1. $x^2 + 3x - 28 = 0$

$x \quad +7$
$x \quad -4$

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

$x+7=0 \qquad x-4=0$
$\quad x=-7 \qquad \quad x=4$

2. $x^2 - 14x + 45 = 0$

$x \quad -9$
$x \quad -5$

$(x-9)(x-5)=0$

$x-9=0 \qquad x-5=0$
$\quad x=9 \qquad \quad x=5$

3. $2x^2 + 6x - 36 = 0$

$x^2 + 3x - 18 = 0$

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

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

$x+6=0 \qquad x-3=0$
$\quad x=-6 \qquad \quad x=3$

4. $5x^2 - 5x - 10 = 0$

$x^2 - x - 2 = 0$

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

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

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

5. $-4x^2 + 32x - 48 = 0$

$-x^2 + 8x - 12 = 0$
$x^2 - 8x + 12 = 0$

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

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

$x-6=0 \qquad x-2=0$
$\quad x=6 \qquad \quad x=2$

6. $-2x^2 + 26x - 72 = 0$

$-x^2 + 13x - 36 = 0$
$x^2 - 13x + 36 = 0$

$x \quad -9$
$x \quad -4$

$(x-9)(x-4)=0$

$x-9=0 \qquad x-4=0$
$\quad x=9 \qquad \quad x=4$

7. $-7x^2 + 42x + 49 = 0$

$-x^2 + 6x + 7 = 0$
$x^2 - 6x - 7 = 0$

$x \quad -7$
$x \quad +1$

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

$x-7=0 \qquad x+1=0$
$\quad x=7 \qquad \quad x=-1$

8. $-2x^2 + 13x - 20 = 0$

$2x^2 - 13x + 20 = 0$

$2x \quad -5$
$x \quad -4$

$(2x-5)(x-4)=0$

$2x-5=0 \qquad x-4=0$
$2x=5 \qquad \quad x=4$
$x=\frac{5}{2}$

9. $-3x^2 + 11x - 6 = 0$

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

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

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

$3x-2=0 \qquad x-3=0$
$3x=2 \qquad \quad x=3$
$x=\frac{2}{3}$

10. $-4x^2 + 8x - 3 = 0$

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

$2x \quad -3$
$2x \quad -1$

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

$2x-3=0 \qquad 2x-1=0$
$2x=3 \qquad \quad 2x=1$
$x=\frac{3}{2} \qquad \quad x=\frac{1}{2}$

11. $-4x^2 + 24x - 35 = 0$

$4x^2 - 24x + 35 = 0$

$2x \quad -7$
$2x \quad -5$

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

$2x-7=0 \qquad 2x-5=0$
$2x=7 \qquad \quad 2x=5$
$x=\frac{7}{2} \qquad \quad x=\frac{5}{2}$

12. $-4x^2 + 24x - 27 = 0$

$4x^2 - 24x + 27 = 0$

$2x \quad -9$
$2x \quad -3$

$(2x-9)(2x-3)=0$

$2x-9=0 \qquad 2x-3=0$
$2x=9 \qquad \quad 2x=3$
$x=\frac{9}{2} \qquad \quad x=\frac{3}{2}$

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selesaikan dengan guna kaedah rumus

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

$a = 1, b = -3, c = 2$

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

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

$$= \frac{3 \pm \sqrt{1}}{2}$$

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

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

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

2. $x^2 - 2x - 35 = 0$

$a = 1, b = -2, c = -35$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-35)}}{2(1)}$$

$$= \frac{2 \pm \sqrt{144}}{2}$$

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

$$x = \frac{2 + 12}{2} \qquad x = \frac{2 - 12}{2}$$

$$x = 7 \qquad x = -5$$

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

$a = 2, b = -3, c = -2$

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

$$= \frac{3 \pm \sqrt{25}}{4}$$

$$= \frac{3 \pm 5}{4}$$

$$x = \frac{3 + 5}{4} \qquad x = \frac{3 - 5}{4}$$

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

4. $-2x^2 - 5x + 3 = 0$

$a = -2, b = -5, c = 3$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(-2)(3)}}{2(-2)}$$

$$= \frac{5 \pm \sqrt{49}}{-4}$$

$$= \frac{5 \pm 7}{-4}$$

$$x = \frac{5 + 7}{-4} \qquad x = \frac{5 - 7}{-4}$$

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

5. $-3x^2 = -6x - 2$

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

$a = -3, b = 6, c = 2$

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

$$= \frac{-6 \pm \sqrt{60}}{-6}$$

① $x = \frac{-6 + \sqrt{60}}{-6}$

$x = -0.29099$

② $x = \frac{-6 - \sqrt{60}}{-6}$

$x = 2.29099$

6. $3x^2 = 10x - 4$

$3x^2 - 10x + 4 = 0$

$a = 3, b = -10, c = 4$

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

$$= \frac{10 \pm \sqrt{52}}{6}$$

① $x = \frac{10 + \sqrt{52}}{6}$

$x = 2.8685$

② $x = \frac{10 - \sqrt{52}}{6}$

$x = 0.4648$

7. $6 - 2x = 5x^2$

$-5x^2 - 2x + 6 = 0$

$a = -5, b = -2, c = 6$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(-5)(6)}}{2(-5)}$$

$$= \frac{2 \pm \sqrt{124}}{-10}$$

① $x = \frac{2 + \sqrt{124}}{-10}$

$x = -1.3136$

② $x = \frac{2 - \sqrt{124}}{-10}$

$x = 0.9136$

8. $4x - 1 = -2x^2$

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

$a = 2, b = 4, c = -1$

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

$$= \frac{-4 \pm \sqrt{24}}{4}$$

① $x = \frac{-4 + \sqrt{24}}{4}$

$x = 0.2247$

② $x = \frac{-4 - \sqrt{24}}{4}$

$x = -2.2247$

selesaikan dengan guna kaedah penyempurnaan kuasa dua

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

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

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

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

2. $x^2 + 6x + 5 = 0$

$$x^2 + 6x = -5$$
$$x^2 + 6x + \left(\frac{6}{2}\right)^2 = -5 + \left(\frac{6}{2}\right)^2$$
$$x^2 + 6x + 9 = -5 + 9$$
$$(x + 3)^2 = 4$$
$$x + 3 = \pm\sqrt{4}$$
$$x + 3 = \pm 2$$

① $x + 3 = 2$
$$\underline{x = -1}$$

② $x + 3 = -2$
$$\underline{x = -5}$$

3. $x^2 + 8x - 9 = 0$

$$x^2 + 8x = 9$$
$$x^2 + 8x + \left(\frac{8}{2}\right)^2 = 9 + \left(\frac{8}{2}\right)^2$$
$$x^2 + 8x + 16 = 9 + 16$$
$$(x + 4)^2 = 25$$
$$x + 4 = \pm\sqrt{25}$$
$$x + 4 = \pm 5$$

① $x + 4 = 5$
$$\underline{x = 1}$$

② $x + 4 = -5$
$$\underline{x = -9}$$

4. $x^2 - 9x + 18 = 0$

$$x^2 - 9x = -18$$
$$x^2 - 9x + \left(-\frac{9}{2}\right)^2 = -18 + \left(-\frac{9}{2}\right)^2$$
$$x^2 - 9x + \frac{81}{4} = -18 + \frac{81}{4}$$
$$\left(x - \frac{9}{2}\right)^2 = \frac{9}{4}$$
$$x - \frac{9}{2} = \pm\sqrt{\frac{9}{4}}$$
$$x - \frac{9}{2} = \pm\frac{3}{2}$$

① $x - \frac{9}{2} = \frac{3}{2}$
$$x = \frac{3}{2} + \frac{9}{2}$$
$$\underline{x = 6}$$

② $x - \frac{9}{2} = -\frac{3}{2}$
$$x = -\frac{3}{2} + \frac{9}{2}$$
$$x = \frac{6}{2}$$
$$\underline{x = 3}$$

5. $x^2 - 3x - 28 = 0$

$$x^2 - 3x = 28$$
$$x^2 - 3x + \left(-\frac{3}{2}\right)^2 = 28 + \left(-\frac{3}{2}\right)^2$$
$$x^2 - 3x + \frac{9}{4} = 28 + \frac{9}{4}$$
$$\left(x - \frac{3}{2}\right)^2 = \frac{121}{4}$$
$$x - \frac{3}{2} = \pm\sqrt{\frac{121}{4}}$$
$$x - \frac{3}{2} = \pm\frac{11}{2}$$

① $x - \frac{3}{2} = \frac{11}{2}$
$$x = \frac{11}{2} + \frac{3}{2}$$
$$\underline{x = 7}$$

② $x - \frac{3}{2} = -\frac{11}{2}$
$$x = -\frac{11}{2} + \frac{3}{2}$$
$$\underline{x = -4}$$

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

$$x^2 - \frac{1}{2}x - 3 = 0$$
$$x^2 - \frac{1}{2}x = 3$$
$$x^2 - \frac{1}{2}x + \left(\frac{-\frac{1}{2}}{2}\right)^2 = 3 + \left(\frac{-\frac{1}{2}}{2}\right)^2$$
$$x^2 - \frac{1}{2}x + \frac{1}{16} = 3 + \frac{1}{16}$$
$$\left(x - \frac{1}{4}\right)^2 = \frac{49}{16}$$
$$x - \frac{1}{4} = \pm\sqrt{\frac{49}{16}}$$
$$x - \frac{1}{4} = \pm\frac{7}{4}$$

① $x - \frac{1}{4} = \frac{7}{4}$
$$x = \frac{7}{4} + \frac{1}{4}$$
$$\underline{x = 2}$$

② $x - \frac{1}{4} = -\frac{7}{4}$
$$x = -\frac{7}{4} + \frac{1}{4}$$
$$\underline{x = -\frac{3}{2}}$$

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

$$x^2 - \frac{3}{2}x - 1 = 0$$
$$x^2 - \frac{3}{2}x = 1$$
$$x^2 - \frac{3}{2}x + \left(-\frac{3}{2}\right)^2 = 1 + \left(-\frac{3}{2}\right)^2$$
$$x^2 - \frac{3}{2}x + \frac{9}{16} = 1 + \frac{9}{16}$$
$$\left(x - \frac{3}{4}\right)^2 = \frac{25}{16}$$
$$x - \frac{3}{4} = \pm\sqrt{\frac{25}{16}}$$
$$x - \frac{3}{4} = \pm\frac{5}{4}$$

① $x - \frac{3}{4} = \frac{5}{4}$
$$x = \frac{5}{4} + \frac{3}{4}$$
$$\underline{x = 2}$$

② $x - \frac{3}{4} = -\frac{5}{4}$
$$x = -\frac{5}{4} + \frac{3}{4}$$
$$\underline{x = -\frac{1}{2}}$$

8. $3x^2 + 2x - 1 = 0$

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

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

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

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

$$2x^2 - 5x + 3 = 0$$
$$x^2 - \frac{5}{2}x + \frac{3}{2} = 0$$
$$x^2 - \frac{5}{2}x = -\frac{3}{2}$$
$$x^2 - \frac{5}{2}x + \left(-\frac{5}{2}\over 2\right)^2 = -\frac{3}{2} + \left(-\frac{5}{2}\over 2\right)^2$$
$$x^2 - \frac{5}{2}x + \frac{25}{16} = -\frac{3}{2} + \frac{25}{16}$$
$$\left(x - \frac{5}{4}\right)^2 = \frac{1}{16}$$
$$x - \frac{5}{4} = \pm\sqrt{\frac{1}{16}}$$
$$x - \frac{5}{4} = \pm\frac{1}{4}$$

① $x - \frac{5}{4} = \frac{1}{4}$
$$x = \frac{1}{4} + \frac{5}{4}$$
$$\underline{x = \frac{3}{2}}$$

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

10. $-2x^2 + 9x + 5 = 0$

$$2x^2 - 9x - 5 = 0$$
$$x^2 - \frac{9}{2}x - \frac{5}{2} = 0$$
$$x^2 - \frac{9}{2}x = \frac{5}{2}$$
$$x^2 - \frac{9}{2}x + \left(-\frac{9}{2}\over 2\right)^2 = \frac{5}{2} + \left(-\frac{9}{2}\over 2\right)^2$$
$$x^2 - \frac{9}{2}x + \frac{81}{16} = \frac{5}{2} + \frac{81}{16}$$
$$\left(x - \frac{9}{4}\right)^2 = \frac{121}{16}$$
$$x - \frac{9}{4} = \pm\sqrt{\frac{121}{16}}$$
$$x - \frac{9}{4} = \pm\frac{11}{4}$$

① $x - \frac{9}{4} = \frac{11}{4}$
$$x = \frac{11}{4} + \frac{9}{4}$$
$$\underline{x = 5}$$

② $x - \frac{9}{4} = -\frac{11}{4}$
$$x = -\frac{11}{4} + \frac{9}{4}$$
$$\underline{x = -\frac{1}{2}}$$

11. $-3x^2 + 5x - 2 = 0$

$$3x^2 - 5x + 2 = 0$$
$$x^2 - \frac{5}{3}x + \frac{2}{3} = 0$$
$$x^2 - \frac{5}{3}x = -\frac{2}{3}$$
$$x^2 - \frac{5}{3}x + \left(-\frac{5}{3}\over 2\right)^2 = -\frac{2}{3} + \left(-\frac{5}{3}\over 2\right)^2$$
$$x^2 - \frac{5}{3}x + \frac{25}{36} = -\frac{2}{3} + \frac{25}{36}$$
$$\left(x - \frac{5}{6}\right)^2 = \frac{1}{36}$$
$$x - \frac{5}{6} = \pm\sqrt{\frac{1}{36}}$$
$$x - \frac{5}{6} = \pm\frac{1}{6}$$

① $x - \frac{5}{6} = \frac{1}{6}$
$$x = \frac{1}{6} + \frac{5}{6}$$
$$\underline{x = 1}$$

② $x - \frac{5}{6} = -\frac{1}{6}$
$$x = -\frac{1}{6} + \frac{5}{6}$$
$$\underline{x = \frac{2}{3}}$$

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

$$4x^2 + x - 3 = 0$$
$$x^2 + \frac{1}{4}x - \frac{3}{4} = 0$$
$$x^2 + \frac{1}{4}x = \frac{3}{4}$$
$$x^2 + \frac{1}{4}x + \left(\frac{1}{4}\over 2\right)^2 = \frac{3}{4} + \left(\frac{1}{4}\over 2\right)^2$$
$$x^2 + \frac{1}{4}x + \frac{1}{64} = \frac{3}{4} + \frac{1}{64}$$
$$\left(x + \frac{1}{8}\right)^2 = \frac{49}{64}$$
$$x + \frac{1}{8} = \pm\sqrt{\frac{49}{64}}$$
$$x + \frac{1}{8} = \pm\frac{7}{8}$$

① $x + \frac{1}{8} = \frac{7}{8}$
$$x = \frac{7}{8} - \frac{1}{8}$$
$$\underline{x = \frac{3}{4}}$$

② $x + \frac{1}{8} = -\frac{7}{8}$
$$x = -\frac{7}{8} - \frac{1}{8}$$
$$\underline{x = -1}$$

1. $f(x) = x^2 + 3x - 4$

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

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

$= \left(x + \frac{3}{2}\right)^2 - \frac{25}{4}$

2. $f(x) = x^2 - 10x + 21$

$= x^2 - 10x + \left(-\frac{10}{2}\right)^2 - \left(-\frac{10}{2}\right)^2 + 21$

$= x^2 - 10x + 25 - 25 + 21$

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

3. $f(x) = -x^2 + 11x - 24$

$= -[x^2 - 11x + 24]$

$= -\left[x^2 - 11x + \left(-\frac{11}{2}\right)^2 - \left(-\frac{11}{2}\right)^2 + 24\right]$

$= -\left[x^2 - 11x + \frac{121}{4} - \frac{121}{4} + 24\right]$

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

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

4. $f(x) = -x^2 + 19x - 84$

$= -[x^2 - 19x + 84]$

$= -\left[x^2 - 19x + \left(-\frac{19}{2}\right)^2 - \left(-\frac{19}{2}\right)^2 + 84\right]$

$= -\left[x^2 - 19x + \frac{361}{4} - \frac{361}{4} + 84\right]$

$= -\left[\left(x - \frac{19}{2}\right)^2 - \frac{25}{4}\right]$

$= -\left(x - \frac{19}{2}\right)^2 + \frac{25}{4}$

5. $f(x) = 2x^2 - 15x - 27$

$= 2\left[x^2 - \frac{15}{2}x - \frac{27}{2}\right]$

$= 2\left[x^2 - \frac{15}{2}x + \left(-\frac{15}{2}\right)^2 - \left(-\frac{15}{2}\right)^2 - \frac{27}{2}\right]$

$= 2\left[x^2 - \frac{15}{2}x + \frac{225}{16} - \frac{225}{16} - \frac{27}{2}\right]$

$= 2\left[\left(x - \frac{15}{4}\right)^2 - \frac{441}{16}\right]$

$= 2\left(x - \frac{15}{4}\right)^2 - \frac{441}{8}$

6. $f(x) = 3x^2 - 13x + 4$

$= 3\left[x^2 - \frac{13}{3}x + \frac{4}{3}\right]$

$= 3\left[x^2 - \frac{13}{3}x + \left(-\frac{13}{3}\right)^2 - \left(-\frac{13}{3}\right)^2 + \frac{4}{3}\right]$

$= 3\left[x^2 - \frac{13}{3}x + \frac{169}{36} - \frac{169}{36} + \frac{4}{3}\right]$

$= 3\left[\left(x - \frac{13}{6}\right)^2 - \frac{121}{36}\right]$

$= 3\left(x - \frac{13}{6}\right)^2 - \frac{121}{12}$

7. $f(x) = -2x^2 + 17x - 30$

$= -2\left[x^2 - \frac{17}{2}x + 15\right]$

$= -2\left[x^2 - \frac{17}{2}x + \left(-\frac{17}{2}\right)^2 - \left(-\frac{17}{2}\right)^2 + 15\right]$

$= -2\left[x^2 - \frac{17}{2}x + \frac{289}{16} - \frac{289}{16} + 15\right]$

$= -2\left[\left(x - \frac{17}{4}\right)^2 - \frac{49}{16}\right]$

$= -2\left(x - \frac{17}{4}\right)^2 + \frac{49}{8}$

8. $f(x) = -3x^2 + 5x - 2$

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

$= -3\left[x^2 - \frac{5}{3}x + \left(-\frac{5}{3}\right)^2 - \left(-\frac{5}{3}\right)^2 + \frac{2}{3}\right]$

$= -3\left[x^2 - \frac{5}{3}x + \frac{25}{36} - \frac{25}{36} + \frac{2}{3}\right]$

$= -3\left[\left(x - \frac{5}{6}\right)^2 - \frac{1}{36}\right]$

$= -3\left(x - \frac{5}{6}\right)^2 + \frac{1}{12}$

9. $f(x) = -4x^2 + 16x - 15$

$= -4\left[x^2 - 4x + \frac{15}{4}\right]$

$= -4\left[x^2 - 4x + \left(-\frac{4}{2}\right)^2 - \left(-\frac{4}{2}\right)^2 + \frac{15}{4}\right]$

$= -4\left[x^2 - 4x + 4 - 4 + \frac{15}{4}\right]$

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

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

kapur puteh

membentuk persamaan kuadratik daripada punca-punca

$$x^2 - \boxed{h+p}\, x + \boxed{hdp} = 0$$

hasil tambah punca
$$\alpha + \beta = -\frac{b}{a}$$

hasil darab punca
$$\alpha\beta = \frac{c}{a}$$

---

1. bentukkan persamaan kuadratik daripada punca-punca

A. x = −5 dan x = 3

$h+p = -5+3 = -2$
$hdp = -5\times3 = -15$

$x^2-(h+p)x+hdp=0$
$x^2-(-2)x+(-15)=0$
$x^2+2x-15=0$

B. x = 4 dan x = −7

$h+p = 4+(-7) = -3$
$hdp = 4\times(-7) = -28$

$x^2-(h+p)x+hdp=0$
$x^2-(-3)x+(-28)=0$
$x^2+3x-28=0$

C. x = −6 dan x = −2

$h+p = -6+(-2) = -8$
$hdp = -6\times(-2) = 12$

$x^2-(h+p)x+hdp=0$
$x^2-(-8)x+12=0$
$x^2+8x+12=0$

$x^2+5x-36=0$
$x^2-(-5)x+(-36)=0$
$\uparrow$ h+p $\uparrow$ hdp
$\alpha+\beta = -5$
$\alpha\beta = -36$

---

2. α dan β ialah punca-punca bagi $x^2 + 5x = 36$
bentukkan persamaan kuadratik yang mempunyai punca-punca berikut

A. $\alpha + 3$ dan $\beta + 3$

h+p
$\alpha+3+\beta+3$
$= \alpha+\beta+6$
$= -5+6$
$= 1$

hdp
$(\alpha+3)(\beta+3)$
$= \alpha\beta+3\alpha+3\beta+9$
$= \alpha\beta+3(\alpha+\beta)+9$
$= -36+3(-5)+9$
$= -42$

$x^2-(h+p)x+hdp=0$
$x^2-(1)x+(-42)=0$
$x^2-x-42=0$

B. 2α dan 2β

h+p
$2\alpha+2\beta$
$= 2(\alpha+\beta)$
$= 2(-5)$
$= -10$

hdp
$2\alpha\times2\beta$
$= 4\alpha\beta$
$= 4(-36)$
$= -144$

$x^2-(h+p)x+hdp=0$
$x^2-(-10)x+(-144)=0$
$x^2+10x-144=0$

C. α^2 dan β^2

kena ingat!

h+p
$\alpha^2+\beta^2$
$= (\alpha+\beta)^2-2\alpha\beta$
$= (-5)^2-2(-36)$
$= 97$

hdp
$\alpha^2\times\beta^2$
$= \alpha^2\beta^2$
$= (\alpha\beta)^2$
$= (-36)^2$
$= 1296$

$x^2-(h+p)x+hdp=0$
$x^2-97x+1296=0$

WORKSHEET 5: PERSAMAAN KUADRATIK [7]
membentuk persamaan kuadratik daripada punca-punca

$$x^2 + 2x - 35 = 0$$
$$x^2 - (-2)x + (-35) = 0$$
h+p — hdp
$$\alpha + \beta = -2$$
$$\alpha\beta = -35$$

3. α dan β ialah punca-punca bagi $x^2 = -2x + 35$
bentukkan persamaan kuadratik yang mempunyai punca-punca berikut

A. $\alpha + 3$ dan $\beta + 3$

h+p
$$\alpha + 3 + \beta + 3$$
$$= \alpha + \beta + 6$$
$$= -2 + 6$$
$$= 4$$

hdp
$$(\alpha+3)(\beta+3)$$
$$= \alpha\beta + 3\alpha + 3\beta + 9$$
$$= \alpha\beta + 3(\alpha+\beta) + 9$$
$$= -35 + 3(-2) + 9$$
$$= -32$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - (4)x + (-32) = 0$$
$$x^2 - 4x - 32 = 0$$

B. 2α dan 2β

h+p
$$2\alpha + 2\beta$$
$$= 2(\alpha+\beta)$$
$$= 2(-2)$$
$$= -4$$

hdp
$$2\alpha \times 2\beta$$
$$= 4\alpha\beta$$
$$= 4(-35)$$
$$= -140$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - (-4)x + (-140) = 0$$
$$x^2 + 4x - 140 = 0$$

C. α^2 dan β^2

h+p
$$\alpha^2 + \beta^2$$
$$= (\alpha+\beta)^2 - 2\alpha\beta$$
$$= (-2)^2 - 2(-35)$$
$$= 4 + 70$$
$$= 74$$

hdp
$$\alpha^2 \times \beta^2$$
$$= \alpha^2\beta^2$$
$$= (\alpha\beta)^2$$
$$= (-35)^2$$
$$= 1225$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - (74)x + (1225) = 0$$
$$x^2 - 74x + 1225 = 0$$

$$2x^2 + x - 4 = 0$$
$$x^2 + \tfrac{1}{2}x - 2 = 0$$
$$x^2 - (-\tfrac{1}{2})x + (-2) = 0$$
h+p — hdp
$$\alpha + \beta = -\tfrac{1}{2}$$
$$\alpha\beta = -2$$

4. α dan β ialah punca-punca bagi $2x^2 + x = 4$
bentukkan persamaan kuadratik yang mempunyai punca-punca berikut

A. $\alpha + 4$ dan $\beta + 4$

h+p
$$\alpha + 4 + \beta + 4$$
$$= \alpha + \beta + 8$$
$$= -\tfrac{1}{2} + 8$$
$$= \tfrac{15}{2}$$

hdp
$$(\alpha+4)(\beta+4)$$
$$= \alpha\beta + 4\alpha + 4\beta + 16$$
$$= \alpha\beta + 4(\alpha+\beta) + 16$$
$$= -2 + 4(-\tfrac{1}{2}) + 16$$
$$= 12$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - (\tfrac{15}{2})x + (12) = 0$$
$$x^2 - \tfrac{15}{2}x + 12 = 0$$
$$2x^2 - 15x + 24 = 0$$

B. 3α dan 3β

h+p
$$3\alpha + 3\beta$$
$$= 3(\alpha+\beta)$$
$$= 3(-\tfrac{1}{2})$$
$$= -\tfrac{3}{2}$$

hdp
$$3\alpha \times 3\beta$$
$$= 9\alpha\beta$$
$$= 9(-2)$$
$$= -18$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - (-\tfrac{3}{2})x + (-18) = 0$$
$$x^2 + \tfrac{3}{2}x - 18 = 0$$
$$2x^2 + 3x - 36 = 0$$

C. α^2 dan β^2

h+p
$$\alpha^2 + \beta^2$$
$$= (\alpha+\beta)^2 - 2\alpha\beta$$
$$= (-\tfrac{1}{2})^2 - 2(-2)$$
$$= \tfrac{1}{4} + 4$$
$$= \tfrac{17}{4}$$

hdp
$$\alpha^2 \times \beta^2$$
$$= \alpha^2\beta^2$$
$$= (\alpha\beta)^2$$
$$= (-2)^2$$
$$= 4$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - \tfrac{17}{4}x + 4 = 0$$
$$4x^2 - 17x + 16 = 0$$

$3x^2 - 7x - 6 = 0$
$x^2 - \frac{7}{3}x - 2 = 0$
$x^2 - \left(\frac{7}{3}\right)x + (-2) = 0$
↑h+p   ↑hdp

$\alpha + \beta = \frac{7}{3}$
$\alpha\beta = -2$

5. α dan β ialah punca-punca bagi $3x^2 - 7x = 6$
bentukkan persamaan kuadratik yang mempunyai punca-punca berikut

A. $\alpha + 2$ dan $\beta + 2$

h+p
$\alpha + 2 + \beta + 2$
$= \alpha + \beta + 4$
$= \frac{7}{3} + 4$
$= \frac{19}{3}$

hdp
$(\alpha+2)(\beta+2)$
$= \alpha\beta + 2\alpha + 2\beta + 4$
$= \alpha\beta + 2(\alpha+\beta) + 4$
$= -2 + 2\left(\frac{7}{3}\right) + 4$
$= \frac{20}{3}$

$x^2 - (h+p)x + hdp = 0$
$x^2 - \left(\frac{19}{3}\right)x + \left(\frac{20}{3}\right) = 0$
$\underline{3x^2 - 19x + 20 = 0}$

B. 3α dan 3β

h+p
$3\alpha + 3\beta$
$= 3(\alpha+\beta)$
$= 3\left(\frac{7}{3}\right)$
$= \underline{7}$

hdp
$3\alpha \times 3\beta$
$= 9\alpha\beta$
$= 9(-2)$
$= \underline{-18}$

$x^2 - (h+p)x + hdp = 0$
$x^2 - (7)x + (-18) = 0$
$\underline{x^2 - 7x - 18 = 0}$

C. α^2 dan β^2

h+p
$\alpha^2 + \beta^2$
$= (\alpha+\beta)^2 - 2\alpha\beta$
$= \left(\frac{7}{3}\right)^2 - 2(-2)$
$= \frac{85}{9}$

hdp
$\alpha^2 \times \beta^2$
$= \alpha^2\beta^2$
$= (\alpha\beta)^2$
$= (-2)^2$
$= \underline{4}$

$x^2 - (h+p)x + hdp = 0$
$x^2 - \frac{85}{9}x + 4 = 0$
$\underline{9x^2 - 85x + 36 = 0}$

$5x^2 - 2x - 4 = 0$
$x^2 - \frac{2}{5}x - \frac{4}{5} = 0$
$x^2 - \left(\frac{2}{5}\right)x + \left(-\frac{4}{5}\right) = 0$
↑h+p   ↑hdp

$\alpha + \beta = \frac{2}{5}$
$\alpha\beta = -\frac{4}{5}$

6. α dan β ialah punca-punca bagi $5x^2 - 2x = 4$
bentukkan persamaan kuadratik yang mempunyai punca-punca berikut

A. $\alpha + 5$ dan $\beta + 5$

h+p
$\alpha + 5 + \beta + 5$
$= \alpha + \beta + 10$
$= \frac{2}{5} + 10$
$= \frac{52}{5}$

hdp
$(\alpha+5)(\beta+5)$
$= \alpha\beta + 5\alpha + 5\beta + 25$
$= \alpha\beta + 5(\alpha+\beta) + 25$
$= -\frac{4}{5} + 5\left(\frac{2}{5}\right) + 25$
$= \frac{131}{5}$

$x^2 - (h+p)x + hdp = 0$
$x^2 - \frac{52}{5}x + \frac{131}{5} = 0$
$\underline{5x^2 - 52x + 131 = 0}$

B. 4α dan 4β

h+p
$4\alpha + 4\beta$
$= 4(\alpha+\beta)$
$= 4\left(\frac{2}{5}\right)$
$= \frac{8}{5}$

hdp
$4\alpha \times 4\beta$
$= 16\alpha\beta$
$= 16\left(-\frac{4}{5}\right)$
$= -\frac{64}{5}$

$x^2 - (h+p)x + hdp = 0$
$x^2 - \left(\frac{8}{5}\right)x + \left(-\frac{64}{5}\right) = 0$
$x^2 - \frac{8}{5}x - \frac{64}{5} = 0$
$\underline{5x^2 - 8x - 64 = 0}$

C. α^2 dan β^2

h+p
$\alpha^2 + \beta^2$
$= (\alpha+\beta)^2 - 2\alpha\beta$
$= \left(\frac{2}{5}\right)^2 - 2\left(-\frac{4}{5}\right)$
$= \frac{44}{25}$

hdp
$\alpha^2 \times \beta^2$
$= (\alpha\beta)^2$
$= \left(-\frac{4}{5}\right)^2$
$= \frac{16}{25}$

$x^2 - (h+p)x + hdp = 0$
$x^2 - \frac{44}{25}x + \frac{16}{25} = 0$
$\underline{25x^2 - 44x + 16 = 0}$

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kapur puteh

$$2x^2 + 8x - 3 = 0$$
$$x^2 + 4x - \frac{3}{2} = 0$$
$$x^2 - (-4)x + (-\frac{3}{2}) = 0$$
h+p ↑   hdp ↑

7. α dan β ialah punca-punca bagi $2x^2 + 8x = 3$
bentukkan persamaan kuadratik yang mempunyai punca-punca berikut

A. $\frac{\alpha}{3}$ dan $\frac{\beta}{3}$

h+p
$$\frac{\alpha}{3} + \frac{\beta}{3} = \frac{\alpha+\beta}{3}$$
$$= -\frac{4}{3}$$

hdp
$$\frac{\alpha}{3} \times \frac{\beta}{3} = \frac{\alpha\beta}{9}$$
$$= \frac{-\frac{3}{2}}{9}$$
$$= (-\frac{3}{2})(\frac{1}{9})$$
$$= -\frac{1}{6}$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - (-\frac{4}{3})x + (-\frac{1}{6}) = 0$$
$$x^2 + \frac{4}{3}x - \frac{1}{6} = 0$$
$$\underline{6x^2 + 8x - 1 = 0}$$

B. $\frac{1}{\alpha}$ dan $\frac{1}{\beta}$

h+p
$$\frac{1}{\alpha} + \frac{1}{\beta} = \frac{\beta+\alpha}{\alpha\beta}$$
$$= \frac{-4}{-\frac{3}{2}} = \frac{8}{3}$$

hdp
$$\frac{1}{\alpha} \times \frac{1}{\beta}$$
$$= \frac{1}{\alpha\beta} = \frac{1}{-\frac{3}{2}} = -\frac{2}{3}$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - \frac{8}{3}x - \frac{2}{3} = 0$$
$$\underline{3x^2 - 8x - 2 = 0}$$

C. $\alpha + \frac{1}{\beta}$ dan $\beta + \frac{1}{\alpha}$

h+p
$$\alpha + \frac{1}{\beta} + \beta + \frac{1}{\alpha}$$
$$= \alpha + \beta + \frac{1}{\alpha} + \frac{1}{\beta}$$
$$= \alpha + \beta + \frac{\beta+\alpha}{\alpha\beta}$$
$$= -4 + (\frac{-4}{-\frac{3}{2}}) = -\frac{4}{3}$$

hdp
$$(\alpha + \frac{1}{\beta})(\beta + \frac{1}{\alpha})$$
$$= \alpha\beta + \frac{\alpha}{\alpha} + \frac{\beta}{\beta} + \frac{1}{\alpha\beta}$$
$$= \alpha\beta + 1 + 1 + \frac{1}{\alpha\beta}$$
$$= -\frac{3}{2} + 2 + \frac{1}{-\frac{3}{2}}$$
$$= -\frac{1}{6}$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 + \frac{4}{3}x - \frac{1}{6} = 0$$
$$\underline{6x^2 + 8x - 1 = 0}$$

D. $\frac{\alpha}{\beta}$ dan $\frac{\beta}{\alpha}$

$\alpha + \beta = -4$
$\alpha\beta = -\frac{3}{2}$

h+p
$$\frac{\alpha}{\beta} + \frac{\beta}{\alpha}$$
$$= \frac{\alpha^2 + \beta^2}{\alpha\beta} = \frac{(\alpha+\beta)^2 - 2\alpha\beta}{\alpha\beta}$$
$$= \frac{(-4)^2 - 2(-\frac{3}{2})}{-\frac{3}{2}}$$
$$= -\frac{38}{3}$$

hdp
$$\frac{\alpha}{\beta} \times \frac{\beta}{\alpha} = \frac{\alpha\beta}{\beta\alpha} = 1$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - (-\frac{38}{3})x + 1 = 0$$
$$x^2 + \frac{38}{3}x + 1 = 0$$
$$\underline{3x^2 + 38x + 3 = 0}$$

$$3x^2 - 6x - 1 = 0$$
$$x^2 - 2x - \frac{1}{3} = 0$$
$$x^2 - (2)x + (-\frac{1}{3}) = 0$$
↑ h+p   ↑ hdp

8. α dan β ialah punca-punca bagi $3x^2 - 6x = 1$
bentukkan persamaan kuadratik yang mempunyai punca-punca berikut

$\alpha + \beta = 2$
$\alpha\beta = -\frac{1}{3}$

A. $\frac{\alpha}{4}$ dan $\frac{\beta}{4}$

h+p
$$\frac{\alpha}{4} + \frac{\beta}{4} = \frac{\alpha+\beta}{4}$$
$$= \frac{2}{4} = \frac{1}{2}$$

hdp
$$\frac{\alpha}{4} \times \frac{\beta}{4} = \frac{\alpha\beta}{16}$$
$$= \frac{-\frac{1}{3}}{16}$$
$$= -\frac{1}{48}$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - \frac{1}{2}x - \frac{1}{48} = 0$$
$$\underline{48x^2 - 24x - 1 = 0}$$

B. $\frac{1}{\alpha}$ dan $\frac{1}{\beta}$

h+p
$$\frac{1}{\alpha} + \frac{1}{\beta} = \frac{\beta+\alpha}{\alpha\beta}$$
$$= \frac{2}{-\frac{1}{3}} = -6$$

hdp
$$\frac{1}{\alpha} \times \frac{1}{\beta}$$
$$= \frac{1}{\alpha\beta} = \frac{1}{-\frac{1}{3}} = -3$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 - (-6)x + (-3) = 0$$
$$\underline{x^2 + 6x - 3 = 0}$$

C. $\alpha + \frac{1}{\beta}$ dan $\beta + \frac{1}{\alpha}$

h+p
$$\alpha + \frac{1}{\beta} + \beta + \frac{1}{\alpha}$$
$$= \alpha + \beta + \frac{1}{\alpha} + \frac{1}{\beta}$$
$$= \alpha + \beta + \frac{\beta+\alpha}{\alpha\beta}$$
$$= 2 + \frac{2}{-\frac{1}{3}}$$
$$= 2 + (-6) = -4$$

hdp
$$(\alpha + \frac{1}{\beta})(\beta + \frac{1}{\alpha})$$
$$= \alpha\beta + \frac{\alpha}{\alpha} + \frac{\beta}{\beta} + \frac{1}{\alpha\beta}$$
$$= \alpha\beta + 1 + 1 + \frac{1}{\alpha\beta}$$
$$= -\frac{1}{3} + 2 + \frac{1}{-\frac{1}{3}}$$
$$= -\frac{4}{3}$$

$$x^2 - (h+p)x + hdp = 0$$
$$x^2 + 4x - \frac{4}{3} = 0$$
$$\underline{3x^2 + 12x - 4 = 0}$$

D. $\frac{\alpha}{\beta}$ dan $\frac{\beta}{\alpha}$

h+p
$$\frac{\alpha}{\beta} + \frac{\beta}{\alpha}$$
$$= \frac{\alpha^2 + \beta^2}{\alpha\beta} = \frac{(\alpha+\beta)^2 - 2\alpha\beta}{\alpha\beta}$$
$$= \frac{(2)^2 - 2(-\frac{1}{3})}{-\frac{1}{3}}$$
$$= -14$$

hdp
$$\frac{\alpha}{\beta} \times \frac{\beta}{\alpha} = \frac{\alpha\beta}{\beta\alpha} = 1$$

$$x^2 - (h+p)x + hdp = 0$$
$$\underline{x^2 + 14x + 1 = 0}$$

kapur puteh

1. $x^2 - 4x + 3 > 0$
$(x-3)(x-1) > 0$
$x = 3 \quad x = 1$

a) Kaedah Lakaran Graf
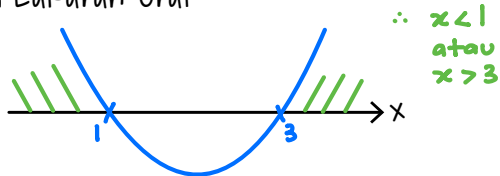
$\therefore x < 1$ atau $x > 3$

b) Kaedah Garis Nombor

$\therefore x < 1$ atau $x > 3$

c) Kaedah Jadual

	julat nilai x		
	$x < 1$	$1 < x < 3$	$x > 3$
$(x-3)$	$-$	$-$	$+$
$(x-1)$	$-$	$+$	$+$
$(x-3)(x-1)$	$+$	$-$	$+$

$\therefore x < 1$ atau $x > 3$

2. $-x^2 + 6x - 8 \leqslant 0$
$(-x+2)(x-4) \leqslant 0$
$x = 2 \quad x = 4$

a) Kaedah Lakaran Graf
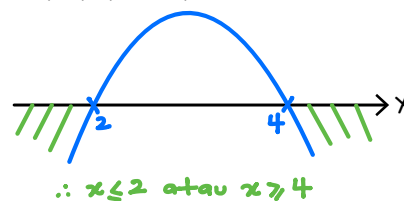
$\therefore x \leqslant 2$ atau $x \geqslant 4$

b) Kaedah Garis Nombor
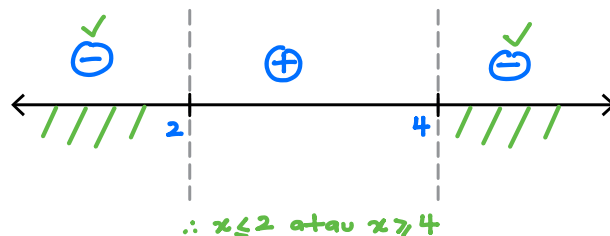
$\therefore x \leqslant 2$ atau $x \geqslant 4$

c) Kaedah Jadual

	julat nilai x		
	$x \leqslant 2$	$2 \leqslant x \leqslant 4$	$x \geqslant 4$
$(-x+2)$	$+$	$-$	$-$
$(x-4)$	$-$	$-$	$+$
$(-x+2)(x-4)$	$-$	$+$	$-$

$\therefore x \leqslant 2$ atau $x \geqslant 4$

3. $x^2 - 3x - 28 < 0$
$(x+4)(x-7) < 0$
$x = -4 \quad x = 7$

a) Kaedah Lakaran Graf

$\therefore -4 < x < 7$

b) Kaedah Garis Nombor

$\therefore -4 < x < 7$
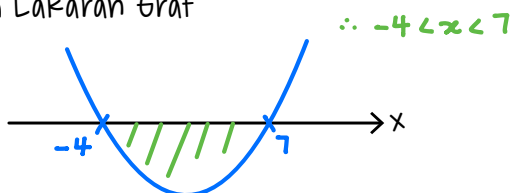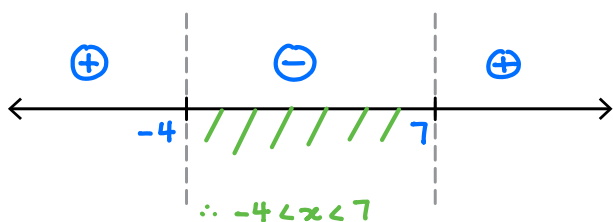
c) Kaedah Jadual

	julat nilai x		
	$x < -4$	$-4 < x < 7$	$x > 7$
$(x+4)$	$-$	$+$	$+$
$(x-7)$	$-$	$-$	$+$
$(x+4)(x-7)$	$+$	$-$	$+$

$\therefore -4 < x < 7$

4. $-2x^2 + 5x - 3 \geqslant 0$
$(-2x+3)(x-1) \geqslant 0$
$x = \frac{3}{2} \quad x = 1$

a) Kaedah Lakaran Graf
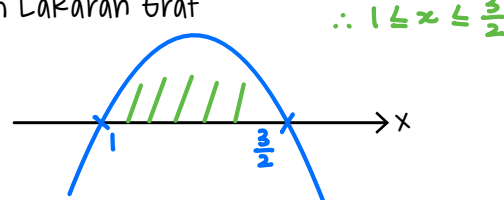
$\therefore 1 \leqslant x \leqslant \frac{3}{2}$

b) Kaedah Garis Nombor
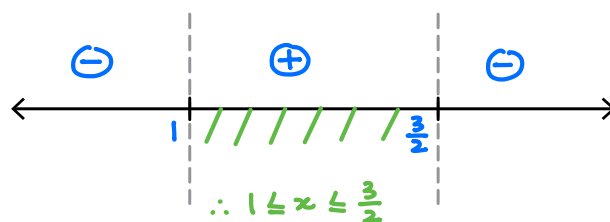
$\therefore 1 \leqslant x \leqslant \frac{3}{2}$

c) Kaedah Jadual

	julat nilai x		
	$x \leqslant 1$	$1 \leqslant x \leqslant \frac{3}{2}$	$x \geqslant \frac{3}{2}$
$(-2x+3)$	$+$	$+$	$-$
$(x-1)$	$-$	$+$	$+$
$(-2x+3)(x-1)$	$-$	$+$	$-$

$\therefore 1 \leqslant x \leqslant \frac{3}{2}$

5. $2x^2 < -x + 6$

$2x^2 + x - 6 < 0$

$(2x-3)(x+2) < 0$

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

a) Kaedah Lakaran Graf
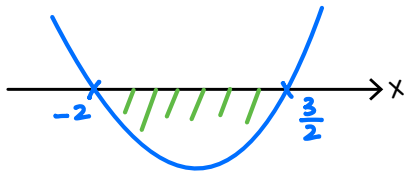
$\therefore -2 < x < \frac{3}{2}$

b) Kaedah Garis Nombor
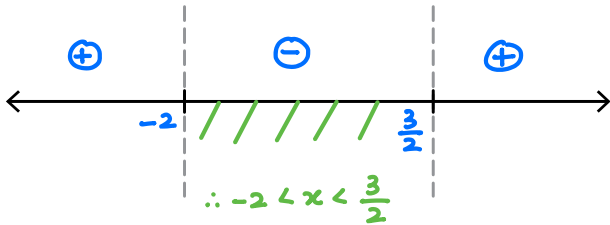
$\therefore -2 < x < \frac{3}{2}$

c) Kaedah Jadual

	julat nilai x		
	$x < -2$	$-2 < x < \frac{3}{2}$	$x > \frac{3}{2}$
$(2x-3)$	$-$	$-$	$+$
$(x+2)$	$-$	$+$	$+$
$(2x-3)(x+2)$	$+$	$-$	$+$

$\therefore -2 < x < \frac{3}{2}$

6. $9x - 10 \leqslant 2x^2$

$-2x^2 + 9x - 10 \leqslant 0 \qquad x = \frac{5}{2} \quad x = 2$

$(-2x+5)(x-2) \leqslant 0$

a) Kaedah Lakaran Graf

$\therefore x \leqslant 2 \text{ atau } x \geqslant \frac{5}{2}$
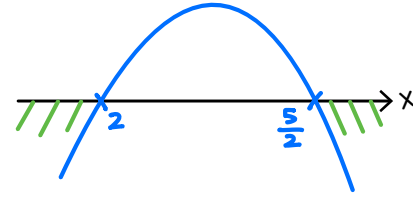
b) Kaedah Garis Nombor
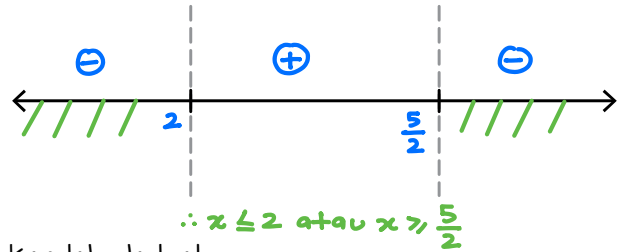
$\therefore x \leqslant 2 \text{ atau } x \geqslant \frac{5}{2}$

c) Kaedah Jadual

	julat nilai x		
	$x \leqslant 2$ ✓	$2 \leqslant x \leqslant \frac{5}{2}$	$x \geqslant \frac{5}{2}$ ✓
$(-2x+5)$	$+$	$+$	$-$
$(x-2)$	$-$	$+$	$+$
$(-2x+5)(x-2)$	$-$	$+$	$-$

$\therefore x \leqslant 2 \text{ atau } x \geqslant \frac{5}{2}$

7. $5x > 2 + 3x^2 \qquad x = \frac{2}{3} \quad x = 1$

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

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

a) Kaedah Lakaran Graf
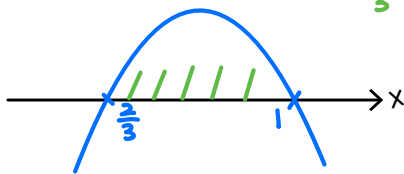
$\therefore \frac{2}{3} < x < 1$

b) Kaedah Garis Nombor
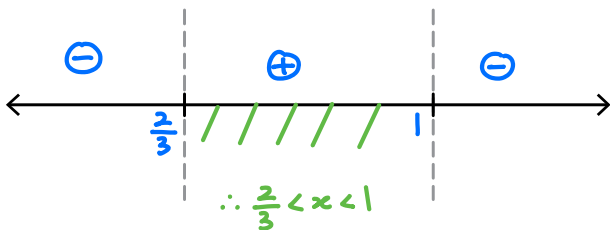
$\therefore \frac{2}{3} < x < 1$

c) Kaedah Jadual

	julat nilai x		
	$x < \frac{2}{3}$	$\frac{2}{3} < x < 1$ ✓	$x > 1$
$(-3x+2)$	$+$	$-$	$-$
$(x-1)$	$-$	$-$	$+$
$(-3x+2)(x-1)$	$-$	$+$	$-$

$\therefore \frac{2}{3} < x < 1$

8. $11x \geqslant 3 - 4x^2 \qquad x = \frac{1}{4} \quad x = -3$

$4x^2 + 11x - 3 \geqslant 0$

$(4x-1)(x+3) \geqslant 0$

a) Kaedah Lakaran Graf

$\therefore x \leqslant -3 \text{ atau } x \geqslant \frac{1}{4}$
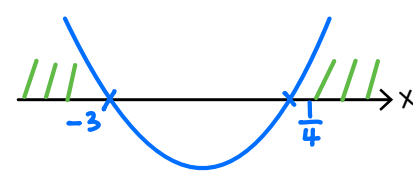
b) Kaedah Garis Nombor
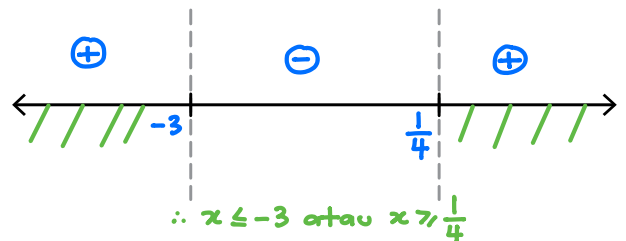
$\therefore x \leqslant -3 \text{ atau } x \geqslant \frac{1}{4}$

c) Kaedah Jadual

	julat nilai x		
	$x \leqslant -3$ ✓	$-3 \leqslant x \leqslant \frac{1}{4}$	$x \geqslant \frac{1}{4}$ ✓
$(4x-1)$	$-$	$-$	$+$
$(x+3)$	$-$	$+$	$+$
$(4x-1)(x+3)$	$+$	$-$	$+$

$\therefore x \leqslant -3 \text{ atau } x \geqslant \frac{1}{4}$

tentukan jenis punca bagi setiap persamaan kuadratik berikut

1. $x^2 + 4x + 4 = 0$

$b^2 - 4ac$
$= (4)^2 - 4(1)(4)$
$= 16 - 16$
$= 0$

* dua punca nyata yang sama

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

$b^2 - 4ac$
$= (5)^2 - 4(2)(-2)$
$= 41 > 0$

* dua punca nyata dan berbeza

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

$b^2 - 4ac$
$= (1)^2 - 4(2)(7)$
$= -55 < 0$

* tiada punca nyata

4. $9x^2 + 6x + 1 = 0$

$b^2 - 4ac$
$= (6)^2 - 4(9)(1)$
$= 0$

* dua punca nyata yang sama

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

$b^2 - 4ac$
$= (3)^2 - 4(1)(-4)$
$= 25 > 0$

* dua punca nyata dan berbeza

6. $3x^2 + 2x + 1 = 0$

$b^2 - 4ac$
$= (2)^2 - 4(3)(1)$
$= -8 < 0$

* tiada punca nyata

7.

$x^2 + 8 = kx - k$ mempunyai dua punca nyata yang sama. Cari nilai yang mungkin bagi k. $= 0$

$x^2 - kx + 8 + k = 0$

$b^2 - 4ac = 0$
$(-k)^2 - 4(1)(8 + k) = 0$
$k^2 - 32 - 4k = 0$
$k^2 - 4k - 32 = 0$
$(k - 8)(k + 4) = 0$

$k = 8 \qquad k = -4$

8.

$(m - 3)x^2 = 2x + 4$ mempunyai dua punca nyata yang berbeza. Cari julat nilai m. > 0

$(m - 3)x^2 - 2x - 4 = 0$

$b^2 - 4ac > 0$
$(-2)^2 - 4(m - 3)(-4) > 0$
$4 + 16m - 48 > 0$
$16m - 44 > 0$
$16m > 44$
$m > \dfrac{44}{16}$
$m > \dfrac{11}{4}$

9.

$1 - p = 2x^2 + 4x$ tidak mempunyai <0 punca nyata. Cari julat nilai p.

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

$b^2 - 4ac < 0$
$(-4)^2 - 4(-2)(1 - p) < 0$
$16 + 8 - 8p < 0$
$24 - 8p < 0$
$-8p < -24$
$p > \dfrac{-24}{-8}$

$p > 3$

10.

$x^2 + h + 3 = hx$ mempunyai dua punca nyata yang sama. Cari nilai yang mungkin bagi h. $= 0$

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

$b^2 - 4ac = 0$
$(-h)^2 - 4(1)(h + 3) = 0$
$h^2 - 4h - 12 = 0$
$(h - 6)(h + 2) = 0$

$h = 6 \qquad h = -2$

11.

$(g + 2)x^2 = 2gx + 3 - g$ mempunyai dua punca nyata yang berbeza. Cari julat nilai g. > 0

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

$b^2 - 4ac > 0$
$(-2g)^2 - 4(g + 2)(-3 + g) > 0$
$4g^2 - 4(-3g + g^2 - 6 + 2g) > 0$
$4g^2 - 4(g^2 - g - 6) > 0$
$4g^2 - 4g^2 + 4g + 24 > 0$
$4g + 24 > 0$
$4g > -24$
$g > -6$

12.

$x^2 + 4x + 13 = k(2 - x)$ tidak mempunyai punca nyata. Cari julat nilai k. < 0

$x^2 + 4x + 13 = 2k - kx$
$x^2 + 4x + kx + 13 - 2k = 0$
$x^2 + (4 + k)x + 13 - 2k = 0$

$b^2 - 4ac < 0$
$(4 + k)^2 - 4(1)(13 - 2k) < 0$
$(4 + k)(4 + k) - 52 + 8k < 0$
$16 + 8k + k^2 - 52 + 8k < 0$
$k^2 + 16k - 36 < 0$
$(k + 18)(k - 2) < 0$
$k = -18 \qquad k = 2$

∴ $-18 < k < 2$

istilah penting:
* tangen kepada graf fungsi kuadratik
* tiada pintasan x
* mempunyai dua pintasan x

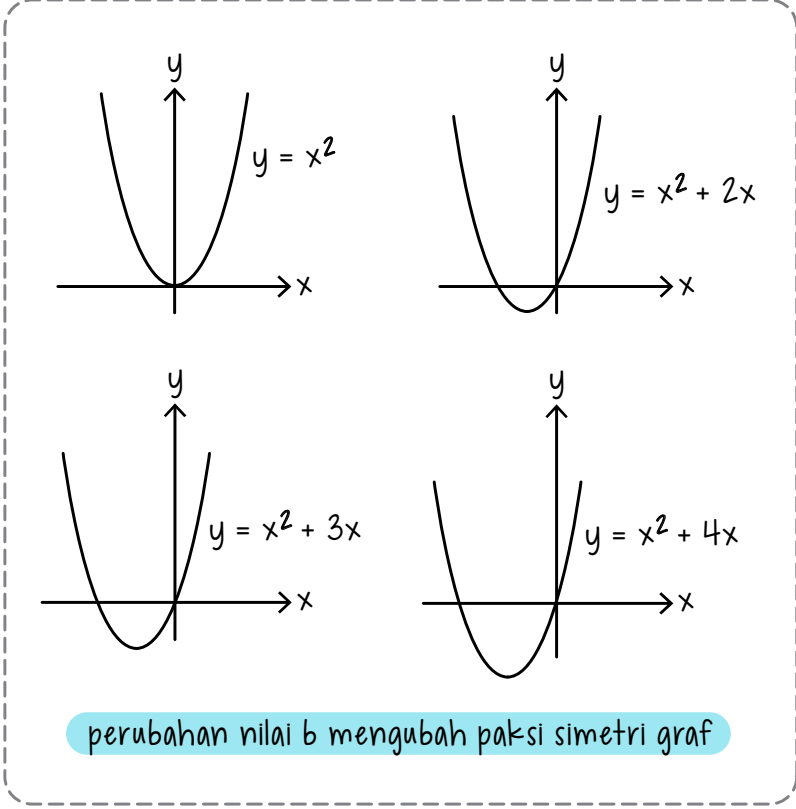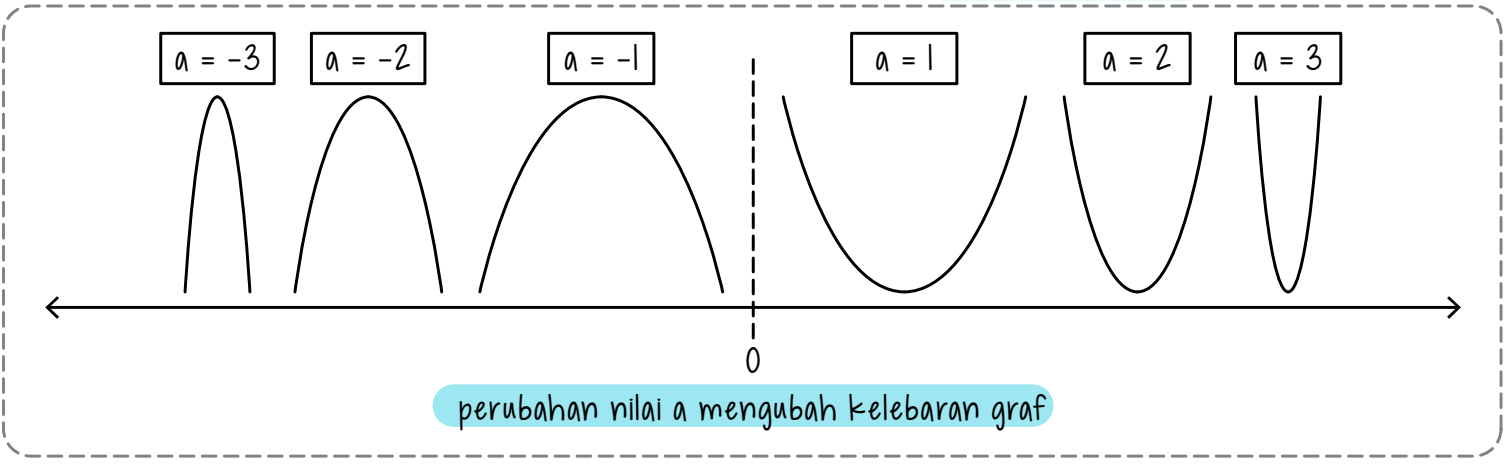perubahan bentuk dan kedudukan graf fungsi $f(x) = ax^2 + bx + c$

| a = -3 | a = -2 | a = -1 | | a = 1 | a = 2 | a = 3 |

0

perubahan nilai a mengubah kelebaran graf

$y = x^2$

$y = x^2 + 2x$

$y = x^2 + 3x$

$y = x^2 + 4x$

perubahan nilai b mengubah paksi simetri graf

perubahan bentuk dan kedudukan
graf fungsi $f(x) = a(x - h)^2 + k$
bentuk verteks

perubahan nilai a mengubah kelebaran
graf, sama seperti kesan perubahan a
pada $f(x) = ax^2 + bx + c$

perubahan nilai h menunjukkan
pergerakan mengufuk graf

$f(x) = 2(x - 1)^2 - 15$
$f(x) = 2(x - 3)^2 - 15$

graf bergerak 2 unit secara
mengufuk ke kanan

$y = -x^2 + 8$

$y = -x^2 + 3$

$y = -x^2$

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

$y = x^2 - 2x + 2$

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

perubahan nilai c mengubah kedudukan
graf ke atas atau ke bawah

$f(x) = 2(x - 1)^2 - 10$

graf bergerak
5 unit ke atas

$f(x) = 2(x - 1)^2 - 15$

perubahan nilai k menunjukkan
pergerakan menegak graf

1. $f(x) = x^2 + 2x - 15$

langkah 1:   a $\boxed{>}$ 0

langkah 2: $b^2 - 4ac$
$$= (2)^2 - 4(1)(-15)$$
$$= 64 > 0 \longrightarrow \text{potong 2 titik}$$

langkah 3:   tentukan verteks

$$f(x) = x^2 + 2x - 15$$
$$= x^2 + 2x + \left(\tfrac{2}{2}\right)^2 - \left(\tfrac{2}{2}\right)^2 - 15$$
$$= x^2 + 2x + 1 - 1 - 15$$
$$= (x+1)^2 - 16$$

∴ titik minimum
   $(-1, -16)$

langkah 4: $f(x) = 0$

$$x^2 + 2x - 15 = 0$$

$x \overset{+5}{\underset{-3}{\times}}$

$$(x+5)(x-3) = 0$$
$$x = -5 \quad x = 3$$

langkah 5:   pintasan y

$$c = -15$$
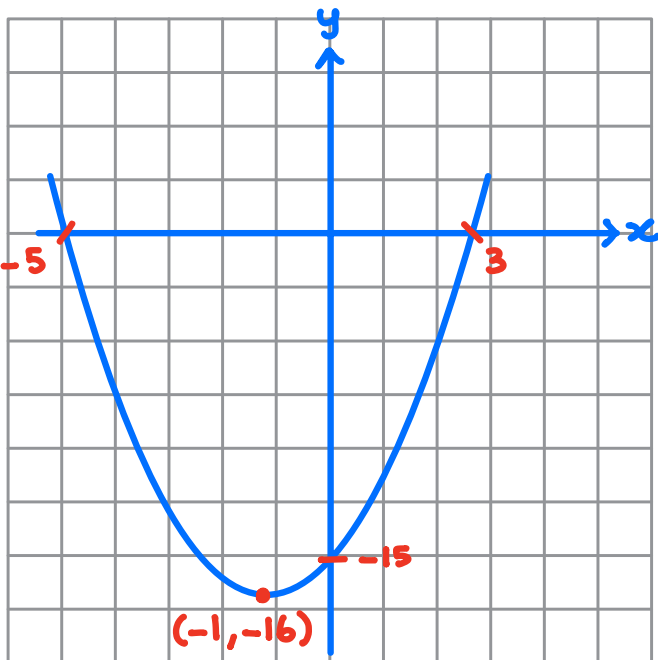
2. $f(x) = -x^2 + 4x + 12$

langkah 1:   a $\boxed{<}$ 0

langkah 2: $b^2 - 4ac$
$$= (4)^2 - 4(-1)(12)$$
$$= 64 > 0 \longrightarrow \text{potong 2 titik}$$

langkah 3:   tentukan verteks

$$f(x) = -x^2 + 4x + 12$$
$$= -[x^2 - 4x - 12]$$
$$= -\left[x^2 - 4x + \left(-\tfrac{4}{2}\right)^2 - \left(-\tfrac{4}{2}\right)^2 - 12\right]$$
$$= -[x^2 - 4x + 4 - 4 - 12]$$
$$= -[(x-2)^2 - 16]$$
$$= -(x-2)^2 + 16$$

∴ titik maksimum
   $(2, 16)$

langkah 4: $f(x) = 0$

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

$-x \overset{2}{\underset{6}{\times}}$

$$(-x-2)(x-6) = 0$$
$$x = -2 \quad x = 6$$

langkah 5:   pintasan y

$$c = 12$$

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3. $f(x) = 2(x + 2)^2 - 2$

sudah dalam bentuk verteks ↓

$f(x) = 2(x+2)(x+2) - 2$
$= 2(x^2 + 4x + 4) - 2$
$= 2x^2 + 8x + 8 - 2$
$= \underline{2x^2 + 8x + 6}$

langkah 1: $a \boxed{>} 0$ ⌣

langkah 2: $b^2 - 4ac$
$(8)^2 - 4(2)(6)$
$= 16 > 0 \longrightarrow$ potong 2 titik

langkah 3: tentukan verteks

$f(x) = 2(x+2)^2 - 2$
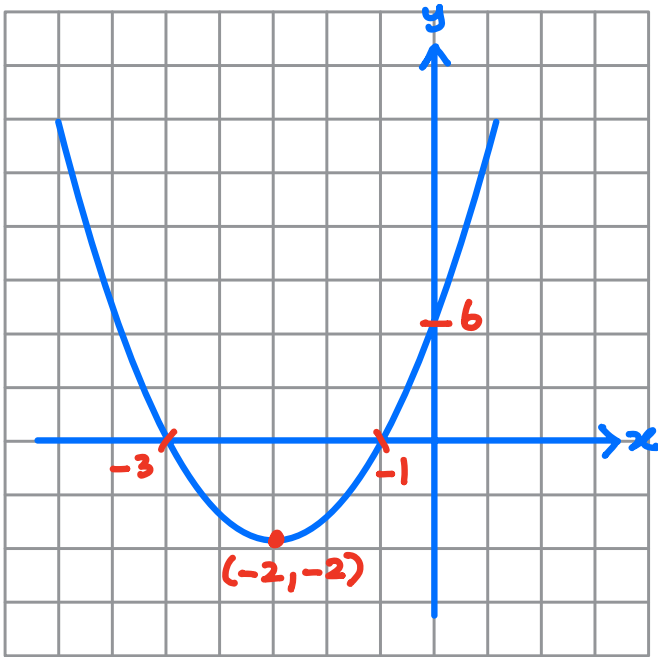
∴ titik minimum
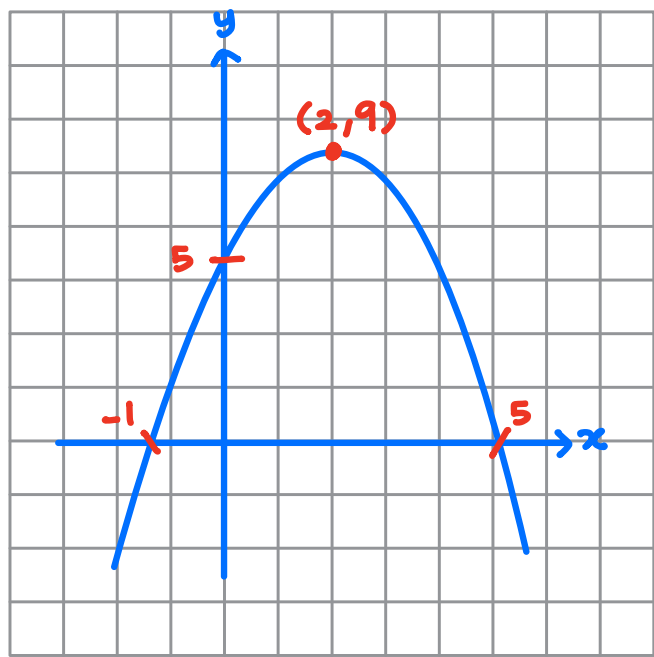$(-2, -2)$

langkah 4: $f(x) = 0$
$2x^2 + 8x + 6 = 0$
$x^2 + 4x + 3 = 0$
$(x+1)(x+3) = 0$
$x = -1 \quad x = -3$

langkah 5: pintasan y
$c = 6$

---

4. $f(x) = 9 - (x - 2)^2$

$f(x) = -(x-2)(x-2) + 9$
$= -(x^2 - 4x + 4) + 9$
$= -x^2 + 4x - 4 + 9$
$= \underline{-x^2 + 4x + 5}$

langkah 1: $a \boxed{<} 0$ ⌢

langkah 2: $b^2 - 4ac$
$(4)^2 - 4(-1)(5)$
$= 36 > 0 \longrightarrow$ potong 2 titik

langkah 3: tentukan verteks

$f(x) = -(x-2)^2 + 9$

∴ titik maksimum
$(2, 9)$

langkah 4: $f(x) = 0$
$-x^2 + 4x + 5 = 0$
$\begin{matrix} -x & -1 \\ x & 5 \end{matrix}$
$(-x-1)(x-5) = 0$
$x = -1 \quad x = 5$

langkah 5: pintasan y
$c = 5$

kapur puteh

lakar graf fungsi kuadratik bagi setiap yang berikut

5. $f(x) = -2(x-1)(x-3)$

$f(x) = -2(x-1)(x-3)$
$= -2(x^2-4x+3)$
$= -2x^2+8x-6$

langkah 1: $a \boxed{<} 0$ ⌢

langkah 2: $b^2 - 4ac$
$= (8)^2 - 4(-2)(-6)$
$= 16 > 0$ → potong 2 titik

langkah 3: tentukan verteks
$f(x) = -2x^2+8x-6$
$= -2[x^2-4x+3]$
$= -2[x^2-4x+(-\frac{4}{2})^2-(-\frac{4}{2})^2+3]$
$= -2[x^2-4x+4-4+3]$
$= -2[(x-2)^2-1]$
$= -2(x-2)^2+2$
$\therefore$ titik maksimum $(2,2)$

langkah 4: $f(x) = 0$
$-2(x-1)(x-3) = 0$
$(x-1)(x-3) = 0$
$x = 1 \quad x = 3$

langkah 5: pintasan y
$c = -6$
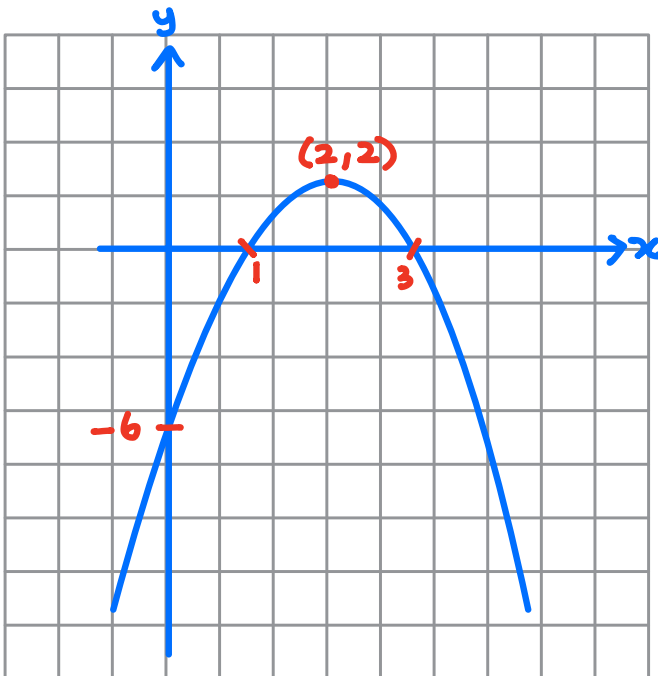
6. $f(x) = 2(x+1)(x-5)$

$f(x) = 2(x+1)(x-5)$
$= 2(x^2-4x-5)$
$= 2x^2-8x-10$

langkah 1: $a \boxed{>} 0$ ⌣

langkah 2: $b^2 - 4ac$
$= (-8)^2 - 4(2)(-10)$
$= 144$ → potong 2 titik

langkah 3: tentukan verteks
$f(x) = 2x^2-8x-10$
$= 2[x^2-4x-5]$
$= 2[x^2-4x+(-\frac{4}{2})^2-(-\frac{4}{2})^2-5]$
$= 2[x^2-4x+4-4-5]$
$= 2[(x-2)^2-9]$
$= 2(x-2)^2-18$
$\therefore$ titik minimum $(2,-18)$

langkah 4: $f(x) = 0$
$2(x+1)(x-5) = 0$
$(x+1)(x-5) = 0$
$x = -1 \quad x = 5$

langkah 5: pintasan y
$c = -10$
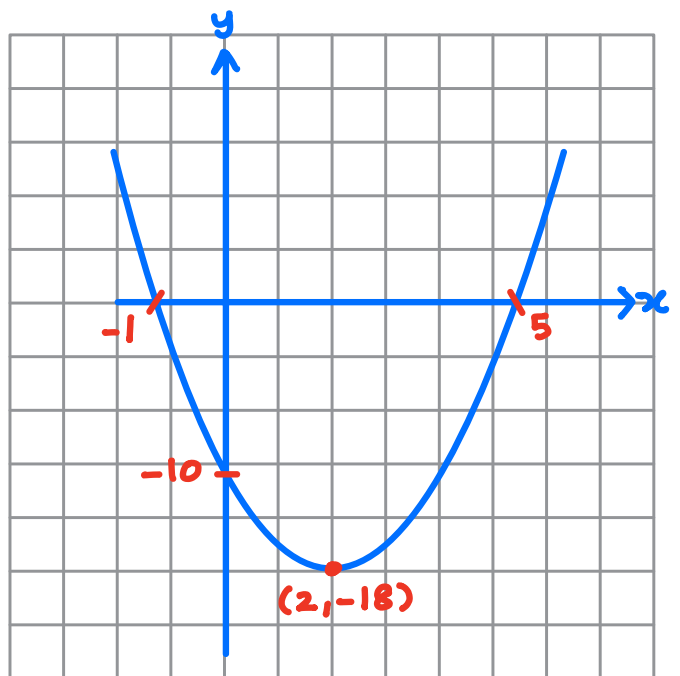
selesaikan setiap yang berikut

1. Sebiji bola dilontarkan dari balkoni hotel yang berketinggian 50 meter dari tanah. Ketinggian bola itu selepas t saat diwakili oleh $h(t) = -16t^2 + 20t + 50$, dengan keadaan h mewakili ketinggian bola, dalam meter dan t mewakili masa dalam saat.

a) ketinggian maksimum dari permukaan tanah yang boleh dicapai oleh bola itu. *bentuk verteks*

b) tempoh masa yang diambil oleh bola itu untuk jatuh ke permukaan tanah. *y=0*

a)
$$h(t) = -16\left[t^2 - \frac{20}{16}t - \frac{50}{16}\right]$$
$$= -16\left[t^2 - \frac{5}{4}t - \frac{25}{8}\right]$$
$$= -16\left[t^2 - \frac{5}{4}t + \left(\frac{-\frac{5}{4}}{2}\right)^2 - \left(\frac{-\frac{5}{4}}{2}\right)^2 - \frac{25}{8}\right]$$
$$= -16\left[t^2 - \frac{5}{4}t + \frac{25}{64} - \frac{25}{64} - \frac{25}{8}\right]$$
$$= -16\left[\left(t - \frac{5}{8}\right)^2 - \frac{225}{64}\right]$$
$$= -16\left(t - \frac{5}{8}\right)^2 + \frac{225}{4}$$

∴ titik maksimum $\left(\frac{5}{8}, \frac{225}{4}\right)$ *tinggi*

b) $-16t^2 + 20t + 50 = 0$
$8t^2 - 10t - 25 = 0$

$$\frac{2t}{4t} \underset{+}{\overset{-}{\times}} \frac{5}{5}$$

$(2t - 5)(4t + 5) = 0$

$t = \frac{5}{2}$ ✓ $\qquad t = -\frac{5}{4}$ ✗

2. Mbappe merejam lembing pada jarak 2 meter dari permukaan tanah. Tinggi lembing yang direjam diberi oleh fungsi $h(t) = -5t^2 + 14t + 2$ dengan keadaan h ialah ketinggian lembing, dalam meter, dan t ialah masa dalam saat.

a) tinggi maksimum lembing yang direjam dari permukaan tanah. *bentuk verteks*

b) masa apabila lembing itu menyentuh permukaan tanah. *y=0*

a)
$$h(t) = -5t^2 + 14t + 2$$
$$= -5\left[t^2 - \frac{14}{5}t - \frac{2}{5}\right]$$
$$= -5\left[t^2 - \frac{14}{5}t + \left(\frac{-\frac{14}{5}}{2}\right)^2 - \left(\frac{-\frac{14}{5}}{2}\right)^2 - \frac{2}{5}\right]$$
$$= -5\left[t^2 - \frac{14}{5}t + \frac{196}{100} - \frac{196}{100} - \frac{2}{5}\right]$$
$$= -5\left[t^2 - \frac{14}{5}t + \frac{49}{25} - \frac{49}{25} - \frac{2}{5}\right]$$
$$= -5\left[\left(t - \frac{7}{5}\right)^2 - \frac{59}{25}\right]$$
$$= -5\left(t - \frac{7}{5}\right)^2 + \frac{59}{5}$$

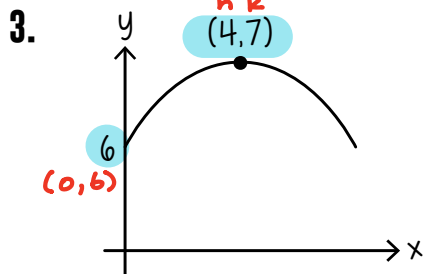∴ titik maksimum $\left(\frac{7}{5}, \frac{59}{5}\right)$ *tinggi*

b) $-5t^2 + 14t + 2 = 0$
$5t^2 - 14t - 2 = 0$

$$t = \frac{-(-14) \pm \sqrt{(-14)^2 - 4(5)(-2)}}{2(5)}$$
$$t = \frac{14 \pm 15.3623}{10}$$

$$t = \frac{14 + 15.3623}{10}$$
$$t = 2.9362 ✓$$

$$t = \frac{14 - 15.3623}{10}$$
$$t = -0.1362 ✗$$

3.

Bola besi dilontarkan pada ketinggian 6 m dan laluannya melalui titik maksimum (4,7).

a) ungkapkan persamaan laluan bola besi itu dalam bentuk $y = a(x - h)^2 + k$ dengan keadaan a, h dan k ialah pemalar.

b) cari jarak mengufuk maksimum bagi lontaran itu. *y=0 (sentuh) tanah*

a) $y = a(x - h)^2 + k$
$y = a(x - 4)^2 + 7$
$6 = a(0 - 4)^2 + 7$
$6 - 7 = 16a$
$-\frac{1}{16} = a$

∴ $y = -\frac{1}{16}(x - 4)^2 + 7$

b) $y = -\frac{1}{16}(x - 4)^2 + 7$
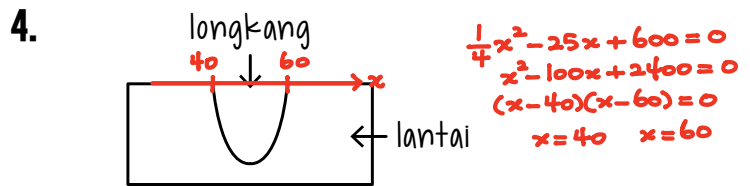$0 = -\frac{1}{16}(x - 4)^2 + 7$
$\frac{1}{16}(x - 4)^2 = 7$
$(x - 4)^2 = 112$
$x - 4 = \pm\sqrt{112}$
$x - 4 = \pm 10.583$

① $x - 4 = 10.583$
$x = 14.583$ ✓

② $x - 4 = -10.583$
$x = -6.583$ ✗

4.

$\frac{1}{4}x^2 - 25x + 600 = 0$
$x^2 - 100x + 2400 = 0$
$(x - 40)(x - 60) = 0$
$x = 40 \quad x = 60$

Bentuk longkang diwakili oleh persamaan $y = \frac{1}{4}x^2 - 25x + 600$. Cari:

a) lebar bukaan longkang $60 - 40 = 20$
b) kedalaman longkang

b)

$y = \frac{1}{4}x^2 - 25x + 600$
$y = \frac{1}{4}(50)^2 - 25(50) + 600$
$= -25$

∴ kedalaman = 25

5.

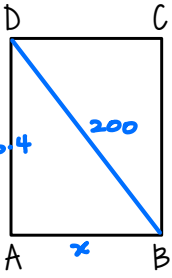Tinggi sebuah pintu berbentuk segiempat tepat ialah 16.4 cm lebih daripada lebarnya. Panjang BD ialah 200 cm. Cari lebar pintu itu.

$$a^2 + b^2 = c^2$$
$$x^2 + (x+16.4)^2 = 200^2$$
$$x^2 + (x+16.4)(x+16.4) = 40000$$
$$x^2 + x^2 + 32.8x + 268.96 - 40000 = 0$$
$$2x^2 + 32.8x - 39731.04 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
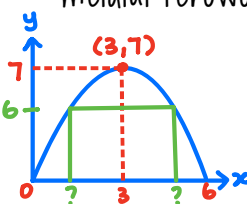$$= \frac{-32.8 \pm \sqrt{32.8^2 - 4(2)(-39731.04)}}{2(2)}$$
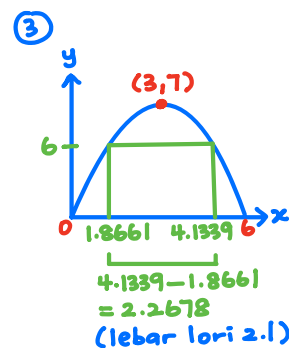$$= \frac{-32.8 \pm 564.7337}{4}$$

$$x = \frac{-32.8 + 564.7337}{4}$$
$$= 132.9834 \checkmark$$

$$x = \frac{-32.8 - 564.7337}{4}$$
$$= -149.3834 \times$$

6.

Sebuah terowong di lebuhraya berbentuk parabola dengan lebar 6 meter dan ketinggian maksimum 7 meter. Adakah sebuah lori dengan ketinggian 6 meter dan lebar 2.1 meter dapat melalui terowong itu?
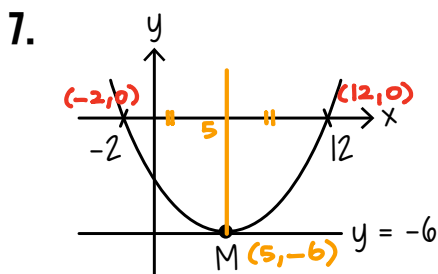

①
$$y = a(x-h)^2 + k$$
$$y = a(x-3)^2 + 7$$
$$0 = a(0-3)^2 + 7$$
$$-7 = 9a$$
$$-\frac{7}{9} = a$$
$$y = -\frac{7}{9}(x-3)^2 + 7$$

②
$$y = -\frac{7}{9}(x-3)^2 + 7$$
$$6 = -\frac{7}{9}(x-3)^2 + 7$$
$$54 = -7(x-3)^2 + 63$$
$$54 = -7(x^2 - 6x + 9) + 63$$
$$54 = -7x^2 + 42x - 63 + 63$$
$$7x^2 - 42x + 54 = 0$$
$$x = 4.1339 \quad] \text{ guna rumus}$$
$$x = 1.8661 \quad]$$

③

$$4.1339 - 1.8661$$
$$= 2.2678$$
(lebar lori 2.1)

✱ maka lori dapat lalu terowong

7.

$$y = -6$$

Garis lurus $y = -6$ ialah tangen kepada graf $y = a(x-h)^2 + k$ pada titik M. Cari:
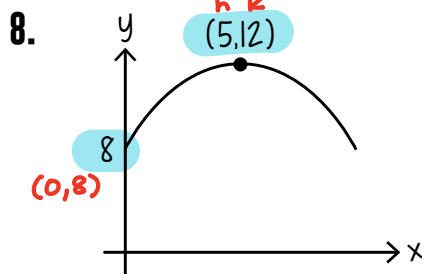
a) koordinat M (5,−6)
b) nilai a

b)
$$y = a(x-5)^2 - 6$$
$$0 = a(-2-5)^2 - 6$$
$$6 = 49a$$
$$\frac{6}{49} = a$$

8.

Anak panah dilepaskan pada ketinggian 8 m dan laluannya melalui titik maksimum (5,12).

a) ungkapkan persamaan laluan anak panah itu dalam bentuk $y = a(x-h)^2 + k$ dengan keadaan a, h dan k ialah pemalar.

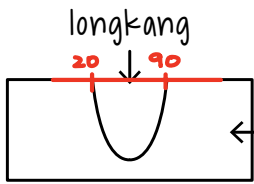b) cari jarak mengufuk maksimum bagi anak panah itu.
$y = 0$ sentuh tanah

a)
$$y = a(x-h)^2 + k$$
$$y = a(x-5)^2 + 12$$
$$8 = a(0-5)^2 + 12$$
$$8 - 12 = 25a$$
$$-\frac{4}{25} = a$$

$$\therefore y = -\frac{4}{25}(x-5)^2 + 12$$

b)
$$y = -\frac{4}{25}(x-5)^2 + 12$$
$$0 = -\frac{4}{25}(x-5)^2 + 12$$
$$-12 = -\frac{4}{25}(x-5)^2$$
$$\frac{-12}{-\frac{4}{25}} = (x-5)^2$$
$$75 = (x-5)^2$$

$$x - 5 = \pm\sqrt{75}$$
$$x - 5 = \pm 8.6603$$

①
$$x - 5 = 8.6603$$
$$x = 13.6603 \checkmark$$

②
$$x - 5 = -8.6603$$
$$x = -3.6603 \times$$

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9.

longkang

20 ↓ 90

← lantai

$\frac{1}{5}x^2 - 22x + 360 = 0$

$x^2 - 110x + 1800 = 0$

$(x-20)(x-90) = 0$

$x = 20 \quad x = 90$

Bentuk longkang diwakili oleh persamaan

$y = \frac{1}{5}x^2 - 22x + 360$. Cari:

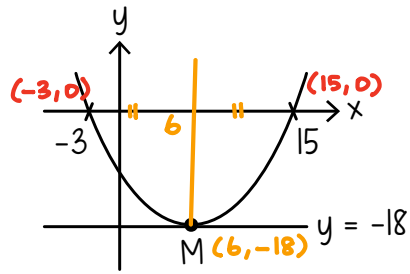a) lebar bukaan longkang $90 - 20 = \underline{70}$

b) kedalaman longkang

b)

20 55 90

(55, −245)
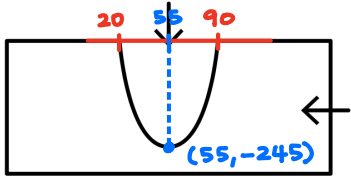
∴ kedalaman = 245

$y = \frac{1}{5}x^2 - 22x + 360$

$= \frac{1}{5}(55)^2 - 22(55) + 360$

$= \underline{-245}$

10.

(−3, 0)   (15, 0)

−3   6   15

M (6, −18)   y = −18
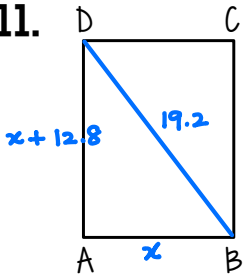
Garis lurus y = −18 ialah tangen kepada graf $y = a(x - h)^2 + k$ pada titik M. Cari:

a) koordinat M (6, −18)

b) nilai a

b) $y = a(x-6)^2 - 18$

$0 = a(-3-6)^2 - 18$

$18 = 81a$

$\frac{18}{81} = a$

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

11.

D   C

x+12.8   19.2

A   x   B

Tinggi sebuah pintu berbentuk segiempat tepat ialah 12.8 cm lebih daripada lebarnya. Panjang BD ialah 192 cm. Cari lebar pintu itu.

$a^2 + b^2 = c^2$

$x^2 + (x + 12.8)^2 = 192^2$

$x^2 + (x + 12.8)(x + 12.8) = 36864$

$x^2 + x^2 + 25.6x + 163.84 - 36864 = 0$

$2x^2 + 25.6x - 36700.16 = 0$

$x = \dfrac{-25.6 \pm \sqrt{(25.6)^2 - 4(2)(-36700.16)}}{2(2)}$

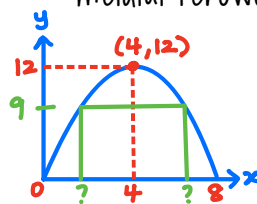$x = \dfrac{-25.6 \pm 542.4543}{4}$

$x = \dfrac{-25.6 + 542.4543}{4}$

$x = 129.2136$ ✓

$x = \dfrac{-25.6 - 542.4543}{4}$

$x = -142.0136$ ✗

12. Sebuah terowong di lebuhraya berbentuk parabola dengan lebar 8 meter dan ketinggian maksimum 12 meter. Adakah sebuah bas dengan ketinggian 9 meter dan lebar 3.2 meter dapat melalui terowong itu?

(4, 12)

12

9

0   ?   4   ?   8

① $y = a(x-h)^2 + k$

$y = a(x-4)^2 + 12$

$0 = a(0-4)^2 + 12$

$-12 = 16a$

$-\frac{12}{16} = a$

$-\frac{3}{4} = a \longrightarrow y = -\frac{3}{4}(x-4)^2 + 12$

② $y = -\frac{3}{4}(x-4)^2 + 12$

$9 = -\frac{3}{4}(x-4)^2 + 12$

$36 = -3(x-4)^2 + 48$

$36 = -3(x^2 - 8x + 16) + 48$

$36 = -3x^2 + 24x - 48 + 48$

$3x^2 - 24x + 36 = 0$

$x^2 - 8x + 12 = 0$

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

$x = 2$

$x = 6$

③

(4, 12)

9

0   2   6

6 − 2 = 4
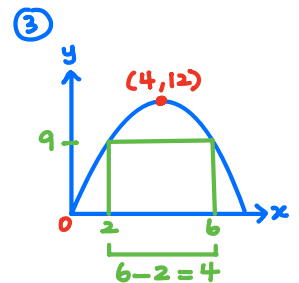
(lebar lori 3.2)

* maka lori dapat lalu terowong

kapur puteh