}$$

height of rocket at launch = $\boxed{144}$

rocket hits the ground after $\boxed{18}$ sec.

After $\boxed{8}$ sec, reaches max. height

max height is $\boxed{400\text{m}}$



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

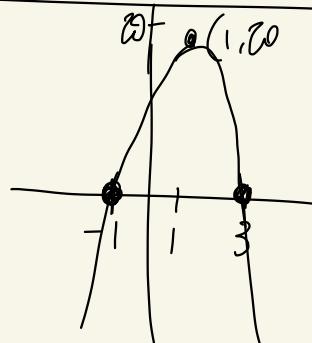
$$x = -1 \quad x = 3$$

$$y = -5(1+1)(1-3)$$

$$y = -5(2)(-2)$$

$$= -5(-4)$$

$$= 20$$



► $h(x) = -(x-11)(x+3)$

$$x=11 \quad x=-3$$

$$-(4-11)(4+3)$$

$$-(-7)(7)$$

$$-(-49) \quad (4, 49)$$

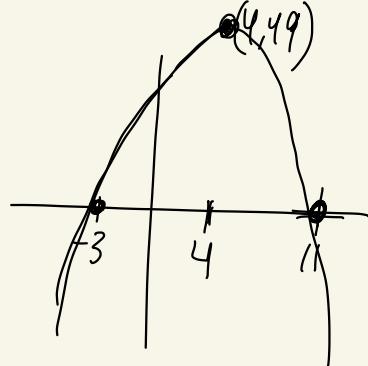
$$y = 49$$

$$-(0-11)(0+3)$$

$$-(-11)(3)$$

$$-(-33)$$

33



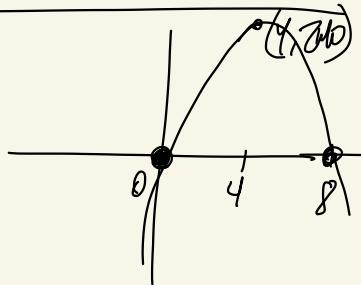
► $f(x) = -15x(x-8)$

$$x=0 \quad x=8$$

$$y = -15(4)(4-8)$$

$$-60(-4) \quad (4, 240)$$

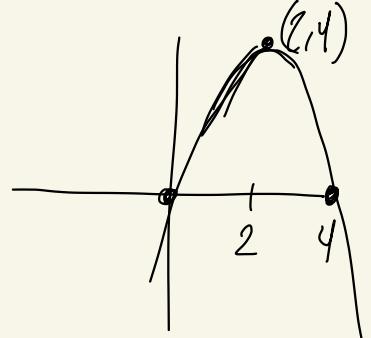
240





$$M(x) = -x(x-4)$$

$$\begin{array}{l} -x = 0 \\ x = 0 \end{array} \quad \begin{array}{l} x - 4 = 0 \\ x = 4 \end{array}$$



$$-2(2-4)$$

$$\begin{array}{l} -2(-2) \\ 4 \end{array}$$

$$(2, 4)$$

4 million

▶

$$h(x) = -5(x+1)(x-9)$$

$$\begin{array}{l} x = -1 \\ x = 9 \end{array}$$

▶

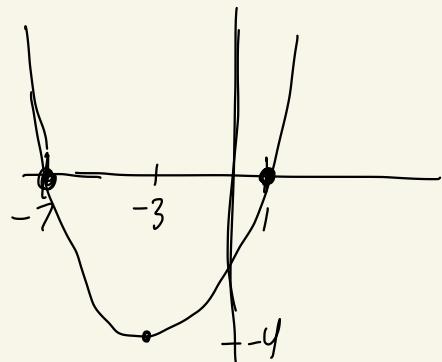
$$h(x) = \frac{1}{4}(x-1)(x+7)$$

$$x = 1 \quad x = -7$$

$$y = \frac{1}{4}(-3-1)(-3+7)$$

$$\frac{1}{4}(-4)(4)$$

$$\frac{1}{4}(-16) = -4$$



► $f(x) = (x-5)(5x+2)$

$$\begin{array}{rcl} x-5=0 & \quad & 5x+2=0 \\ +5 +5 & \quad & -2 -2 \end{array}$$

$$\begin{array}{rcl} x=5 & & \cancel{x=-2} \\ \downarrow & & \cancel{\frac{5}{5}} \end{array}$$

$$\boxed{x=5}$$

$$\boxed{x = -\frac{2}{5}}$$

► $(x+3)^2 = 25$

$$\sqrt{(x+3)^2} = \sqrt{25}$$

$$x+3 = \pm 5$$

$$x = \pm 5 - 3$$

$$x = 5 - 3 \quad x = 5 + 3$$

$$\boxed{x = 2 \quad x = 8}$$



$$(2x-1)^2 = 9$$

$$\sqrt{(2x-1)^2} = \sqrt{9}$$

$$2x-1 = \pm 3$$

$$\frac{2x}{2} = \frac{\pm 3 + 1}{2}$$

$$x = \frac{\pm 3 + 1}{2}$$

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

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

$$x = \frac{4}{2}$$

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

$$\boxed{x=2}$$

$$\boxed{x=-1}$$

► $2x^2 + 3 = 131$

$$-3 -3$$

$$\frac{2x^2}{2} = \frac{128}{2}$$

$$x^2 = 64$$

$$\sqrt{x^2} = \sqrt{64}$$

$$x = \pm 8$$

$$\boxed{x=8 \quad x=-8}$$

$$\Rightarrow 3x^2 - 7 = 5$$
$$+7 +7$$

$$\frac{3x^2 = 12}{3}$$
$$\sqrt{x^2} = \sqrt{4}$$

$$x = \pm 2$$

$$x = 2 \quad x = -2$$

$$\Rightarrow 4(x-1)^2 + 4 = 38$$
$$-4 -4$$

$$\frac{4(x-1)^2 = 36}{4}$$
$$\sqrt{(x-1)^2} = \sqrt{9}$$

$$x-1 = \pm 3$$

$$+1$$

$$x = \pm 3 + 1$$

$$x = -3 + 1 \quad x = 3 + 1$$

$$x = -2 \quad x = 4$$

► $f(x) = 5x^2 - 20$

$$5x^2 - 20 = 0$$

$$\frac{5x^2}{5} = \frac{20}{5}$$
$$\sqrt{x^2} = \sqrt{4}$$

$$x = \pm 2$$

$x = -2, x = 2$

► $5x^2 + 3 = 83$

$$-3 \quad -3$$

$$\frac{5x^2}{5} = \frac{80}{5}$$
$$\sqrt{x^2} = \sqrt{16}$$

$$x = \pm 4$$

$x = -4, x = 4$

$$h(x) = -6x^2 + 384$$

$$\begin{array}{r} -6x^2 + 384 = 0 \\ -384 \quad -384 \end{array}$$

$$\begin{array}{r} -6x^2 = -384 \\ \hline -6 \end{array}$$

$$\sqrt{x^2} = \sqrt{64}$$

$$x = \pm 8$$

$$x = -8, x = 8$$

$$-x^2 - 8 = -33$$

$$+8 \quad +8$$

$$\begin{array}{r} +x^2 = -25 \\ \hline -1 \end{array}$$

$$\sqrt{x^2} = \sqrt{25}$$

$$x = \pm 5$$

$$x = -5, x = 5$$

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

$$\begin{array}{r} +4 \quad +4 \\ \hline \end{array}$$

$$\sqrt{(x+3)^2} = \sqrt{4}$$

$$x + \begin{array}{l} \beta \\ -\beta \end{array} = \pm 2$$

$$\begin{array}{r} \beta \\ -\beta \end{array} = -3$$

$$x = \pm 2 - 3$$

$$x = -2 - 3 \quad x = 2 - 3$$

$$\boxed{x = -5 \quad x = -1}$$

$$\blacktriangleright f(x) = (x-2)^2 - 9$$

$$(x-2)^2 - 9 = 0$$

$$\begin{array}{r} +9 \quad +9 \\ \hline \end{array}$$

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

$$x-2 = \pm 3$$

$$\begin{array}{r} +2 \quad +2 \end{array}$$

$$x = \pm 3 + 2$$



$$\begin{array}{r} x = -3 + 2 \quad x = 3 + 2 \\ \hline x = -1 \quad x = 5 \end{array}$$

► $f(x) = (x-1)^2 - 36$

$$(x-1)^2 - 36 = 0$$

$$+36 \quad +36$$

$$\sqrt{(x-1)^2} = \sqrt{36}$$

$$x-1 = \pm 6$$

$$+1 \quad +1$$

$$x = \pm 6 + 1$$

$$\boxed{\begin{array}{ll} x = 6 + 1 & x = -6 + 1 \\ x = 7 & x = -5 \end{array}}$$

► $(x-3)^2 - 81 = 0$

$$+81 \quad +81$$

$$\sqrt{(x-3)^2} = \sqrt{81}$$

$$x-3 = \pm 9$$

$$x = \pm 9 + 3$$

$$x = -9 + 3 \quad x = 9 + 3$$

$$\boxed{\begin{array}{ll} x = -6 & x = 12 \end{array}}$$

$$\Rightarrow f(x) = (x+4)^2 - 25$$

$$(x+4)^2 - 25 = 0$$

$$\sqrt{(x+4)^2} = \sqrt{25}$$

$$x+4 = \pm 5$$

$$-4 \quad -4$$

$$x = 5 - 4 \quad x = -5 - 4$$

$$x = 1$$

$$x = -9$$

$$(x+8)^2 - 7 = 0$$

$$\sqrt{(x+8)^2} = \sqrt{7}$$

$$x+8 = \sqrt{7}$$

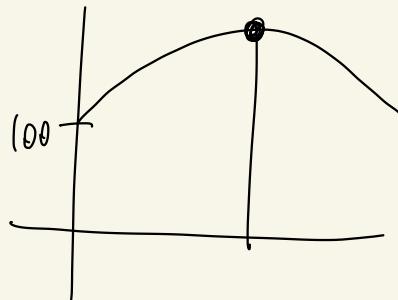
$$x+8 = \pm 2.65$$

$$-8 \quad -8$$

$$x = 2.65 - 8 \quad x = -2.65 - 8$$

$$x = -5.35 \quad x = -10.65$$

► $h(x) = -5(x-4)^2 + 180$



- negative beginning number = ∩

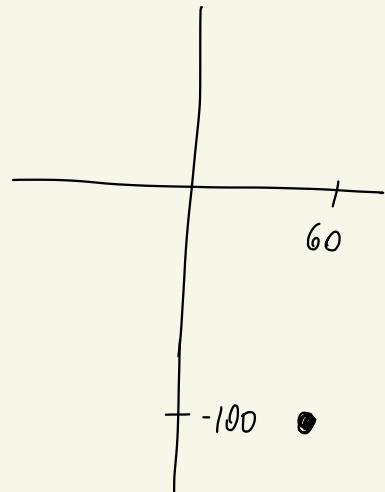
- positive beginning number = ∪

$$h(0) = -5(0-4)^2 + 180$$

$$-80 + 180$$

$$100$$

► $D(x) = \frac{1}{36}(x-60)^2 - 100$



$$\Rightarrow h(x) = -5(x-4)^2 + 180$$

$$-5(x-4)^2 + 180 = 0$$

-180

$$\frac{-5(x-4)^2}{-5} = \frac{-180}{-5}$$

$$\sqrt{(x-4)^2} = \sqrt{36}$$

$$x-4 = \pm 6$$

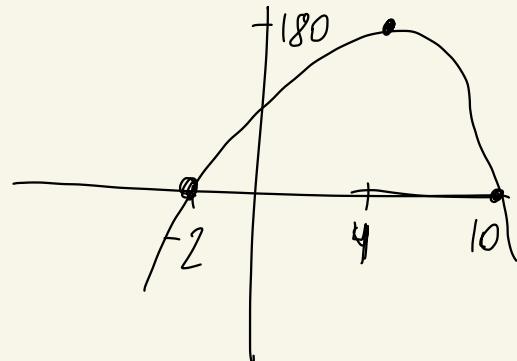
$$+4$$

$$x = \pm 6 + 4$$

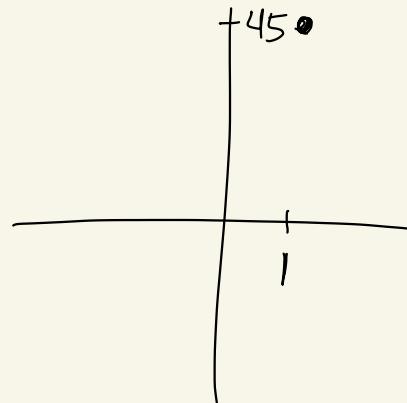
$$x = 6+4 \quad x = -6+4$$

x = 10	x = -2
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$$10 - 0 = \boxed{10}$$

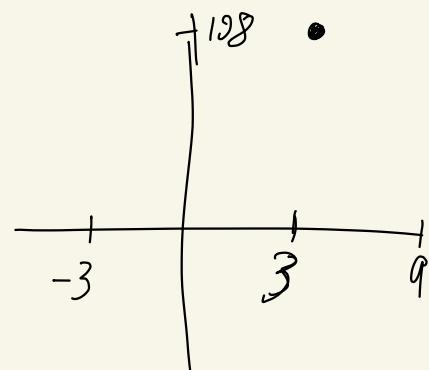


► $h(x) = -5(x-1)^2 + 45$



► $h(x) = -3(x-3)^2 + 108$

$$\begin{array}{r} -3(x-3)^2 + 108 = 0 \\ \hline -108 \quad -108 \end{array}$$



$$\begin{array}{r} \cancel{-3} \cancel{(x-3)^2} = \cancel{-108} \\ \cancel{-3} \quad \cancel{-3} \\ \sqrt{(x-3)^2} = \sqrt{36} \end{array}$$

$$x-3 = \pm 6$$

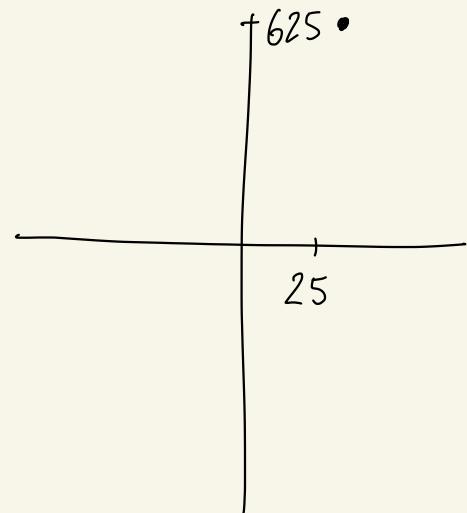
$$x = \pm 6 + 3$$

$$x = 6 + 3 \quad x = -6 + 3$$

$x = 9$ $x = -3$

► $A(x) = -(x-25)^2 + 625$
 $(25, 625)$

625



► $M(x) = -(x-5)^2 + 25$
 $(5, 25)$

25 = MAX

► $h(x) = -(x-2)^2 + 16 \quad (2, 16)$

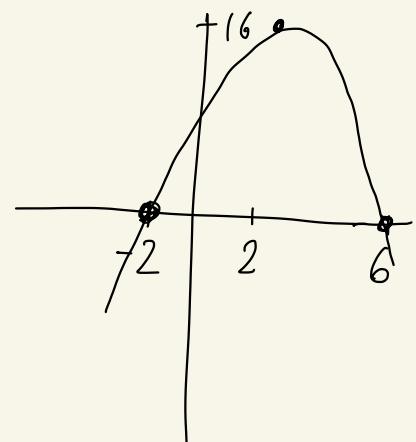
$$-(x-2)^2 + 16 = 0$$

$$-16$$

$$\cancel{(x-2)^2} = \frac{-16}{-1}$$

$$\sqrt{(x-2)^2} = \sqrt{16}$$

$$x-2 = \pm 4$$



$$\begin{array}{rcl} x-2 & = & \pm 4 \\ +2 & & +2 \end{array}$$

$$x = 4 + 2 \quad x = -4 + 2$$

$$\boxed{x=6}$$

$$x = -2$$

$$\Rightarrow D(x) = \frac{1}{36}(x-60)^2 - 100$$

$$60, -100$$

$$\boxed{60}$$

$$\Rightarrow f(x) = (x-1)^2 - 36$$

$$\begin{array}{rcl} (x-1)^2 - 36 & = & 0 \\ +36 & & +36 \end{array}$$

$$\sqrt{(x-1)^2} = \sqrt{36}$$

$$\begin{array}{rcl} x-1 & = & \pm 6 \\ +1 & & +1 \end{array}$$

$$x = 6+1 \quad x = -6+1$$

$$\boxed{x=7 \quad x=-5}$$

► $y = 2(x-4)^2 + 5$

$$2(5-4)^2 + 5$$

$$2(1) + 5$$

$$2+5$$

7

$$(5, 7)$$

► $s^2 - 2s - 35 = 0$

$$(s-7)(s+5)$$

► $(2x-1)(4x-3) = 0$

$$\begin{array}{l} 2x-1=0 \\ \quad +1 \end{array} \quad \begin{array}{l} 4x-3=0 \\ \quad +3 \end{array}$$

$$\begin{array}{r} 2x=1 \\ \hline 2 \end{array} \quad \begin{array}{r} 4x=3 \\ \hline 4 \end{array}$$

$$\boxed{\begin{array}{l} x=\frac{1}{2} \\ x=\frac{3}{4} \end{array}}$$

$$\blacktriangleright x^2 + 5x = 0$$

$$x(x+5) = 0$$

$$\boxed{x=0 \quad x=-5}$$

$$\blacktriangleright x^2 - 11x + 28 = 0$$

$$(x-4)(x-7) = 0$$

$$\boxed{x=4, \quad x=7}$$

$$\blacktriangleright 4x^2 + 4x + 1 = 0$$

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

$$(2x+1)(2x+1)$$

$$\blacktriangleright 3x^2 + 11x - 4 = 0$$

$$a \cdot b = 3 \cdot -4 = -12$$

$$a+b = 11$$

$$12 - 1 = -11$$

$$12 - 1 = 11$$

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

$$3x(x+4) - 1(x+4) = 0$$

$$\boxed{(3x-1)(x+4) = 0}$$

$$\begin{array}{rcl} 3x-1 & = & 0 \\ +1 & & +1 \end{array}$$

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

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

$$\begin{array}{l} x+4 = 0 \\ x = -4 \end{array}$$

$$\boxed{x = -4}$$

$$\Rightarrow 2x^2 - 3x - 20 = x^2 + 34$$

$$-x^2 \quad -34 \quad -x^2 - 34$$

$$x^2 - 3x - 54 = 0$$

$$(x-9)(x+6) = 0$$

$$x = 9, x = -6$$

$$\Rightarrow 3x^2 + 33x + 30 = 0$$

$$\cancel{3(x^2 + 11x + 10) = 0}$$

$$\cancel{3}$$

$$x^2 + 11x + 10 = 0$$

$$(x+10)(x+1) = 0$$

$$x = -10, x = -1$$

$$\Rightarrow 3x^2 - 9x - 20 = x^2 + 15x + 16$$

$$-x^2 - 5x - 16 \quad -x^2 - 5x - 16$$

$$2x^2 - 14x - 36 = 0$$

$$2(x^2 - 7x - 18) = 0$$

$\cancel{2}$

$$x^2 - 7x - 18 = 0$$

$$(x-9)(x+2) = 0$$

$$x = 9, x = -2$$

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

$$(x+4)(x-1)$$

$$x = -4, x = 1$$

$$\Rightarrow x^2 + x - 30 = 0$$

$$(x+6)(x-5) = 0$$

$$x = -6, x = 5$$

$$\Rightarrow x^2 - 18x + 81 = 0$$

$$(x-9)(x-9) = 0$$

$$x = 9$$

$$\Rightarrow x^2 - 11x + 18 = 0$$

$$(x-9)(x-2) = 0$$

$x=9, x=2$

$$\Rightarrow 6x^2 - 120x + 600 = 0$$

$$\cancel{6(x^2 - 20x + 100)} = \cancel{0}$$

$$x^2 - 20x + 100 = 0$$

$$(x-10)(x-10)$$

$x=10$

$$\Rightarrow 5x^2 + 60x + 180 = 0$$

$$\cancel{5(x^2 + 12x + 36)} = \cancel{0}$$

$$x^2 + 12x + 36 = 0$$

$$(x+6)(x+6) = 0$$

$x=-6$

$$4x^2 + 72x + 320 = 0$$

$$\cancel{4(x^2 + 18x + 80)} = \cancel{0}$$

$$x^2 + 18x + 80 = 0$$

$$(x+10)(x+8)$$

$x=-10, x=-8$

$$\Rightarrow 6x^2 + 60x + 150 = 0$$

$$\cancel{6(x^2 + 10x + 25)} = \cancel{0}$$

$$x^2 + 10x + 25 = 0$$

$$(x+5)(x+5) = 0$$

$x=-5$

$$\Rightarrow 4x^2 + 40x + 84 = 0$$

$$\cancel{4(x^2 + 10x + 21)} = \cancel{0}$$

$$x^2 + 10x + 21 = 0$$

$$(x+7)(x+3) = 0$$

$x=-7, x=-3$

$$\blacktriangleright (2x-3)^2 = 4x - 6 \quad p = 2x - 3$$

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

$$p^2 = 2p$$

$$p^2 - 2p = 0$$

$$p(p-2) = 0$$

$$p=0 \text{ or } p=2$$

$$2x-3=0 \\ +3 \quad +3$$

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

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

$$2x-3=2 \\ +3 \quad +3$$

$$\frac{2x}{2} = \frac{5}{2}$$

$$x = \frac{5}{2}$$

$$\blacktriangleright (x^2-2)^2 - 10(x^2-2) + 21 = 0 \quad x^2-2=7 \text{ or } x^2-2=3$$

$$p^2 - 10p + 21 = 0$$

$$(p-7)(p-3)$$

$$p=7 \text{ or } p=3$$

$$+2 \quad +2$$

$$\sqrt{x^2} = \sqrt{9}$$

$$x = \pm 3$$

$$+2 \quad +2$$

$$x^2 = 5$$

$$x = 3, -3, \sqrt{5}$$

$$\blacktriangleright (x^2+3)^2 = 4x^2 + 12 \quad p^2 - 4p = 0$$

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

$$p^2 = 4p$$

$$p(p-4) = 0$$

$$p=0 \text{ or } p=4$$

$$x^2 + 3 = 0 \quad \text{or} \quad x^2 + 3 = 4$$

$$\begin{array}{r} -3 \\ -3 \end{array}$$

$$\sqrt{x^2} = \sqrt{-3}$$

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

$$x^2 = 1$$

$$x = \sqrt{1}$$

$$x = \pm 1$$

$$x = \boxed{\sqrt{-3}, -1, 1}$$

$$\blacktriangleright (2x+3)^2 - 14x - 21 = -6$$

$$(2x+3)^2 - 7(2x+3) = -6$$

$$(2x+3)^2 - 7(2x+3) + 6 = 0$$

$$\boxed{m^2 - 7m + 6 = 0}$$

$$\blacktriangleright (x^2 + 3)^2 + 21 = 10x^2 + 30$$

$$(x^2 + 3)^2 + 21 = 10(x^2 + 3)$$

$$p^2 + 21 = 10p$$

$$p^2 - 10p + 21 = 0$$

$$(p-7)(p-3) = 0$$

$$\boxed{p=7 \text{ or } p=3}$$

$$\blacktriangleright x^2 + 14x + 49 = 0$$

$$(x+7)(x+7) = 0$$

$$\boxed{x=-7}$$

$$\blacktriangleright 3x^2 + 3x - 90 = 0$$

$$\cancel{3(x^2 + x - 30)} = 0$$

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

$$x^2 + x - 30 = 0$$

$$(x+6)(x-5) = 0$$

$$\boxed{x=-6, 5}$$

$$x^2 + 3 = 7 \quad \text{or} \quad x^2 + 3 = 3$$

$$\begin{array}{r} -3 \\ -3 \end{array}$$

$$\sqrt{x^2} = \sqrt{4}$$

$$x = \pm 2$$

$$x^2 = 0$$

$$x = 0$$

$$\boxed{x = -2, 0, 2}$$

$$\blacktriangleright (x^2 + 3)^2 = 4x^2 + 12$$
$$(x^2 + 3)^2 = 4(x^2 + 3)$$

$$p^2 = 4p$$

$$p^2 - 4p = 0$$

$$p(p-4) = 0$$

$$p=0 \text{ or } p=4$$

$$x^2 + 3 = 0 \text{ or } x^2 + 3 = 4$$

$$\begin{array}{cc} -3 & -3 \\ \sqrt{x^2} = \sqrt{-3} & x^2 = 1 \end{array}$$

$$x = \sqrt{-3} \text{ or } \boxed{x = -1, 1}$$

The Quadratic Formula

$$ax^2 + bx + c = 0 \rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x^2 + 4x - 21 = 0$$

$$a=1, b=4, c=-21$$

$$x = \frac{-4 \pm \sqrt{4^2 - 4(1)(-21)}}{2(1)} = \frac{-4 \pm \sqrt{16 - (4)(-21)}}{2} = \frac{-4 \pm \sqrt{16 + 84}}{2}$$

$$\frac{-4 \pm \sqrt{100}}{2} = \frac{-4 \pm 10}{2}$$
$$\begin{array}{c} \frac{-4 + 10}{2} \\ \downarrow \\ \frac{6}{2} \\ \downarrow \\ \boxed{x = 3} \end{array} \quad \begin{array}{c} \frac{-4 - 10}{2} \\ \downarrow \\ \frac{-14}{2} \\ \downarrow \\ \boxed{x = -7} \end{array}$$

$$\boxed{x = 3 \text{ or } x = -7}$$

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

$$3x^2 + 6x = -10$$

$$3x^2 + 6x + 10 = 0$$

$$a = 3, b = 6, c = 10$$

Because there is
a negative inside
square root

$$X = \frac{-6 \pm \sqrt{(6)^2 - 4(3)(10)}}{2(3)}$$

$$= \frac{-6 \pm \sqrt{36 - 120}}{6}$$

$$= \frac{-6 \pm \sqrt{-84}}{6}$$

No real solutions

$$\blacktriangleright -3x^2 + 12x + 1 = 0$$

$$a = -3, b = 12, c = 1$$

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

$$= \frac{-12 \pm \sqrt{12^2 - 4(-3)(1)}}{2(-3)}$$

$$= \frac{-12 \pm \sqrt{144 + 12}}{-6}$$

$$\frac{-12 \pm \sqrt{156}}{-6}$$

$$\begin{array}{r} 156 \\ 11 \\ 78 \quad 2 \\ 1 \end{array}$$

$$\frac{-12 \pm 2\sqrt{39}}{-6} = \frac{-6 \pm \sqrt{39}}{-3}$$

$$= \boxed{2 + \frac{\sqrt{39}}{-3} \text{ or } 2 - \frac{\sqrt{39}}{-3}}$$

$$\blacktriangleright -x^2 + 8x = 1 \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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

$$a = -1, b = 8, c = -1 \quad x = \frac{-8 \pm \sqrt{8^2 - 4(-1)(-1)}}{2(-1)}$$

60
 11
 30 2
 11
 15
 11
 5 3

$$\frac{-8 \pm \sqrt{64 - 4}}{-2} = \frac{-8 \pm \sqrt{60}}{-2} = \frac{-8 \pm 2\sqrt{15}}{-2}$$

$$\boxed{x = -4 + \sqrt{15}} \quad \text{or} \quad \boxed{x = -4 - \sqrt{15}}$$

$$\blacktriangleright -3x^2 + 10x - 3 = 0 \quad a = -3, b = 10, c = -3$$

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

$$x = \frac{-10 \pm \sqrt{10^2 - 4(-3)(-3)}}{2(-3)}$$

$$x = \frac{-10 \pm \sqrt{100 - 36}}{-6}$$

$$x = \frac{-10 \pm \sqrt{64}}{-6}$$

$$x = \frac{-10 + 8}{-6} \quad \text{or} \quad x = \frac{-10 - 8}{-6}$$

$$x = \frac{-2}{-6} \quad \text{or} \quad x = \frac{-18}{-6}$$

$$\boxed{x = \frac{1}{3}} \quad \text{or} \quad \boxed{x = 3}$$

$$6 - 6x^2 - 3x = 0$$

$$-6x^2 - 3x + 6$$

$$a = -6, b = -3, c = 6$$

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

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(-6)(6)}}{2(-6)}$$

$$x = \frac{3 \pm \sqrt{9 + 144}}{-12}$$

$$x = \frac{3 \pm \sqrt{153}}{-12}$$

$$\begin{array}{r} 153 \\ 11 \quad 9 \\ \hline 17 \end{array}$$

(33)

$$x = \frac{3 \pm 3\sqrt{17}}{-12}$$

$$\boxed{x = \frac{1 + \sqrt{17}}{-4} \quad \text{or} \quad x = \frac{1 - \sqrt{17}}{-4}}$$

$$-7x + 8 - 10x^2 = 7$$

$$-10x^2 - 7x + 8 = 7$$

-7 -7

$$-10x^2 - 7x + 1 = 0$$

$$a = -10, b = -7, c = 1$$

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

$$x = \frac{-(-7) \pm \sqrt{(-7)^2 - 4(-10)(1)}}{2(-10)}$$

$$x = \frac{7 \pm \sqrt{49 + 40}}{-20}$$

$$\boxed{x = \frac{7 \pm \sqrt{89}}{-20}}$$

$$\begin{array}{r} -6x = 3x^2 + 1 \\ +6x \quad +6x \\ \hline 3x^2 + 6x + 1 = 0 \end{array}$$

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

$$a = 3, b = 6, c = 1$$

$$x = \frac{-6 \pm \sqrt{6^2 - 4(3)(1)}}{2(3)}$$

$$x = \frac{-6 \pm \sqrt{36 - 12}}{6}$$

$$x = \frac{-6 \pm \sqrt{24}}{6}$$

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

$$\boxed{x = \frac{-3 \pm \sqrt{6}}{3}}$$

$$\begin{array}{r} 24 \\ | \\ 6 \quad 4 \\ | \quad | \\ 2 \quad 3 \quad 20 \\ | \quad | \\ 2 \quad \boxed{20} \\ 2 \sqrt{6} \end{array}$$

$$\begin{array}{r} 9 + 7x = 7x^2 \\ -7x^2 \quad -7x^2 \\ \hline -7x^2 + 7x + 9 = 0 \end{array}$$

$a = -7, b = 7, c = 9$

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

$$x = \frac{-7 \pm \sqrt{7^2 - 4(-7)(9)}}{2(-7)}$$

$$x = \frac{-7 \pm \sqrt{49 + 252}}{-14}$$

$$\boxed{x = \frac{-7 \pm \sqrt{301}}{-14}}$$

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

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

$$a = 7, b = 1, c = -4$$

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

$$x = \frac{-1 \pm \sqrt{1^2 - 4(7)(-4)}}{2(7)}$$

$$x = \frac{-1 \pm \sqrt{1 + 112}}{14}$$

$$x = \frac{-1 \pm \sqrt{113}}{14}$$

Discriminant is the part of the quadratic formula under the square root.

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

$b^2 - 4ac$ = discriminant

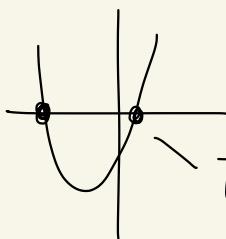
$$\blacktriangleright f(x) = 3x^2 + 24x + 48$$

$$a = 3, b = 24, c = 48$$

$$b^2 - 4ac = (24)^2 - 4(3)(48)$$

$$= 576 - 576$$

$$= 0$$



Two roots = positive discriminant

$$\blacktriangleright f(x) = x^2 - 3x + 18$$

$$a=1, b=-3, c=18$$

$$b^2 - 4ac = (-3)^2 - 4(1)(18)$$

$$= 9 - 72$$

$$= \boxed{-63}$$

\rightarrow 0 distinct zeroes

$$f(x) = 3x^2 + 12x + 5$$

$$b^2 - 4ac = (12)^2 - 4(3)(5)$$

$$= 144 - 60$$

$$= \boxed{84}$$

\rightarrow Two Solutions

$$\blacktriangleright 6 - 6x^2 - 3x = 0$$

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

$$a = -6, b = -3, c = 6$$

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

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(-6)(6)}}{2(-6)}$$

$$x = \frac{3 \pm \sqrt{9 + 144}}{-12}$$

$$x = \frac{3 \pm \sqrt{153}}{-12}$$

$$x = \frac{3 \pm 3\sqrt{17}}{-12}$$

$$x = \frac{1 \pm \sqrt{17}}{-4}$$

► $5x^2 + 20x + 245 = 0$

$$\cancel{5(x^2 + 14x + 49)} = 0$$

5

$$x^2 + 14x + 49 = 0$$

$$(x+7)(x+7) = 0$$

$$\boxed{x = -7}$$

► $f(x) = -4x^2 + 10x - 8$

$$b^2 - 4ac = (10)^2 - 4(-4)(-8)$$

$$= 100 - 128 = \boxed{-28}$$

► $(2x-3)^2 = 4x - 6$
 $(2x-3)^2 = 2(2x-3)$

$$p^2 = 2p$$

$$p^2 - 2p = 0$$

$$p(p-2) = 0$$

$$p = 0 \text{ or } p = 2$$

$$2x-3 = 0 \quad \text{or} \quad 2x-3 = 2$$

+3 +3 +3 +3

$$\cancel{2x} = \frac{3}{2}$$

$$\cancel{2x} = \frac{5}{2}$$

$$\boxed{x = \frac{3}{2} \quad \text{or} \quad x = \frac{5}{2}}$$

No zeros

$$\blacktriangleright x^2 - 44x + c \quad (x+a)^2 = (x+a)(x+a)$$

$$-44 = 2a$$

$$-22 = a$$

$$c = (-22)^2$$

$$c = 484$$

$$x^2 - 44x + 484$$

$$x^2 + 2(-22)x + (-22)^2$$

$$(x-22)(x-22)$$

$$(x-22)^2$$

$$\blacktriangleright x^2 - 8x + c$$

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

$$-4 = a$$

$$c = (-4)^2 = 16$$

$$(x+a)^2 = (x+a)(x+a)$$

$$x^2 + ax + ax + a^2$$

$$x^2 + 2ax + a^2$$

$$\blacktriangleright x^2 - 4x + c$$

$$\frac{-4}{2} = \frac{2a}{2}$$

$$c = a^2$$

$$-2 = a$$

$$c = (-2)^2$$

$$c = 4$$

$$\blacktriangleright x^2 + 6x + c$$

$$\frac{6}{2} = \frac{6a}{2}$$

$$a = 3$$

$$c = 3^2 = 9$$

$$c = 9$$

$$\Rightarrow x^2 + 10x + c$$

$\frac{10}{2} = \frac{2a}{2}$

$5 = a$

$c = a^2$

$c = (5)^2$

$c = 25$

$$\Rightarrow x^2 + \boxed{16x} + 9 \quad (x+a)^2 + b$$

$\frac{16}{2} = \frac{2a}{2}$

$a = 8$

$a^2 = 8^2 = 64$

$c = 64$

$$\Rightarrow x^2 - 2x - 8 = 0$$

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

$a = -1$

$a^2 = (-1)^2 = 1$

$c = 1$

$x^2 + 16x + 64 + 9 - 64$

$2ax$

$a = 8$

$(x+8)^2 - 55$

$$x^2 - 2x + 1 - 8 - 1$$

$$(x-1)^2 - 9$$

$$(x-1)^2 - 9 = 0$$

$+9 \quad +9$

$\sqrt{(x-1)^2} = \sqrt{9}$

$$x-1 = \pm 3$$

$$x = \pm 3 + 1$$

$$x = 3 + 1 \quad \text{or} \quad x = -3 + 1$$

$x = 4$	$x = -2$
---------	----------

$$C = 81, a = 9$$

$$\boxed{x^2 + 18x + 81} + \boxed{80 - 81}$$

$$(x+9)^2 - 1 = 0$$

$$\boxed{(x+9)^2 = 1}$$

$$\Rightarrow x^2 + 14x + 49 = 0$$
$$(x+7)(x+7) = 0$$
$$\boxed{(x+7)^2 = 0}$$

$$\Rightarrow f(x) = x^2 - 8x - 2$$

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

$$a = -4$$

$$a^2 = (-4)^2 = 16$$

$$C = 16$$

$$\Rightarrow f(x) = x^2 - 16x - 100$$

$$\frac{-16}{2} = \frac{2a}{2}$$

$$-8 = a$$

$$a^2 = (-8)^2 = 64$$

$$C = 64$$

$$\boxed{x^2 - 16x + 64} - \boxed{100 - 64}$$

$$\boxed{(x-8)^2 - 164}$$

$$\boxed{x^2 - 8x + 16 - 2 - 16}$$

$$\boxed{(x-4)^2 - 18}$$

$$\blacktriangleright x^2 - 6x - 16 = 0$$

$$\frac{-6}{2} = \frac{2a}{2}$$

$$a = -3$$

$$a^2 = (-3)^2 = 9$$

$$c = 9$$

$$x^2 - 6x + 9 - 16 - 9 = 0$$

$$(x-3)^2 - 25 = 0$$

$$+25 +25$$

$$(x-3)^2 = 25$$

$$\blacktriangleright x^2 - 8x + 1 = 85$$

$$-85$$

$$x^2 - 8x - 84$$

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

$$-4 = a$$

$$a^2 = (-4)^2 = 16$$

$$c = 16$$

$$\blacktriangleright f(x) = x^2 + 12x + 7$$

$$\frac{12}{2} = \frac{2a}{2}$$

$$a = 6$$

$$a^2 = 6^2 = 36$$

$$c = 36$$

$$\frac{x^2 + 12x + 36 + 7 - 36}{(x+6)^2 - 29}$$

$$x^2 - 8x + 16 - 84 - 16$$

$$(x-4)^2 - 100 = 0$$

$$\sqrt{(x-4)^2} = \sqrt{100}$$

$$x - 4 = \pm 10$$

$$x = \pm 10 + 4$$

$$x = 10 + 4 \quad \text{or} \quad x = -10 + 4$$

$$\boxed{x = 14 \quad \text{or} \quad x = -6}$$

$$\blacktriangleright x^2 + 6x + 3 = 0$$

$$\frac{6}{2} = \frac{p}{2}$$

$$a = 3$$

$$a^2 = (3)^2 = 9$$

$$c = 9$$

$$\underbrace{x^2 + 6x + 9 + 3 - 9}_{(x+3)^2 - 6 = 0}$$

$$(x+3)^2 - 6 = 0$$

$$+6 \quad +6$$

$$\sqrt{(x+3)^2} = \sqrt{6}$$

$$x+3 = \sqrt{6}$$

$$-3 \quad -3$$

$$x = \sqrt{6} - 3$$

$$\blacktriangleright x^2 + 10x + c$$

$$\frac{10}{2} = \frac{p}{2}$$

$$a = 5$$

$$c = a^2 = (5)^2 = 25$$

$$\boxed{c = 25}$$

$$\blacktriangleright x^2 - 2x + c$$

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

$$a = -1$$

$$c = a^2 = (-1)^2 = 1$$

$$\boxed{c = 1}$$

$$\blacktriangleright x^2 + \frac{1}{2}x + c$$

$$c = a^2 = \left(\frac{1}{4}\right)^2 = \boxed{\frac{1}{16}}$$

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

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

$$\blacktriangleright x^2 + 6x$$

$$\begin{array}{c} \boxed{b} \\ \hline \frac{b}{2} = \frac{6}{2} \\ b = 6 \end{array}$$

$$\frac{b}{2} = a$$

$$C = a^2 = \left(\frac{b}{2}\right)^2 = \boxed{\frac{b}{4}}$$

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

$$\begin{array}{c} \boxed{b} \\ \hline \frac{b}{2} = \frac{3}{2} \\ b = 3 \end{array}$$

$$x^2 + 3x + \frac{1}{4} = 0$$

$$\begin{array}{c} \boxed{a} \\ \hline \frac{a}{2} = \frac{3}{2} \\ a = \frac{3}{2} \end{array}$$

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

$$\begin{array}{c} \boxed{x^2 + 3x + \frac{9}{4}} \\ \hline + \frac{1}{4} - \frac{9}{4} \end{array}$$

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

$$\blacktriangleright x^2 - 8x = 5$$

$$\begin{array}{c} \boxed{b} \\ \hline \frac{b}{2} = \frac{-8}{2} \\ b = -8 \end{array}$$

$$a = -4$$

$$C = a^2 = (-4)^2 = 16$$

$$x^2 - 8x + (6 - 5 - 16)$$

$$\begin{array}{c} \boxed{b} \\ \hline (x - 4)^2 - 21 = 0 \end{array}$$

$$\sqrt{(x - 4)^2} = \sqrt{21}$$

$$x - 4 = \sqrt{21}$$

$$+ 4 \qquad \qquad + 4$$

$$\boxed{x = \sqrt{21} + 4}$$

or

$$\boxed{x = -\sqrt{21} + 4}$$



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

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

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

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

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

$$x = \sqrt{2} - \frac{3}{2} \text{ or } x = -\sqrt{2} - \frac{3}{2}$$

$$\frac{4x^2 + 20x - 3}{4} = 0$$

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

$$\frac{4a=5}{k=2}$$

$$a = \frac{5}{2}$$

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

$$x^2 + 5x + \frac{25}{4} - \frac{3}{4} - \frac{25}{4}$$

$$\left(x + \frac{5}{2}\right)^2 - 7 = 0$$

$$+7 +7$$

$$\left(x + \frac{5}{2}\right)^2 = \sqrt{7}$$

$$x + \frac{5}{2} = \sqrt{7}$$

$$x = \sqrt{7} - \frac{5}{2}$$

$$\text{or}$$

$$x = -\sqrt{7} - \frac{5}{2}$$

► $x^2 - 2x + 17$

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

$$a = -1$$

$$a^2 = c = (-1)^2 = 1$$

$$c = 1$$

$$x^2 - 2x + 1 + 17 - 1$$

$$(x-1)^2 + 16$$

$$\Rightarrow x^2 - \boxed{14x} + 40 = 0$$

$$\frac{a = -14}{2}$$

$$a = -7$$

$$c = a^2 = (-7)^2 = 49$$

$$\boxed{x^2 - 14x + 49 + 40 - 49}$$

$$\boxed{(x-7)^2 - 9 = 0}$$

$$\boxed{(x-7)^2 = 9}$$

$$\sqrt{x-7} = \sqrt{9}$$

$$x-7 = \pm 3$$

$$+7 \qquad \qquad$$

$$x = \pm 3 + 7$$

$$x = 3 + 7 \text{ or } x = -3 + 7$$

$$\boxed{x = 10 \text{ or } x = 4}$$

$$\Rightarrow x^2 + \boxed{4x} + 1 = 0$$

$$\frac{a = 4}{2}$$

$$a = 2$$

$$a^2 = (2)^2 = 4$$

$$c = 4$$

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

$$\boxed{(x+2)^2 - 3 = 0}$$

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

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

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

$$-2 \qquad -2$$

$$\boxed{x = \sqrt{3} - 2 \text{ or } x = -\sqrt{3} - 2}$$

$$\Rightarrow x^2 = -8x - 7$$

$$-x^2$$

$$\frac{0}{-1} = \frac{-x^2 - 8x - 7}{-1}$$

$$x^2 + 8x + 7 = 0$$

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

$$a = 4$$

$$a^2 = 4^2 = 16$$

$$c = 16$$

$$x^2 + 8x + 16 + 7 - 16$$

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

$$(x+4)^2 = 9$$

$$\sqrt{(x+4)^2} = \sqrt{9}$$

$$x+4 = \pm 3$$

$$-4$$

$$x = 3 - 4 \text{ or } x = -3 - 4$$

$$x = -1 \text{ or } x = -7$$

$$\Rightarrow -34 = x^2 - 14x + 10$$

$$+34$$

$$x^2 - 14x + 44 = 0$$

$$\frac{2a}{2} = \frac{-14}{2}$$

$$a = -7$$

$$a^2 = (-7)^2 = 49$$

$$x^2 - 14x + 49 + 44 - 49$$

$$(x-7)^2 - 5 = 0$$

$$(x-7)^2 = 5$$

$$\sqrt{(x-7)^2} = \sqrt{5}$$

$$x-7 = \sqrt{5}$$

$$+7 \quad +7$$

$$x = 7 \pm \sqrt{5}$$

$$\blacktriangleright x^2 - 51 = 14x$$

$$-14x$$

$$x^2 - 14x - 51$$

$$\frac{2a}{2} = \frac{-14}{2}$$

$$a = -7$$

$$a^2 = (-7)^2 = 49$$

$$x^2 - 14x + 49 - 51 - 49$$

$$(x-7)^2 - 100 = 0$$

$$(x-7)^2 = 100$$

$$\sqrt{(x-7)^2} = \sqrt{100}$$

$$x-7 = \pm 10$$

$$+7 \quad +7$$

$$x = 7 \pm 10$$

$$\blacktriangleright x^2 + 11x + 24 = 0$$

$$\frac{11}{2} = \frac{2a}{2}$$

$$a = \frac{11}{2}$$

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

$$x^2 + 11x + \frac{121}{4} + 24 - \frac{121}{4} = 0$$

$$\left(x + \frac{11}{2}\right)^2 - \frac{25}{4} = 0$$

$$\left(x + \frac{11}{2}\right)^2 = \frac{25}{4}$$

$$\Rightarrow f(x) = \frac{2x^2 + 13x + 20}{2}$$

$$= x^2 + \underbrace{\frac{13}{2}x}_{2a} + 10$$

$$\frac{\frac{13}{2}}{2} = \frac{2a}{2}$$

$$a = \frac{13}{4}$$

$$a^2 = \left(\frac{13}{4}\right)^2 = \frac{169}{16}$$

$$\left(x^2 + \frac{13}{2}x + \frac{169}{16} \right) + (10 - \frac{169}{16})$$

$$\left(x + \frac{13}{4} \right)^2 - \frac{9}{16}$$

$$2 \left(x + \frac{13}{4} \right)^2 - \frac{9}{16} \cdot 2$$

$$\boxed{2 \left(x + \frac{13}{4} \right)^2 - \frac{9}{8}}$$

$$\Rightarrow \frac{4x^2 - 4x + 1}{4} = 0$$

$$x^2 - x + \frac{1}{4} = 0$$

$$\frac{2a}{2} = \frac{-1}{2}$$

$$a = -\frac{1}{2}$$

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

$$x^2 - x + \frac{1}{4} + \frac{1}{4} - \frac{1}{4} = 0$$

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

$$\blacktriangleright \frac{4x^2 - 12x + 9 = 0}{4}$$

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

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

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

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

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

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

$$\blacktriangleright g(x) = \cancel{8x^2 - 7x + 5}$$

$$\boxed{x^2 - \frac{7}{2}x + \frac{5}{2}}$$

$$\frac{-\frac{7}{2}}{2} = \frac{2a}{2}$$

$$a = -\frac{7}{4}$$

$$a^2 = \frac{49}{16}$$

$$\boxed{x^2 - \frac{7}{2}x + \frac{49}{16} + \frac{5}{2} - \frac{49}{16}}$$

$$\frac{2 \left(x - \frac{7}{4}\right)^2 - \frac{9}{16} \cdot 2}{2 \left(x - \frac{7}{4}\right)^2 - \frac{9}{8}}$$

$$\boxed{2 \left(x - \frac{7}{4}\right)^2 - \frac{9}{8}}$$

$$\blacktriangleright 8x^2 - 3x - 5 = 0$$

$$x^2 - \frac{3}{2}x - \frac{5}{2} = 0$$

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

$$a = -\frac{3}{4}$$

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

$$\left[x^2 - \frac{3}{2}x + \frac{9}{16} \right] - \frac{5}{2} - \frac{9}{16}$$

$$2 \left(x - \frac{3}{4} \right)^2 - \frac{49}{16} \cdot 2$$

$$2 \left(x - \frac{3}{4} \right)^2 - \frac{49}{8} = 0$$

$$+\frac{49}{8} \quad +\frac{49}{8}$$

$$2 \left(x - \frac{3}{4} \right)^2 = \frac{49}{8}$$

$$\boxed{\left(x - \frac{3}{4} \right)^2 = \frac{49}{16}}$$

$$\blacktriangleright f(x) = x^2 - 9x + 14$$

$$\frac{2a}{2} = \frac{-9}{2}$$

$$a = -\frac{9}{2}$$

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

$$x^2 - 9x + \underbrace{\frac{81}{4}}_{\left(x - \frac{9}{2}\right)^2 - \frac{25}{4}} + 14 - \frac{81}{4}$$

$$\blacktriangleright x^2 - x - 6$$

$$\frac{2a}{2} = \frac{-1}{2}$$

$$a = -\frac{1}{2}$$

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

$$x^2 - x + \frac{1}{4} - 6 - \frac{1}{4} = 0$$

$$\boxed{(x - \frac{1}{2})^2 - \frac{25}{4} = 0}$$

$$\blacktriangleright 2x^2 - 11x + 14 = 0$$

$$a^2 = \left(-\frac{11}{4}\right)^2 = \frac{121}{16}$$

$$x^2 - \underbrace{\frac{11}{2}x}_{2a} + 7 = 0$$

$$x^2 - \frac{11}{2}x + \frac{121}{16} + 7 - \frac{121}{16} = 0$$

$$\frac{2a}{2} = \frac{-11}{2}$$

$$a = -\frac{11}{4}$$

$$2\left(x - \frac{11}{4}\right)^2 - \frac{9}{16} \cdot 2 = 0$$

$$2\left(x - \frac{11}{4}\right)^2 - \frac{9}{8} = 0$$

$$2\left(x - \frac{11}{4}\right)^2 - \frac{9}{8} = 0$$

$$+ \frac{9}{8} + \frac{9}{8}$$

~~$$2\left(x - \frac{11}{4}\right)^2 = \frac{9}{8}$$~~

$$\underline{-8} \quad \underline{2}$$

$$\boxed{\left(x - \frac{11}{4}\right)^2 = \frac{9}{16}}$$

►

$$\begin{array}{rcl} -2x & = & x^2 - 6 \\ +2x & & +2x \\ \hline x^2 + 2x - 6 & = & 0 \end{array}$$

$$\frac{2a}{2} = \frac{2}{2}$$

$$a = 1$$

$$a^2 = (1)^2 = 1$$

$$\boxed{x^2 + 2x + 1 - 6 - 1}$$

$$(x+1)^2 - 7 = 0$$

$$\boxed{(x+1)^2 = 7}$$

$$\sqrt{(x+1)^2} = \sqrt{7}$$

$$x+1 = \sqrt{7}$$

$$\begin{array}{l} -1 \\ x = \sqrt{7} - 1 \quad \text{or} \quad x = -\sqrt{7} - 1 \end{array}$$

$$\blacktriangleright 3+x = x^2 + 3x$$

$$-3-x$$

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

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

$$a = 1$$

$$a^2 = (1)^2 = 1$$

$$x^2 + 2x + \boxed{1} - 3 - \boxed{1} = 0$$

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

$$\boxed{(x+1)^2 = 4}$$

$$\sqrt{(x+1)^2} = \sqrt{4}$$

$$x+1 = \pm 2$$

$$\boxed{x = -1 \pm 2}$$

$$\blacktriangleright g(x) = \frac{-x^2 - 6x - 6}{-1}$$

$$x^2 + 6x + 6$$

$$\frac{2a}{2} = \frac{6}{2}$$

$$a = 3$$

$$a^2 = 9$$

$$x^2 + 6x + 9 + 6 - 9$$

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

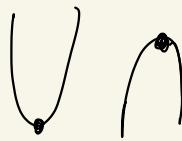
$$+3 \quad +3$$

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

$$x+3 = 3$$



$$y = 5x^2 - 20x + 15$$



$$x\text{-cord of vertex} = \frac{-b}{2a} = \frac{-(-20)}{10} = \frac{20}{10} = 2$$

$$y\text{-cord of vertex} = 5(2)^2 - 20(2) + 15 = -5$$

$$y = 5(x^2 - 4x + 3)$$

$$\frac{-4}{2} = \cancel{2a}$$

$$-2 = a$$

$$a^2 = (-2)^2 = 4$$

$$5(x^2 - 4x + 4 + 3 - 4)$$



$$5(x-2)^2 - 1 \cdot 5$$

$$5(x-2)^2 - 5$$

$$-5 = y\text{-vertex}$$

$\Rightarrow y = 5x^2 - 20x + 15$
 $y = (5x^2 - 20x + 15)/5$
 $x^2 - 4x + 3 = 0$
 $(x-3)(x-1) = 0$
 $x-3=0 \quad x-1=0$
 $x=3 \quad x=1$
 $(3, 0) \quad (1, 0)$

$\frac{1+3}{2} = \frac{4}{2} = 2$
 $y = 5(2)^2 - 20(2) + 15$
 $= 20 - 40 + 15$
 $= -20 + 15$
 $= -5$

$\boxed{(2, -5) = \text{vertex}}$

$\Rightarrow y = 4x^2 + 8x + 7$
 $(0, 7) = y - \text{int}$

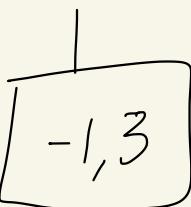
$x - \text{Crd}$
 $\text{of vertex} = -\frac{b}{2a} = -\frac{8}{2(4)} = -\frac{8}{8} = -1$

$$4(-1)^2 + 8(-1) + 7$$

$$4(1) - 8 + 7$$

$$4 - 8 + 7 = -4 + 7 = 3$$

vertex



$$\boxed{-1, 3}$$

$$\blacktriangleright h(x) = -2x^2 + 20x + 48$$

$$\begin{array}{l} \text{Vertex} \\ \text{---} \\ x - \text{coord} = -\frac{b}{2a} = \frac{-20}{2(-2)} = \frac{-20}{-4} = 5 \end{array}$$

$$h(x) = -2(5)^2 + 20(5) + 48$$

$$= -2(25) + 100 + 48$$

$$= -50 + 100 + 48$$

$$= 50 + 48$$

$$= 98$$

$$h(x) = 98$$

$$\blacktriangleright h(x) = -5x^2 + 20x + 60$$

$$= -5(x^2 - 4x - 12)$$

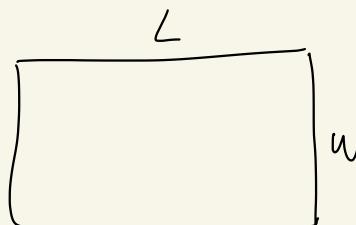
$$\cancel{-5(x-6)(x+2)} = 0$$

$$(x-6)(x+2) = 0$$

$$x = 6, x = -2$$

$$x = 6$$

► $A(x) = -x^2 + 100x$



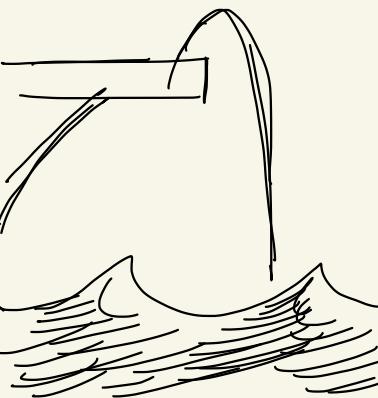
$$\text{X-CORD of vertex} = \frac{-b}{2a} = \frac{-100}{2(-1)} = \frac{-100}{-2} = 50$$

$$-(50)^2 + 100(50)$$

$$-2500 + 5000$$

$$(50, 2500)$$

$$x = 50$$



► $h(x) = -5x^2 + 10x + 15$

$$y-\text{int} = -5(0)^2 + 10(0) + 15$$

$$y-\text{int} = 15$$

$$y-\text{int} = (0, 15)$$

$$\blacktriangleright h(t) = (t-4)(t+8)$$

$$t=4, t=-8$$

$$t^2 + 8t - 4t - 32$$

$$t^2 + 4t - 32$$

$$\begin{matrix} x\text{-cord} \\ \text{vertex} \end{matrix} = \frac{-b}{2a} = \frac{-4}{2(1)} = \frac{-4}{2} = -2$$

$$(-2)^2 + 4(-2) - 32$$

$$4 - 8 - 32$$

$$4 - 40$$

$$-36$$

$$\boxed{\text{Vertex} = (-2, -36)}$$

$$\blacktriangleright g(r) = r^2 - 6r - 55$$

$$(r-11)(r+5)$$

$$r=11, r=-5$$

$$\text{vertex-}x = \frac{-b}{2a} = \frac{-(-6)}{2(1)} = \frac{6}{2} = 3$$

$$(3)^2 - 6(3) - 55$$

$$9 - 18 - 55$$

$$-9 - 55$$

$$-64$$

$$\boxed{(3, -64)}$$

vertex

$$\blacktriangleright f(t) = (t-5)^2 - 9$$

$$(t-5)^2 - 9 = 0$$

$$\cancel{(t-5)}^{\pm 9} \cancel{+ 9}^{\pm 9} = \sqrt{9}$$

$$t-5 = \pm 3$$

$$+ 5$$

$$t = \pm 3 + 5$$

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

$$t = 8 \quad \text{or} \quad t = 2$$

$$\blacktriangleright f(x) = (x+2)(x-4)$$

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

$$x^2 - 2x - 8$$

$$\text{vertex-}x = \frac{-b}{2a} = \frac{-(-2)}{2(1)}$$

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

$$(1)^2 - 2(1) - 8$$

$$1 - 2 - 8$$

$$-1 - 8 = -9$$

$$\text{vertex-} \boxed{(1, -9)}$$

$$\blacktriangleright g(x) = \frac{1}{3}(x-6)^2 + 1$$

$$\text{vertex} = (6, 1)$$

$$g(0) = \frac{1}{3}(0-6)^2 + 1$$

$$= \frac{1}{3}(-6)^2 + 1$$

$$= \frac{1}{3}(36) + 1$$

$$= 12 + 1 = 13$$

$$\boxed{(0, 13) = \text{y-int}}$$

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

$$\text{vertex-}x = \frac{-b}{2a} = \frac{-2}{2(-\frac{1}{5})} = 5$$

$$-\frac{1}{5}(5)^2 + 2(5)$$

$$-5 + 10$$

$$5$$

$$\boxed{\text{vertex} = (5, 5)}$$

► $g(x) = 2(x+4)(x)$ $x = -4$

$$2x + 8(x)$$

$$2x^2 + 8x$$

$$\frac{-b}{2a} = \frac{-8}{2(2)} = \frac{-8}{4} = -2$$

$$2(-2)^2 + 8(-2)$$

$$2(4) - 16$$

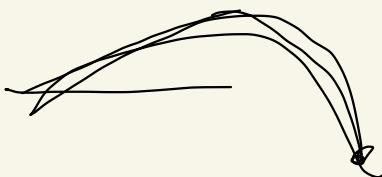
$$8 - 16 = -8$$

$$\boxed{(-2, -8) = \text{vertex}}$$

► $g(x) = -\frac{3}{2}(x-2)^2$

$$-\frac{3}{2}(4-2)^2$$

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



► $h(t) = -3t^2 + 24t + 60$

$$-3(t^2 - 8t - 20)$$

$$-3(t-10)(t+2)$$

$$t=10, t=-2$$

$t=10$

► $V(t) = 2t^2 - 20t$

$$\text{vertex } x = \frac{-b}{2a} = \frac{-(-20)}{2(2)} = \frac{20}{4} = 5$$

$$2(5)^2 - 20(5)$$

$$2(25) - 100$$

$$50 - 100$$

$$-50$$

$\text{vertex } = (5, -50)$

$$\Rightarrow y = 2(x+1)(x-1)$$

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

$$2(1)(-1) = -2$$

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

$$2x^2 - \cancel{2x} + \cancel{2x} - 2$$

$$2x^2 - 2$$

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

$$-\frac{b}{2a} = \frac{-0}{2(2)} = \frac{0}{4} = 0$$

$(0, -2)$

vertex

$$\Rightarrow y = -2(x-1)^2 - 4$$

$$\Rightarrow v(t) = 2t^2 - 12t - 14$$

$$2(t^2 - 6t - 7)$$

$$\frac{-6}{2} = \frac{2a}{2}$$

$$a = -3$$

$$a^2 = (-3)^2 = 9$$

$$2 \cdot t^2 - 6t + 9 - 7 - 9$$

$$2(t-3)^2 - 16 \cdot 2$$

$$2(t-3)^2 - 32$$

$$\blacktriangleright h(t) = -5t^2 + 40t$$

$$= -5t(t - 8)$$

$$\begin{array}{r} -5t = 0 \\ \hline -5 \end{array}$$

$$t = 0$$

$$\begin{array}{r} t - 8 = 0 \\ \boxed{t = 8} \end{array}$$

$$h(t) = -2t^2 + 4t + 30$$

$$-2(t^2 - 2t - 15)$$

$$\begin{array}{r} -2 = 2a \\ \hline 2 \end{array}$$

$$-1 = a$$

$$a^2 = (-1)^2 = 1$$

$$-2 \cdot \underbrace{t^2 - 2t + 1}_{-15 - 1}$$

$$2(t - 1)^2 - 16 \cdot 2$$

$$\boxed{-2(t - 1)^2 + 32}$$

$$\blacktriangleright h(t) = -5t^2 + 20t + 160$$

$$-5(t^2 - 4t - 32)$$

$$\frac{-4}{2} = \frac{2a}{2}$$

$$-2 = a$$

$$a^2 = (-2)^2 = 4$$

$$-5(t^2 - 4t + 4) - 32 - 4 \cdot 5$$

$$-5(t - 2)^2 - 36 - 5$$

$$\boxed{-5(t - 2)^2 + 180}$$

$$\blacktriangleright h(t) = -5t^2 + 5t + 10$$

$$-5(t^2 - t - 2)$$

$$-5(t - 2)(t + 1)$$

$$t = -1, t = 2$$

$$\blacktriangleright h(x) = -\frac{1}{3}x^2 + 2x - 4$$

$$\begin{matrix} x\text{-cord} \\ \text{vertex} \end{matrix} = \frac{-b}{2a} = \frac{-2}{2(-\frac{1}{3})} = 3$$

$$-\frac{1}{3}(3)^2 + 2(3) - 4$$

$$-\frac{1}{3}(9) + 6 - 4$$

$$-3 + 6 - 4$$

$$3 - 4$$

$$-1 \quad (3, -1) = \text{vertex}$$

$$\blacktriangleright m(x) = -x^2 + 14x$$

$$-x^2 + 14x + 0$$

$$-1(x^2 - 14x + 0)$$

$$\frac{2a}{2} = \frac{-14}{2}$$

$$a = -1$$

$$a^2 = (-7)^2 = 49$$

$$\blacktriangleright y = 4x^2 + 8x + 7$$

$$\begin{matrix} x\text{-cord} \\ \text{vertex} \end{matrix} = \frac{-b}{2a} = \frac{-8}{2(4)} = \frac{-8}{8} = -1$$

$$y = 4(-1)^2 + 8(-1) + 7$$

$$= 4(1) - 8 + 7$$

$$= 4 - 8 + 7$$

$$= -4 + 7$$

$$y = 3 \boxed{\text{vertex} = (-1, 3)}$$

$$y = 4(x)^2 + 8(x) + 7$$

$$y = 7 \boxed{(0, 7) = \text{point}}$$

~~$$-1(x^2 - 14x + 49 + 0 - 49)$$

$$= -1(x-7)^2 + 0$$

$$(7, 0)$$~~

$$\Rightarrow f(x) = x^2 + 6x + 8$$

$$(x+4)(x+2)$$

$$\boxed{x = -4, x = -2}$$

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

$$(-3)^2 + 6(-3) + 8$$

$$= 9 - 18 + 8$$

$$= -9 + 8$$

$$= -1$$

$$\boxed{[-3, -1]}$$

$$\Rightarrow h(t) = -4t^2 + 8t + 32$$

$$\begin{matrix} x-\text{cord} \\ \text{vertex} \end{matrix} = \frac{-b}{2a} = \frac{-8}{2(-4)} = \frac{-8}{8} = 1$$

$$-4(1)^2 + 8(1) + 32$$

$$-4 + 8 + 32$$

$$4 + 32$$

$$36$$

$$\boxed{1, 36}$$

$$-4(t^2 \underbrace{-2t - 8})$$

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

$$a = -1$$

$$a^2 = 1$$

$$\underbrace{t^2 - 2t + 1}_{-8 - 1}$$

$$\boxed{\begin{aligned} & -4(t-1)^2 - 8 - 1 = -4 \\ & -4(t-1)^2 + 36 \end{aligned}}$$

$$h(t) = -5t^2 + 20t + 105$$

$$-5(t^2 - 4t - 21)$$

$$\frac{4a}{2} = \frac{-4}{2}$$

$$a = -2$$

$$a^2 = (-2)^2 = 4$$

$$-5 \cdot t^2 - 4t + 4 - 21 - 4 \cdot -5$$

$$-5(t-2)^2 - 25 - 5$$

$$-5(t-2)^2 + 125$$

(2, 125)

125

$$h(x) = -\frac{1}{3}x^2 + 2x - 4$$

$$\begin{aligned} x-\text{cord of vertex} &= \frac{-b}{2a} = \frac{-2}{2(-\frac{1}{3})} \\ &= \frac{-2}{\frac{-2}{3}} = 3 \end{aligned}$$

$$-\frac{1}{3}(3)^2 + 2(3) - 4$$

$$-\frac{1}{3}(9) + 6 - 4$$

$$-3 + 6 - 4$$

$$3 - 4$$

$$\boxed{\frac{-1}{(3, -1)}}$$

$$\cancel{-\frac{1}{3}(0)^2 + 2(0) - 4}$$

$$\boxed{y = -4}$$

$$\boxed{0, -4}$$

$$g(r) = (r+14)^2 - 49$$

$$(r+14)^2 - 49 = 0$$

$$+49 +49$$

$$\sqrt{(r+14)^2} = \sqrt{49}$$

$$r+14 = \pm 7$$

$$-14 \qquad -14$$

$$r = 7 - 14, r = -7 - 14$$

$$\boxed{r = -7, r = -21}$$

$$h(x) = -5x^2 + 10x + 15$$

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

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

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

$$\boxed{x=3}$$

$$y = -\frac{5}{4}(x-1)(x+3)$$

$$-\frac{5}{4}(x^2 + 3x - x - 3)$$

$$-\frac{5}{4}(x^2 + 2x - 3)$$

$$-\frac{5}{4}x^2 - \frac{5}{2}x + \frac{15}{4}$$

$$-\frac{b}{2a} = \frac{-(-\frac{5}{2})}{2(-\frac{5}{4})} = -1$$

$$y = -\frac{5}{4}(-1)^2 - \frac{5}{2}(-1) + \frac{15}{4}$$

$$-\frac{5}{4} + \frac{25}{4}$$

$$y = 5$$

vertex
 $\boxed{(-1, 5)}$

► $f(x) = 4x^2 - 108$

U - concave up

$$-4x^2 - 108$$

U - concave down

Unit Test

► $V(t) = 2t^2 - 12t - 14$

$$2(t^2 - 6t - 7)$$

$$2(t-7)(t+1)$$

$$t = 7, t = -1$$

► $2x^2 - 16x + 14 = 0$

$$2(x^2 - 8x + 7) = 0$$

$$2(x-7)(x-1)$$

$x = 7, x = 1$

► $x^2 + 3x - 28 = 0$

$$\frac{2a}{2} = \frac{3}{2}$$

$$a = \frac{3}{2}$$

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

$$x^2 + 3x + \frac{9}{4} - 28 - \frac{9}{4} = 0$$

► $y = -\frac{1}{8}x^2 + x - 4$

$$x\text{-ord vertex} = \frac{-b}{2a} = \frac{-1}{2(-\frac{1}{8})} = 4$$

$$y = -\frac{1}{8}(4)^2 + 4 - 4$$

$$= -2$$

$(4, -2)$

$$\left(x + \frac{3}{2}\right)^2 - \frac{121}{4} = 0 = \left(x + \frac{3}{2}\right)^2 = \frac{121}{4}$$

$$\blacktriangleright x^2 - 4x + 4 = 2x$$

$$-2x \quad -2x$$

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

\boxed{}

$$\frac{2a}{2} = \frac{-6}{2}$$

$$a = -3$$

$$a^2 = (-3)^2 = 9$$

$$\underbrace{x^2 - 4x + 9}_{(x-3)^2} + 4 - 9$$

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

$$+5 \quad +5$$

$$\boxed{(x-3)^2 = 5}$$

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

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

$$+3 \quad +3$$

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

$$\blacktriangleright g(x) = 2(x-2)^2 + 2$$

$$\blacktriangleright f(t) = -(t-2)(t-15)$$

$$-(t^2 - 15t - 2t + 30)$$

$$-(t^2 - 17t + 30)$$

$$-t^2 + 17t - 30$$

$$\frac{-b}{2a} = \frac{-17}{2(-1)} = \frac{-17}{-2} =$$

$$\frac{17}{2}$$

$$-\left(\frac{17}{2}\right)^2 + 17\left(\frac{17}{2}\right) - 30 =$$

$$\blacktriangleright y = 4(x+6)(x+4)$$

$$4(-5)^2 + 40(-5) + 96$$

$$x^2 + 4x + 6x + 24$$

$$4(25) - 200 + 96$$

$$4(x^2 + 10x + 24)$$

$$100 - 200 + 96$$

$$y = 4x^2 + 40x + 96$$

$$-100 + 96$$

$$-4$$

$$\frac{-b}{2a} = \frac{-40}{2(4)} = \frac{-40}{8} = -5$$

$$(-5, -4)$$

$$\blacktriangleright p = 3x + 4$$

$$(3x+4)^2 - 36 = 15x + 20$$

$$(3x+4)^2 - 36 = 5(3x+4)$$

$$p^2 - 36 = 5p$$

$$-5p$$

$$p^2 - 5p - 36 = 0$$

$$\blacktriangleright (x-3)^2 - 81 = 0$$

$$+81 \quad +81$$

$$\sqrt{(x-3)^2} = \sqrt{81}$$

$$x-3 = \pm 9$$

$$+3$$

$$x = \pm 9 + 3$$

$$x = 9 + 3 \quad \text{or} \quad x = -9 + 3$$

$$\blacktriangleright P(x) = -12x^2 + 120x$$

$$-12(x^2 - 10x)$$

$$\frac{2a}{2} = \frac{10}{2}$$

$$a = -5$$

$$a^2 = (-5)^2 = 25$$

$$-12(x-5)^2 + 300 = 0$$

$$(5, 300)$$

5

$$-12 \cdot \underbrace{x^2 + 10x + 25}_{+0 - 25 - 12}$$

$$\blacktriangleright -7x + 8 - 10x^2 = 7$$
$$\quad \quad \quad -7 \qquad \quad -7$$

$$-10x^2 - 7x + 1 = 0$$

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

$$\frac{-(-7) \pm \sqrt{(-7)^2 - 4(-10)(1)}}{2(-10)}$$

$$= \frac{7 \pm \sqrt{49 + 40}}{-20}$$

$$= \frac{7 \pm \sqrt{89}}{-20}$$

